

AN APPLIED MATERIALS COMPANY

NEMA® pico VG 1000 Graphics Processing Unit

Hardware User Manual

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1 Overview

NEMA® | pico VG 1000, member of the NEMA-GPU Series, brings high quality graphics for User Interfaces in a very small silicon/ power budget targeting the Microcontrollers Market (MCU). NEMA® | pico VG 1000 is the perfect candidate to support entry level IoT-platforms, wearable and embedded devices with low cost and ultra-low power requirements supporting SoC's with a 32/64-bit MCU (e.g. ARM Cortex-M processors) and provide fluid graphics experience for a wide range of applications. Developers are able to create compelling Graphical User Interfaces (GUIs) and software applications with ultra-long battery life at a significantly lower cost for power-memory-area constrained IoT devices.

1.1 Features

- Hardware Components:
 - Programmable Shader engine with a VLIW instruction set
 - Command list based DMAs to minimize CPU overhead
 - Primitive Rasterizer
 - Texture Mapping unit (with radial fill capability)
 - Blending unit
- Drawing Primitives:
 - Pixel/Line drawing
 - Filled rectangles
 - Triangles (Gouraud Shaded)
 - Ouadrilateral
- · Color formats
 - 32-bit RGBA8888/BGRA8888/ABGR8888
 - 24-bit RGB
 - 16-bit AL88/RGBA5551/BGRA5551/ARGB1555/ABGR1555/RGB565/BGR565/RG-BA4444/BGRA444/ARGB4444/ABGR4444
 - 8-bit A8/L8/AL44/RGB332/RGBA2222/ABGR2222/BGRA2222/ARGB2222
 - 4-bit A4/L4
 - 2-bit A2/L2
 - 1-bit A1/L1
 - YUV (Read only)
 - TSC™
- Compression schemes (Optional)
 - TSC[™]4(4 bits per pixel)
 - TSC[™]6/ TSC[™]6a(6 bits per pixel with/out Alpha)
 - TSC[™]12/TSC[™]12a(12 bits per pixel with/out Alpha)



- Image transformation
 - Texture mapping
 - Point sampling
 - Bilinear filtering
 - Blit support
 - Rotation any angle
 - Mirroring
 - Stretch (independently on x and y axis)
 - Source and/or destination color keying
 - Format conversions on the fly
 - 2.5D Perspective Correct Projections
- Text rendering supports
 - Bitmap antialiased A1/A2/A4/A8
 - Font Kerning
 - Unicode(UTF8)
- · Blending Support
 - Fully Programmable Alpha blending modes(Source and Destination)
 - Source/Destination color keying
- Antialiasing
 - 8x MSAA
 - Quaddrilaterals per edge Antialising
 - Triangles per edge Antialiasing
 - Antialiased Thick lines
 - Antialiased Circles

1.2 Configuration Options

NEMA® | pico VG 1000 can be customized during design time by configuring a number of parameters that enable/disable several features of the design. The NEMA® | pico VG 1000 GUI Configurator, a Graphical User Interface Configurator Tool, is used for the configuration of NEMA® | pico VG 1000 parameters.

- Cache Sizes
- Compression Schemes
 - TSC[™]4
 - TSC[™]6 / TSC[™]6a
 - TSC[™]12 / TSC[™]12a
- Master Interface
 - AMBA AHB 32bit
 - AMBA AXI4 32/64/128bit



1.3 Integration - Verification

The NEMA® | pico VG 1000 GPU IP Platform is available in Verilog/SystemVerilog code and is easily integrated and verified. The NEMA® | pico VG 1000 ASIC reference designs have been evaluated in various process technologies and has been verified through extensive simulation and rigorous code coverage measurements. It is accompanied with a complete verification suite that compares reference images with rendered images.

1.4 Software

- · OS support
 - Bare Metal (no-OS)
 - RTOS (NEMA® | GFX Library in ANSI C)
 - Linux
- Graphics API support
 - NEMA® | GFX API library in pure C
 - NEMA® | GFX VG Extensions
 - Video Overlay Extensions
 - DirectFB
 - Ot
- · Software Emulators and suites
 - NEMA® | pix-presso
 - NEMA® | gui-builder
 - NEMA® | Bits

NEMA® | GFX library which is available in pure ANSI C with no dependencies, allows easy portability to systems running RTOS or even to OS-less systems. The software package includes OS drivers for Linux and Software Libraries for supporting 2D Graphics APIs such as DirectFB and Qt

- NEMA® | GFX: Enables high quality 2.5D graphics on RTOS and OS-less systems. NE-MA® | GFX is a proprietary low level library that interfaces directly with the NEMA GPUs and provides a software abstraction layer to organize and employ drawing commands with ease and efficiency. NEMA® | GFX can be used as a back-end to existing APIs and as a standalone Graphics API.
- DirectFB: Enables software development with application and Graphic User Interface (GUI) creation frameworks, such as GTK. DirectFB (Direct Frame Buffer) is a set of graphics APIs implemented on top of the Linux Frame Buffer abstraction layer.

The software package includes Linux drivers, Software Libraries for 2D Graphics APIs and comes together with:

 NEMA® | gui-builder, a graphical cross-platform software framework enabling rapid high-end Graphics User Interface (GUI) development on low resource hard-



ware (non-commercial version, free download https://www.think-silicon.com/?section=2335&language=en US)

- NEMA® | pix-presso, a utility software for converting images to/from formats suitable for low power embedded devices (non-commercial version, free download https:// www.think-silicon.com/?section=2335&language=en_US)
- NEMA® | Bits, an EVK Kit for technology evaluation and pre-silicon application development



2 Register Specification (RDL)

2.1 Registers' Memory Map

The memory organization of the register map is shown in the tables of this section:

Address	Access	Reset Value	Name
0x0000	rw	0x0	NEMA_TEX0_BASE
0x0004	rw	0x0	NEMA_TEX0_FSTRIDE
8000x0	rw	0x0	NEMA_TEX0_RESXY
0x0010	rw	0x0	NEMA_TEX1_BASE
0x0014	rw	0x0	NEMA_TEX1_FSTRIDE
0x0018	rw	0x0	NEMA_TEX1_RESXY
0x001c	rw	0x0	NEMA_TEX_COLOR
0x0020	rw	0x0	NEMA_TEX2_BASE
0x0024	rw	0x0	NEMA_TEX2_FSTRIDE
0x0028	rw	0x0	NEMA_TEX2_RESXY
0x0030	rw	0x0	NEMA_TEX3_BASE
0x0034	rw	0x0	NEMA_TEX3_FSTRIDE
0x0038	rw	0x0	NEMA_TEX3_RESXY
0x0048	rw	0x0	NEMA_TSC_NEW_BLOCK_TRIG
0x004c	rw	0x0	NEMA_TSC_NEW_BLOCK_SEL
0x0080	rw	0x0	NEMA_BREAKPOINT
0x008c	rw	0x0	NEMA_BREAKPOINT_MASK
0x0094	rw	0x0	NEMA_CGCTRL
0x0098	rw	0xffffffff	NEMA_DIRTYMIN
0x009c	r	0x0	NEMA_DIRTYMAX
0x00c0	rw	0x0	NEMA_BUS_CTRL
0x00c4	rw	0x0	NEMA_IMEM_ADDR
0x00c8	rw	0x0	NEMA_IMEM_DATA_LOW
0x00cc	rw	0x0	NEMA_IMEM_DATA_HIGH



Address	Access	Reset Value	Name
0x00d0	rw	0x0	NEMA_BURST_SIZE
0x00e4	rw	0x80640007	NEMA_FLUSH_CTRL
0x00e8	rw	0x0	NEMA_CMDSTATUS
0x00ec	rw	0x0	NEMA_CMDRINGSTOP
0x00f0	rw	0x0	NEMA_CMDADDR
0x00f4	rw	0x0	NEMA_CMDSIZE
0x00f8	rw	0x0	NEMA_INTERRUPT
0x00fc	rw	0x0	NEMA_STATUS
0x0100	rw	0x0	NEMA_DRAW_CMD_NOHOLD
0x0104	rw	0x0	NEMA_DRAW_STARTXY
0x0108	rw	0x0	NEMA_DRAW_ENDXY
0x010c	rw	0x0	DRAW_FAN_X
0x0110	rw	0x0	NEMA_CLIPMIN
0x0114	rw	0x7fff7fff	NEMA_CLIPMAX
0x0118	rw	0x05000000	NEMA_MATMULT
0x011c	rw	0x0	NEMA_CODEPTR
0x0120	rw	0x0	NEMA_DRAW_PT0_X
0x0124	rw	0x0	NEMA_DRAW_PTO_Y
0x0128	rw	0x0	DRAW_FAN_Y
0x012c	rw	0x0	NEMA_DRAW_COLOR
0x0130	rw	0x0	NEMA_DRAW_PT1_X
0x0134	rw	0x0	NEMA_DRAW_PT1_Y
0x0138	rw	0x0	NEMA_BYPASS_ADDR
0x013c	rw	0x0	BYPASS_DATA
0x0140	rw	0x0	NEMA_DRAW_PT2_X
0x0144	rw	0x0	NEMA_DRAW_PT2_Y
0x0148	rw	0x0	NEMA_CLID
0x0150	rw	0x0	NEMA_DRAW_PT3_X
0x0154	rw	0x0	NEMA_DRAW_PT3_Y



Address	Access	Reset Value	Name
0x0158	rw	0x0	NEMA_CLIPMIN1
0x015c	rw	0x7fff7fff	NEMA_CLIPMAX1
0x0160	rw	0x0	NEMA_MM00
0x0164	rw	0x0	NEMA_MM01
0x0168	rw	0x0	NEMA_MM02
0x016c	rw	0x0	NEMA_MM10
0x0170	rw	0x0	NEMA_MM11
0x0174	rw	0x0	NEMA_MM12
0x0178	rw	0x0	NEMA_MM20
0x017c	rw	0x0	NEMA_MM21
0x0180	rw	0x0	NEMA_MM22
0x0184	rw	0x0	NEMA_DEPTH_START_L
0x0188	rw	0x0	NEMA_DEPTH_START_H
0x018c	rw	0x0	NEMA_DEPTH_DX_L
0x0190	rw	0x0	NEMA_DEPTH_DX_H
0x0194	rw	0x0	NEMA_DEPTH_DY_L
0x0198	rw	0x0	NEMA_DEPTH_DY_H
0x01a0	rw	0x0	NEMA_RED_DX
0x01a4	rw	0x0	NEMA_RED_DY
0x01a8	rw	0x0	NEMA_GRE_DX
0x01ac	rw	0x0	NEMA_GRE_DY
0x01b0	rw	0x0	NEMA_BLU_DX
0x01b4	rw	0x0	NEMA_BLU_DY
0x01b8	rw	0x0	NEMA_ALF_DX
0x01bc	rw	0x0	NEMA_ALF_DY
0x01c0	rw	0x0	NEMA_RED_INIT
0x01c4	rw	0x0	NEMA_GRE_INIT
0x01c8	rw	0x0	NEMA_BLU_INIT
0x01cc	rw	0x0	NEMA_ALF_INIT



Address	Access	Reset Value	Name
0x01d0	rw	0x0	NEMA_ROPBLENDER_BLEND_MODE
0x01d4	rw	0x0	NEMA_ROPBLENDER_DST_CKEY
0x01d8	rw	0x0	NEMA_ROPBLENDER_CONST_COLOR
0x01dc	r	0x00231000	NEMA_IP_VERSION
0x01e0	rw	0x0	NEMA_CODEPTR2
0x01ec	r	0x86362000	NEMA_IDREG
0x01f0	r	0xd4010104	NEMA_CONFIG
0x01f4	r	0x000003e3	NEMA_CONFIGH
0x0200	w	0x0	NEMA_CO_REG
0x0204	w	0x0	NEMA_C1_REG
0x0208	w	0x0	NEMA_C2_REG
0x020c	w	0x0	NEMA_C3_REG
0x0320	w	0x0	DRAW_PT0_X
0x0324	w	0x0	DRAW_PT0_Y
0x0328	w	0x0	DRAW_FP_FAN_X
0x032c	w	0x0	DRAW_FP_FAN_Y
0x0330	w	0x0	DRAW_PT1_X
0x0334	w	0x0	DRAW_PT1_Y
0x0340	w	0x0	DRAW_PT2_X
0x0344	w	0x0	DRAW_PT2_Y
0x0350	w	0x0	DRAW_PT3_X
0x0354	w	0x0	DRAW_PT3_Y
0x0360	rw	0x3f800000	VMM00
0x0364	rw	0x0	VMM01
0x0368	rw	0x0	VMM02
0x036c	rw	0x0	VMM10
0x0370	rw	0x3f800000	VMM11
0x0374	rw	0x0	VMM12
0x0378	rw	0x0	VMM20



Address	Access	Reset Value	Name
0x037c	rw	0x0	VMM21
0x0380	rw	0x3f800000	VMM22
0x04d0	rw	0x00000fff	NEMA_COORD_MASK
0x04d4	rw	0x00008000	DRAW_FLATNESS
0x0ff0	rw	0x0	NEMA_IRQ_ID
0x0ff4	rw	0x0	NEMA_GP_FLAGS
0x0ff8	rw	0x0	NEMA_SYS_INTERRUPT
0x0ffc	rw	0x0	NEMA_BUSERROR_MASK

2.2 Registers' Description

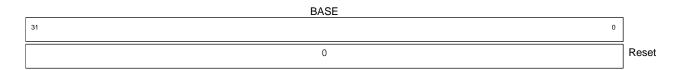
The following section is a detailed description of the register file. All registers are 32 bits wide.



NEMA_TEXO_BASE

Address	Access	Reset	Description
0x0000	rw	0x0	Base address of drawing surface 0.

Fields



Fields Description

BASE

Specifies the base address or drawing surface 0.



NEMA_TEXO_FSTRIDE

Address	Access	Reset	Description
0x0004	rw	0x0	Image 0 Mode and Stride

Fields

Q	≻ FORMAT		8PZ	FILL	111/	E WRAP	& S	NO CO	STRIDE		
31	30	24	23	22 21	20	19 18	17	16	5	0	
0	0		0	0	0	0	0	0	0		Reset

Fields Description

STRIDE

Specifies the image stride distance in bytes from one scanline to another (signed)

MODE

Specifies the image mode (applicable only for Textures not for Framebuffer)

- * 0x0 Point sampling
- * 0x1 Bilinear filtering

WRAP

Specifies the image wrapping mode (applicable only for Textures not for Framebuffer).

- * 0x0 Clamp
- * 0x1 Repeat
- * 0x2 Border
- * 0x3 Mirror

TILE

Enables the Tile Mode.

RADFILL

Radial fill enable

FORMAT

Specifies the image format

- * 0x00 RGBX8888
- * 0x01 RGBA8888
- * 0x02 XRGB8888
- * 0x03 ARGB8888
- * 0x04 RGBA5650
- * 0x05 RGBA5551
- * 0x06 RGBA4444
- * 0x08 RGBA0008 (Only available as input format)
- * 0x09 L8
- * 0x0B L1 (Only available as input format)



- * 0x0C A1 (Only available as input format)
- * 0x0D UYVY (Only available as input format)
- * 0x0E ABGR8888 (Only available as input format)
- * 0x10 BGRA (Only available as input format)
- * 0x11 BGRX (Only available as input format)
- * 0x12 TSC4
- * 0x16 TSC6
- * 0x17 TSC6A
- * 0x4C TSC12
- * 0x4D TSC12A
- * 0x27 A1LE (Only available as input format)
- * 0x28 A2LE (Only available as input format)
- * 0x29 A4LE (Only available as input format)
- * 0x2A L1LE (Only available as input format)
- * 0x2B L2LE (Only available as input format)
- * 0x2C L4LE (Only available as input format)
- * 0x30 A2 (Only available as input format)
- * 0x31 L2 (Only available as input format)
- * 0x34 A4 (Only available as input format)
- * 0x35 L4 (Only available as input format)
- * 0x38 RGBA3320 (Only available as input format)
- * 0x39 BGR24
- * 0x3C RGB24
- * 0x40 RGBA2222
- * 0x41 ABGR2222
- * 0x42 BGRA2222
- * 0x43 ARGB2222

DITH

If set for destination texture, enables color dithering. (Applicable to output formats RGBA5650, RGBA5551, RGBA4444).



NEMA_TEXO_RESXY

Address	Access	Reset	Description
0x0008	rw	0x0	Image 0 Resolution

Fields

RESY		RESX	_
31	16	15	
0		0	Reset

Fields Description

RESX

Specifies the size of resolution X

RESY

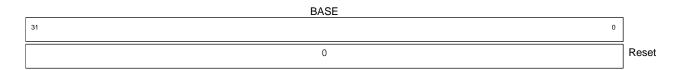
Specifies the size of resolution Y



NEMA_TEX1_BASE

Address	Access	Reset	Description
0x0010	rw	0x0	Base address of drawing surface 1.

Fields



Fields Description

BASE

Specifies the base address or drawing surface 1.



NEMA_TEX1_FSTRIDE

Address	Access	Reset	Description
0x0014	rw	0x0	Image 1 Mode and Stride

Fields

Q	≻ FORMAT		8PZ	FILL	111/	E WRAP	& S	NO CO	STRIDE		
31	30	24	23	22 21	20	19 18	17	16	5	0	
0	0		0	0	0	0	0	0	0		Reset

Fields Description

STRIDE

Specifies the image stride distance in bytes from one scanline to another (signed)

MODE

Specifies the image mode (applicable only for Textures not for Framebuffer)

- * 0x0 Point sampling
- * 0x1 Bilinear filtering

WRAP

Specifies the image wrapping mode (applicable only for Textures not for Framebuffer).

- * 0x0 Clamp
- * 0x1 Repeat
- * 0x2 Border
- * 0x3 Mirror

TILE

Enables the Tile Mode.

RADFILL

Radial fill enable

FORMAT

Specifies the image format

- * 0x00 RGBX8888
- * 0x01 RGBA8888
- * 0x02 XRGB8888
- * 0x03 ARGB8888
- * 0x04 RGBA5650
- * 0x05 RGBA5551
- * 0x06 RGBA4444
- * 0x08 RGBA0008 (Only available as input format)
- * 0x09 L8
- * 0x0B L1 (Only available as input format)



- * 0x0C A1 (Only available as input format)
- * 0x0D UYVY (Only available as input format)
- * 0x0E ABGR8888 (Only available as input format)
- * 0x10 BGRA (Only available as input format)
- * 0x11 BGRX (Only available as input format)
- * 0x12 TSC4
- * 0x16 TSC6
- * 0x17 TSC6A
- * 0x4C TSC12
- * 0x4D TSC12A
- * 0x27 A1LE (Only available as input format)
- * 0x28 A2LE (Only available as input format)
- * 0x29 A4LE (Only available as input format)
- * 0x2A L1LE (Only available as input format)
- * 0x2B L2LE (Only available as input format)
- * 0x2C L4LE (Only available as input format)
- * 0x30 A2 (Only available as input format)
- * 0x31 L2 (Only available as input format)
- * 0x34 A4 (Only available as input format)
- * 0x35 L4 (Only available as input format)
- * 0x38 RGBA3320 (Only available as input format)
- * 0x39 BGR24
- * 0x3C RGB24
- * 0x40 RGBA2222
- * 0x41 ABGR2222
- * 0x42 BGRA2222
- * 0x43 ARGB2222

DITH

If set for destination texture, enables color dithering. (Applicable to output formats RGBA5650, RGBA5551, RGBA4444).



NEMA_TEX1_RESXY

Address	Access	Reset	Description
0x0018	rw	0x0	Image 1 Resolution

Fields

RESY		RESX	_
31	16	15	
0		0	Reset

Fields Description

RESX

Specifies the size of resolution X

RESY

Specifies the size of resolution Y



NEMA_TEX_COLOR

Address	Access	Reset	Description
0x001c	rw	0x0	Texture Map's default color (for use with Luminance and Alpha-only color formats)

Fields

ALPHA	BLUE	GREEN	RED	_
31 24	23 16	15 8	7 0	
0	0	0	0	Reset

Fields Description

RED

Specifies the Red (R) value

GREEN

Specifies the Green (G) value

BLUE

Specifies the Blue (B) value

ALPHA

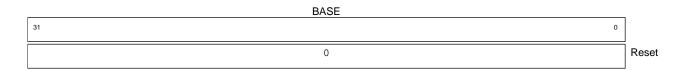
Specifies the Alpha (A) value



NEMA_TEX2_BASE

Address	Access	Reset	Description
0x0020	rw	0x0	Base address of drawing surface 2.

Fields



Fields Description

BASE

Specifies the base address or drawing surface 2.



NEMA_TEX2_FSTRIDE

Address	Access	Reset	Description
0x0024	rw	0x0	Image 2 Mode and Stride

Fields

QÍ.	► FORMAT		P.P.	JEILL PEND	\/\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	E NRAP	Q(5)	NO CO	STRIDE		_
31	30	24	23	22 21	20	19 18	17	16		0	
0	0		0	0	0	0	0	0	0		Reset

Fields Description

STRIDE

Specifies the image stride distance in bytes from one scanline to another (signed)

MODE

Specifies the image mode (applicable only for Textures not for Framebuffer)

- * 0x0 Point sampling
- * 0x1 Bilinear filtering

WRAP

Specifies the image wrapping mode (applicable only for Textures not for Framebuffer).

- * 0x0 Clamp
- * 0x1 Repeat
- * 0x2 Border
- * 0x3 Mirror

TILE

Enables the Tile Mode.

RADFILL

Radial fill enable

FORMAT

Specifies the image format

- * 0x00 RGBX8888
- * 0x01 RGBA8888
- * 0x02 XRGB8888
- * 0x03 ARGB8888
- * 0x04 RGBA5650
- * 0x05 RGBA5551
- * 0x06 RGBA4444
- * 0x08 RGBA0008 (Only available as input format)
- * 0x09 L8
- * 0x0B L1 (Only available as input format)



- * 0x0C A1 (Only available as input format)
- * 0x0D UYVY (Only available as input format)
- * 0x0E ABGR8888 (Only available as input format)
- * 0x10 BGRA (Only available as input format)
- * 0x11 BGRX (Only available as input format)
- * 0x12 TSC4
- * 0x16 TSC6
- * 0x17 TSC6A
- * 0x4C TSC12
- * 0x4D TSC12A
- * 0x27 A1LE (Only available as input format)
- * 0x28 A2LE (Only available as input format)
- * 0x29 A4LE (Only available as input format)
- * 0x2A L1LE (Only available as input format)
- * 0x2B L2LE (Only available as input format)
- * 0x2C L4LE (Only available as input format)
- * 0x30 A2 (Only available as input format)
- * 0x31 L2 (Only available as input format)
- * 0x34 A4 (Only available as input format)
- * 0x35 L4 (Only available as input format)
- * 0x38 RGBA3320 (Only available as input format)
- * 0x39 BGR24
- * 0x3C RGB24
- * 0x40 RGBA2222
- * 0x41 ABGR2222
- * 0x42 BGRA2222
- * 0x43 ARGB2222

DITH

If set for destination texture, enables color dithering. (Applicable to output formats RGBA5650, RGBA5551, RGBA4444).



NEMA_TEX2_RESXY

Address	Access	Reset	Description
0x0028	rw	0x0	Image 2 Resolution

Fields

	RESY	RESX	_
31	16	15 0	
	0	0	Reset

Fields Description

RESX

Specifies the size of resolution X

RESY

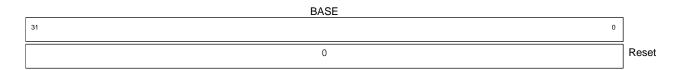
Specifies the size of resolution Y



NEMA_TEX3_BASE

Address	Access	Reset	Description
0x0030	rw	0x0	Base address of drawing surface 3.

Fields



Fields Description

BASE

Specifies the base address or drawing surface 3.



NEMA_TEX3_FSTRIDE

Address	Access	Reset	Description
0x0034	rw	0x0	Image 3 Mode and Stride

Fields

Q	≻ FORMAT		8PZ	FILL	111/	E WRAP	& S	'NC	STRIDE		
31	30	24	23	22 21	20	19 18	17	16	5	0	
0	0		0	0	0	0	0	0	0		Reset

Fields Description

STRIDE

Specifies the image stride distance in bytes from one scanline to another (signed)

MODE

Specifies the image mode (applicable only for Textures not for Framebuffer)

- * 0x0 Point sampling
- * 0x1 Bilinear filtering

WRAP

Specifies the image wrapping mode (applicable only for Textures not for Framebuffer).

- * 0x0 Clamp
- * 0x1 Repeat
- * 0x2 Border
- * 0x3 Mirror

TILE

Enables the Tile Mode.

RADFILL

Radial fill enable

FORMAT

Specifies the image format

- * 0x00 RGBX8888
- * 0x01 RGBA8888
- * 0x02 XRGB8888
- * 0x03 ARGB8888
- * 0x04 RGBA5650
- * 0x05 RGBA5551
- * 0x06 RGBA4444
- * 0x08 RGBA0008 (Only available as input format)
- * 0x09 L8
- * 0x0B L1 (Only available as input format)



- * 0x0C A1 (Only available as input format)
- * 0x0D UYVY (Only available as input format)
- * 0x0E ABGR8888 (Only available as input format)
- * 0x10 BGRA (Only available as input format)
- * 0x11 BGRX (Only available as input format)
- * 0x12 TSC4
- * 0x16 TSC6
- * 0x17 TSC6A
- * 0x4C TSC12
- * 0x4D TSC12A
- * 0x27 A1LE (Only available as input format)
- * 0x28 A2LE (Only available as input format)
- * 0x29 A4LE (Only available as input format)
- * 0x2A L1LE (Only available as input format)
- * 0x2B L2LE (Only available as input format)
- * 0x2C L4LE (Only available as input format)
- * 0x30 A2 (Only available as input format)
- * 0x31 L2 (Only available as input format)
- * 0x34 A4 (Only available as input format)
- * 0x35 L4 (Only available as input format)
- * 0x38 RGBA3320 (Only available as input format)
- * 0x39 BGR24
- * 0x3C RGB24
- * 0x40 RGBA2222
- * 0x41 ABGR2222
- * 0x42 BGRA2222
- * 0x43 ARGB2222

DITH

If set for destination texture, enables color dithering. (Applicable to output formats RGBA5650, RGBA5551, RGBA4444).



NEMA_TEX3_RESXY

Address	Access	Reset	Description
0x0038	rw	0x0	Image 3 Resolution

Fields

RESY		RESX	_
31	16	15	
0		0	Reset

Fields Description

RESX

Specifies the size of resolution X

RESY

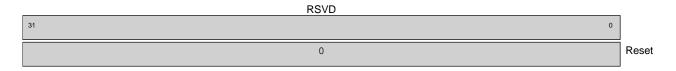
Specifies the size of resolution Y



NEMA_TSC_NEW_BLOCK_TRIG

Address	Access	Reset	Description
0x0048	rw	0x0	Trigger to reset TSc block.

Fields



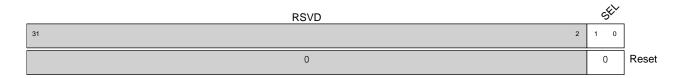
Fields Description



NEMA_TSC_NEW_BLOCK_SEL

Address	Access	Reset	Description
0x004c	rw	0x0	Select how TSc block will be reset.

Fields



Fields Description

SEL

- 0: Reset TSc block when NEMA_DRAW_CMD_NOHOLD is written or tesselator starts new geometry or NEMA_TSC_NEW_BLOCK_TRIG is written.
- 1: Reset TSc block when NEMA_DRAW_CMD_NOHOLD is written or NEMA_TSC_NEW_BLOCK_TRIG is written.
- 2: Reset TSc block when NEMA_TSC_NEW_BLOCK_TRIG is written.



NEMA_BREAKPOINT

Address	Access	Reset	Description
0x0080	rw	0x0	Debug feature. Specifies a Breakpoint on the Command List

Fields

_	NEMA_BREAKPOINT	_
	31 0	
L] 1
	0	Reset

Fields Description

NEMA_BREAKPOINT

Specifies the Breakpoint ID



NEMA_BREAKPOINT_MASK

Address	Access	Reset	Description
0x008c	rw	0x0	Debug feature. Specifies a Breakpoint Mask.

Fields

MASK	_
31 0	
0	Reset

Fields Description

MASK

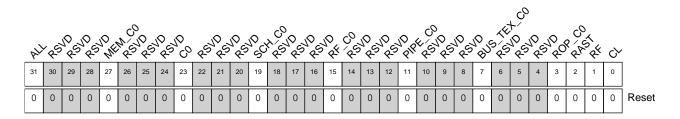
Specifies the Breakpoint Mask



NEMA_CGCTRL

Address	Access	Reset	Description
0x0094	rw	0x0	Clock gating controller

Fields



Fields Description

CL

Disable clock gating for the Command List Processor

RF

Disable clock gating for the NemaP Configuration Register File

RAST

Disable clock gating for the NemaP Rasterizer

ROP CO

Disable clock gating for the Render Output Unit of core 0

BUS TEX CO

Disable clock gating for the BusInterface (memory System) and Core 0 Texture

Map

PIPE CO

Disable clock gating for Core 0 Pipeline

RF_C0

Disable clock gating for Core 0 Register File

SCH CO

Disable clock gating for Core 0 Scheduler

C0

Disable clock gating for Core 0

MEM CO

Disable clock gating for Core 0 Instruction Memory

ALL

Disable clock gating for all modules



NEMA_DIRTYMIN

Address	Access	Reset	Description
0x0098	rw	0xfffffff	Read the Dirty_Min value. Resets dirty region to resolution size on write function.

Fields

DIRTYMIN	_
31 0	
FFFFFFF	Reset

Fields Description

DIRTYMIN

Write any value to reset dirty region to resolution size Read the Dirty_min value



NEMA_DIRTYMAX

Address	Access	Reset	Description
0x009c	r	0x0	Read the Dirty Max value

Fields

	DIRTYMAX		_
31		0	
	0		Reset

Fields Description

DIRTYMAX (Read only)

Read the Dirty_max value



NEMA_BUS_CTRL

Address Access Reset		Reset	Description
0x00c0	rw	0x0	Indicates the value of the AWCACHE and the ARCACHE signals of the AXI Bus Interface.

Fields

RSVD	AWCACHE	ARCACHE	_
31 8	7 4	3 0	
0	0	0	Reset

Fields Description

ARCACHE

Specifies the value of the output ARCACHE signal of the AXI Master Read Bus Interface

AWCACHE

Specifies the value of the output AWCACHE signal of the AXI Master Write Bus Interface



NEMA_IMEM_ADDR

Address Access Reset		Reset	Description
0x00c4	rw	0x0	Load shader instruction memory address. This register can be auto incremented. Its content should be considered volatile

Fields

RSVD	ADDF	?	_
31 4	3	0	
0	0		Reset

Fields Description

ADDR

Specifies the load shader instruction memory address



NEMA_IMEM_DATA_LOW

Address Access Reset		Reset	Description
0x00c8	rw	0x0	The lower bits (31-0) of the 64-bit load shader instruction memory data

Fields

IMEM_DATA_LOW	_
31	
0	Reset

Fields Description

IMEM_DATA_LOW

Specifies the lower bits (31-0) of the load shader instruction memory data



NEMA_IMEM_DATA_HIGH

Address	Access	Reset	Description	
0x00cc	rw	0x0	The higher bits (63-32) of the 64-bit load shader instruction memory data	

Fields

IMEM_DATA_HIGH	
31 0	
	ļ
0	Reset

Fields Description

IMEM_DATA_HIGH

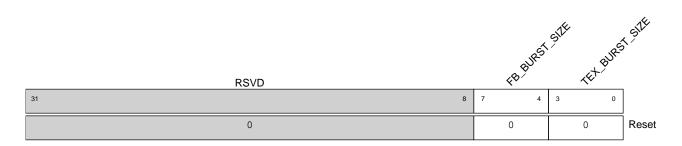
Specifies the higher bits (63-32) of the load shader instruction memory data



NEMA_BURST_SIZE

Address Access Reset		Reset	Description
0x00d0	rw	0x0	Controls the size of the burst for the texture and framebuffer read.

Fields



Fields Description

TEX BURST SIZE

Value of the texture read burst size in log2(bytes).

Value of 0 or greater than log2(UNEMA_TEX_BURST) will result in burst size equal to UNEMA TEX BURST (biggest possible).

Value of 1 or smaller than log2(UNEMA_AXI_WIDTH_M/8) will result in burst size equal to UNEMA_AXI_WIDTH_M/8 (smallest possible).

Value should be greater or equal to the texture format size used, e.g. TSc6 (12 bytes) mode requires a value greater or equal to 4.

FB BURST SIZE

Value of the framebuffer read burst size in log2(bytes).

Value of 0 or greater than log2(UNEMA_FB_BURST) will result in burst size equal to UNEMA_FB_BURST (biggest possible).

Value of 1 or smaller than log2(UNEMA_AXI_WIDTH_M/8) will result in burst size equal to UNEMA_AXI_WIDTH_M/8 (smallest possible).

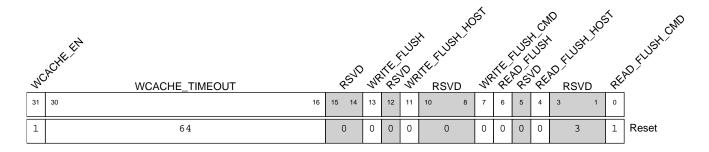
Value should be greater or equal to the framebuffer format size used, e.g. TSc6 (12 bytes) mode requires a value greater or equal to 4.



NEMA_FLUSH_CTRL

Address	Access	Reset	Description
0x00e4	rw	0x80640007 Controls the system flush	

Fields



Fields Description

READ FLUSH CMD

If set to 1, the read caches are flushed when the Command List Processor triggers the Rasterizer (Register NEMA_DRAW_CMD_NOHOLD)

READ FLUSH HOST

If set to 1, the read caches are fluhsed when the Host triggers the Rasterizer (Register NEMA DRAW CMD NOHOLD)

READ FLUSH

When set to 1, flush read caches

WRITE FLUSH CMD

If set to 1, the write caches are flushed when the Command List Processor triggers the Rasterizer (Register NEMA_DRAW_CMD_NOHOLD)

WRITE FLUSH HOST

If set to 1, the write caches are flushed when the Host triggers the Rasterizer (Register NEMA DRAW CMD NOHOLD)

WRITE FLUSH

When set to 1, flush write caches

WCACHE TIMEOUT

Timeout for the lines of the WCache

WCACHE EN

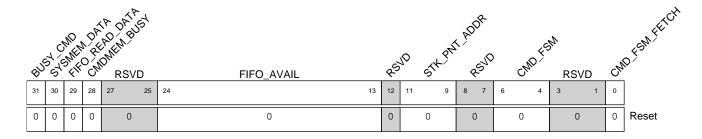
When set to 1, write cache is enabled



NEMA_CMDSTATUS

Address Access Reset		Reset	Description
0x00e8	rw	0x0	On read, returns internal CL processor status. On write, resets CL processor. Its content should be considered volatile.

Fields



Fields Description

CMD_FSM_FETCH

Indicates the state of the FSM responsible for fetching

CMD FSM

Indicates the state of CMDList internal FSM.

STK PNT ADDR

Show the address of the stack pointer

FIFO AVAIL

Show how many cells are still available in FIFO

CMDMEM BUSY

Indicates if the Command List Processor System Memory is busy

FIFO READ DATA

Indicates if there are available data to read from FIFO

SYSMEM DATA

Indicates if there are data available in System Memory

BUSY CMD

Indicates if the Command List Processor is busy



NEMA_CMDRINGSTOP

Address A	ccess Res	et Descripti	Description	
0x00ec rv	v 0x0	Ring Buffe	er's pointer.	

Fields

	CMDRINGSTOP		_
31		0	
	0		Reset

Fields Description

CMDRINGSTOP

Stores the Ring Buffer's last written address



NEMA_CMDADDR

Address	Access	Reset	Description
0x00f0	rw	0x0	Command list base address.

Fields

	CMDADDR	_
31	0	
	0	Reset

Fields Description

CMDADDR

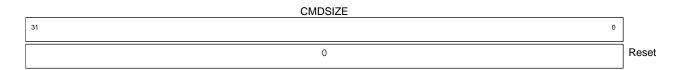
Specifies the base address of every new command list ready to be executed



NEMA_CMDSIZE

Address	Access	Reset	Description
0x00f4	rw	0x0	Command list length in words(32-bits)

Fields



Fields Description

CMDSIZE

Specifies the length of the command list ready to be executed.



NEMA_INTERRUPT

Address	Access	Reset	Description
0x00f8	rw	0x0	Interrupt control register

Fields

cit,	DIFS	\N	RSVD	ď	ind.	AN CV	, ⁶ 0	ARITY
31 30	29 28	27	26 4	3	2	1	0	
0	0	0	0	0	0	0	0	Reset

Fields Description

POLARITY

1: IRQ signal is active low

0: IRQ signal is active high

CL

When set to 1, signals an interrupt at the end of a command list

DRAW

When set to 1, signals an interrupt at the end of a drawing command

When set to 1, the interrupt in the NEMA_IRQ_ID register is cleared

THROTTLE

When set to 1, the throttle signal will be ignored.

CLK DVFS

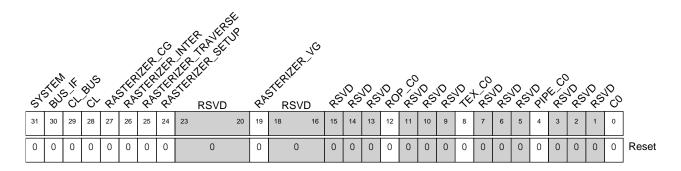
Specify the core_clk_dvfs output



NEMA_STATUS

Address	Access	Reset	Description
0x00fc	rw	0x0	On read, returns Nema's status. On writes, resets the GPU.

Fields



Fields Description

C₀

Indicates if the Core 0 is busy

PIPE CO

Indicates if the Core 0 graphics pipeline is busy

TEX CO

Indicates if the Core 0 Texture Map Unit is busy

ROP CO

Indicates if the Core 0 Render Output Unit is busy

RASTERIZER VG

Indicates if the Rasterizer Vertex Matrix Multiplication Unit and Tesselation Unit are busy

RASTERIZER SETUP

Indicate if the Rasterizer Setup Unit is busy

RASTERIZER TRAVERSE

Indicate if the Rasterizer Traverse Unit is busy

RASTERIZER INTER

Indicate if the Rasterizer Interpolation Unit is busy

RASTERIZER CG

Indicate if the Rasterizer Clockgating Unit is busy

CL

Indicates if the Command List Processor is busy

CL BUS

Indicates if the Command List bus is busy

BUS IF

Indicates if the Bus Interface Unit is busy



SYSTEM

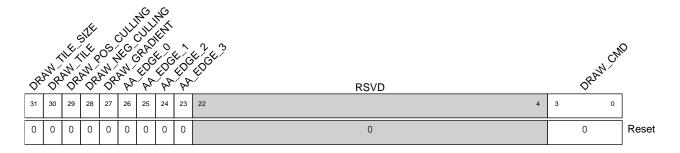
Indicates if the system is busy



NEMA_DRAW_CMD_NOHOLD

Address	Access	Reset	Description
0x0100	rw	0x0	Rasterizer Command (e.g. draw triangle, rectangle etc)

Fields



Fields Description

DRAW CMD

Draw Command

- * 0x01 Draw Line
- * 0x02 Draw Rectangle
- * 0x03 Draw Point
- * 0x04 Draw Triangle
- * 0x05 Draw Quadrilateral
- * 0x06 Draw Quadratic Bezier
- * 0x07 Draw Cubic Bezier
- * 0x08 Draw Ouadratic Bezier Line
- * 0x09 Draw Cubic Bezier Line
- * 0x0A Stroke line (1 pixel width)
- * 0x0B Draw Triangle Fan

AA EDGE 3

When set to 1, Antialiasing feature is enabled for edge 3

AA EDGE 2

When set to 1, Antialiasing feature is enabled for edge 2

AA EDGE 1

When set to 1, Antialiasing feature is enabled for edge 1

AA_EDGE_0

When set to 1, Antialiasing feature is enabled for edge 0

DRAW GRADIENT

When set to 1, color gradient is enabled

DRAW NEG CULLING

When set to 1, negative culling (clockwise) is enabled



DRAW_POS_CULLING

When set to 1, positive culling (counter-clockwise) is enabled

DRAW_TILE

When set to 1, tile mode is enabled

DRAW_TILE_SIZE

When set to 1, tile size is 2x2



NEMA_DRAW_STARTXY

Address	Access	Reset	Description
0×0104	rw	0x0	Vertex 0 drawing primitive. This register is used only for integer values. For greater accuracy NEMA_DRAW_START_X and NEMA_DRAW_START_Y registers are used which accept 16.16 fixed point values. This register is updated also by NEMA_DRAW_START_X and NEMA_DRAW_START_Y. Its content should be considered volatile.

Fields

	START_Y	START_X	_
31	16	15 0	
	0	0	Reset

Fields Description

START_X

Specifies the X coordinate (integer value) of vertex 0

START_Y

Specifies the Y coordinate (integer value) of vertex 0



NEMA_DRAW_ENDXY

Address	Access	Reset	Description
0x0108	rw	0x0	Vertex 1 drawing primitive. This register is used only for integer values. For greater accuracy NEMA_DRAW_END_X and NEMA_DRAW_END_Y registers are used which accept 16.16 fixed point values. This register is updated also by NEMA_DRAW_END_X and NEMA_DRAW_END_Y. Its content should be considered volatile.

Fields

	END_Y	END_X	_
31	16	15 0	
	0	0	Reset

Fields Description

END X

Specifies the X coordinate (integer value) of vertex 1

END Y

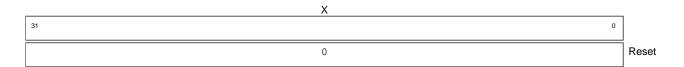
Specifies the Y coordinate (integer value) of vertex 1



DRAW_FAN_X

Address	Access	Reset	Description
0x010c	rw	0x0	X coordinate of the Fan center point. Its content should be considered volatile.

Fields



Fields Description

X

Specifies the X coordinate of bezier vertex 4 drawing primitive (fixed point 16.16 format)



NEMA_CLIPMIN

Address	Access	Reset	Description
0x0110	rw	0x0	Clipping Rectangle upper left vertex

Fields

	CLIPMIN_Y	CLIPMIN_X	_
31	16	15 0	
	0	0	Reset

Fields Description

CLIPMIN X

Define the upper left X coordinate

CLIPMIN_Y

Define the upper left Y coordinate



NEMA_CLIPMAX

Address	Access	Reset	Description
0x0114	rw	0x7fff7fff	Clipping Rectangle bottom right vertex

Fields

CLIPMAX_Y	CLIPMAX_X	_
31 16	15 0	
7FFF	7FFF	Reset

Fields Description

CLIPMAX X

Define the bottom left X coordinate

CLIPMAX_Y

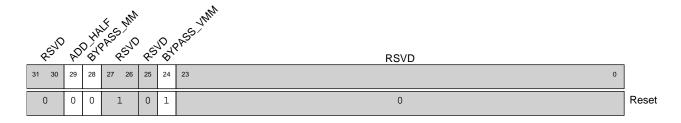
Define the bottom left Y coordinate



NEMA_MATMULT

Address	Access	Reset	Description
0x0118	rw	0x5000000	Rasterizer matrix multiplication control. This register is partially updated by other registers. Its content should be considered volatile.

Fields



Fields Description

BYPASS_VMM

When set to 1, the vertex matrix multiplications are bypassed

BYPASS MM

When set to 1, the matrix multiplications are bypassed

ADD_HALF

When set to 1, the 0.5 value is added to the X and Y coordinates



NEMA_CODEPTR

Address	Access	Reset	Description
0x011c	rw	0x0	Shader code pointer

Fields

BCG	FRG	_
31 16	15 0	
0	0	Reset

Fields Description

FRG

Specifies the pointer for the instruction that will be executed for the foreground pixels

BCG

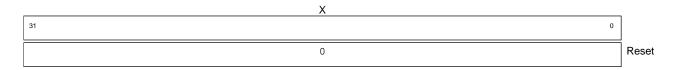
Specifies the pointer for the instruction that will be executed for the background pixels



NEMA_DRAW_PTO_X

Address	Access	Reset	Description
0x0120	rw	0x0	X coordinate of vertex 0 drawing primitive. The value is 16.16 fixed point. This register is updated also by NEMA_DRAW_PT0 and NEMA_DRAW_PT1. Its content should be considered volatile.

Fields



Fields Description

X

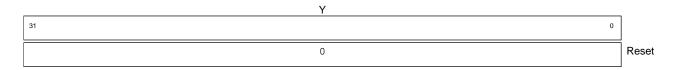
Specifies the X coordinate of vertex 0 drawing primitive (16.16 fixed point)



NEMA_DRAW_PTO_Y

Address	Access	Reset	Description
0x0124	rw	0x0	Y coordinate of vertex 0 drawing primitive. The value is 16.16 fixed point. This register is updated also by NEMA_DRAW_PT0 and NEMA_DRAW_PT1. Its content should be considered volatile.

Fields



Fields Description

Υ

Specifies the Y coordinate of vertex 0 drawing primitive (16.16 fixed point)



DRAW_FAN_Y

Address	Access	Reset	Description
0x0128	rw	0x0	Y coordinate of the Fan center point. Its content should be considered volatile.

Fields



Fields Description

Υ

Specifies the X coordinate of bezier vertex 4 drawing primitive (fixed point 16.16 format)



NEMA_DRAW_COLOR

Address	Access	Reset	Description
0x012c	rw	0x0	Rasterizer drawing color for filling primitives

Fields

DRAW_COLOR		
31	0	
0		Reset

Fields Description

DRAW_COLOR

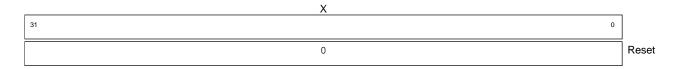
Specifies the drawing color for filling primitives



NEMA_DRAW_PT1_X

Address	Access	Reset	Description
0x0130	rw	0x0	X coordinate of vertex 1 drawing primitive. The value is 16.16 fixed point. This register is updated also by NEMA_DRAW_PT0 and NEMA_DRAW_PT1. Its content should be considered volatile.

Fields



Fields Description

X

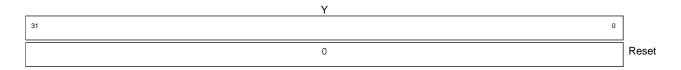
Specifies the X coordinate of vertex 1 drawing primitive (16.16 fixed point)



NEMA_DRAW_PT1_Y

Address	Access	Reset	Description
0x0134	rw	0x0	Y coordinate of vertex 1 drawing primitive. The value is 16.16 fixed point. This register is updated also by NEMA_DRAW_PT0 and NEMA_DRAW_PT1. Its content should be considered volatile.

Fields



Fields Description

Y

Specifies the Y coordinate of vertex 1 drawing primitive (16.16 fixed point)



NEMA_BYPASS_ADDR

Address	Access	Reset	Description
0x0138	rw	0x0	Address of bypass mode of rasterizer
			setup access

Fields

NEMA_BYPASS_ADDR	
31 0	
0	Reset

Fields Description

NEMA_BYPASS_ADDR

Address of bypass mode of rasterizer setup access



BYPASS_DATA

Address	Access	Reset	Description
0x013c	rw	0x0	Data and enable of bypass mode of rasterizer

Fields

NEMA_BYPASS_DATA	_
31 0	
	J
0	Reset

Fields Description

NEMA_BYPASS_DATA

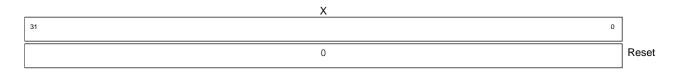
Data and enable of bypass mode of rasterizer



NEMA_DRAW_PT2_X

Address	Access	Reset	Description
0x0140	rw	0x0	X coordinate of vertex 2 drawing primitive. The value is 16.16 fixed point

Fields



Fields Description

X

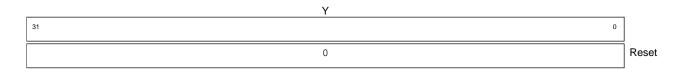
Specifies the X coordinate of vertex 2 drawing primitive (16.16 fixed point)



${\bf NEMA_DRAW_PT2_Y}$

Address	Access	Reset	Description
0x0144	rw	0x0	Y coordinate of vertex 2 drawing primitive. The value is 16.16 fixed point

Fields



Fields Description

Υ

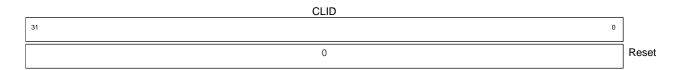
Specifies the Y coordinate of vertex 2 drawing primitive (16.16 fixed point)



NEMA_CLID

Address	Access	Reset	Description
0x0148	rw	0x0	Command List ID Kev

Fields



Fields Description

CLID

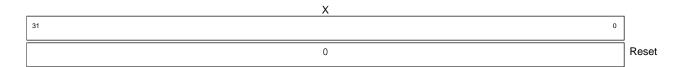
Specifies the last executed command list



${\bf NEMA_DRAW_PT3_X}$

Address	Access	Reset	Description
0x0150	rw	0x0	X coordinate of vertex 3 drawing primitive. The value is 16.16 fixed point

Fields



Fields Description

X

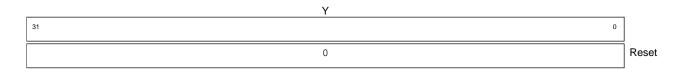
Specifies the X coordinate of vertex 3 drawing primitive (16.16 fixed point)



NEMA_DRAW_PT3_Y

Address	Access	Reset	Description
0x0154	rw	0x0	Y coordinate of vertex 3 drawing primitive. The value is 16.16 fixed point

Fields



Fields Description

Υ

Specifies the Y coordinate of vertex 3 drawing primitive (16.16 fixed point)



NEMA_CLIPMIN1

Address	Access	Reset	Description
0x0158	rw	0x0	Second Clipping Rectangle upper left vertex

Fields

CLIPMIN_Y	CLIPMIN_X	
31 16	15 0	
0	0	Reset

Fields Description

CLIPMIN_X

Define the upper left X coordinate

CLIPMIN_Y

Define the upper left Y coordinate



NEMA_CLIPMAX1

Address	Access	Reset	Description
0x015c	rw	0x7fff7fff	Second Clipping Rectangle bottom right vertex

Fields

CLIPMAX_Y	CLIPMAX_X	_
31 16	15 0	
7FFF	7FFF	Reset

Fields Description

CLIPMAX X

Define the bottom left X coordinate

CLIPMAX_Y

Define the bottom left Y coordinate



Address	Access	Reset	Description
0x0160	rw	0x0	(0,0) matrix floating point element. On read return the floating point value with the selected characteristics

Fields

	RSVD	MM00	_
31	21	20 0	
	0	0	Reset

Fields Description

MM00

Specifies the (0,0) element



Address	Access	Reset	Description
0x0164	rw	0x0	(0,1) matrix floating point element. On read return the floating point value with the selected characteristics

Fields

	RSVD	MM01	_
31	21	20 0	
	0	0	Reset

Fields Description

MM01

Specifies the (0,1) element



Address	Access	Reset	Description
0x0168	rw	0x0	(0,2) matrix floating point element. On read return the floating point value with the selected characteristics

Fields

	RSVD	MM02	_
31	21	20 0	
	0	0	Reset

Fields Description

MM02

Specifies the (0,2) element



Address	Access	Reset	Description
0x016c	rw	0x0	(1,0) matrix floating point element. On read return the floating point value with the selected characteristics

Fields

RSVD	MM10	_
31 21	20 0	
0	0	Reset

Fields Description

MM10

Specifies the (1,0) element



Address	Access	Reset	Description
0x0170	rw	0x0	(1,1) matrix floating point element. On read return the floating point value with the selected characteristics

Fields

RSVD	MM11	_
31 21	20 0	
0	0	Reset

Fields Description

MM11

Specifies the (1,1) element



Address	Access	Reset	Description
0x0174	rw	0x0	(1,2) matrix floating point element. On read return the floating point value with the selected characteristics

Fields

RSVD		MM12	
31	21	20 0	
	0	0	Reset

Fields Description

MM12

Specifies the (1,2) element



Address	Access	Reset	Description
0x0178	rw	0x0	(2,0) matrix floating point element. On read return the floating point value with the selected characteristics

Fields

RSVD		MM20	
31	21	20 0	
	0	0	Reset

Fields Description

MM20

Specifies the (2,0) element



Address	Access	Reset	Description
0x017c	rw	0x0	(2,1) matrix floating point element. On read return the floating point value with the selected characteristics

Fields

RSVD	MM21	_
31 21	20 0	
0	0	Reset

Fields Description

MM21

Specifies the (2,1) element



Address	Access	Reset	Description
0x0180	rw	0x0	(2,2) matrix floating point element. On read return the floating point value with the selected characteristics

Fields

RSVD	MM22	_
31 21	20 0	
0	0	Reset

Fields Description

MM22

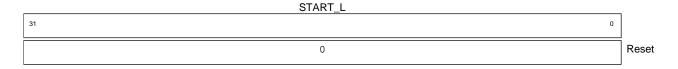
Specifies the (2,2) element



NEMA_DEPTH_START_L

Address	Access	Reset	Description
0x0184	rw	0x0	Depth value of the STARTXY pixel. This register defines the integral part of the depth value which is the lower 32 bits

Fields



Fields Description

START_L

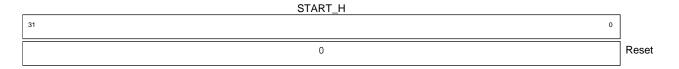
Specifies the fractional part of the depth value of the STARTXY pixel



NEMA_DEPTH_START_H

Address	Access	Reset	Description
0x0188	rw	0x0	Depth value of the STARTXY pixel. This register defines the integral part of the depth value which is the higher 32 bits

Fields



Fields Description

START_H

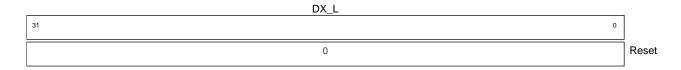
Specifies the integral value of the depth value of the STARTXY pixel



NEMA_DEPTH_DX_L

Address	Access	Reset	Description
0x018c	rw	0x0	For each step at x-axis, depth value is added. This register defines the fractional part of the depth value which is the lower 32 bits

Fields



Fields Description

DX_L

Specifies the fractional part of the added depth value for each step at x-axis



NEMA_DEPTH_DX_H

Address	Access	Reset	Description
0x0190	rw	0x0	For each step at x-axis, depth value is added. This register defines the integral part of the depth value which is the higher 32 bits

Fields



Fields Description

DX_H

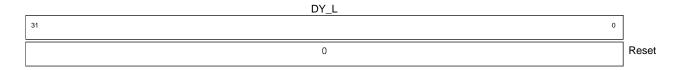
Specifies the integral part of the added depth value for each step at x-axis



NEMA_DEPTH_DY_L

Address	Access	Reset	Description
0x0194	rw	0x0	For each step at y-axis, depth value is added. This register defines the fractional part of the depth value which is the lower 32 bits

Fields



Fields Description

DY_L

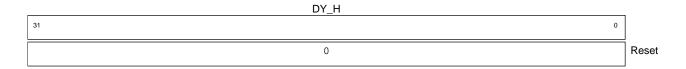
Specifies the fractional part of the added depth value for each step at y-axis



NEMA_DEPTH_DY_H

Address	Access	Reset	Description
0x0198	rw	0x0	For each step at y-axis, depth value is added. This register defines the integral part of the depth value which is the higher 32 bits

Fields



Fields Description

DY_H

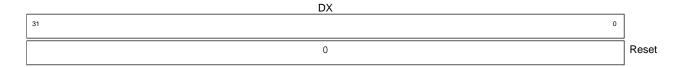
Specifies the integral part of the added depth value for each step at y-axis



NEMA_RED_DX

Address	Access	Reset	Description
0x01a0	rw	0x0	For each step at x-axis, Red (R) value is added. The value is 16.16 fixed point

Fields



Fields Description

DX

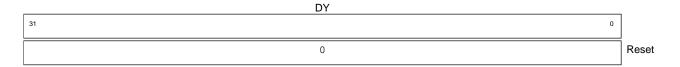
Specifies the added Red (R) value for each step at x-axis



NEMA_RED_DY

Address	Access	Reset	Description
0x01a4	rw	0x0	For each step at y-axis, Red (R) value is added. The value is 16.16 fixed point

Fields



Fields Description

DY

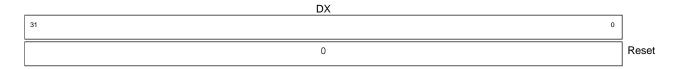
Specifies the added Red (R) value for each step at y-axis



NEMA_GRE_DX

Address	Access	Reset	Description
0x01a8	rw	0x0	For each step at x-axis, Green (G) value is added. The value is 16,16 fixed point

Fields



Fields Description

DX

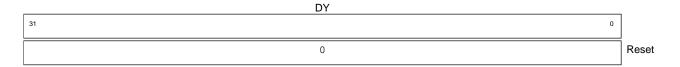
Specifies the added Green (G) value for each step at x-axis



NEMA_GRE_DY

Address	Access	Reset	Description
0x01ac	rw	0x0	For each step at y-axis, Green (G) value is added. The value is 16,16 fixed point

Fields



Fields Description

DY

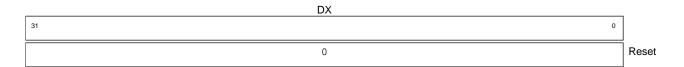
Specifies the added Green (G) value for each step at y-axis



NEMA_BLU_DX

Address	Access	Reset	Description
0x01b0	rw	0x0	For each step at x-axis, Blue (B) value is added. The value is 16.16 fixed point

Fields



Fields Description

DX

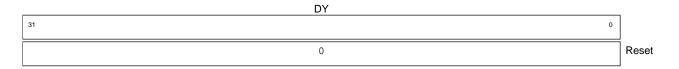
Specifies the added Blue (B) value for each step at x-axis



${\bf NEMA_BLU_DY}$

Address	Access	Reset	Description
0x01b4	rw	0x0	For each step at y-axis, Blue (B) value is added. The value is 16.16 fixed point

Fields



Fields Description

DY

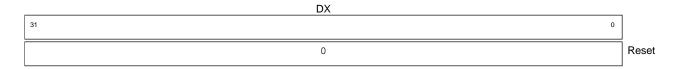
Specifies the added Blue (B) value for each step at y-axis



NEMA_ALF_DX

Address	Access	Reset	Description
0x01b8	rw	0x0	For each step at x-axis, Alpha (A) value is added. The value is 16.16 fixed point

Fields



Fields Description

DX

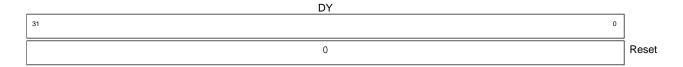
Specifies the added Alpha (A) value for each step at x-axis



NEMA_ALF_DY

Address	Access	Reset	Description
0x01bc	rw	0x0	For each step at y-axis, Alpha (A) value is added. The value is 16,16 fixed point

Fields



Fields Description

DY

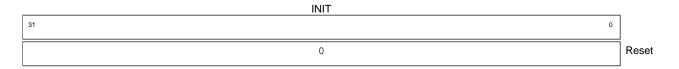
Specifies the added Alpha (A) value for each step at y-axis



NEMA_RED_INIT

Address	Access	Reset	Description
0x01c0	rw	0x0	Red (R) value of the STARTXY pixel. The value is 16,16 fixed point

Fields



Fields Description

INIT

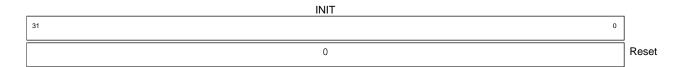
Specifies the Red (R) value of the STARTXY pixel



NEMA_GRE_INIT

Address	Access	Reset	Description
0x01c4	rw	0x0	Green (G) value of the STARTXY pixel. The value is 16.16 fixed point

Fields



Fields Description

INIT

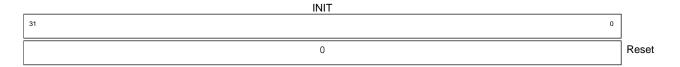
Specifies the Green (G) value of the STARTXY pixel



NEMA_BLU_INIT

Address	Access	Reset	Description
0x01c8	rw	0x0	Blue (B) value of the STARTXY pixel. The value is 16.16 fixed point

Fields



Fields Description

INIT

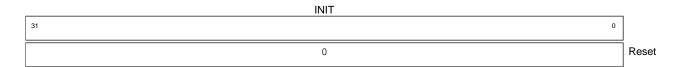
Specifies the Blue (B) value of the STARTXY pixel



NEMA_ALF_INIT

Address	Access	Reset	Description
0x01cc	rw	0x0	Alpha (A) value of the STARTXY pixel. The value is 16.16 fixed point

Fields



Fields Description

INIT

Specifies the Alpha (A) value of the STARTXY pixel



NEMA_ROPBLENDER_BLEND_MODE

Address	Access	Reset	Description
0x01d0	rw	0x0	Blending Modes for different calculations between the source (Fragment Processing Core) and destination (Frame Buffer) colors

Fields

,	Ε ^λ .	E SEC		OK*		IIALIASING						
C/	, c ₂	RSVD	φ,	RSVD	M	RSVD		DEST		RSVD	SOURCE	_
31	30	29 26	25	24 17	16	15 12	11	8	7	4	3 0	
0	0	0	0	0	0	0		0		0	0	Reset

Fields Description

SOURCE

Blending mode of the current pixel (source pixel)

DEST

Blending mode of the stored pixel in the FrameBuffer (destination pixel)

ANTIALIASING

If set, disables Antialiasing

BLD OFF

If set, enables Negative Destination Color Keying.

CLKEY SRC

If set, enables Source Color Keying

CLKEY DST

If set, enables Destination Color Keying



NEMA_ROPBLENDER_DST_CKEY

Address	Access	Reset	Description
0x01d4	rw	0x0	When Color Keying is enabled. The new pixel is written in the Frame Buffer, only if the destination pixel has the same RGB value with the Destination Color Key, which is the value of this register

Fields

ALPHA	BLUE	GREEN	RED	
31 24	23 16	15 8	7 0	
0	0	0	0	Reset

Fields Description

RED

Specifies the Red (R) value

GREEN

Specifies the Green (G) value

BLUE

Specifies the Blue (B) value

ALPHA

Specifies the Alpha (A) value



NEMA_ROPBLENDER_CONST_COLOR

Address	Access	Reset	Description
0x01d8	rw	0x0	Constant Color value which is used for blending when the blending modes. DSBF_CONSTCOLOR and DSBF_CONSTALPHA are configured in the NEMA_ROPBLENDER_BLEND_MODE Register. * if the blending mode is DSBF_CONSTALPHA then the Constant Alpha value Ca is obtained from bits 31-24 * if the blending mode is DSBF_CONSTCOLOR then the Constant Alpha value Cc is obtained from bits 31-0

Fields

ALPHA	BLUE	GREEN	RED	
31 24	23 16	15 8	7 0	
0	0	0	0	Reset

Fields Description

RED

Specifies the Red (R) value

GREEN

Specifies the Green (G) value

BLUE

Specifies the Blue (B) value

ALPHA

Specifies the Alpha (A) value



NEMA_IP_VERSION

Address A	Access	Reset	Description
0x01dc r		0x231000	Returns the current GPU IP version

Fields

UNEMA_VERSION	_
31 0	
231000	Reset

Fields Description

UNEMA_VERSION (Read only)

The current version of the GPU IP



NEMA_CODEPTR2

Address	Access	Reset	Description
0x01e0	rw	0x0	Shader code pointer

Fields

	BCG			FRG		
31		16	15		0	
	0	-		0		Reset

Fields Description

FRG

Specifies the pointer for the instruction that will be executed for the foreground pixels if we are working on neg_area geometries (rasterizer)

BCG

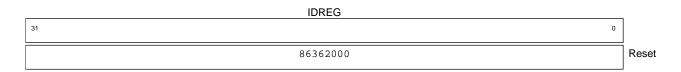
Specifies the pointer for the instruction that will be executed for the background pixels if we are working on neg area geometries (rasterizer)



NEMA_IDREG

Address Acc	ess Reset	Description			
0x01ec r	0x863620	0x86362000 GPU ID Register (fixed value)			

Fields



Fields Description

IDREG (Read only)

The fixed value is 0x86362000



NEMA_CONFIG

Address	Access	Reset	Description		
0x01f0	r	0xd4010104 GPU configuration status			

Fields

♦	5°	, <g< th=""><th>ς ' ψ\</th><th>ind indi</th><th>A OIL</th><th>Eq.</th><th>RSVD</th><th colspan="2">MPR</th><th>NP C</th><th colspan="3"></th><th>RES</th><th></th><th>THREADS</th><th></th><th></th></g<>	ς ' ψ\	ind indi	A OIL	Eq.	RSVD	MPR		NP C				RES		THREADS		
31	30	29	28	27	26	25		18	17	16	15	12	11	8	7		0	
1	1	0	1	0	1		0		0	1	0			1		4		Reset

Fields Description

THREADS (Read only)

Indicates the log2 number of threads

CORES (Read only)

Indicates the number of cores

CG (Read only)

When set to 1, indicates that clock gating is enabled

COMPRESS (Read only)

When set to 1, indicates that TSC compression mode is enabled

DIRTY (Read only)

When set to 1, indicates that Dirty Region is enabled

ASYNC (Read only)

When set to 1, Bus to Memory is Asynchronous to core clock

BLENDER (Read only)

When set to 1, indicates that H/W Blender is enabled

TSC6 (Read only)

When set to 1, indicates that TSC6 compression mode is enabled.

BL (Read only)

When set to 1, indicates that Bilinear filtering is enabled

BUS (Read only)

When set to 1, indicates that the master bus is AXI

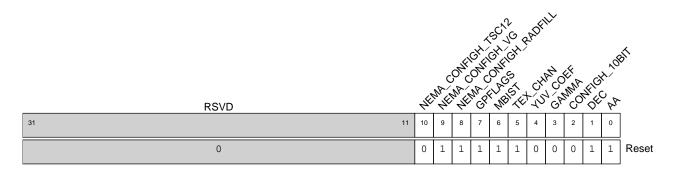
When set to 0, indicates that the master bus is AHB



NEMA_CONFIGH

Address	Access	Reset	Description
0x01f4	r	0x3e3	GPU configuration status (high bits)

Fields



Fields Description

AA (Read only)

Indicates that the Antialiasing feature is enabled

DEC (Read only)

Indicates that the TSc Framebuffer/Texture Decompression is enabled

CONFIGH 10BIT (Read only)

Indicates that 10-bit precision is selected

GAMMA (Read only)

Indicates that Gamma Correction is enabled

YUV COEF (Read only)

Indicates that YUV coefficients are present

TEX CHAN (Read only)

Indicates that Texture map unit has two channels

MBIST (Read only)

Indicates that separate logic/mem Clock Gating is enabled

GPFLAGS (Read only)

Indicates that external debug interface (GP_FLAG, SYSERROR_IRQ, FREEZE) is enabled

NEMA CONFIGH RADFILL (Read only)

Indicates that Radial Fill is enabled

NEMA CONFIGH VG (Read only)

Indicates that NemaVG is enabled

NEMA CONFIGH TSC12 (Read only)

When set to 1, indicates that TSC12 compression mode is enabled



NEMA_CO_REG

Address	Access	Reset	Description
0x0200	W	0x0	A 32-bit integer RGBA value is stored in constant register 0 for fragment calculations.

Fields

	ALPHA	BLUE	GREEN	RED	
3	1 24	23 16	15 8	7 0	
	0	0	0	0	Reset

Fields Description

RED (Write only)

Specifies the Red (R) value

GREEN (Write only)

Specifies the Green (G) value

BLUE (Write only)

Specifies the Blue (B) value

ALPHA (Write only)



NEMA_C1_REG

Address	Access	Reset	Description
0x0204	W	0x0	A 32-bit integer RGBA value is stored in constant register 1 for fragment calculations.

Fields

	ALPHA	BLUE	GREEN	RED	
31	24	23 16	15 8	7 0	
	0	0	0	0	Reset

Fields Description

RED (Write only)

Specifies the Red (R) value

GREEN (Write only)

Specifies the Green (G) value

BLUE (Write only)

Specifies the Blue (B) value

ALPHA (Write only)



NEMA_C2_REG

Address	Access	Reset	Description
0x0208	W	0x0	A 32-bit integer RGBA value is stored in constant register 2 for fragment calculations.

Fields

	ALPHA	BLUE	GREEN	RED	
3	1 24	23 16	15 8	7 0	
	0	0	0	0	Reset

Fields Description

RED (Write only)

Specifies the Red (R) value

GREEN (Write only)

Specifies the Green (G) value

BLUE (Write only)

Specifies the Blue (B) value

ALPHA (Write only)



NEMA_C3_REG

Address	Access	Reset	Description
0x020c	W	0x0	A 32-bit integer RGBA value is stored in constant register 3 for fragment calculations.

Fields

	ALPHA	BLUE	GREEN	RED	
3	1 24	23 16	15 8	7 0	
	0	0	0	0	Reset

Fields Description

RED (Write only)

Specifies the Red (R) value

GREEN (Write only)

Specifies the Green (G) value

BLUE (Write only)

Specifies the Blue (B) value

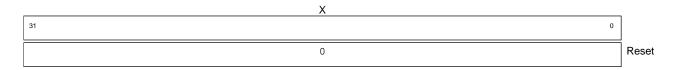
ALPHA (Write only)



DRAW_PT0_X

Address	Access	Reset	Description
0x0320	W	0x0	X coordinate of bezier vertex 0 drawing primitive. This register is written in FP32 IEEE format and can be read from the corresponding PT_X (0x162) register. Its content should be considered volatile.

Fields



Fields Description

X (Write only)

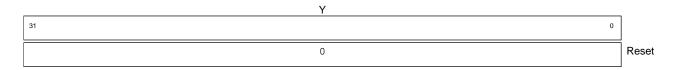
Specifies the X coordinate of bezier vertex 0 drawing primitive (fp32 format)



DRAW_PT0_Y

Address	Access	Reset	Description
0x0324	W	0x0	Y coordinate of bezier vertex 0 drawing primitive. This register is written in FP32 IEEE format and can be read from the corresponding PT_Y (0x162) register. Its content should be considered volatile.

Fields



Fields Description

Y (Write only)

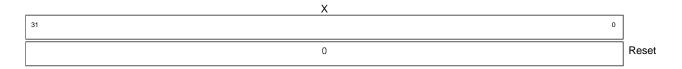
Specifies the Y coordinate of bezier vertex 0 drawing primitive (fp32 format)



DRAW_FP_FAN_X

Address	Access	Reset	Description
0x0328	W	0x0	X coordinate of the Fan center point. Its content should be considered volatile.

Fields



Fields Description

X (Write only)

Specifies the X coordinate of bezier vertex 4 drawing primitive (fp32 format)



${\bf DRAW_FP_FAN_Y}$

Address	Access	Reset	Description
0x032c	W	0x0	Y coordinate of the Fan center point. Its content should be considered volatile.

Fields



Fields Description

Y (Write only)

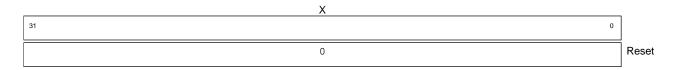
Specifies the X coordinate of bezier vertex 4 drawing primitive (fp32 format)



DRAW_PT1_X

Address	Access	Reset	Description
0x0330	W	0x0	X coordinate of bezier vertex 1 drawing primitive. This register is written in FP32 IEEE format and can be read from the corresponding PT_X (0x163) register. Its content should be considered volatile.

Fields



Fields Description

X (Write only)

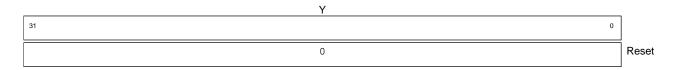
Specifies the X coordinate of bezier vertex 1 drawing primitive (fp32 format)



DRAW_PT1_Y

Address	Access	Reset	Description
0x0334	W	0x0	Y coordinate of bezier vertex 1 drawing primitive. This register is written in FP32 IEEE format and can be read from the corresponding PT_Y (0x163) register. Its content should be considered volatile.

Fields



Fields Description

Y (Write only)

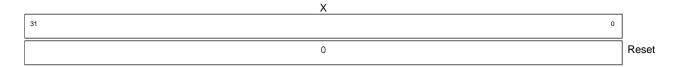
Specifies the Y coordinate of bezier vertex 1 drawing primitive (fp32 format)



DRAW_PT2_X

Address	Access	Reset	Description
0x0340	W	0x0	X coordinate of bezier vertex 2 drawing primitive.

Fields



Fields Description

X (Write only)

Specifies the X coordinate of bezier vertex 2 drawing primitive (fp32 format)



DRAW_PT2_Y

Address	Access	Reset	Description
0x0344	W	0x0	Y coordinate of bezier vertex 2 drawing primitive.

Fields



Fields Description

Y (Write only)

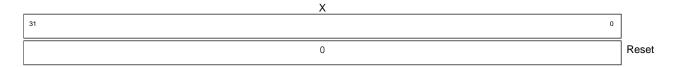
Specifies the Y coordinate of bezier vertex 2 drawing primitive (fp32 format)



DRAW_PT3_X

Address	Access	Reset	Description
0x0350	W	0x0	X coordinate of bezier vertex 3 drawing primitive.

Fields



Fields Description

X (Write only)

Specifies the X coordinate of bezier vertex 3 drawing primitive (fp32 format)



DRAW_PT3_Y

Address	Access	Reset	Description
0x0354	W	0x0	Y coordinate of bezier vertex 3 drawing primitive.

Fields



Fields Description

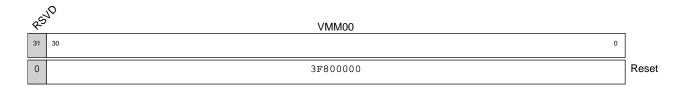
Y (Write only)

Specifies the Y coordinate of bezier vertex 3 drawing primitive (fp32 format)



Address	Access	Reset	Description
0x0360	rw		(0,0) Bezier Vertex Transformation matrix floating point element. On read return the floating point value with the selected characteristics

Fields



Fields Description

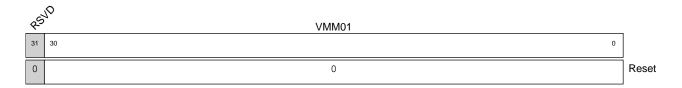
VMM00

Specifies the (0,0) element



Address	Access	Reset	Description
0x0364	rw	0x0	(0,1) Bezier Vertex Transformation matrix floating point element. On read return the floating point value with the selected characteristics

Fields



Fields Description

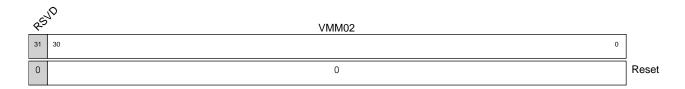
VMM01

Specifies the (0,1) element



Address	Access	Reset	Description
0x0368	rw	0x0	(0,2) Bezier Vertex Transformation matrix floating point element. On read return the floating point value with the selected characteristics

Fields



Fields Description

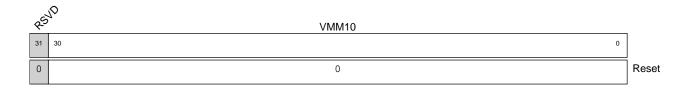
VMM02

Specifies the (0,2) element



Address	Access	Reset	Description
0x036c	rw	0x0	(1,0) Bezier Vertex Transformation matrix floating point element. On read return the floating point value with the selected characteristics

Fields



Fields Description

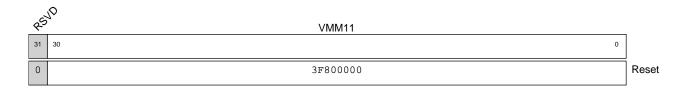
VMM10

Specifies the (1,0) element



Address	Access	Reset	Description
0x0370	rw		(1,1) Bezier Vertex Transformation matrix floating point element. On read return the floating point value with the selected characteristics

Fields



Fields Description

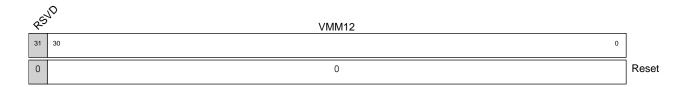
VMM11

Specifies the (1,1) element



Address	Access	Reset	Description
0x0374	rw	0x0	(1,2) Bezier Vertex Transformation matrix floating point element. On read return the floating point value with the selected characteristics

Fields



Fields Description

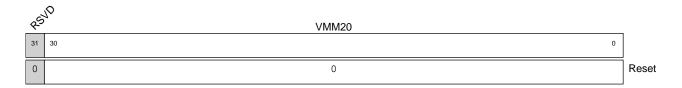
VMM12

Specifies the (1,2) element



Address	Access	Reset	Description
0x0378	rw	0x0	(2,0) Bezier Vertex Transformation matrix floating point element. On read return the floating point value with the selected characteristics

Fields



Fields Description

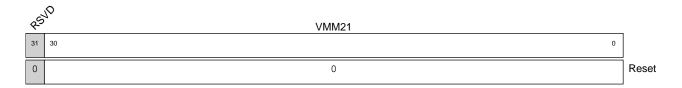
VMM20

Specifies the (2,0) element



Address	Access	Reset	Description
0x037c	rw	0x0	(2,1) Bezier Vertex Transformation matrix floating point element. On read return the floating point value with the selected characteristics

Fields



Fields Description

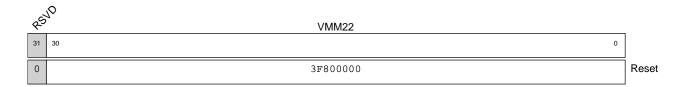
VMM21

Specifies the (2,1) element



Address	Access	Reset	Description
0x0380	rw		(2,2) Bezier Vertex Transformation matrix floating point element. On read return the floating point value with the selected characteristics

Fields



Fields Description

VMM22

Specifies the (2,2) element



NEMA_COORD_MASK

Address	Access	Reset	Description
0x04d0	rw	0xfff	Inverted mask for rasterizer coordinates

Fields

	NEMA_COORD_MASK		
31		0	
	FFF		Reset

Fields Description

NEMA_COORD_MASK

Inverted mask for rasterizer coordinates



DRAW_FLATNESS

Address	Access	Reset	Description
0x04d4	rw	0x8000	Width in pixels of Bezier Curve flatness.
			(Lower values improve accuracy)

Fields

FLATNESS	
31 0	
8000	Reset

Fields Description

FLATNESS

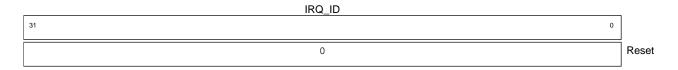
Specifies the convergence point of de Casteljau's Algorithm for drawing Bezier Curves (fixed point 16.16 format)



NEMA_IRQ_ID

Address	Access	Reset	Description
0x0ff0	rw	0x0	Signals an interrupt when written

Fields



Fields Description

IRQ_ID

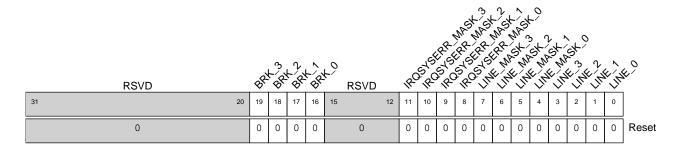
Write any value to signal an interrupt



NEMA_GP_FLAGS

Address	Access	Reset	Description
0x0ff4	rw	0x0	Stop/Break the command list when debugging

Fields



Fields Description

LINE 0

GP FLAG line 0.

LINE 1

GP FLAG line 1.

LINE 2

GP FLAG line 2.

LINE 3

GP FLAG line 3.

LINE MASK 0

 $\ensuremath{\mathsf{GP_FLAG_mask}}$ when set to 1 masks/enables the generation of the output FREEZE signal from line 0

LINE MASK 1

GP_FLAG_mask when set to 1 masks/enables the generation of the output FREEZE signal from line 1

LINE MASK 2

GP_FLAG_mask when set to 1 masks/enables the generation of the output FREEZE signal from line 2

LINE MASK 3

GP_FLAG_mask when set to 1 masks/enables the generation of the output FREEZE signal from line 3

IRQSYSERR_MASK_0

GP_FLAG_irqmask when set to 1 masks/enables the generation of the IRQ_SYSERROR from line 0



IRQSYSERR_MASK_1

GP_FLAG_irqmask when set to 1 masks/enables the generation of the IRQ SYSERROR from line 1

IRQSYSERR MASK 2

GP_FLAG_irqmask when set to 1 masks/enables the generation of the IRQ_SYSERROR from line 2

IRQSYSERR MASK 3

GP_FLAG_irqmask when set to 1 masks/enables the generation of the IRQ_SYSERROR from line 3

BRK 0

When set to 1, set breakpoint for GP_FLAG line 0 if NEMA_GP_FLAGS[0] bit value is high.

BRK 1

When set to 1, set breakpoint for GP_FLAG line 0 if NEMA_GP_FLAGS[1] bit value is high.

BRK 2

When set to 1, set breakpoint for GP_FLAG line 0 if NEMA_GP_FLAGS[2] bit value is high.

BRK 3

When set to 1, set breakpoint for GP_FLAG line 0 if NEMA_GP_FLAGS[3] bit value is high.



NEMA_SYS_INTERRUPT

Address	Access	Reset	Description
0x0ff8	rw	0x0	On Read: Returns the SYSERROR_IRQ ID. On write: Clears the SYSERROR IRQ.

Fields

RSVD		LP C	tok bis fikk	s co	ૂર્જ	Le la	\$\frac{\partial}{p}\cdot{\partial}{p}\part	(OF)		JIK	Jak Jak O
	12	11	10 7	6	5	4	3	2	1	0	
0		0	0	0		0	0	0	0	0	Reset

Fields Description

ERROR LINE 0

Indicates that IRQ_SYSERROR due to GP_FLAG line 0.

ERROR LINE 1

Indicates that IRQ SYSERROR due to GP FLAG line 1.

ERROR LINE 2

Indicates that IRQ_SYSERROR due to GP_FLAG line 2.

ERROR_LINE_3

Indicates that IRQ SYSERROR due to GP FLAG line 3.

ERROR BUS CODEO

Indicates the Interface Error Code(AXI only).

0: SLVERR

1: DECERR

ERROR BUS CODE1

Indicates the Bus Error Code occurence direction (AXI only).

01: Read Direction

10: Write Direction

ERROR_BUS_CODE2

Indicates the Bus Error Code Interface.

1000: AHB/AXI Slave Port

0100: AHB/AXI M0 Master Port

0010: AHB/AXI M1 Master Port

0001: AXI CL Master Port

ERROR BUS ERR

Indicates that a bus error has occurred.



NEMA_BUSERROR_MASK

Address	Access	Reset	Description
0x0ffc	rw	0x0	Sets the mask for the Buserror Interrupt.

Fields

RSVD	MASK2	MASK	, 89	'NO
31 7	6 3	2 1	0	
0	0	0	0	Reset

Fields Description

MASK1

Sets the mask for the Bus Error Code occurence direction (AXI only).

01: Read Direction 10: Write Direction

MASK2

Sets the mask for the Bus Error Code Interface.

1000: AHB/AXI Slave Port 0100: AHB/AXI M0 Master Port 0010: AHB/AXI M1 Master Port 0001: AXI CL Master Port