ArcticLink® III VX3 Solution Platform Data Sheet

High Definition Visual Enhancement Engine (VEE HD+) and Display Power Optimizer (DPO HD+) Solution

Platform Highlights

High Definition Visual Enhancement Engine

- VEE HD+ compensates for different viewing environments by restoring and enhancing the display content through contrast and dynamic range optimization.
- Greatly enhanced image and video quality even under low backlight or bright ambient conditions.
- Supports up to WUXGA (1920x1200) (MIPI "video mode" only).
- Based on proven, patented technology, licensed from Apical Ltd.

High Definition Display Power Optimizer

- Dramatically improves battery life up to 50% by reducing liquid crystal display (LCD) backlight or organic light-emitting diode (OLED) brightness.
- Tightly coupled with the VEE HD+ technology for optimal operation.
- Directly controls the pulse-width modulation (PWM) for backlight management.
- Integrated Intelligent Brightness Control (IBC) feature allows up to an additional 10% power savings by modulating display brightness based on display content.

Serial Peripheral Interface (SPI) Master

- Serial interface to control sensors, peripherals, and/or displays.

Onboard Clock Generation

- Integrated, very low power phase-locked loop (PLL) for generating the clocks necessary for VEE HD+.

I²C Client

- CPU interface for configuring and controlling internal VEE HD+ registers, DPO HD+ registers and look-up tables (LUT).

NOTE: The MIPI interface can also be used instead of I²C.

Small Form Factor Packaging

- 120-ball, 4.5 mm x 4.5 mm WLCSP, 0.4 mm ball pitch.

Applications Overview

The ArcticLink III VX3 solution platform consists of the following main modules:

- VEE HD+
- DPO HD+

This highly integrated, yet flexible architecture makes it the ideal platform to implement display path solutions for smartphones, tablets, and smartbooks.

The ArcticLink III VX3 solution platform can be used to replace several discrete components typically used in mobile devices today to reduce power consumption, reduce bill of materials (BOM) cost, and save precious printed circuit board (PCB) space.

High Definition Visual Enhancement Engine

The ArcticLink III VX3 solution platform embeds the VEE HD+ technology with very low power and optimal die size for lowest BOM costs. QuickLogic and Apical Limited partnered to architect and develop the optimal blend of algorithms and interfaces for mobile and portable multimedia products. The VEE HD+ technology is based on a proven core licensed from Apical Limited, which is substantiated by nearly a decade of scientific research. These algorithms implement a model of human perception; resulting in a displayed image that retains detail, color and vitality even under variable viewing conditions. It specifically addresses the problem of the low contrast ratio of mobile displays to bring a more TV-like viewing experience to the mobile devices.

The QuickLogic proprietary VEE HD+ solution substantially enhances image and video quality by optimizing the dynamic range, contrast, and color saturation pixel-by-pixel to provide a natural viewing experience under low backlight or bright ambient light conditions. Seamlessly integrated into the display path, the VEE HD+ technology enhances the user's mobile multimedia visual experience while DPO HD+ drastically reduces backlight power to extend battery life.

High Definition Display Power Optimizer

As consumer devices have become more power hungry, system designers are constantly looking for ways to lower system power consumption. As displays typically consume 30% to 60% of the total system power, there has been a tremendous amount of research put into methods of reducing display power. A common solution is to lower the backlight level of the LCD or average brightness level of an OLED. Unfortunately, this solution significantly diminishes the viewing experience since most details are lost due to the lowered contrast ratio.

While the VEE HD+ technology uses statistical information gathered pixel-by-pixel, frame-by-frame to adjust the value of individual pixels, DPO HD+ uses that same information to adjust the backlight or display brightness. The ability to provide a unique tone curve for each pixel and tight control over the display backlight gives greater flexibility than the global adjustments of alternative implementations. The QuickLogic approach results in greater power savings and the entirely new capability of adapting to a bright environment.

The ArcticLink III VX3 solution platform also contains the QuickLogic IBC feature, which allows additional battery savings by modulating the display brightness based upon actual display content. If the content being displayed is of a lower contrast or dynamic range (such as streamed video from popular internet video sites), display brightness can be lowered without affecting the viewing experience. This results in a system-level battery savings.

DPO HD+ seamlessly integrates with the QuickLogic VEE HD+, ensuring longer battery life and an excellent visual experience by coupling the PWM driving the display backlight with the display content processing parameters of the VEE HD+ technology.

ArcticLink III VX3 Solution Platform Variants

The ArcticLink III VX3 solution platform features three distinct variants as described in **Table 1**.

Table 1: ArcticLink III VX3 Solution Platform Variants

QuickLogic Part Order Number	Part Number	Device Input	Device Output	Max. Resolution[a] (60 FPS)	Primary Application
CSSP-BBFDN120	VX3B3B	MIPI-4	MIPI-4[b]	1920 x 1200	Smartphones and tablets
CSSP-ASFDN120	VX3B2B	MIPI-2	MIPI-2[c]	1366 x 768	Smartphones and tablets
CSSP-ABFDN120	VX3B2F	MIPI-2	MIPI-4	1366 x 768	Smartphones and tablets with chip-on-glass

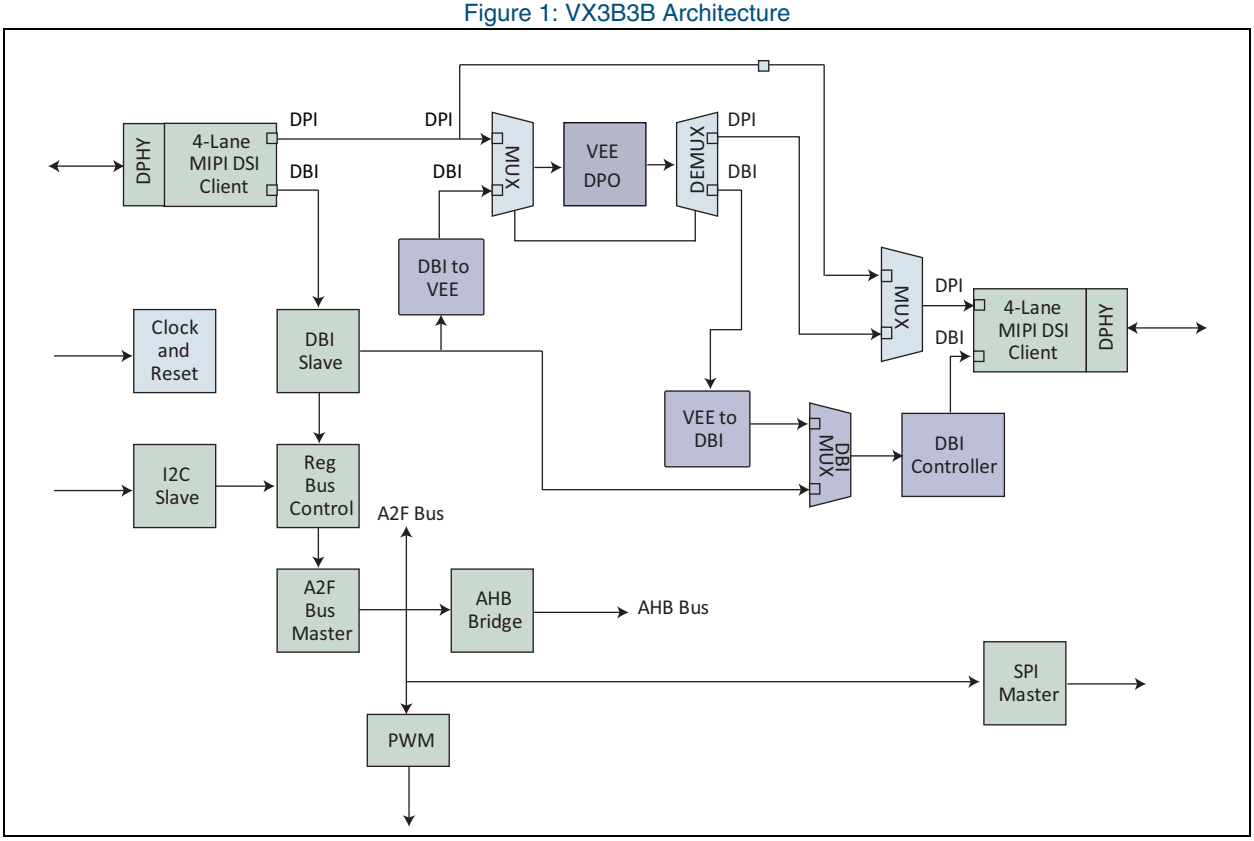
a. MIPI “video mode” only.
b. MIPI-4: Four lane MIPI.
c. MIPI-2: Two lane MIPI.

Data Paths

CAUTION: MIPI command mode can only be used for video data if command mode is used on the video input and output of the ArcticLink III VX3 device. The ArcticLink III VX3 device cannot convert video data from MIPI command mode to MIPI video mode, or vice versa. It is possible to simultaneously send video data through MIPI video mode and register commands through MIPI command mode. Video data sent over MIPI command mode is limited to no more than FWVGA (854x480) resolutions.

VX3B3B — MIPI-4 to MIPI-4

Figure 1: VX3B3B Architecture



Use Case

Data path input and outputs are:

- Input – MIPI 4-lane
- Output – MIPI 4-lane

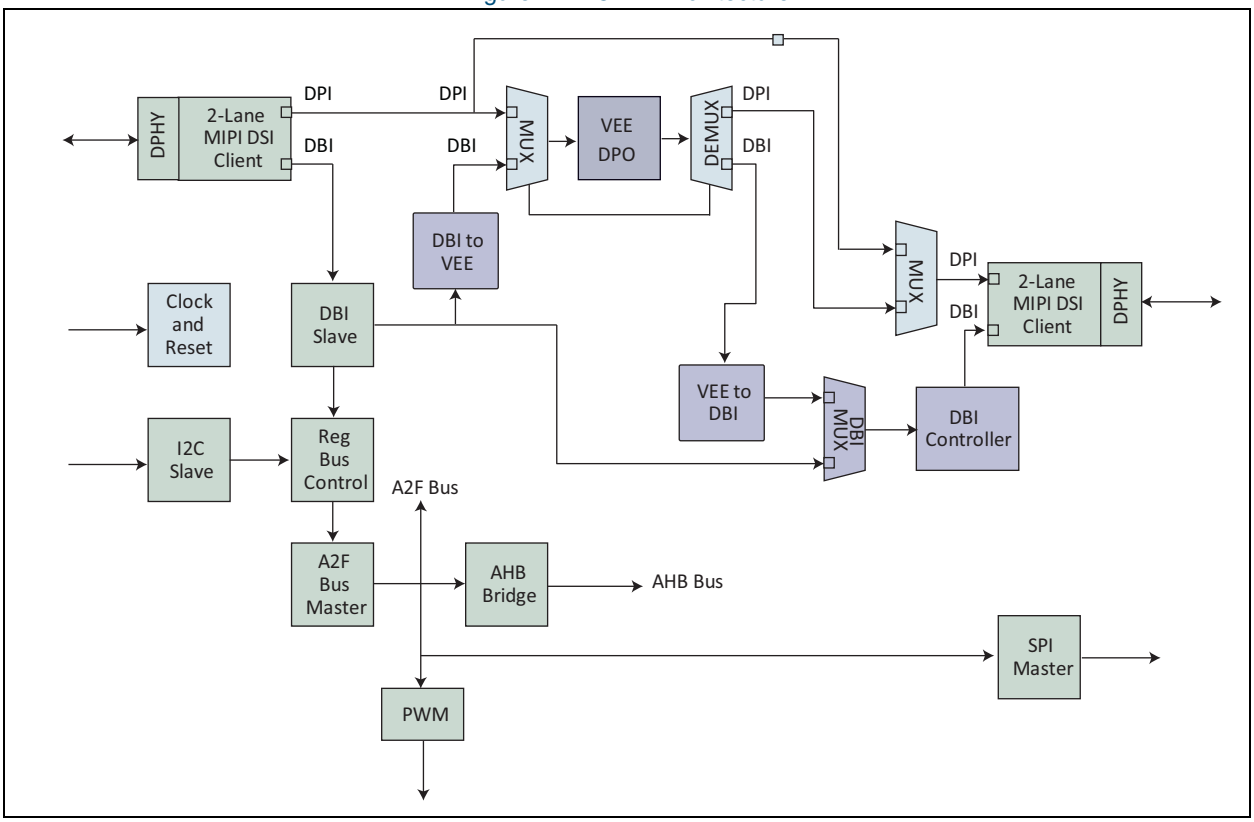
Control path input and outputs are:

- Input – I^2C and/or MIPI display bus interface (DBI)
- Output – SPI and/or MIPI DBI

Maximum resolution is WUXGA (1920 x 1200) at 24 bpp at 60 fps. The speed is limited by MIPI bandwidth.

VX3B2B — MIPI-2 to MIPI-2

Figure 2: VX3B2B Architecture



Use Case

Data path input and outputs are:

- Input – MIPI 2-lane
- Output – MIPI 2-lane

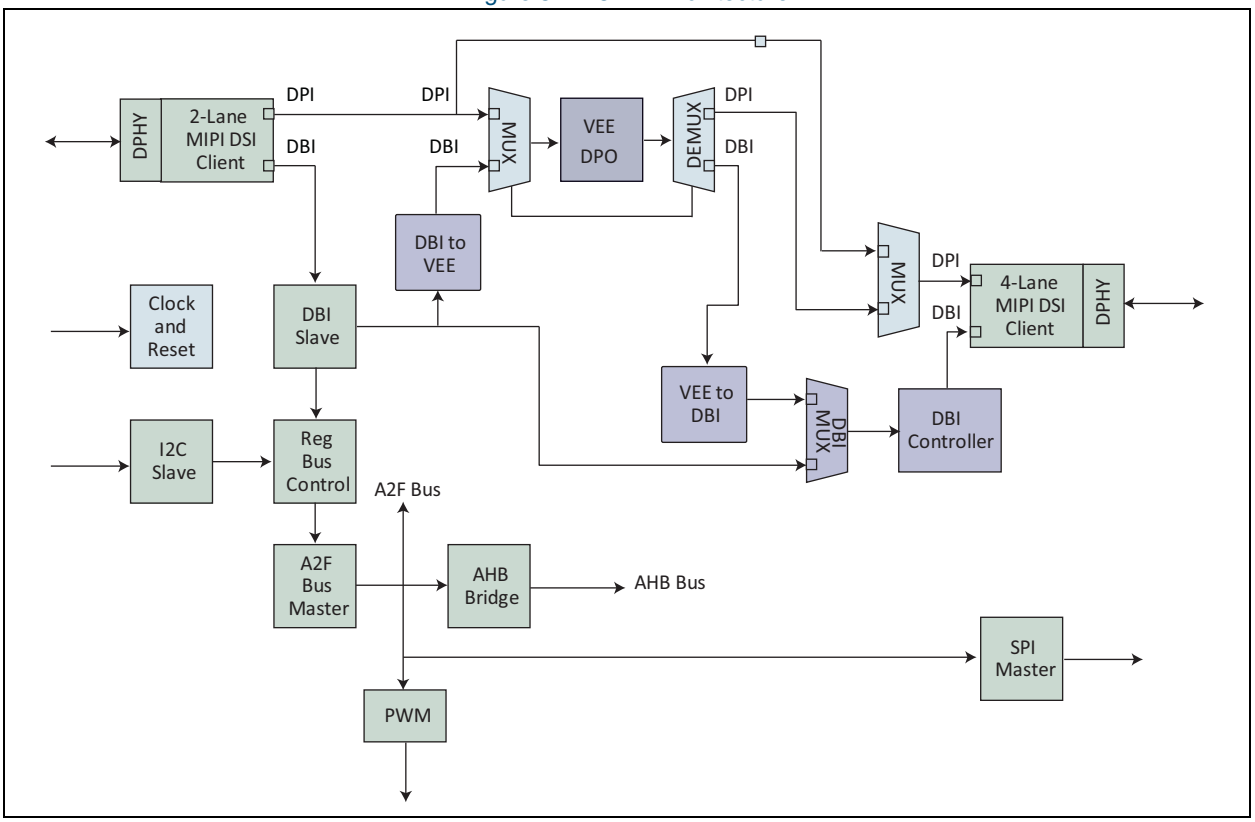
Control path input and outputs are:

- Input – I^2C and/or MIPI DBI
- Output – SPI and/or MIPI DBI

Maximum resolution is WXGA (1366 x 768) at 24 bpp at 60 fps. The speed is limited by MIPI bandwidth.

VX3B2F — MIPI-2 to MIPI-4

Figure 3: VX3B2F Architecture



Use Case

Data path input and outputs are:

- Input – MIPI 2-lane
- Output – MIPI 4-lane

Control path input and outputs are:

- Input – I^2C and/or MIPI DBI
- Output – SPI and/or MIPI DBI

Maximum resolution is WXGA (1366 x 768) at 24 bpp at 60 fps. The speed is limited by MIPI bandwidth.

Package Thermal Characteristics

The ArcticLink III VX3 solution platform is available for the Commercial (-30°C to 85°C Junction) temperature range.

Thermal Resistance Equations:

$\theta_{JC} = (T_J - T_C)/P$
$\theta_{JA} = (T_J - T_A)/P$
$P_{MAX} = (T_{JMAX} - T_{AMAX})/\theta_{JA}$

Parameter Description:

θ_{JC}: Junction-to-case thermal resistance

θ_{JA}: Junction-to-ambient thermal resistance

T_J: Junction temperature

T_A: Ambient temperature

P: Power dissipated by the device while operating

P_{MAX}: The maximum power dissipation for the device

T_{JMAX}: Maximum junction temperature

T_{AMAX}: Maximum ambient temperature

NOTE: Maximum junction temperature (T_{JMAX}) is 100°C. To calculate the maximum power dissipation for a device package look up θ_{JA} from **Table 2**, pick an appropriate T_{AMAX} and use:
$P_{MAX} = (125°C - T_{AMAX})/ \theta_{JA}$

Table 2: Package Thermal Characteristics[a]

Package Description				θ_{JA} (°C/W)			θ_{JC} (°C/W)
Name	Package Code	Package Type	Pin Count	0 LFM	200 LFM	400 LFM	
ArcticLink III VX3	FO	WLCSP (4.5 mm x 4.5 mm)	120	31.8	29.1	28.2	8.0

a. Contact QuickLogic for θ_{JA} values.

Power Consumption

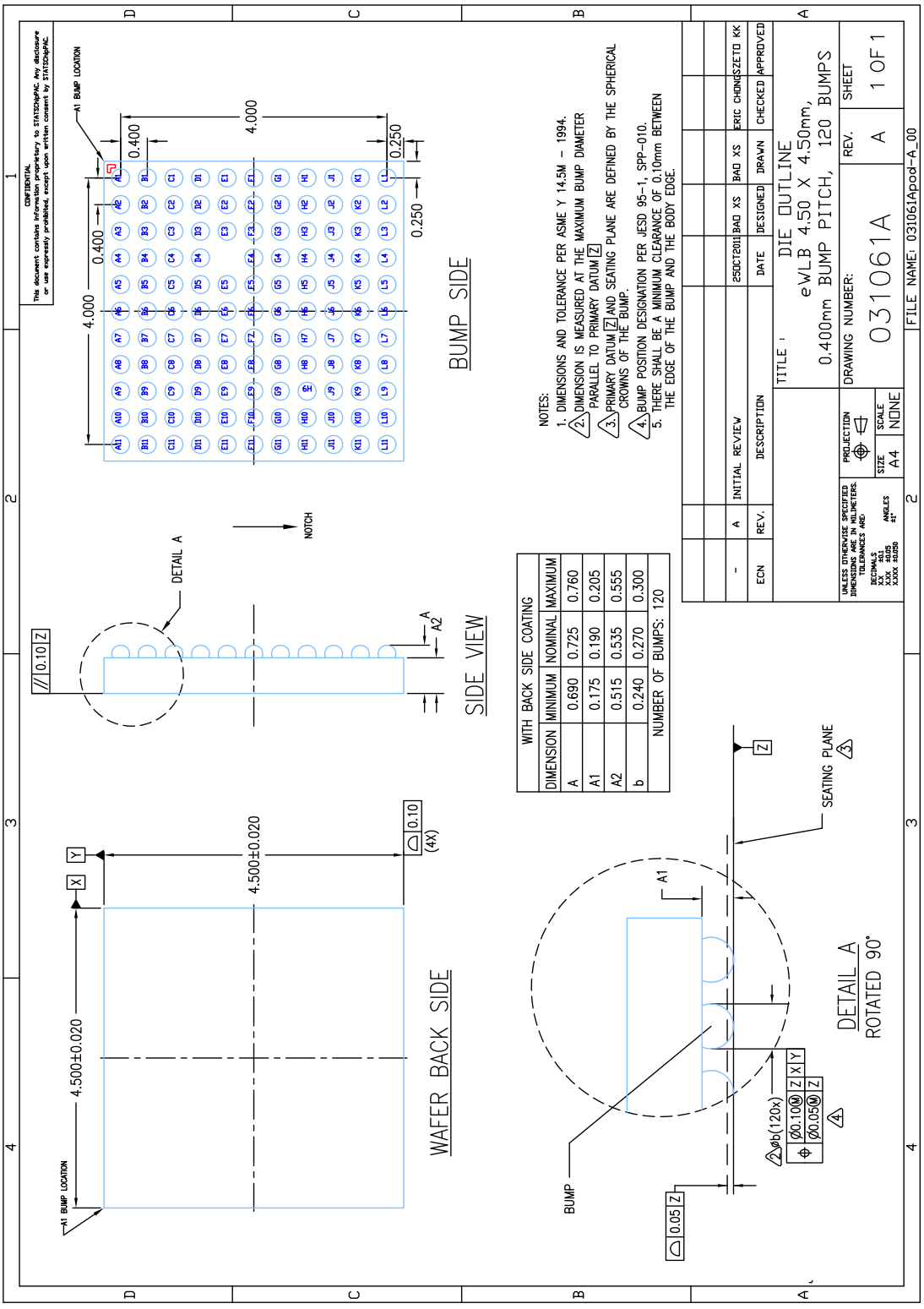
Table 3 shows the power consumption in various operating modes.

Table 3: VX3Bxx Power Consumption (mW) at 60 fps[a]

Resolution	Display Width	Display Height	VX3B2B		VX3B2F		VX3B3B	
			18 bpp	24 bpp	18 bpp	24 bpp	18 bpp	24 bpp
QVGA	320	240	33.8	33.8	33.5	33.5	32.4	32.8
VGA	640	480	38.6	39.5	37.6	37.6	36.4	36.9
WVGA	854	480	41.5	42.6	39.5	39.5	38.3	38.7
PAL	768	576	42.7	43.8	40.2	40.2	39.0	39.5
SVGA	800	600	43.5	45.0	40.9	41.0	39.6	40.2
XGA	1,024	768	52.3	51.0	46.9	47.8	45.4	46.8
HD 720	1,280	720	50.0	52.0	49.2	50.2	47.7	49.2
WXGA	1,366	768	52.9	55.1	51.7	52.7	50.1	51.7
SXGA	1,280	960	58.1	-	56.3	-	54.6	56.6
SXGA	1,280	1,024	60.2	-	59.3	-	56.1	58.2
SXGA+	1,400	1,050	62.9	-	61.6	-	58.4	60.4
UXGA	1,600	1,200	-	-	-	-	72.3	74.6
HD 1080	1,920	1,080	-	-	-	-	75.3	77.4
WUXGA	1,920	1,200	-	-	-	-	80.1	82.4

a. MIPI DBI command mode is limited to FWVGA (854x480) maximum.

Mechanical Drawing



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Revision History

Revision	Date	Originator and Comments
1.0	October 2012	Initial production release
1.1	June 2013	Paul Karazuba and Kathleen Bylsma Updated contact information.
1.2	June 2016	Brian Faith and Kathleen Bylsma Added QuickLogic Part Order Number to Table 1.

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