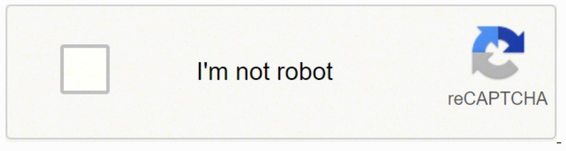

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Dell p2415q display

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When you need help, the computer can solve individual letters, words, or even the whole puzzle for you! ©2016 PennyDellPuzzles.com MonitoresSKU: P2415Q Descripción Especificaciones Peso y dimensiones Profundidad 46.9 mm Altura del dispositivo (con soporte) 369.5 mm Altura 336.1 mm Altura del paquete 456.2 mm Profundidad dispositivo (con soporte) 205 mm Ancho del paquete 249.2 mm Profundidad del paquete 673.1 mm Peso 3.34 kg Peso del paquete 8.68 kg Ancho del dispositivo (con soporte) 566.6 mm Ancho 566.6 mm Control de energía Consumo de energía (apagado) 0.5 W Consumo energético 45 W Clase de eficiencia de energía C Consumo de energía (max) 90 W Frecuencia de entrada AC 50 – 60 Hz Consumo de energía (inactivo) 0.5 W Consumo de energía anual 52 kWh Voltaje de entrada AC 100 – 240 V Exhibición Forma de la pantalla Plana Número de colores de la pantalla 1,073 mil millones de colores Diagonal de la pantalla 23.8pulg. Formatos gráficos soportados 3840 x 2160 Intervalo de escaneado horizontal 31 – 140 kHz Intervalo de escaneado vertical 29 – 76 Hz Ángulo de visión, horizontal 178° Tamaño visible, horizontal 52.7 cm Resolución de la pantalla 3840 x 2160 Pixeles Ángulo de visión, vertical 178° Tiempo de respuesta 6 ms Tamaño visible, diagonal 60.5 cm Relación de aspecto nativa 16:9 Tecnología de visualización LCD Tamaño de pixel 0.13725 x 0.13725 mm Tamaño visible, vertical 29.6 cm Tipo HD 4K Ultra HD Display brightness (typical) 300 cd / m^2 DDC / CI Pantalla LED Relación de aspecto 16:9 Relación de contraste (dinámico) 2000000:1 Tipo de retroiluminación LED Máxima velocidad de actualización 60 Hz 3D Razón de contraste (típica) 1000:1 Superficie de la pantalla Mate Tipo de pantalla IPS Puertos e Interfaces Enlace de alta definición móvil (MHL) Cantidad de DisplayPorts 2 Número de puertos HDMI 1 Puerto DVI Entrada de CA Versión de conector USB USB 3.0 (3.1 Gen 1) Cantidad de puertos Mini Display 1 Conector USB incorporado Cantidad de puertos USB descendentes de tipo A 4 Salida de auriculares Diseño Color del producto Negro Posicionamiento de mercado Negocios Ergonomía Ranura para cable de seguridad Interruptor de encendido/apagado integrado Conectar y usar (Plug and Play) Ajuste de la inclinación Indicadores LED montaje VESA Interfaces de montaje VESA 100 x 100 mm Giratorio Eje Ajustes de altura Otras características HDMI Entrada de audio Salida de audio Número de cajas de cartón por palé 12 Cantidad por palé 12 pieza(s) Número de capas por palé 2 Condiciones ambientales Altitud de funcionamiento 0 – 5000 m Intervalo de temperatura de almacenaje -20 – 60 °C Intervalo de humedad relativa para funcionamiento 10 – 80% Altitud no operativa 5000 – 12192 m Intervalo de humedad relativa durante almacenaje 5 – 90% Intervalo de temperatura operativa 0 – 35 °C Aprobaciones reguladoras Certificado Energy Star Conformidad EPEAT Gold Certificación EDID, TCO Acorde RoHS Contenido del embalaje Cables incluidos Corriente alterna, USB Manual de usuario Stand incluido Audio Altavoces incorporados Características de administración Exhibición en pantalla (OSD) Multimedia Sintonizador de TV integrado Cámara incorporada Cliente fino / Thin Client Cliente delgado instalado Desempeño AMD FreeSync NVIDIA G-SYNC Empaquetado Material del envase Cartón corrugado, Polietileno (PE) Datos logísticos Anchura del palé 101.6 cm Peso del palé 124.2 kg Longitud del palé 121.9 cm Peso del envase completo 8.68 kg Longitud de la caja 67.3 cm Cantidad por caja 1 pieza(s) Largo de la caja principal 24.9 cm Altura del palé 103.2 cm Cantidad por capa 6 pieza(s) Alto de la caja principal 45.6 cm Página inicial › Dell › P2415Q Pantalla: 23.8 in, AH-IPS, W-LED, 3840 x 2160 pixelsÁngulos de visión (H/V): 178 ° / 178 °Brillo/Luminosidad: 300 cd/m^{2}Contraste estático: 1000 : 1, Contraste dinámico: 2000000 : 1Frecuencia de actualización: 29 Hz - 76 HzsRGB: 99 %, NTSC: 72 %Dimensiones: 566.64 x 336.06 x 46.93 mmPeso: 3.34 kg Añadir para comparar Sugerir una modificación Pantalla: 23.8 in, AH-IPS, W-LED, 3840 x 2160 pixelsÁngulos de visión (H/V): 178 ° / 178 °Brillo/Luminosidad: 300 cd/m^{2}Contraste estático: 1000 : 1, Contraste dinámico: 2000000 : 1Frecuencia de actualización: 29 Hz - 76 HzsRGB: 99 %, NTSC: 72 %Dimensiones: 566.64 x 336.06 x 46.93 mmPeso: 3.34 kg La información en la página web se proporciona en el principio "tal y como es" y "tal y como está disponible" sin cualquier tipo de garantías. DisplaySpecifications no es responsable en caso de omisiones, discrepancias y otros errores en los datos publicados. Queda prohibida la reproducción de cualquier parte del sitio total o parcialmente o bajo cualquier otra forma sin nuestro previo acuerdo escrito. Las marcas comerciales, los logos y los logotipos de los fabricantes de los dispositivos móviles, el hardware, el software etc. pertenecen a los respectivos propietarios. política de cookies | términos de uso sobre nosotros | contáctanos | noticias © 2022 displayspecifications.com Author: Adam Simmons Date published: January 5th 2015 Introduction Until recently there were two distinct paths for consumers looking for '4K' UHD (Ultra High Definition) monitors with 3840 x 2160 resolutions. Either they settled for a model with a 28" TN (Twisted Nematic) panel, or they forked out for a more expensive model with an IPS (In-Plane Switching) or similar panel. The Dell P2415Q marks something of a turning point, providing a UHD AH-IPS panel without costing a small fortune. We put this intriguing monitor through its paces in a series of 'real-world' tests, including seeing how it performs in a range of game and movies titles. Specifications This monitor uses a 23.8" '4K' UHD panel, which is an AH-IPS (Advanced High-Performance In-Plane Switching) model manufactured by LG Display. This model has a 10-bit panel, using 8-bits per subpixel plus fine FRC (Frame Rate Control) dithering. A grey to grey response time of 6ms is specified with the adjustable pixel overdrive control set to 'Fast' and 8ms with it set to 'Normal'. As with most aspects of the specification, these figures can be hugely misleading and really have to be tested – which is exactly what we're doing here. The key 'talking points' of the specification have been highlighted in blue below. Panel type: LG Display LM238WR2-SLA1 AH-IPS (In-Plane Switching) LCD Panel Native resolution: 3840 x 2160 Typical maximum brightness: 300 cd/m^2 Colour support: 1.07 billion (8-bits per subpixel plus dithering) Contrast ratio: 1,000:1 (2m:1 Dynamic Contrast) Viewing angle: 178º horizontal, 178º vertical Power consumption: 45W typical Backlight: WLED (White Light Emitting Diode) Typical price as reviewed: £375 ($580 USD) As an Amazon Associate I earn from qualifying purchases made using the below link. Where possible, you'll be redirected to your nearest store. Further information on supporting our work. Features and aesthetics From the front the monitor adopts a modern homely Dell style. It is reminiscent of the P14 series with gently rounded corners, matte black plastic bezels and a silver matte plastic outer surround. The bezels are of moderate thickness; 19mm (0.75 inches) on all sides. The screen surface is light matte anti-glare, described in more detail later. You can see slight reflections in a bright room when the monitor is off (first picture), with objects getting a soft outline. These are not at all like the sharp reflections of a glossy screen. Once switched on and particularly when displaying mixed or light content (second image) the good glare-handling characteristics become apparent. The stand offers full ergonomic flexibility; tilt (21° back, 5° forwards), height adjustment (140mm or 5.5 inches), swivel (45° left or right) and pivot (90° clockwise into portrait). At lowest height the bottom bezel sits just 40mm (1.57 inches) above the table with the top of the screen 365mm (14.37 inches) above the desk surface. The image below shows the screen in portrait orientation. The OSD (On Screen Display) menu system is controlled by pressable buttons. With the monitor in its normal landscape orientation, these run down the bottom of the right bezel. Their functions are as follows; 'Custom Key 1 (Preset Modes by default)/Up', 'Custom Key 2 (Inputs by default)/Down', 'Menu/Select' and 'Exit'. There is also a power button with illuminated power symbol in the bottom right corner of the monitor. This glows white when the monitor is on (can be disabled in the OSD) and intermittently flashes white if the monitor is in a low power state (standby). When you push the button to turn the monitor off, the light turns off. The buttons and menu system itself is well laid out and easy to navigate. The video below shows how the menu system operates and some of the key features of the OSD. At the side the monitor is fairly slender at around 40mm (1.57 inches) maximum excluding the stand. The stand is as solid as it looks, as you'd hope for from a modern Dell monitor of this sort. The rear of the monitor shows the central stand attachment point. It attaches using a proprietary Dell bracket attachment mechanism. There is a quick-release button underneath the attachment point. There are 100 x 100mm VESA holes here if you wish to use an alternative VESA 100 mounting solution. A thin row of ventilation slats run along the top, neatly hidden away and not visible in the photo below. At the bottom there are the ports of the monitor, with a clip-on port cover (shown in photo) keeping things neat. To the left of this is a K-Slot and to the right a USB 3.0 port with fast-charging capability. Towards the right of the stand (in the 'concealed' port area) is a down-firing AC power input (internal power converter). The remaining ports are also down-firing and from left to right are; HDMI 1.4 (with MHL 2.0 support), DP 1.2 input, MiniDP 1.2 input, DP 1.2 output (for MST daisy-chaining), 3.5mm audio output, USB 3.0 upstream, 3 USB 3.0 downstream ports (making 4 downstream in total). Only the DP 1.2 and MiniDP 1.2 ports support 60Hz at the native resolution of the monitor, whereas HDMI and DP 1.1 is limited to 30Hz at the native resolution. The monitor uses SST (Single Stream Transport) internally, meaning that it is seen as a single display by the Operating System. This avoids the potential pitfalls of internal MST which is used on some '4K' monitors to achieve 60Hz at 3840 x 2160 over DisplayPort. A power cable, USB 3.0 upstream cable (required to use the USB ports) and MiniDP to DP cable is included in the box. The MiniDP-DP cable can be used either way, meaning GPUs with full sized DP or mini DP outputs can be connected to the monitor directly. Calibration Subpixel layout and screen surface The monitor uses a light matte screen surface which provides potentially greater clarity and vibrancy than 'heavier' matte screen surfaces. This screen surface is also able to tackle glare effectively, providing a comfortable experience even in moderately bright viewing environments. This screen surface imparted a bit more graininess to whites and light colours than some other light or very matte screen surfaces we've seen. The image didn't look as clean – the surface texture didn't seem as 'smooth' as on some otherwise comparable matte surfaces. It is at least free from the heavy 'smeary' grain that is pretty much exclusive to 'heavier' matte surfaces. The subpixel layout is the usual RGB (Red, Green and Blue) stripe. This is the 'default' expected by Operating Systems such as Microsoft Windows and Apple's Mac OS. On Apple systems you can therefore expect good text clarity without the 'fringing' issues caused by other subpixel layouts. On Windows systems you can run 'ClearType' to optimise the experience. The text-viewing experience is quite different to on models with lower pixel densities so we recommend running the 'ClearType' wizard and setting things according to your preferences. Testing the presets The P2415Q has a number of 'Preset Modes' available; 'Standard', 'Multimedia', 'Movie', 'Game', 'Paper', 'Warm', 'Cool' and 'Custom Color'. The table below provides some key readings (gamma and white point), extra features available that aren't there in all presets and some general observations on the image provided by a selection of these presets. We've excluded the presets which we feel give an (in some cases very) unappealing image balance from the analysis. With the exception of our 'Test Settings' and 'Game' assume everything other than the preset itself was left at default. For the 'Game' preset we disabled Dynamic Contrast during this testing. For reference, our test system used an Nvidia GTX 970 connected using the supplied MiniDP to DP cable. We were using Windows 8.1 with the monitor in its 'plug and play' state with no additional drivers or ICC profiles installed. We also tested on an AMD R9 Series GPU and found very little difference in the image compared to on our Nvidia GPU. This was the case whether using DP-DP, MiniDP-DP or HDMI-HDMI. As mentioned previously HDMI and DP revisions earlier than 1.2 (i.e. 1.1) are limited to 30Hz at the native resolution. Preset Mode Gamma (central average) White point (kelvins) Extra OSD features Notes Standard 2.2 6515K Uniformity Compensation Fairly bright without being retina-scorching. Image is very nicely balanced with excellent shade depth and variety. A good vivid but natural look. Game 2.1 5738K Hue, Saturation, Dynamic Contrast Again quite bright. Image has a warm and slightly green tint but is fairly well balanced otherwise. Paper 2.1 5161K This is essentially a 'Low Blue Light' setting. It dims the image (brightness is adjustable, '75' by default) and gives it a noticeably warm tint. This setting is good for relaxing evening viewing in particular and certainly has good utility in our opinion. Warm 2.1 5806K The image is fairly bright. Although technically 'Warm' (colour temperature of around 5800K) it's actually 'less warm' than some of the other presets. Custom Color (Factory Defaults) 2.2 5625K Uniformity Compensation, colour channel adjustments – R, G, B Only a touch brighter than 'Standard', although doesn't appear so due to the warm tint. This is warmer than the 'Warm' preset but not as warm as the 'Paper' preset – colour channels are of course adjustable. Lowering the red and green a little would be desirable for normal daytime viewing. Test Settings (as below) 2.2 6517K Simply 'Standard' with reduced brightness. Straight from the box the monitor comes in the 'Custom Color' preset, with all colour channels set to '100'. The image is a bit warm but otherwise well balanced. The 'Standard' setting makes use of the full factory calibration which all P2415Qs undergo. A factory calibration report is included with the monitor as shown below for our unit. Our readings mirrored those made by Dell at the factory. In the 'Standard' mode and indeed our test settings the colour temperature was pretty much bang on the 6500K daylight target and the gamma tracking was exceptional as shown below. Although not included in our discussion here, we also tested the colour accuracy and have no reason to doubt the reported values (with an average DeltaE of Outside of the 'Standard' and 'Custom Color' the gamma slackened off a little, average 2.1. It still followed the curve quite closely, though, so there was nothing particularly bothersome there. We should also mention the 'Paper' mode, which isn't exclusive to this model but is something we really appreciate. It's basically a 'Low Blue Light' setting and makes for very comfortable evening viewing to our eyes. Test Settings As mentioned previously our 'Test Settings' simply involved using the 'Standard' preset and reducing the brightness a bit. There was no need to make any adjustments to the colour channels or anything else on our unit. Note that individual units can vary, even those that are apparently factory calibrated in this way. Changes can also be expected over time, so please feel free to experiment with other settings (particularly in 'Custom Color') if you need to. For reference a 6500K white point could be achieved our unit in 'Custom Color' by setting the colour channels to 92/98/100 (R/G/B), but the contrast was just a touch weaker than in the 'Standard' setting after these adjustments. We have also included the 'Response Time' used in the review here for reference. Any settings not mentioned here were kept at default. Brightness= 50 (according to preferences and lighting) Response Time= Normal Contrast and brightness Contrast ratios A Konica Minolta CS-200 luminance meter was used to measure the luminance of white and black using various monitor settings. From these figures a static contrast ratio was calculated. The table below shows the values and calculated ratios with blue highlights indicating the highest white luminance, lowest black luminance and peak contrast ratio recorded. The results using our test settings are highlighted in black. With the exception of our test settings and disabling 'Dynamic Contrast' when using the 'Game' setting, any settings not mentioned in the table were left at default. Monitor Profile White luminance (cd/m^2) Black luminance (cd/m^2) Contrast ratio (x:1) 100% brightness 331 0.30 1182 80% brightness 255 0.23 1109 60% brightness 199 0.18 1106 40% brightness 148 0.13 1138 20% brightness 94 0.08 1175 0% brightness 39 0.03 1300 Factory Defaults (75% brightness, Custom Color) 237 0.21 1129 Standard 230 0.25 920 Game 282 0.25 920 Paper 127 0.13 977 Warm 280 0.26 1077 Test Settings 167 0.18 928 The average contrast ratio of the P2415Q with brightness only adjusted was 1155:1, which is quite impressive. Using out test settings or indeed the 'Standard' mode on which these are based dropped the contrast – 928:1 in the case of our test settings. That's because the native colour temperature of the monitor is quite warm (~5600K) and the 'Standard' mode includes a fairly thorough factory calibration which includes aiming for a 6500K white point. The 'Paper' mode provided a slight drop in contrast as well, this time to 977:1 as the colour temperature was adjusted the other way – becoming even warmer than native (~5150K). The 'Warm' mode resulted in an insignificant drop in contrast to 1077:1 as the target colour temperature was fairly close to native anyway (~5800K). The maximum luminance recorded was 331 cd/m^2 whilst the minimum white luminance was a fairly low 39 cd/m^2. This gave the monitor a pleasing luminance adjustment range of 292 cd/m^2. A 'Dynamic Contrast' setting is included on the monitor, which can be activated in the 'Game' and 'Movie' modes. The backlight reacted rapidly to changes in scene brightness with this mode active, reflecting the overall balance of 'light' or 'dark' on the screen. The brightness tended to be too high during mixed content and even some fairly dark-biased content but did dim effectively for the darkest scenes. As with all current LCD monitor backlights the whole backlight is controlled as a single unit, so the monitor can't simultaneously keep one part of the screen bright whilst dimming another. With these limitations in mind the 'Dynamic Contrast' mode is of limited appeal to us, but it's there if you want to use it. PWM (Pulse Width Modulation) The monitor does not use PWM (Pulse Width Modulation) to regulate backlight brightness to any level and instead using DC (Direct Current) regulation. This means that the monitor is considered 'flicker-free' which will come as welcome news to those sensitive to flickering or who want to minimise visual fatigue when using their monitor. Luminance uniformity Whilst observing a black screen in a dark room under our test settings we could see a degree of backlight bleed and some clouding around the bottom corners in particular. This was visible to the naked eye when viewing a black screen fill in a dark room as patches of 'golden grey' compared to a more neutral dark grey surrounding. This wasn't really an issue during normal use and in fact was largely nullified by 'IPS glow' as explored later. The picture below shows the uniformity of the screen in a dark room whilst displaying black using our test settings. You can see backlight bleed exhibited on our sample was most extensive towards the bottom left corner, although it is perhaps exaggerated a bit in the image. The picture was taken from a few metres back to eliminate 'IPS glow'. This glow is visible from a normal viewing positon and essentially drowns out the most of the bleed there was on our sample. It appears as a slight golden-grey and blue sheen towards the corners of the screen, from a normal viewing position. It 'blooms out' as you move your viewing position relative to the screen. A video further on in the review demonstrates this blooming out and the effects of this 'IPS glow' are described during regular viewing as well. The Spyder4Elite was also used to assess the uniformity of lighter colours, represented by 9 equidistant white quadrants running from the top left to bottom right of the screen. The following tables show the percentage deviation between a given quadrant and the brightest point recorded on the screen alongside the luminance recorded at each quadrant. For the first table, the monitor was set up according to our test settings with 'Uniformity Compensation' (UC) set to 'Off'. The second table has UC set to 'Calibrated'. This feature is designed to improve the uniformity of the screen when set to the factory default brightness and contrast values – these cannot be adjusted when this feature is enabled. The luminance uniformity was quite good overall using our test settings. The maximum luminance was recorded at 'quadrant 5' in the centre of the screen (166.2 cd/m^2). The greatest deviation from this occurred at 'quadrant 3' towards the top right of the screen (147 cd/m^2 which is 12% dimmer than the centre). The lowest deviation was recorded at 'quadrant 7' towards the bottom left of the screen (155.4 cd/m^2 which is 5% dimmer than the centre). The average (mean) deviation was around 8.4% which is pleasing. With the UC feature enabled the screen became brighter overall, as brightness was set to '75' rather than '50'. The maximum luminance was recorded at 'quadrant 7' towards the bottom left of the screen (194.5 cd/m^2). The greatest deviation was recorded at 'quadrant 3' towards the top right of the screen (167.8 cd/m^2 which is 14% dimmer than the centre). The lowest deviation was recorded at 'quadrant 4' left of centre (192.2 cd/m^2 which is a mere 1% dimmer than centre). The average (mean deviation) was around 9.75% which is reasonable. From this analysis, it doesn't appear that the 'Uniformity Compensation' feature is working all that well, for white at any rate. The uniformity seemed better overall with the feature disabled, at least with the brightness lowered (which isn't possible with the feature turned on). It's worth remembering that this feature is set at the factory and uniformity does vary not just between individual units but with the same unit over time. Mileage may vary. For those that prefer a graphical representation of the uniformity we've included some contour maps below. The first map shows the results using our test settings and the second map with UC enabled. On these maps darker greys represent lower luminance than lighter greys. The same 9 quadrants were used to assess the consistency of colour temperature (white point) as well. The graphics below represent the deviation recorded between each quadrant and the 6500K (D65) daylight white point target. Deviations are given as a DeltaE value, with a DeltaE of under 3 being considered deviation that most users won't readily notice by eye. The first map shows the results using our test settings and the second with 'Uniformity Compensation' enabled. Darker colours on this map represent higher deviation from the central value (a higher DeltaE). The results here are good, with no significant deviation between the recorded points and the desirable 6500K daylight target. The highest deviation recorded using our test settings was a DeltaE of 2.3 ('quadrant 3' towards the top right) and using UC was a DeltaE of 2.9 ('quadrant 9' towards the bottom right). The average (mean) DeltaE was around 1.67 using our test settings and around 1.98 with UC enabled. Again, it doesn't seem that the UC mode is having a positive effect, at least not on our unit. Fortunately the performance was quite pleasing under our test settings anyway, without this feature. Contrast in games and movies The monitor put in a respectable contrast performance on Battlefield 4. Visibility in dark scenes was largely as it should be, with the exception of some peripheral detail being lost due to IPS glow. Some fairly minor details could be observed in more central regions of the screen not affected by IPS glow. Bright elements contrasted well with their dark surroundings. The distinction between closely matching light shades was also strong – they didn't appear bleached nor did they take on an inappropriate tint. Some of these light colours, particularly where single static bright shades dominated (i.e. a light shining through the night), appeared a little grainy due to the screen surface. This was not the smeary or 'dirty' appearance that accompanies some stronger matte surfaces but wasn't as 'clean' as we've seen from some 'semi-glossy' surfaces, either. The contrast was good overall on Dirt 3. There was again some detail lost due to IPS glow, particularly towards the bottom two corners of the screen from a normal ergonomically correct viewing position. This made some subtle detail such as material textures inside the car and tire tread patterns difficult to see at times. Elsewhere detail levels were respectable and overall the distinction between 'light' and 'dark' and more subtle distinctions between was good. There was again slight graininess visible on light shades (particularly bright headlights at night) due to the screen surface. The contrast performance was good on the Blu-ray of Skyfall. Dark scenes exhibited a good level of detail, with the aspect ratio of the film giving black bars at the top and bottom which 'soaked up' much of the IPS glow. Bright elements contrasted well, with the neon lights in Shanghai and candles floating along the river at night in Macau looking quite punchy. Lagom contrast tests We used Lagom's tests for contrast to help highlight slight weaknesses in the contrast performance of the monitor, some of which may not be obvious during other testing. We observed the following. Performance on the contrast gradients was excellent with distinct brightness steps in all cases. Performance on the black level test was good. The first two blocks were perhaps a little more distinct than they ideally should be (for a monitor following '2.2 gamma') but the blocks were generally represented as they should be. The viewing angle had little influence on the colour temperature, which remained a good neutral grey and showed appropriate distinctiveness throughout the range. There was no noticeable dithering. Performance on the white saturation test was excellent. All checkerboard patterns were visible and the grey patterns were appropriately neutral. The final pattern was a little less visible than it could be, shrouded somewhat by the slight graininess of the screen surface. The greyscale gradient was exceptionally smooth. There was no obvious dithering, perhaps some hints here and there but it was extremely well masked and not really visible under normal viewing conditions. The lightest shades didn't appear as 'clean' and 'pure' as they might when viewed on a monitor with a smoother screen surface, but didn't appear overly grainy either. Colour reproduction Colour gamut The Dell P2415Q offers complete coverage of the sRGB colour space and a bit of extension beyond, as shown in the following gamut representation. This slight extension invites a little extra vibrancy in places without things looking unnatural or completely oversaturated. Colour in games and movies The monitor showcased a pleasing variety and quality to colours on Battlefield 4. Things looked much as they should, with environments showing an array of rich greens and browns alongside more muted shades. There were plenty of vibrant shades, where appropriate, such as; warming orange fires, bright red and yellow paints, good bright greens for aircraft HUD elements and brilliant bright cyans for in-game markers and the engineer's blowtorch. Some of these colours were quite striking in their richness, which was good to see. The colour performance was also pleasing on Dirt 3. The range of subtly different green, brown and red shades within the environments was excellent and brought a good natural look to them. There were plenty of dashing vibrant colours, too, especially noticeable on the car liveries and advertising around the track. Bright pinks, deep reds, strong deep blues and bright cyans were amongst some particularly striking shades. The screen surface helped preserve a decent degree of vibrant 'pop', but lacked the smoothness of some screen surfaces which would give colours that 'painted onto the screen' look. The monitor also provided an impressive range of appropriately represented colours on Elder Scrolls Online (ESO). There was a good range of natural greens and earthy browns, giving the environments a good natural look. Good and consistent neutral greys and mossy greens were also displayed, for example on some of the rocks and mountainous environments. Ornate buildings and structures showcased an impressive variety of woody shades as well with even very subtle variations in shade displayed appropriately. There were plenty of nice vibrant elements as well, such as impressively deep red spell effects and vibrant-looking orange flames. The Blu-ray of Skyfall was also represented well in the colour department. Skin tones, greens and browns from vegetation and buildings showed appropriate saturation levels – looking rich but realistic. Explosions, bright paints and the neon lights of Shanghai showcased some impressively deep shades with a good rich look – with deep reds and purples being particularly impressive here. We also observed the colour reproduction on the Blu-ray of Futurama: Into the Wild Green Yonder. With its eclectic mix of pastel shades, deep shades and neon shades coupled this is a good test for the colour reproduction of a monitor – more so given that large areas of a single shade often fill the screen, allowing weaknesses in consistency to be readily analysed. The P2415Q put in a pleasing performance here, showing a nice range of muted shades alongside plenty of 'loud' neon shades and good deep shades. Bright bold pinks, luminous neon greens and deep reds were displayed particularly well. The consistency of shades was also very strong, with the saturation maintained throughout the screen. This allowed the monitor to distinctly display subtly different pastel shades (such as skin tones) and kept colours appropriately rich regardless of on-screen position. Viewing angles Lagom's tests for viewing angle were used to analyse the viewing angle performance and colour consistency of the monitor more closely. The following observations were made from a normal viewing position (70cm from the screen in our case). The purple block appeared a consistent light purple throughout without any obvious pink sheen. There was a slight pink hue towards the very edges but nothing severe. The red block was a rich and fairly striking red throughout. The green block appeared lime green throughout. This was quite consistent without any noticeable yellowing or deepening of the green. The blue block was a good royal blue throughout. The Lagom text appeared a blended grey throughout without green or red flashes. This indicates a low level of viewing angle dependency to the monitor's gamma curve and is what you would hope for from an IPS panel. The following video shows the results of this test from a variety of viewing angles, as well as a mixed and dark desktop background. The dark desktop background highlights how the IPS glow blooms out as viewing position is altered relative to the screen. Responsiveness Input lag We used a sensitive camera to compare the latency of the monitor, using our test settings, with a range of displays where the latency is known. To assist in this, a small tool called SMTT 2.0 was used. Using this method we calculated 11.85ms (under ¾ of a frame) of input lag for the Dell P2415Q. This was not altered by using the 'Game' mode of the monitor. This value takes into account not only the component of input lag that you 'feel', known as the signal delay, but also the component that you 'see' (i.e. it is influenced by pixel response time). This indicates a relatively low signal delay which is especially pleasing to see on a '4K' monitor such as this. We feel that even users who are quite sensitive to latency should find this monitor quite good for a 60Hz model in that respect. Pixel responsiveness We used the UFO Motion Test for ghosting and a highly sensitive camera to assess the pixel responsiveness of the monitor. This test was set to run at a speed of '3840 Pixels Per Sec', meaning that the UFO travelled rapidly across the screen, traversing it in 1 second. The following image shows the pixel response of the monitor using both its 'Normal' (first column) and 'Fast' (second column) 'Response Time' settings. The top row in our image corresponds to the first row of the test, which has the UFO moving against a relatively dark cyan background. The bottom row in our image corresponds to the middle row of the test, showing the UFO moving against a medium cyan background. The final column in this image shows the results from a Samsung S27A750D set to 'Faster' and running at 60Hz. This indicates how the test looks on a very fast but artifact-free model with a TN panel. Note that the separation distance between the original object and any trails is lower on the Samsung because it was set to a speed of '1920 Pixels Per Sec'. This gives a like-for-like transition on both monitors, as it ensures that the UFO is travelling at the same speed, matching the respective resolutions of the monitors. Regardless of the 'Response Time' setting, the Dell produces a bold primary trail for both sets of transitions (top and bottom row). In contrast, the fast 60Hz reference produces quite a faint primary trail. There is also a very faint secondary trail, particularly noticeable on the darker background. The nature of this secondary trail changes if you increase the response time setting from 'Normal' to 'Fast'. It becomes inverted, indicating that the grey to grey acceleration being applied is too aggressive, giving overshoot and an inverse ghosting effect. An important take-home message from this test is that it gives a decent impression of how rapid and 'artifact free' (or not) the pixel transitions being analysed are. It is clear that the fast 60Hz reference is performing these transitions more rapidly, as the trailing is much weaker. It is also clear that the 'Fast' response time provides a bit too much acceleration, giving moderate overshoot. We found the 'Normal' setting preferable for the inverse-ghosting free experience and found the 'Fast' mode too aggressive without providing any real benefit in practice. What is of pivotal importance, though, is that your eyes do not perceive motion on a monitor in the same way as a camera does when taking a photograph. As this article explores in great detail, the movement of your eyes creates a significant level of motion blur. This is particularly true on a 60Hz 'sample and hold' monitor (your typical LCD) such as this. Once you consider the masking effect that this blur has on pixel response times and also that different pixel transitions (involving different shades) can occur at quite different speeds, this test seems a bit limited. That's why we also like to bring everything together by analysing the performance 'in the real world' using some familiar game titles and also some movies. Responsiveness in games and movies On Battlefield 4 there was a moderate degree of blur, with the movement of your eyes being by far the most significant contributor to this. The level of motion blur was really surprisingly similar to even the fastest 60Hz monitor (including our fast reference screen which we compared side-by-side throughout). The '4K' (UHD) models with 28" TN panels have some stand-out transitions which occur noticeably more slowly than others. On these models a more noticeable extended trail can be seen on top of the motion blur caused by eye movement in certain circumstances. When strafing past a dark grey helicopter rotor blade with light grey or white clouds in the background, for example. That didn't seem to be an issue on the P2415Q with such transitions occurring fast enough to spare any additional trailing. There was no evidence of overshoot either, which is good. Dirt 3 told a similar story. Right across the range of pixel transitions things were much in-line with the fastest overshoot-free 60Hz LCDs when it came to motion blur. There was a moderate degree of blur noticeable when cornering in particular and a resulting loss of sharpness to textures during movement, but this occurs on all 60Hz LCDs. Even during the fast-paced Gymkhana mode with its insane spins and other manoeuvres, things were much as you'd see on what is technically a much faster 60Hz monitor. There was no evidence of inverse ghosting during any transition, either. The performance on this AH-IPS panel was really quite pleasing given what the weaknesses we've seen on other 4K models with both TN and IGZO IPS-type panels. We also observed the motion performance on our Blu-ray movie titles. As I'm sure you can predict, performance here was really as good as you can hope for from a 60Hz LCD. The pixel responses didn't cause any issues with trailing or inverse ghosting, although the fluidity of the films is limited by their frame rate (~24fps). The '4K' UHD experience In this article we looked at some of the trials and tribulations of running the '4K' UHD resolution of 3840 x 2160 on a 28" monitor. This is of course a 23.8" screen, which gives a greater pixel density of 185.12 PPI (Pixels Per Inch) compared to an already impressive 157.35 PPI. A lot of this article still applies just as much to this model as the 28" (and indeed 27" screens), however. We will work on the assumption that you've read and understand that article, but will briefly expand on some of the key concepts with examples on the P2415Q. Windows 8.1 and possibly newer versions (such as Windows 10) automatically apply scaling to the desktop when a UHD monitor such as this is detected. We would recommend playing around with the scaling settings, which can be found in 'Control Panel – Appearance and Personalisation – Display' (refer to our 'experience' article for further information). If you select 'Smaller – 100%' then everything is displayed natively. You will notice that desktop elements such as icons and the taskbar are truly tiny, as are elements in the File Explorer. The amount of content that can be displayed on this relatively small screen is phenomenal. If you select 'Medium – 125%', things become just a little larger but are still rather tiny. If you recall, this was our preferred setting on the 28" models – but is really too diminutive for our taste on this 23.8" screen. The 'Large – 150%' setting provided a comfortable size for our eyes, similar to 'Medium – 125%' on the 28" models. Things were still rather diminutive but we didn't find reading things to be a strain (this will of course depend on your preferences and eyesight). The Windows elements still had a really high resolution feel to them, scaling cleanly with good clarity. Scaling is of course a key issue that is looked at in some detail in our 'UHD experience' article. Not everything scales cleanly or indeed at all. The following image shows three popular 'gaming clients'. At the top left is AMD's Raptr and underneath that is Valve's Steam. At the right of the image is EA's Origin. Both Raptr and Origin refuse to scale at all, leaving some truly tiny text and navigational elements. Steam sits on the opposite end of the spectrum. It does scale according to the relevant Windows setting, but it doesn't do so in a 'clean' way and looks a bit blurry and not as crisp as it should. This isn't clear from the image, that's just there to set the scene. Many applications, including Microsoft Office programs and web browsers, allow the user to control the zoom level independently of any scaling that is applied in Windows. The immense amount of screen real-estate really comes into its own on these sorts of applications, giving superb productivity potential and paving the way for efficient multi-tasking. Below you can see Microsoft Word open alongside Internet Explorer, each with an immense amount of content being displayed at once. Although not captured in the image, text and images remain very sharp even if rather small. Another thing which really can't be shown in images is the immense amount of detail that can be brought to games when running them at the UHD resolution. Here are some images showing the monitor in action on a couple of game titles – not representative of what you see first-hand, but we know people like to see images like this anyway. As noted in our infamous article, there are only some elements which really take full advantage of the resolution – it's highly game and texture dependent. The overall crispness is excellent, though, and the detail far into the distance is superb. From a normal viewing distance, which in our case is around 70cm, the level of detail is actually very similar to on the 28" '4K' screen that the article focuses on. The pixel density is already so high that the differences are only really obvious in-game if your nose is practically touching the screen. Even from fairly close up (say 40-50cm) the experience was very similar in terms of the crispness and detail of the games. To use a specific example which wasn't used in the article, Tomb Raider (shown above) looked very impressive overall in '4K'. There were many painted wooden textures and some rock faces that showed very impressive detail even if you are very close to them on the game. There were then some textures that appeared very crisp and detailed until you got particularly close to them. Buildings generally had an excellent level of detail from the usual third person perspective, but lacked detail if you zoom in (i.e. aim with a weapon). Some other textures never looked particularly detailed regardless of whether you were zoomed in with a weapon or observing from a third-person perspective. It's also worth noting that the need for anti-aliasing is greatly reduced with this sort of pixel density – although it is not entirely eliminated. On all of the game titles we tested, which include the titles shown in the screenshots above and those mentioned in our original article, most objects appeared to have very smooth and well-defined edges. There is a slight shimmering effect and some jagged edges on thin objects such as wires, poles and posts. This is particularly true when such objects are rendered in the distance and therefore appear thinner. In this respect we didn't feel the extra pixel density of this monitor over the 28" UHD model really made a difference. The same areas of games appeared smooth even without anti-aliasing whilst the same objects exhibited aliasing which became more noticeable with movement. We do accept that some users dislike even small amounts of aliasing whilst others wouldn't really notice this – certainly not as much as the hit in frame rate that comes with enabling anti-aliasing at such a resolution. Movies are another area that the '4K' resolution can really enhance, by providing immense amounts of detail. In this respect things were exactly as they were on the 28" model used for our article. This is really an area where we expect to see immense growth in the coming months and years. For now, though, the amount of '4K' movie content available is extremely limited. Netflix doesn't currently support such content for PC users, Amazon Instant Video lacks such content at the moment and Blu-rays are currently limited to the Full HD resolution of 1920 x 1080. We really enjoyed watching UHD content on YouTube – it had just the same 'wow' factor as on the 28" UHD screen but didn't really gain anything from the increased pixel density at a normal viewing distance. Interpolation and upscaling The 3840 x 2160 resolution is quite demanding when gaming and indeed you may wish to use the monitor with a games console or other such device that is limited to a lower resolution, such as 1920 x 1080. This monitor has a number of different 'Aspect Ratio' settings in the 'Display' section of the OSD. We've demonstrated these settings in the OSD video featured previously, but just to remind you we've included the relevant section of that video below. As you can see the '1:1' mode ensures that only the pixels specified in the resolution (for example 1920 x 1080) are actually used and therefore the image is crisp and undistorted. The obvious downside is that running the 1920 x 1080 resolution provides a rather diminutive image (12" diagonally and maintaining the 16:9 aspect ratio). Selecting a resolution of 2560 x 1440 fills 16" of the screen diagonally, again in the 16:9 aspect ratio. The other main mode to consider, particularly for these two resolutions, is the 'Wide 16:9' mode. This ensures that all 3840 x 2160 are used to display an image, with an interpolation process used to transpose the chosen resolution onto those pixels. It is a common misconception that running 1920 x 1080 on a '4K' UHD monitor will automatically provide equivalent sharpness to a native 1920 x 1080 display. That belief is held because the UHD resolution has exactly twice as many pixels vertically and twice as many pixels horizontally as the Full HD resolution. In practice monitor interpolation processes aren't perfect. In the case of the Dell P2415Q, though, the interpolation process is surprisingly good. In fact we'd go as far as to say it's excellent. If you run the monitor at 2560 x 1440 (WQHD) or 1920 x 1080 (Full HD) then you do lose a degree of sharpness compared to running that resolution on a 23.8" model that has a similar screen surface. This loss of sharpness is fairly minor, though, and is in fact one of the lowest losses of sharpness we've seen from an interpolation process on any monitor. On the desktop text looks a little soft but not really blurry as you'd usually observe from a normal viewing distance. When looking at images or playing games the monitor seems to capture a lot of the detail you'd expect when running the resolution natively. This interpolation performance is much better than we've seen on other '4K' UHD models and we feel makes the monitor rather flexible. If you run a Blu-ray movie or other film content on the monitor via software on the PC, you'd generally keep the monitor at its native 3840 x 2160 resolution. If the movie content is a lower resolution than that (for example 1920 x 1080), then the GPU or software is responsible for upscaling it. The monitor doesn't have a say in this process. Fortunately things worked very nicely for the 1920 x 1080 movie content we watch. There was an inconsequential loss of sharpness compared to running the same content on an otherwise equivalent 1920 x 1080 display. Things looked much as they should. Conclusion Leaving aside the resolution for the moment and looking at it like we would any other monitor, the Dell P2415Q proved itself to be a rather capable all-rounder. Before even using the monitor we knew that Dell would have ticked a number of important boxes for some users with the ergonomic flexibility and fairly straightforward design without potentially unwanted fripperies such as touch-sensitive buttons. Very early on in our testing it became apparent that Dell had calibrated the monitor very nicely in the 'Standard' mode. It was pretty much spot on the promised 6500K white point and tracked the 2.2 gamma nice and tightly. The colour gamut was generous without being excessive and the colour produced were rich, vibrant and accurately represented. There were no worrisome uniformity issues with our unit either, even without the 'Uniformity Compensation' mode enabled. In fact enabling this mode seemed counter-productive – locking the contrast and brightness controls of the monitor whilst making uniformity a little worse if anything. The contrast performance was much as we were hoping for really. Static contrast was as high as you generally see on IPS panels and the distinction between 'light' and 'dark' shades, as well as nuances in between, were good. There was the expected 'IPS glow', which dampened peripheral detail to a degree, but elsewhere detailing was appropriate. Despite being what would generally be considered a 'semi-glossy' screen surface we did find the image a little grainy at times. Not obnoxiously so, but a little surprising on such a light (low haze value), vibrancy-preserving matte screen surface. Another area that was quite solid was responsiveness. Within the confines of the 60Hz refresh rate, which is unavoidable on '4K' monitors currently, the overall responsiveness was as good as you could hope for really. The pixel responsiveness was good enough to drive this refresh rate without any obvious additional trailing, whilst the pixel overdrive implementation left the monitor free from overshoot (inverse ghosting) using the 'Normal' setting. Input lag was also pretty much a non-issue. Our testing suggested a fairly low signal delay which even fairly sensitive users should find perfectly fine. And now onto the all-important resolution. '4K' UHD monitors are quite polarising entities. On the one hand they provide a tremendous number of pixels, bringing potentially incredible detail and real-estate to the desktop, movies and games. We found the overall detail and clarity on games to be excellent although no better than the 28" models we'd tested from a normal viewing position. Even with our noses practically touching the screen we didn't feel hard done by in the way of pixel density. On the other hand, pushing this many pixels requires a relatively large amount of graphical power. And even if the hardware (GPU and monitor) is fully capable of providing a pleasing '4K' experience, the software may not be up to the task. In this article and indeed this very review we look at some potential scaling issues, lack of support in movies and games not generally taking full advantage of the resolution. We still got a lot of enjoyment out of the monitor and for our uses, at least, didn't come across any particularly irksome issues related to scaling or being completely unable to play our favourite games. We are still in the early stages of '4K' monitor technology and things do need some ironing out – but we definitely see light at the end of the tunnel. If you aren't put off with the potential issues and accept that this is a developing technology that will mature and get better with age, then the P2415Q can be considered like a fine wine. It's already a good product, but it's yet to show its true colours. Positives Negatives Calibration of our unit in the 'Standard' mode was outstanding – gamma and white point was right at the promised targets and colours were vibrant, accurately presented and varied. The generous but not excessive colour gamut and very light matte screen surface helped in this respect as well The 'UHD' standard calls for a much broader colour space (Rec. 2020) than the 'sRGB' that this monitor covers, although that's technically and logistically a no-go at the moment Pleasing static contrast performance and pleasing uniformity on our unit. Quite in-line with our expectation of a good IPS monitor really Despite being light matte, the surface texture of the screen proved a little grainy for our taste. This won't bother everyone and wasn't really excessive, however. IPS glow was also an issue, although an expected one The monitor performed well within the confines of its 60Hz refresh rate, with well-balanced pixel responsiveness and relatively low input lag Some users would prefer a higher refresh rate and perhaps extras such as 'G-SYNC' or 'FreeSync' for gaming – current UHD and most GPU options will not please those people, however An excellent pixel density produced stunning detail and clarity and games, (some) movies and on the desktop. The amount of useable work space crammed into the 23.8" screen was fantastic Application support for the resolution is not where it ideally would be – there are scaling issues, some out of place elements in games and a lack of '4K' movies. Also, it's very demanding graphically As an Amazon Associate I earn from qualifying purchases made using the below link. Where possible, you'll be redirected to your nearest store. 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