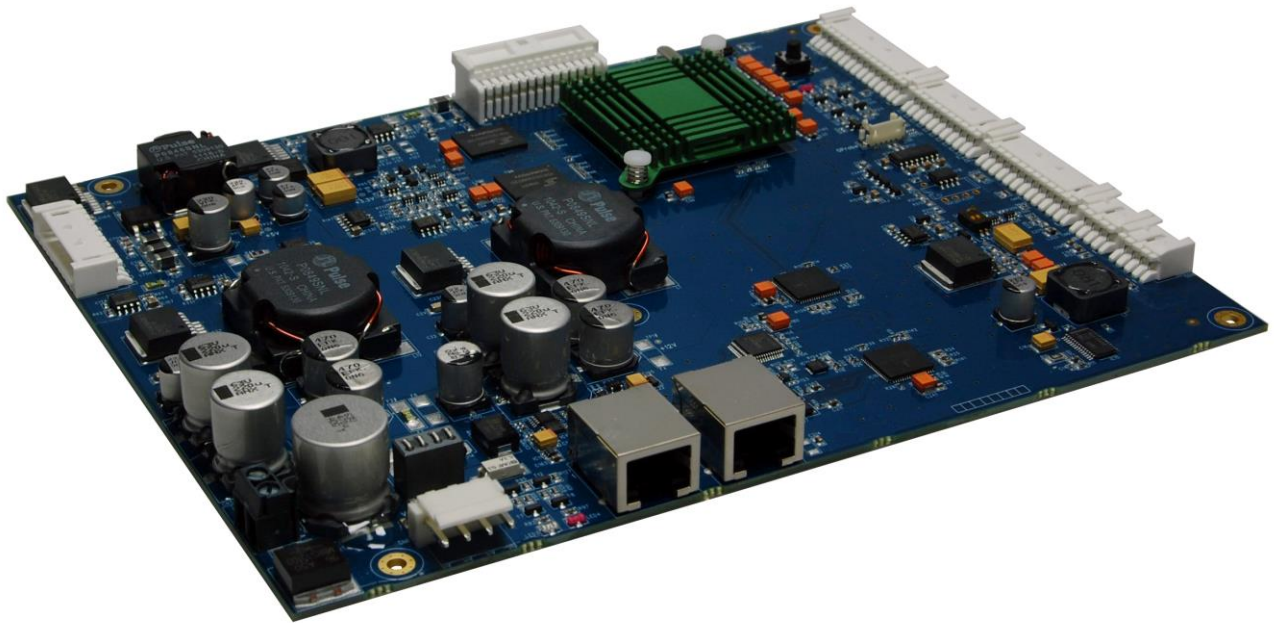# PrismaMobility

DVI/HDMI Converter Board for Harsh Environments

For VGA – WUXGA Panels

Rev 1.0.1

September 03, 2013

PRELIMINARY

Table of Contents

1. Revision History

Date	Rev.No.	Description	Page
March 28, 2012	1.0.0	Release of preliminary data sheet	
September 03, 2013	1.0.1	Format of the whole document changed	

2. Overview

The PrismaMobility is a powerful graphics processing board, providing high-quality images for TFT panels. This converter supports 6/8/10-bit LVDS panels up to WUXGA (1920 x 1200) and can be used in a variety of systems.

3. General Features

- Zoom and shrink scaling
- Frame rate conversion
- Faroudja Truelife video enhancer
- Faroudja RealColor color enhancing
- PWM or voltage controlled backlight intensity
- Wide-range input voltage (up to 36V)
- Temperature-controlled operation
- Six-button external OSD - keypad interface and on-screen menus allow adjustments to the system
- True High Definition 1080p on HDMI 1.3 input
- RS232 remote control capability (Remote OSD via WIN-PC) (optional)
- Lead-free

4. Hardware Features

High-Quality Advanced Scaling
- Moiré cancellation
- Motion Adaptive De-interlacing
- Motion Adaptive Noise Reduction
- Low Angle Diagonal Interpolation

Ultra-Reliable HDMI 1.3 Receiver
- One single Link TMDS Rx for up to 12-bit 1080p (16-bit supported but dithered)
- Direct connect to all HDMI compliant TMDS transmitters
- HDCP support

Faroudja DCDI Cinema Format Conversion for Videoinput
- Low Angle De-interlacing processing
- Per Pixel Motion Adaptive De-Interlacing (MADi) up to 1080i format
- Format conversion up to WUXGA
- Panoramic and Anamorphic non-linear scaling
- Adaptive Media Display Processing for 3:2 and 2:2 video content
- Adaptive 3D noise reduction

LVDS Interface
- Fully programmable LVDS mappings for compliance with all LVDS protocols

LCD Overdrive
- Reduces video smearing artifacts of rapid luminance transition scenes cause by slow LCD panel response

RealColorTM Technology
- Color filtering in YUV domain
- Digital brightness, contrast, hue and saturation control for analog, digital and video inputs

Frame Store
- Frame rate conversion
- Shrink scaling

On Screen Display
- Horizontal and vertical stretch of OSD images
- Blinking, transparency and blending
- 16 True Color bitmap tiles with 1, 2, 4, and 8-bit per pixel

Output Format
- Single/double wide LVDS up to WUXGA 60Hz output
- Support for 10, 8 or 6-bit panels (with high-quality dithering)

Operation Modes
- Frame rate conversion and scaling of images
- Bypass mode with no filtering and/or frame buffering
- 1:1 centering
- Frame Sync, Free Run and Auto Sync display synchronization modes

Thermostat function
- User can select a high and a low temperature, in Celsius. The power supply to the internal parts of the board will be automatically cut-off when the ambient temperature exceeds the defined temperature range. Default high-end temperature is 75°C and the default low-end temperature is -5°C. There is a hysteresis of 2°C on both ends.
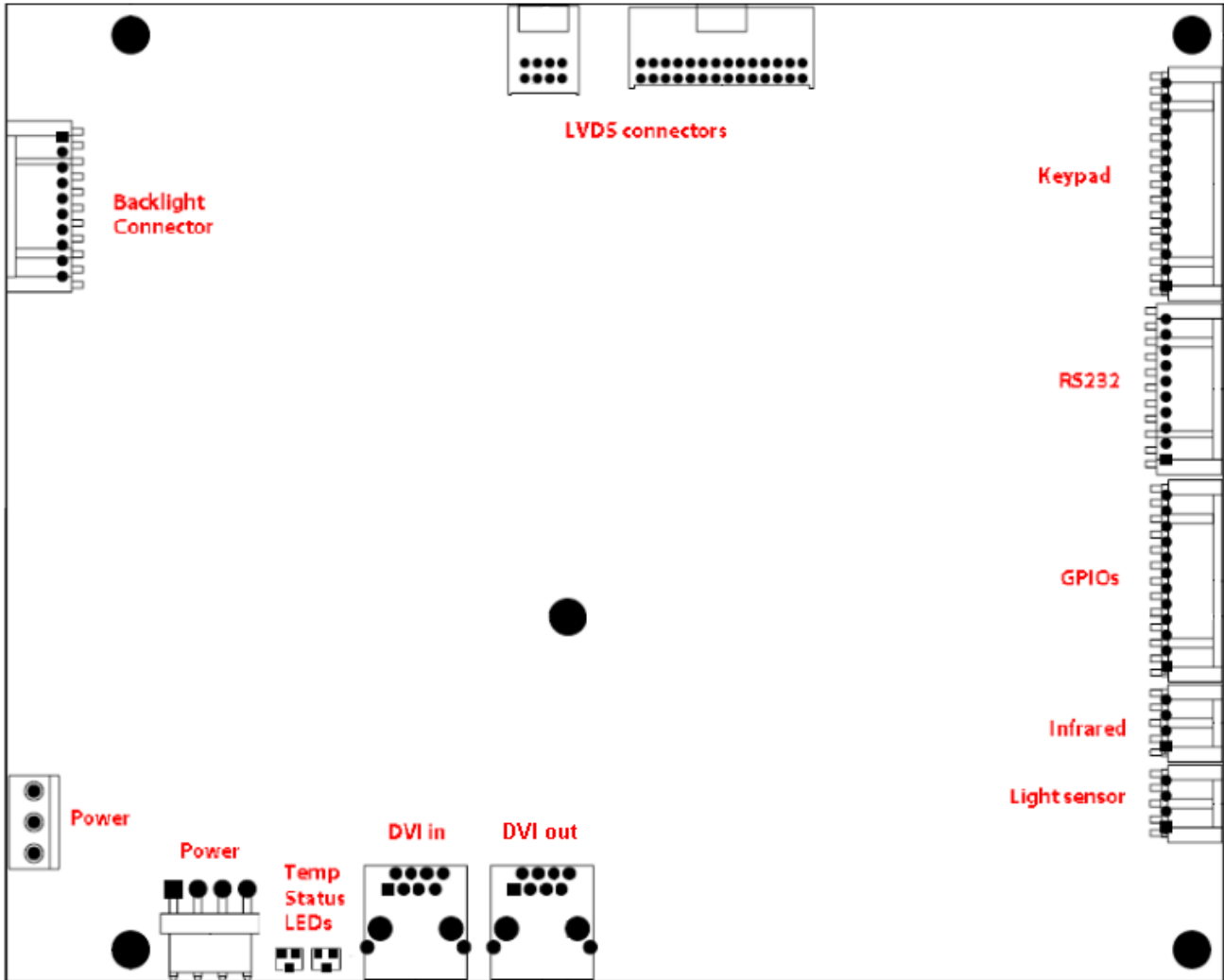
Wide range input supply
- The PrismaMobility can work within a voltage range of 18-36V, and can filter instantaneous peaks (10/1000us wave form) up to 58V.

5. Input / Output Interfaces

The following drawing shows the input and output interfaces of the PrismaMobility.
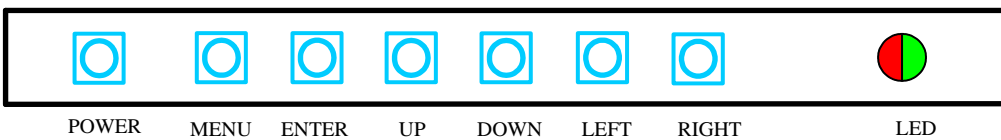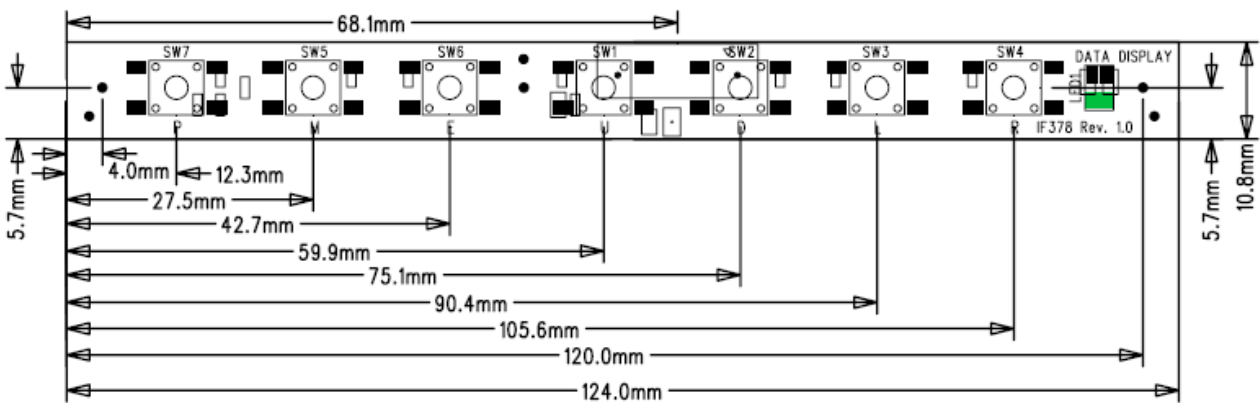
6. OSD Menu and User Controls

The OSD allows selection of input source and fine tuning of various functional parameters like brightness, contrast etc. These parameters can be adjusted by an external interface.

6.1 OSD Control Through External Keypad

| POWER | MENU | ENTER | UP | DOWN | LEFT | RIGHT | LED |

Controls are the same as on-board buttons.

All dimensions are in mm.

Key	Function
POWER	Switch Power On / Off
RESET	Reset PrismaMobility to last saved state

The six buttons of the OSD control can either be used to navigate within the OSD or to access various functions directly. The following two tables give you an overview about the functionality.

Key	Function	Remark
Up	Zoom IN	
Down	Zoom OUT	
Left	Switch Main Input Port	HDMI – Video1 – Video2 – Svideo1 – Svideo2 – CMPT – VGA – HDMI
Right	Switch Pip Input Port	HDMI – Video1 – Video2 – Svideo1 – Svideo2 – CMPT – VGA – HDMI
Menu	Opens the OSD Main Menu	
Enter	No function	

Functionality while OSD is closed

Key	Function	Remark
MENU	Leave OSD main menu	
	Leave submenu	Go to upper menu
	Leave function	
ENTER	Opens selected menu	
	Opens selected sub-menu	
	Enables selected operation	In selected functions
UP	Moves up through menu / sub-menu / functions	In open OSD menu
	Select next sub-menu item	Select next submenu item & toggle next item selection
DOWN	Moves down through menu / sub-menu / functions	In open OSD menu
	Select previous sub-menu item	Select previous submenu item & toggle next item selection
LEFT	Exits current sub-menu / function.	Go to upper menu
	Decreases set value of function slider or cycles left through possible operation modes	When a function is selected
RIGHT	Enters current sub-menu / function.	
	Increases set value of function slider or cycles right through possible operation modes	When a function is selected

Functionality while OSD is open

The status LED on the external interface show the current status of the board:

Color	Meaning
Green	Normal operation
Fast Green Blink	Input Search
Slow Green Blink	Input signal not supported
Red	Power off
Green & Red	Sleep Mode

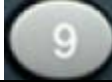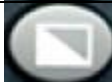Status LEDs

6.2 OSD Control through IR Remote Control
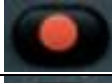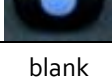
Alternative to the external keypad, the PrismaMobility can also be controlled through a remote control device. In order to communicate through IR, an IR-amplifier can be attached through connector CN9 of the PrismaMobility. Detailed information on the connector can be found under chapter 11.

Remote controller functionality:

Position	hex code	Rubber key marking	Chase marking	Functions
1	0x01		Power	Power on/off board
2	0x37	1		
3	0x38	2		
4	0x39	3		
5				
6	0x3a	4		
7	0x3b	5		
8	0x3c	6		
9				
10	0x3d	7		
11	0x3e	8		

12	0x3f			
13				
14	0x1A	blank	Freeze	Freeze image
15	0x36			
16	0x0B		PAP	
17	0x0C			
18	0x32			
19	0x33			
20	0x34			
21	0x21	blank	Auto	Auto-configuration for VGA input
22	0x05		Mute	
23	0x17	blank	Aspect Main	
24	0x0A	blank	Aspect PIP	
25				
26				
27	0x04		Volume	Increase volume while OSD is closed
28	0x03			Decrease volume while OSD is closed
29	0x30		Brightness	Increases brightness while OSD is closed
30	0x31			Decreases brightness while OSD is closed
31				
32				
33	0x27	blank	Menu	Opens OSD
34	0x13	blank	Exit	Closes OSD
35	0x23	M	Source	
36	0x24	P	Source	
37	0x14	blank	PIP Select	Switches between PIP on and off

38	0x02	blank	PIP Swap	Swaps input of main and PIP, when PIP is open
39	0x15	blank	PIP Size	Switches PIP size(small, large)
40	0x16	blank	PIP Position	Switches between 4 PIP position (left-top, left-bottom, right-top, right-bottom)
41	0x0D			Moves up through possible selections, Switch main input port while OSD is closed
42	0x0E			Exits current sub-menu / function (goes to upper menu), Moves left through possible selections or slider, Decrease brightness while OSD is closed
43	0x0F			Enters chosen function
44	0x10			Enters current sub-menu / function, Moves right through possible selections or slider, Increase brightness while OSD is closed
45	0x11			Moves down through possible selections, Switch pip input port while OSD is closed

7. On-Screen-Menu (OSM)

*Pictures are from the PrismaMEDIA-II board, since the PrismaMobility OSD is not ready. There may be slight changes to the OSD, but it will be similar in general.

7.1 Sub-Menu "Image Settings"
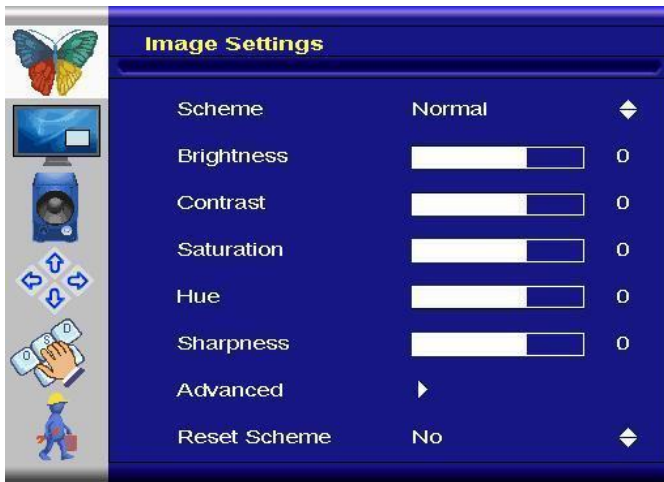
Figure 7.1.a "Image Settings" Menu for video mode of HDMI/DVI.
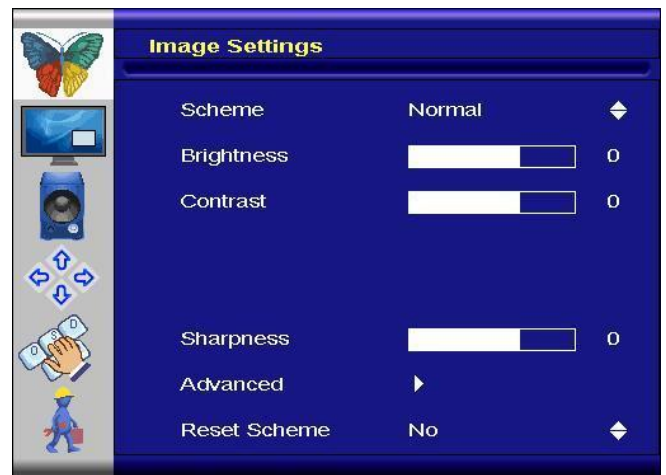
Figure 7.1.b "Image Settings" Menu for graphics mode of HDMI/DVI.

Scheme: Switches between normal/sport/game/cinema/vivid preset values. Each scheme has particular brightness, contrast, etc. values.

Brightness: Brightness of the image can be controlled using this function, with left and right buttons after the brightness slider is selected. This function modifies RGB data to change the brightness.

Contrast: Allows <Contrast> adjustment in the Y domain. The modification affects all color channels and all input types and is a direct multiplication of the Y data after YUV black level adjustment.

Hue: Allows <Hue> adjustment in the UV domain. The modification affects all color channels and all input types.

Saturation: Allows <Saturation> adjustment in the UV domain. The modification affects all color channels and all input types.

Sharpness: Allows <Sharpness> adjustment on the image.

Advanced: The advanced menu opens in two different ways, according to input type:

Figure 7.1.c "Advanced" Menu for video mode of HDMI/DVI.

Figure 7.1.d "Advanced" Menu for graphics mode of HDMI/DVI.

- *Color:*

  o **Color Temp:** Allow selection of different color temperature schemes.

  o **User Color:** If the user has a preference other than the pre-set color temperatures, the menu below can be used to create a new color scheme.
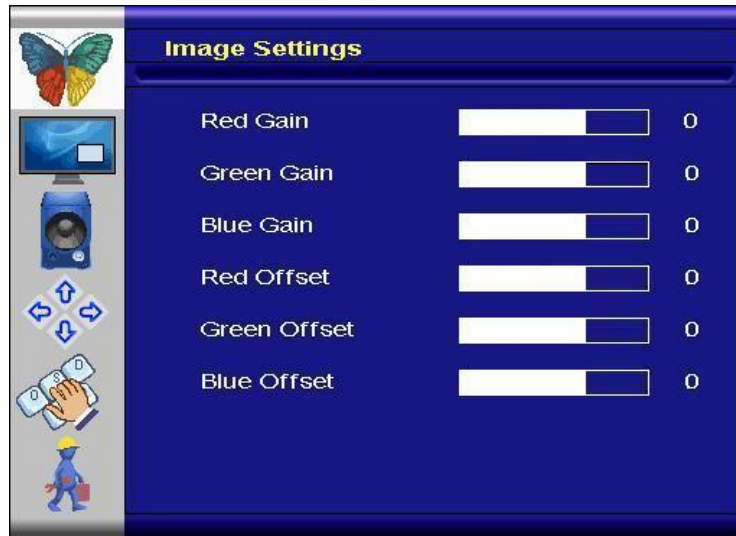
- **Red Gain:** Boost adjustment on red.
- **Green Gain:** Boost adjustment on green.
- **Blue Gain:** Boost adjustment on blue.
- **Red Offset:** Base level increase on red.
- **Green Offset:** Base level increase on green.
- **Blue Offset:** Base level increase on blue.

- *Noise Reduction:*
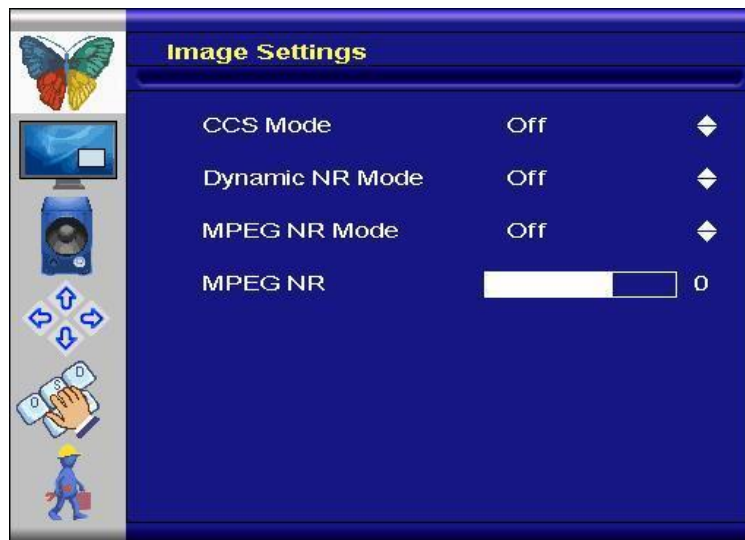
- o **CCS Mode:** Changes Cross-Color Suppression between off/adaptive/normal. Adjust for best image.
- o **Dynamic NR Mode:** Changes Dynamic Noise Reduction between low/medium/high/off/adaptive. High setting may cause loss of detail, adjust f for best image.
- o **MPEG NR Mode:** Enables/disables the MPEG NR Mode.
- o **MPEG NR:** Allow user to manually set the level of MPEG noise reduction.

- *Video Processing:*

- o **Main DCDi:** Turns DCDi on/off on main channel.

- o **Main MADI Mode:** Changes Motion Adaptive De-Interlacing between normal/off/adaptive modes.

- *Film Mode:* This feature can be used to adjust image when viewing 2:2/3:2 pulled-down video camera films.

- o **Film Mode Detection:** Selection of Video-3:2/Video-2:2/Video-3:2-2:2/off.
- o **Film Display Mode:** Selection of Normal 3:2.

Reset Scheme: Can be used to reset scheme (normal/sport/game/cinema/vivid) settings to factory value.

7.2   Sub-Menu "Display Settings"

Aspect Ratio: Used to adjust display between full screen, Letter Box Expand and Pillar Box.

When a film or video that was not originally designed for widescreen is shown on a widescreen display, black bars are placed on the sides of the image. This is called pillar boxing.
Letterboxing is the practice of transferring a film shot in a widescreen aspect ratio to standard-width video formats while preserving the film's original aspect ratio, by placing black bars above and below the image.

PIP: Not applicable since there is only one input.

Tiling: The tiling function (for video wall applications) can be used with all input types.
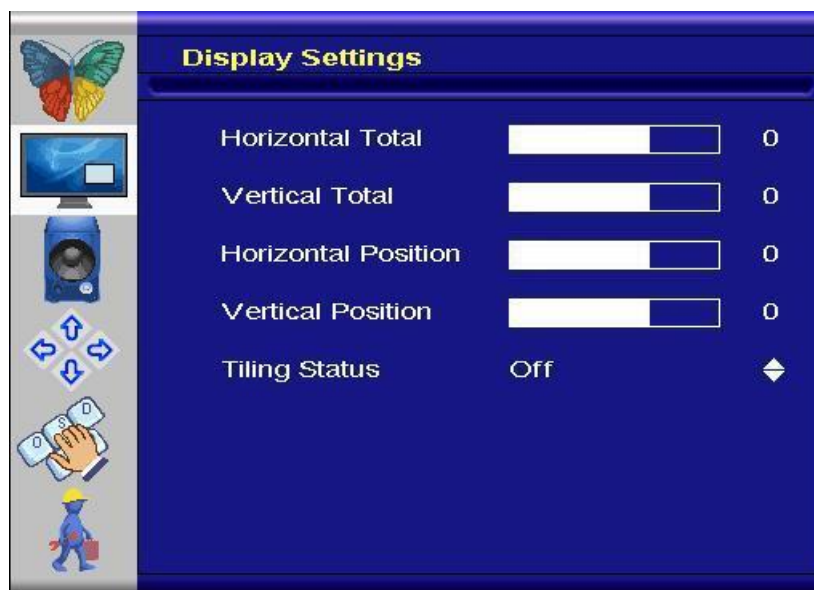
Horizontal Total: Defines the total horizontal number of displays.

Vertical Total: Defines the total vertical number of displays.

Horizontal Position: Defines the horizontal position of the actual display unit.

Vertical Position: Defines the vertical position of the actual display unit

Tiling Status: Enables/disables the tiling function. If the PIP-Mode is PAP-Tall or side-by-side, the tiling status will be off and disabled.

Example: 3 by 3 video wall: Definition of Horizontal/Vertical display position:

Horizontal Vertical	1	2	3
1	1/1	2/1	3/1
2	1/2	2/2	3/2
3	1/3	2/3	3/3

Limitations:
- Tiling property can not be used while image is flipped or PAP (picture and picture) is active.
- Image flipping can not be adjusted while tiling is on.
- Image and position menus are disabled while tiling is on.

Note:
- For best results the Horizontal Total and Vertical Total has to be set to the values which is one of the integer dividers of the input width/height. For example if input is 1280x768 horizontal total has to be set to 2, 4, 5, 8 and vertical total has to be set to 2, 3, 4, 6, 8.

7.3 Sub-Menu "Position Settings"

"Position Settings" menu for video mode of HDMI input

Width: Adjusts total width of the image by stretching or shrinking.

Height: Adjusts total height of the image by stretching or shrinking.

Horizontal Start: Changes the starting point of the image horizontally, without altering height.

Vertical Start: Changes the starting point of the image vertically, without altering width.

"Position Settings" menu for graphics mode of HDMI input

7.4 Sub-Menu "OSD Settings"
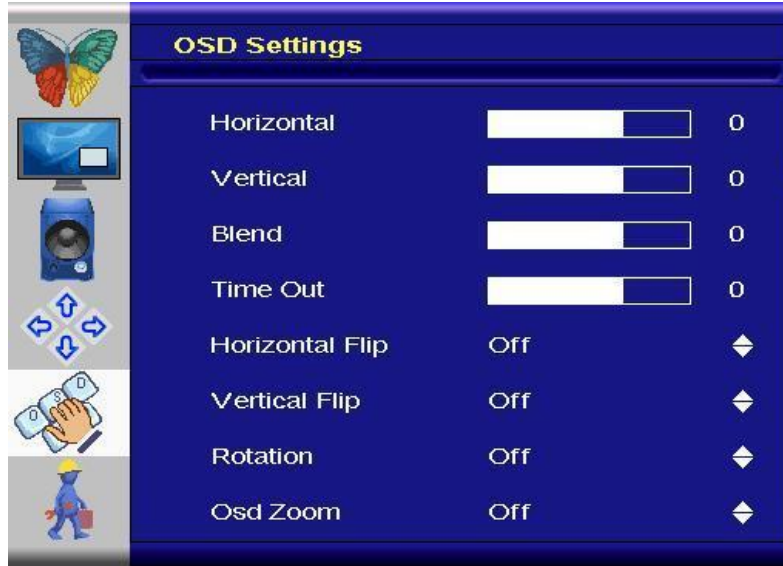
Horizontal:	This function can be used to move the OSD window on a horizontal line.
Vertical:	This function can be used to move the OSD window on a horizontal line.
Blend:	This function can be used to change the transparency of the OSD window.
Time Out:	This function determines after how many seconds the OSD will close itself.
Horizontal Flip:	Flips the OSD on the horizontal.
Vertical Flip:	Flips the OSD on the vertical.
Rotation:	Rotates the OSD
OSD Zoom:	Changes OSD size

7.5 Sub-Menu "Setup"

Factory Reset: This function can be used to load back factory-loaded values.

Speed Mode: In graphics mode, fast image transfer is supported.

Show Menu Of: Changes the menu between main image and PIP if the PIP mode is on.

8. Supported Input Modes

The PrismaMobility can support the following input modes.

8.1   HDMI – Graphics

The factory preset supported input modes include:

Resolution	Resolution
640 x 480 @ 60 Hz (VESA)	1366 x 768 @ 60 Hz
800 x 600 @ 60 Hz (VESA)	1368 x 768 @ 60 Hz
1024 x 768 @ 60 Hz (VESA)	1600 x 1200 @ 60 Hz (VESA)
1280 x 768 @ 60 Hz	1920 x 1200 @ 60 Hz
1280 x 1024 @ 60 Hz (VESA)	1920 x 1080 @ 60 Hz
1360 x 768 @ 60 Hz	

8.2   HDMI – Video

The factory preset supported input modes include:

Resolution	Resolution
720 x 480 @ 60	1280 x 720 @ 60
720 x 576 @ 50	1920 x 1080 @ 50
1280 x 720 @ 50	1920 x 1080 @ 60

9. Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit	Note
Supply Voltage	V_{in}	0	38	VDC	1, 2, 3
Storage Temperature	T_{St}	-35	+85	°C	
Operating Temperature	T_{Op}	-20	+75	°C	

Note (1) Within operating temperature range.
Note (2) Permanent damage to the device may occur if maximum values are exceeded.

10. Electrical Characteristics

Remark: All values are average values of repeated measurements. Other PrismaMobility/panel combinations can have different electrical characteristics.

Item	Condition	MIN.	TYP.	MAX.	Unit	Note
Supply Voltage		18	28	36	VDC	1,2
Current Consumption (12V)	Power-OFF	40	43	46	mA	3, 4, 5
	Sleep mode	160	165	170	mA	3, 4, 5
	Board only	256	262	266	mA	3, 4, 5, 6
LTM190BT03 with GH317A		820	833	860	mA	

1) Supply voltage limits are for the PrismaMobility supplying a 5V@2A or 12V@4A inverter. If a different voltage or higher current inverter is to be used, it will have to be powered externally.
2) Instantaneous peaks (10/1000us wave form) up to 58V will be filtered and will not cause damage.
3) All measurements done at 25°C ambient temperature.
4) Input voltage has been held constant at 28V for all measurements.
5) The tested board's DVI output was connected to a second (running) PrismaMobility board's DVI input during all measurements except the board-only case (connecting the DVI output increases current by 1mA).
6) For the board-only measurement, the panel/inverter/keypad/DVI_out were disconnected.

11. Connector Overview

CN	DESCRIPTION	TYPE	MATCHING PART	MANUFACTURER
CN2	DVI input	3004CB6201	8-pin RJ45 plug	Nexus
CN5	Serial Programming / RS232 Remote Control	53426-1010	51103-1000	Molex
CN6	Power Supply Input	35978-0420	35977-0400	Molex
CN7	OSD Control	53426-1410	51103-1400	Molex
CN8	Gprobe Connector	DF13B-5P-1.25V	DF13-5S-1.25H	Hirose
CN9	Infrared connector	53426-0410	51103-0400	Molex
CN10	Dual LVDS (8-bit)	55959-2830	51353-2800	Molex
CN11	Dual LVDS (10-bit LSB)	55959-0830	51353-0800	Molex
CN12	DVI output	3004CB6201	8-pin RJ45 plug	Nexus
CN13	Backlight Power Supply	53426-1010	51103-1000	Molex
CN15	GPIOs	53426-1210	51103-1200	Molex
CN18	Ambient Light Sensor	53426-0410	51103-0400	Molex
CN510	Power Supply Input	Adapter bushing	---	---

HDMI/DVI INPUT CONNECTOR CN2		
Pin	Signal	Description
1	RX0+_IN	Differential TMDS Data 0+
2	RX0-_IN	Differential TMDS Data 0-
3	RX1+_IN	Differential TMDS Data 1+
4	RX1-_IN	Differential TMDS Data 1-

Pin	Signal	Description
5	RX2+_IN	Differential TMDS Data 2+
6	RX2-_IN	Differential TMDS Data 2-
7	RXC+_IN	Differential TMDS Clock+
8	RXC-_IN	Differential TMDS Clock-

SERIAL COMMUNICATION CON. CN5		
Pin	Signal	Description
1	T1_OUT / TXD	RS232 / serial output port
2	R1_IN / RXD	RS232 / serial input port
3	NC	Not connected
4	NC	Not connected
5	NC	Not connected
6	NC	Not connected
7	DCD	Not connected

Pin	Signal	Description
8	DSR	Not connected
9	RTS	Not connected
10	DTR	Not connected
11	CTS	Not connected
12	+5V	+5V power supply
13	GND	Ground
14	NC	Not connected

* RS232 Rx / Tx signals: +/-12V typical, +/-5V minimum, and +/-15V absolute maximum rating.

POWER SUPPLY CONNECTOR CN6

Pin	Signal	Description	Pin	Signal	Description
1	V_IN	Main power input	3	GND	Ground
2	V_IN	Main power input	4	GND	Ground

EXTERNAL KEYPAD CONNECTOR CN7

Pin	Signal	Description	Pin	Signal	Description
1	GND	Ground	8	SOURCE	Status LED green (signal good)
2	+5V	+5V power	9	KEY_RIGHT	OSD button
3	+3.3V	+3.3V power	10	KEY_LEFT	OSD button
4	POWER_ON/OFF		11	KEY_DOWN	OSD button
5	LED_GREEN	Status LED green	12	KEY_UP	OSD button
6	LED_RED	Status LED red	13	ENTER	OSD button
7	LBADC_IN1	Low-bandwidth ADC return	14	MENU	OSD button

GRPOBE DEBUG CONNECTOR CN8

Pin	Signal	Description	Pin	Signal	Description
1	TX	Serial Output	4	+5V	5V Power supply
2	RX	Serial Input	5	GND	Ground
3	+3.3V	3.3V Power supply			

IR REMOTE CONTROL CONNECTOR CN9

Pin	Signal	Description	Pin	Signal	Description
1	IR	Amplified IR signal	3	+5V	5V Power supply
2	+3.3V	3.3V Power supply	4	GND	Ground

LVDS CONNECTOR (8-bit) CN10

Pin	Signal	Description	Pin	Signal	Description
1	PANELCTRL1	Panel control signal 1	15	TXB0-	LVDS data 1st pixel
2	PANELCTRL2	Panel control signal 2	16	TXB0+	LVDS data 1st pixel
3	5V/3.3V/GND	Selectable signal level (default NC)	17	TXB1-	LVDS data 1st pixel
4	BKLT_EN	Enable backlight signal	18	TXB1+	LVDS data 1st pixel
5	TXA0-	LVDS data 2nd pixel	19	TXB2-	LVDS data 1st pixel
6	TXA0+	LVDS data 2nd pixel	20	TXB2+	LVDS data 1st pixel
7	TXA1-	LVDS data 2nd pixel	21	TXBCL-	LVDS clock 1st pixel
8	TXA1+	LVDS data 2nd pixel	22	TXBCL+	LVDS clock 1st pixel
9	TXA2-	LVDS data 2nd pixel	23	TXB3-	LVDS data 1st pixel
10	TXA2+	LVDS data 2nd pixel	24	TXB3+	LVDS data 1st pixel
11	TXACL-	LVDS clock 2nd pixel	25	GND	Ground
12	TXACL+	LVDS clock 2nd pixel	26		
13	TXA3-	LVDS data 2nd pixel	27	PANEL_POWER	Switched panel power supply +3,3V/ +5V/ +12V (fused)
14	TXA3+	LVDS data 2nd pixel	28		

SECONDARY LVDS CON. for 10-bit CN11 (optional)		
Pin	Signal	Description
1	GND	Ground
2	GND	Ground
3	TXA4-	LVDS data 2nd pixel
4	TXA4+	LVDS data 2nd pixel

Pin	Signal	Description
5	GND	Ground
6*	GND	Ground
7*	TXB4-	LVDS data 1st pixel
8*	TXB4+	LVDS data 1st pixel

HDMI/DVI OUTPUT CONNECTOR CN12		
Pin	Signal	Description
1	TX0+	Differential TMDS Data 0+
2	TX0-	Differential TMDS Data 0-
3	TX1+	Differential TMDS Data 1+
4	TX1-	Differential TMDS Data 1-

Pin	Signal	Description
5	TX2+	Differential TMDS Data 2+
6	TX2-	Differential TMDS Data 2-
7	TXC+	Differential TMDS Clock+
8	TXC-	Differential TMDS Clock-

BACKLIGHT SUPPLY CONNECTOR CN13		
Pin	Signal	Description
1	V_INV	Backlight power supply
2	GND	Ground
3	BKLT_EN	Enable backlight signal
4	BRT_ADJ	Brightness control signal
5	+5V_INV	5V switched power supply

Pin	Signal	Description
6	+5V_INV	5V switched power supply
7	V_INV	Backlight power supply
8	V_INV	
9	GND	Ground
10	GND	

GPIO CONNECTOR CN15		
Pin	Signal	Description
1	+5V	5V power supply
2	EXT_GPIO_0	External GPIO 1
3	EXT_GPIO_1	External GPIO 2
4	EXT_GPIO_2	External GPIO 3
5	EXT_GPIO_3	External GPIO 4
6	EXT_GPIO_4	External GPIO 5

Pin	Signal	Description
7	EXT_GPIO_5	External GPIO 6
8	EXT_GPIO_6	External GPIO 7
9	EXT_GPIO_7	External GPIO 8
10	SCL	I2C Clock
11	SDA	I2C Data
12	GND	Ground

  *   External GPIO pins are open-drain, pulled up to 3.3V by 4.7kohm resistor
  **   During full power-off mode, only EXT_GPIO_0 and EXT_GPIO_1 are active.
  *** The 8 GPIOs connected to CN15 can be configured as either or output, using custom firmwares. There also
        is an I2C line, for control of external I2C devices.

AMBIENT LIGHT SENSOR CONNECTOR CN18		
Pin	Signal	Description
1	+3.3V	3.3V Power supply
2	SCL	I2C Clock

Pin	Signal	Description
3	SDA	I2C Data
4	GND	Ground

POWER SUPPLY CONNECTOR CN510		
Pin	Signal	Description
1	+5V	5V Power supply (optional)
2	GND	Ground

Pin	Signal	Description
3	V_IN	Main power input (**up to 5A**)

12. Connector Placement
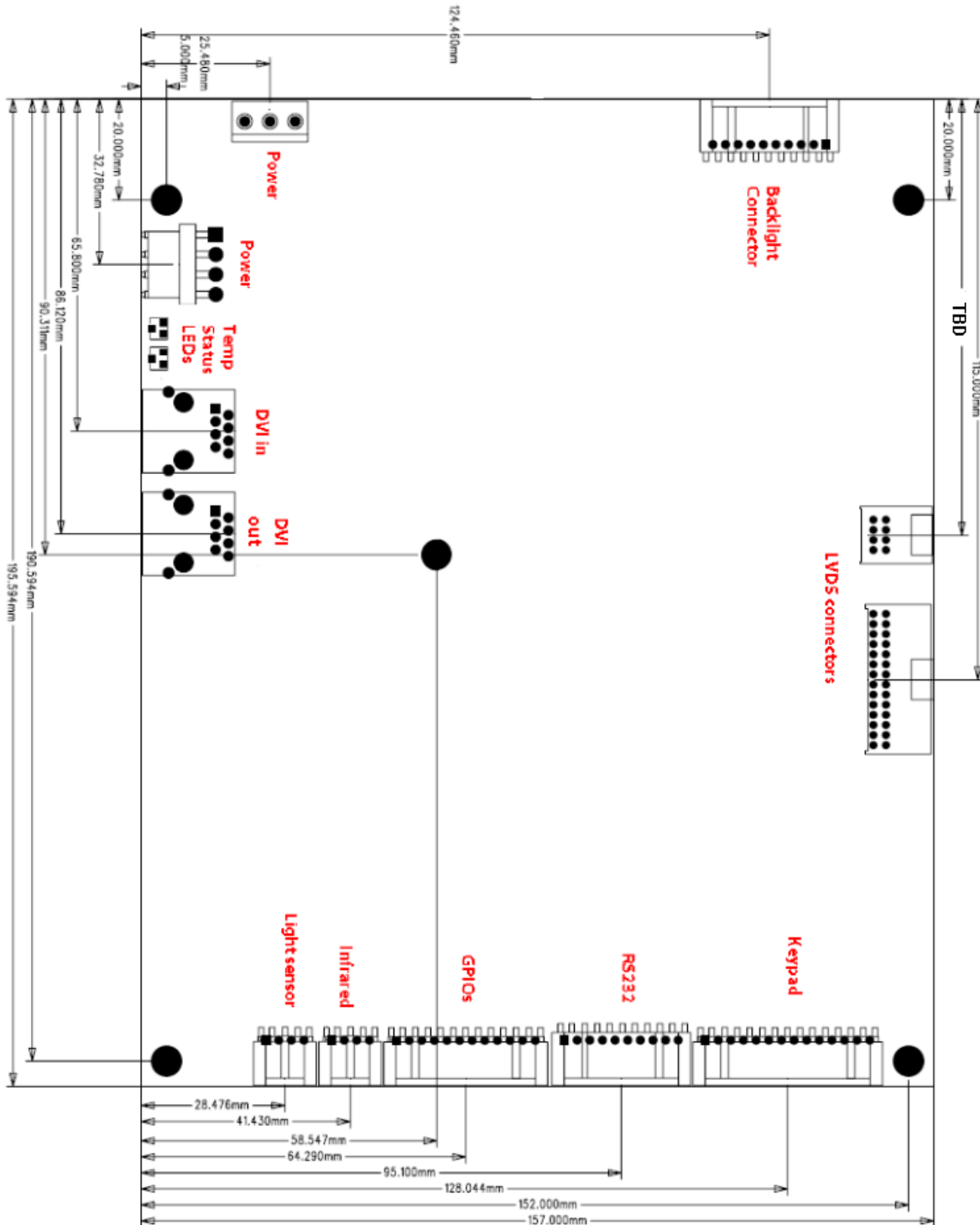
13. Assembly Information

Top- and bottom silkscreen can be seen on separate PDF-files.

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