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# INTEL<sup>®</sup> LOW POWER DISPLAY TECHNOLOGY (LPDT) 3.1 SPECIFICATION



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# REVISION HISTORY

LPDT 3.0	Update the naming of the display categories: Rename "Regular Display" to "Display with Baseline Features". Rename "Premium Display" to "Display with Visual Quality Enhanced Features"
	Update power consumption criteria and pass/fail condition to be based on the brightness level at 300 nits from 185 nits for Display with Baseline Features and 230 nits from 120 nits for Display with Visual Quality Enhanced Features
	Display with Baseline Features spec update : thickness criteria for 12"-14" changed from 2.05 mm to 2.4 mm (Max)
	Updated Contrast Ratio criteria to be $\geq 1000:1$ (min value in spec) & $\geq 1200:1$ (measured) from $\geq 800:1$
	Added (Max) to bezel border and thickness criteria for clarity
	Added measurement of Off-Axis CR at 45°diag $>12\%$ of perpendicular CR as reference data
	Display with Visual Quality Enhanced Features spec update: thickness criteria for 12"-14" changed to $\leq 2.0$ mm (Max) and for 15.6" changed to $\leq 2.2$ mm (Max) ; Added reflection rate $\leq 6\%$ as new criteria
	Color Accuracy measurement (as reference data) update: Measure Delta E $\leq 4$ at 100 nits in SDR mode. Measure Delta ITP in HDR mode based on VESA CTS 1.1
	Removed Windows Desktop as testing pattern for power measurement
	Added exceptional brightness condition for displays with In-Cell or On-Cell touch: when measuring power consumption, brightness can be reduced to 275 nits for Display with Baseline Features and 220 nits for Display with Visual Quality Enhanced Features
Update flicker testing pattern from Gary 128 to Gray 127.	
Update PSR criteria to PSR II for clarity; Remove DMRRS wording in the spec as it is already covered by LRR criteria. Added ALRR as one of the LRR versions. Added exception rule: in the case that PSR II feature needs to be turned off due to platform restriction. PSR II requirement can be waived. For OLED, LRR requirement is optional.	

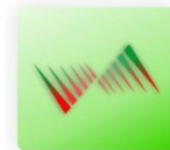
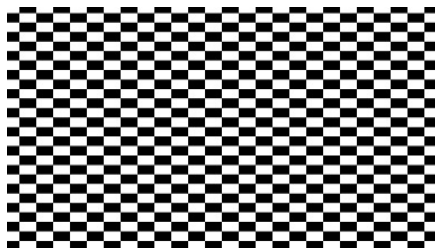
# OVERVIEW

	Spec for	Brightness Measurement point	Power	Flicker <sup>*8</sup>	Intel Low power technologies <sup>*11</sup>	Pass/Fail Test Pattern	Reference Test Pattern
LPDT 3.0 (2021/06~)	Display with Baseline Features	300 nits <sup>*9</sup> <sup>*13</sup> & 185 nits (ref)	√	√	√ <sup>*12</sup>	32X32 Mosaic	TOS/ MobileMark 2018
	Display with Visual Quality Enhanced Features <sup>*10</sup>	230 nits <sup>*9</sup> <sup>*13</sup> & 120 nits (ref)	√	√	√ <sup>*12</sup>		

*8	Flicker test is only required for panel whose refresh rate can reach $\leq 40\text{Hz}$ for Display with Baseline Features or $\leq 48\text{Hz}$ for Display with Visual Quality Enhanced Features. For panels that pass LPDT Flicker test, the display vendors are required to meet this minimum criteria in production units.
*9	Power consumption criteria are set at 300 nits for Display with Baseline Features (Power at 185 nits is measured as reference data) and 230 nits for Display with Visual Quality Enhanced Features (Power at 120 nits is measured as reference data).
*10	A display is required to meet additional criteria to be categorized as Display with Visual Quality Enhanced Features. A display can only be categorized as EITHER Display with Baseline Features OR Display with Visual Quality Enhanced Features.
*11	A display must support DPST, PSR II and a version of LRR (1.0, 2.0, 2.5 or ALRR). DMRRS is included in LRR.
*12	Exception rules: 1. In the case that PSR II feature needs to be turned off due to platform restriction. PSR II requirement can be waived. 2. For OLED type display, DPST and LRR requirement can be waived.
*13	Exception rule: The power consumption of display with In-Cell or On-Cell touch can be measured at 275 nits for Display with Baseline Features and "display with visual enhanced features" category can be tested under brightness 220 nits

# Panel Power Measurement Test Setting

- Idle Scenarios
  - ✓ 32x32 Mosaic
  - ✓ Full White
- Video Scenarios
  - ✓ Tears of Steel Video
  - ✓ Mobile Mark 2018
- Brightness Settings for Display with Baseline Features
  - ✓ 300 nits
  - ✓ 185 nits
  - ✓ Maximum Brightness
- Brightness Settings for Display with Visual Quality Enhanced Features
  - ✓ 230 nits
  - ✓ 120 nits
  - ✓ Maximum Brightness



MOBILEMARK 2018

# LPDT Power Consumption Criteria—Display with Baseline Features 1/2

Power: mW	Feature		Display only	Display only	Mandatory Requirement
	Brightness Spec		@185 Nits (as reference)	@300 Nits (LDPT 3.0 Judgement Criteria)	
12.3~12.5"	16:9 / 16:10	Logic	350	350	Max Brightness @5 point : 400 nits (Typ) 340 nits (Min) 32x32 Mosaic Pattern (Idle) 8 Bits 100% sRGB (typ) , 95% sRGB (Min) Panel Thickness T ≤ 2.4 mm (Max) Bezel (L/R/U) ≤ 2.55mm (Max) Contrast Ratio : measured >1200:1 , 1000:1 (Min) PSR 2 /LRR **1 is requried
	1920x1080	Backlight	650	1050	
	<b>Total Power</b>		<b>1000</b>	<b>1400</b>	
	3:2	Logic	350	350	
	1920x1280	Backlight	850	1380	
	<b>Total Power</b>		<b>1200</b>	<b>1730</b>	
	16:9 / 16:10	Logic	400	400	
	2560X1440	Backlight	850	1380	
	<b>Total Power</b>		<b>1250</b>	<b>1780</b>	
	13.3~14"	16:9 / 16:10	Logic	350	
1920x1080		Backlight	850	1380	
<b>Total Power</b>		<b>1200</b>	<b>1730</b>		
3:2		Logic	350	350	
1920x1280		Backlight	1050	1700	
<b>Total Power</b>		<b>1400</b>	<b>2050</b>		
16:9 / 16:10		Logic	400	400	
2560X1440		Backlight	1100	1800	
<b>Total Power</b>		<b>1500</b>	<b>2200</b>		
3:2		Logic	500	500	
3000x2000		Backlight	1250	2050	
<b>Total Power</b>		<b>1750</b>	<b>2550</b>		
16:9 / 16:10		Logic	800	800	
3840x2160		Backlight	1450	2350	
<b>Total Power</b>		<b>2250</b>	<b>3150</b>		

Reference data measurement:  
 1. Measure Off-Axis CR at 45°diag >12% of perpendicular CR  
 2. Measure Delta E ≤ 4 at 100 nits in SDR mode. Measure Delta ITP in HDR mode based on VESA CTS 1.1

# LPDT Power Consumption Criteria—Display with Baseline Features 2/2

Power: mW	Feature		Display only	Display only	Mandatory Requirement
	Brightness Spec		@185 Nits (as reference)	@300 Nits (LDPT 3.0 Judgement Criteria)	
15.6"	16:9 / 16:10	Logic	350	350	Max Brightness @5 point : 400 nits (Typ) 340 nits (Min) 32x32 Mosaic Pattern (Idle) 8 Bits 100% sRGB (Typ) , 95% sRGB (Min) Panel Thickness T ≤ 2.7mm (Max) Bezel (L/R/U) ≤ 2.55mm (Max) Constrast Ratio : <b>measured &gt;1200:1 , 1000:1 (Min)</b> PSR 2 /LRR <sup>*11</sup> is requied
	1920x1080	Backlight	1050	1700	
	<b>Total Power</b>		<b>1400</b>	<b>2050</b>	
	3:2	Logic	350	350	
	1920x1280	Backlight	1200	1950	
	<b>Total Power</b>		<b>1550</b>	<b>2300</b>	
	16:9 / 16:10	Logic	400	400	
	2560X1440	Backlight	1400	2270	
	<b>Total Power</b>		<b>1800</b>	<b>2670</b>	
	3:2	Logic	500	500	
	3000x2000	Backlight	1400	2270	
	<b>Total Power</b>		<b>1900</b>	<b>2770</b>	
	16:9 / 16:10	Logic	800	800	
	3840x2160	Backlight	1700	2750	
<b>Total Power</b>		<b>2500</b>	<b>3550</b>		

Reference data measurement:

1. Measure Off-Axis CR at 45°diag >12% of perpendicular CR
2. Measure Delta E ≤ 4 at 100 nits in SDR mode. Measure Delta ITP in HDR mode based on VESA CTS 1.1

# LPDT Power Consumption Criteria—Display with Visual Quality Enhanced Features

Power: mW	Feature		Display only @230 nits or Display with touch ( & Stylus , if applicable) @ 200 nits	Mandatory Requirement
	Brightness Spec			
Display with High Visual Quality 15.6"	16:9 / 16:10	Whole panel	6700	DCI-P3 99% (Typ) 90% (Min)  HDR 500 or HDR 400 (TrueBlack)  Panel Thickness for 12-14 inches ≤ 2.mm (Max)  Panel Thickness for 14.5"-15.6" ≤ 2.2 mm(Max)  Bezel (L/R/U) ≤ 2.05mm (Max)  Reflection rate ≤6%
	3840X2160			
Display with High Visual Quality 13.3"	16:9 / 16:10	Whole panel	5000	
	3840X2160			
Display with High Visual Quality 13.3"	16:9 / 16:10	Whole panel	3400	
	1920X1080			
Display with High Visual Quality 13.5"	3:2	Whole panel	4360	
	3000X2000			

Reference data measurement:

1. Measure Off-Axis CR at 45°diag >12% of perpendicular CR
2. Measure Delta E ≤ 4 at 100 nits in SDR mode. Measure Delta ITP in HDR mode based on VESA CTS 1.1



# SDC Panel List

Segment	Size	Resolution	AR	Model code	Refreshrate	Logic	Panel	Power (W)	LPDT3.0		Condition
13.3~13.5"	13.3"	1920x1080	16:9	ATNA33XCxx	60Hz	0.9	1.5	2.4	Done		230nit, OPR 50% (Mosaic 32x32)
	13.3"	2880x1800	16:10	ATNA33AAxx	60Hz	1.8	1.5	3.3	Need to add	SPL Now	
	13.5"	3000x2000	3:2	ATNA35VJxx	60HZ	1.8	1.7	3.5	Done		
	13.4"	3456x2160	16:10	ATNA34XKxx	60Hz	2.1	1.7	3.8	Need to add	SPL Now	
	13.3"	3840x2160	16:9	ATNA33XCxx	60Hz	2.1	2.1	4.2	Done		
14.0~14.5"	14.0"	1920x1200	16:10	TBD	60Hz	(MP '22.4Q)		Need to add	SPL '22Jun		
	14.0"	2880x1800	16:10	ATNA40YKxx	60/90Hz	2.0	1.9	3.9	Need to add	MP	
	14.0"	2880x1800	16:10	ATNA40BKxx	48~120Hz	(MP '22.4Q)		Need to add	SPL '22Jun		
	14.0"	3840x2400	16:10	ATNA40YNxx	60Hz	2.3	1.9	4.2	Need to add	MP	
	14.5"	2880x1800	16:10	ATNA45AFxx	60/120Hz	2.0	2.0	4.0	Need to add	SPL Now	
15.6~16"	15.6"	1920x1080	16:9	ATNA56YXxx	60Hz	0.9	2.2	3.1	Need to add	MP	
	15.6"	2880x1620	16:10	ATNA56ACxx	60/120Hz	2.0	2.4	4.4	Need to add	SPL Now	
	15.6"	3456x2160	16:10	ATNA56XGxx	60Hz	2.1	2.4	4.5	Need to add	MP	
	15.6"	3840x2160	16:9	ATNA56WRxx	60Hz	2.1	3	5.1	Done		
	16.0"	1920x1200	16:10	TBD	60Hz	(MP '22.4Q)		Need to add	SPL '22Jun		
	16.0"	2880x1800	16:10	TBD	48~120Hz	(MP '22.4Q)		Need to add	SPL '22Jun		
	16.0"	3200x2000	16:10	ATNA60BXxx	60/120Hz	(MP '22.2Q)		Need to add	SPL '22.Mar		
	16.0"	3840x2400	16:10	ATNA60YVxx	60Hz	2.4	2.8	5.2	Need to add	MP	

# Flicker Criteria\*8

Test Patterns (Steady Patterns)		Pass/Fail criteria	
		JETA Flicker ( Any refresh rates claimed by the panel EDID)	Luminance Deviation (Switch in between 60Hz & Low Refresh Rate)
1	Gray 127	< -50 dB	< 0.6 %
2	Windows 10 Desktop	< -50 dB	< 0.6 %
3	Gray 186H	< -30 dB	
4	Gray 186V	< -30 dB	
5	GreenMagenta 193H	< -30 dB	
6	GreenMagenta 193V	< -30 dB	
7	GreenMagenta1 dot 1 193	< -30 dB	
8	GreenMagenta1 dot 2 193	< -30 dB	

\*8 Flicker test is only required for panel whose refresh rate can reach  $\leq 40\text{Hz}$  for Display with Baseline Features or  $\leq 48\text{Hz}$  for Display with Visual Quality Enhanced Features. For panels that pass LPDT Flicker test, the display vendors are required to meet this minimum criteria in production units.

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# INTEL<sup>®</sup> DISPLAY OPTICS SPECIFICATION FOR PROJECT ATHENA



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# OPTICS TEST SPECIFICATION

Test Item	Criteria	
	Panel Standalone (including in-cell and on-cell touch with cover glass)	With cover glass and touch or full system
Brightness	300 nits (Min)	250 nits (Min)
Color Depth	≥8-bit True Color (≥16M colors)	
Contrast Ratio	800:1	
Color Gamut	90% sRGB	
Viewing Angle	Viewing Angles:≥150° (with Contrast ratio >10:1 @ 150° viewing angles)	
<p>Reference data measurement:</p> <ol style="list-style-type: none"> <li>1. Measure Off-Axis CR at 45°diag &gt;12% of perpendicular CR</li> <li>2. Measure Delta E ≤ 4 at 100 nits in SDR mode. Measure Delta ITP in HDR mode based on VESA CTS 1.1</li> </ol>		

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