

RP ICT01/07:

Overview of MTP Desktop Projector Power Consumption Testing Activities and Results

Executive summary

This report gives an overview of MTP testing¹ results of the power consumption requirements of portable multimedia projectors primarily for use in projecting presentations from computers onto screens.

In total, 11 multimedia projectors were tested in September 2006. These were categorised as ultraportable data projectors by the sample provider for magazine publication purposes.

The projectors in on mode used between 163.46 W and 231.26 W, although all except one had an eco mode in which they consumed between 131.47 W and 210.44 W. The imaging technology used in these projectors was predominantly digital light processing (DLP), but there were three liquid crystal display (LCD) projectors in the test. There seemed to be no relationship between power consumption and imaging technology, but a correlation between the brightness and power consumption could be observed. The highest consuming projectors were capable of producing 2,000 to 2,700 ANSI lumens (a measure of brightness).

¹ As part of ongoing equipment testing (at MTP consortium partner Intertek) there has been the opportunity to run power measurements on samples as they come into the laboratory. This greatly reduced the cost of compliance testing as the purchase of samples was not required.

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1 Background

As part of a programme of on-going computer testing², MTP has had the opportunity to carry out compliance testing on batches of samples, available for only a limited period in the testing lab, during which time power measurements and other commissioned tests had to be performed.

Much of the additional specification data (e.g. contrast ratio) on the samples were provided by the sample provider and has not been verified. As such, these additional specification data should be used for guidance only.

2 Samples tested

In total, 11 ultraportable desktop projector samples underwent power measurements in September 2006. This was the first opening that MTP had to gather data on the power consumption of desktop projectors, and provided an important opportunity to quantify (and use this data to predict into the future), the energy consumption of this potentially expanding and high consuming product. The ultraportable desktop projectors category was defined and specified by the sample provider for purposes of group testing for a magazine review. These were all fairly small and light, and were designed to be carried to different venues and connected to a computer to project a presentation onto a big screen.

² As part of ongoing computer testing (at MTP consortium partner Intertek) there has been the opportunity to run power measurements on samples as they come into the laboratory. This greatly reduced the cost of compliance testing as the purchase of samples was not required.

3 Power modes

Slide projectors project a still image onto a large screen by shining a bright light through a small image on a translucent material and focusing it onto the screen. The tested liquid crystal display (LCD) projectors project still and moving images by displaying the computer video output on a small translucent LCD display and shining a light through that. In the case of the tested digital light processing (DLP) projectors, the light is reflected off a grid of tiny mirrors etched onto silicon through a synchronised spinning disc made of coloured translucent material. This method aims to be more efficient by capturing and recycling some of the reflected light, which would otherwise be lost, to produce a brighter image. Projectors consume different amounts of energy depending on their modes of operation.

Projector power measurements were taken in the following modes:

- On mode.
- Eco mode.
- Sleep mode.
- Standby (off mode).

3.1 On mode and eco mode

Projectors consume most energy when in the on mode and projecting an image. Generally, the brighter the light source, the higher the power consumption. Some projectors feature an 'eco mode' in which the light source runs at a lower brightness level. Primarily, this is to ensure that the lamp life is extended (usually to twice the life) as projector lamps can be very costly. This also results in lower power consumption.

3.2 Sleep mode

Sleep mode is a low power mode from which the projector can quickly be returned to its on mode. Some projectors were able to sense the lack of video signal (e.g. when the source computer was turned off) and switch to this mode automatically after a period of time.

3.3 Standby (off mode)

In this mode, the projector is connected to the mains electricity supply, but has been switched into this mode using the appropriate button either on the device or remote control. This is the lowest power mode, but to return to the on mode, the projector has to boot its operating system and warm up the lamp.

Table 3.1 General ENERGY STAR® Definitions for Monitors

Projectors are not covered by the ENERGY STAR Program Requirements for Computer Monitors (Version 4.1), but the power state definitions can be applied.

Power mode	Description
On mode	The product is connected to a power source and produces an image. The power requirement in this mode is typically greater than the power requirement in sleep and off modes.
Sleep mode	The reduced power state that the product enters after receiving instructions from a computer or via other functions. A blank screen and reduction in power consumption characterise this mode. The product returns to on mode with full operational capability upon sensing a request from a user/computer (e.g. user moves the mouse or presses a key on the keyboard)
Standby (off mode)	The lowest power consumption mode that cannot be switched off (influenced) by the user and that may persist for an indefinite time when a product is connected to the main electricity supply and used in accordance with the manufacturer's instructions. For purposes of this specification, off mode is defined as the power state when the product is connected to a power source, produces no images, and is waiting to be switched to on mode by a direct signal from a user/computer (e.g. user pushes power switch).
Hard off	A condition where the product is still plugged into the mains, but has been disconnected from an external power source. This mode is usually engaged by the consumer via a 'hard off switch'. While in this mode, a product will not draw any electricity and will usually measure 0 watts when metered.

4 Power measurements

Power measurements were taken using a calibrated power analyser. A voltage stabiliser was also used to regulate the mains supply voltage to 230 V during testing.

Measurements were recorded in watts (rounded to two decimal places) and were integrated³ over five minutes.

4.1 Test methodology followed for desktop projectors

Each sample was connected to a 230V mains supply via the voltage stabiliser, with the power analyser set to take measurements.

4.1.1 Eco mode and on mode

This was measured by turning the sample on and allowing it to fully boot. A still image of a 100% colour bar test pattern was displayed via a computer output. A measurement was taken 15 minutes after switching the projector on and averaged over a five-minute duration. This is referred to as the on mode.

A measurement was also taken 15 minutes after putting the projector into eco mode if it was available.

4.1.2 Sleep mode

The sample was then put into sleep mode by removing the input video signal. After a period of time, the samples with a sleep mode, switched to this mode automatically. A measurement was taken 15 minutes after they switched to this mode.

4.1.3 Standby (off mode)

This was measured by turning the sample on and allowing it to fully boot. The projector was allowed to warm up for around 20 minutes then it was powered off via the off control button on the sample. A measurement was then taken. In this mode, the internal components would consume a small amount of energy.

³ Integrated values are the average energy consumption over a user-selected time interval.

5 Results summary

An analysis was carried out on the best and worst performing samples in each power where there were data available to perform the analysis. The figures below apply to the five lowest recorded measurements, the five highest recorded measurements and an overall average of all measurements. See Table 5.4 for the full table of results.

5.1 On mode and eco mode

5.1.1 On mode

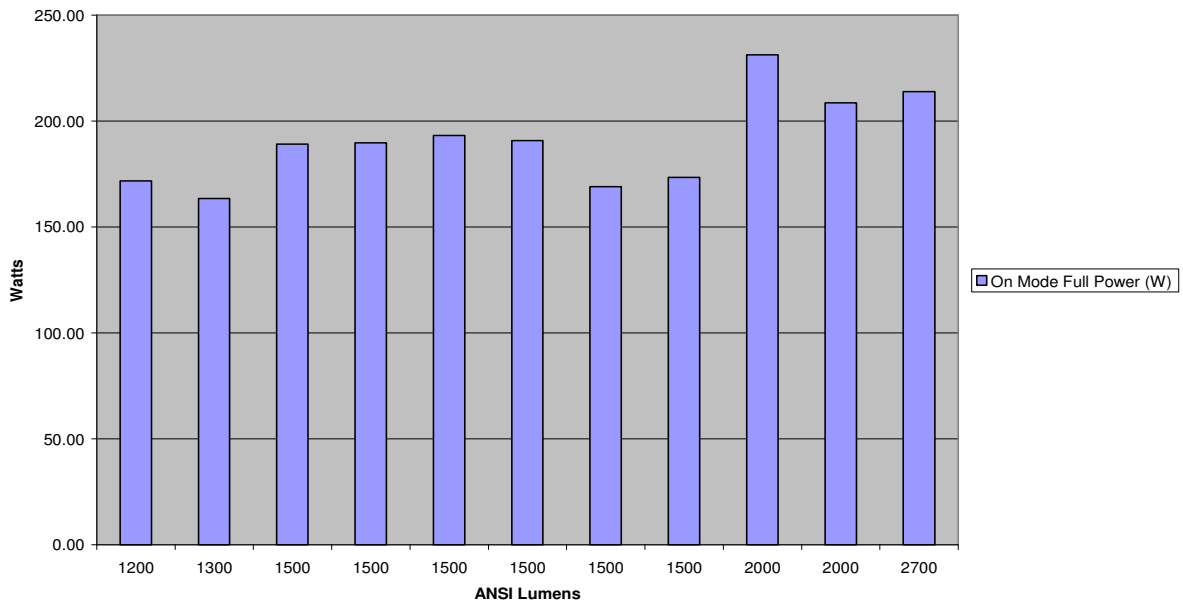
There was some correlation between power consumption and brightness (ANSI lumens), although some samples with equivalent brightness consumed less power than others. For example, three samples with ANSI lumen values of 1,500 and contrast ratios of 2000:1 varied in power consumption by 23 W. Consumption did not appear to depend on display technology, but the distribution of samples between the technologies was not sufficient to confirm this.

Table 5.1 On-mode results summary

On mode		
	Measurement	Observations
Lowest power consumption	163.46 W to 169.13 W	The sample measuring the lowest value was a DLP model. At 1,300 ANSI lumens, it was the next to dimmest rated projector (the dimmest was rated at 1,200 ANSI lumens).
Average power consumption	190.42 W	
Highest power consumption	190.84 W to 231.26 W	The sample measuring the highest value was a DLP model. At 2,000 ANSI lumens, it was the next to brightest rated projector with a high contrast ratio of 2,000:1 (the brightest was rated at 2,700 ANSI lumens, but only had a 400:1 contrast ratio).

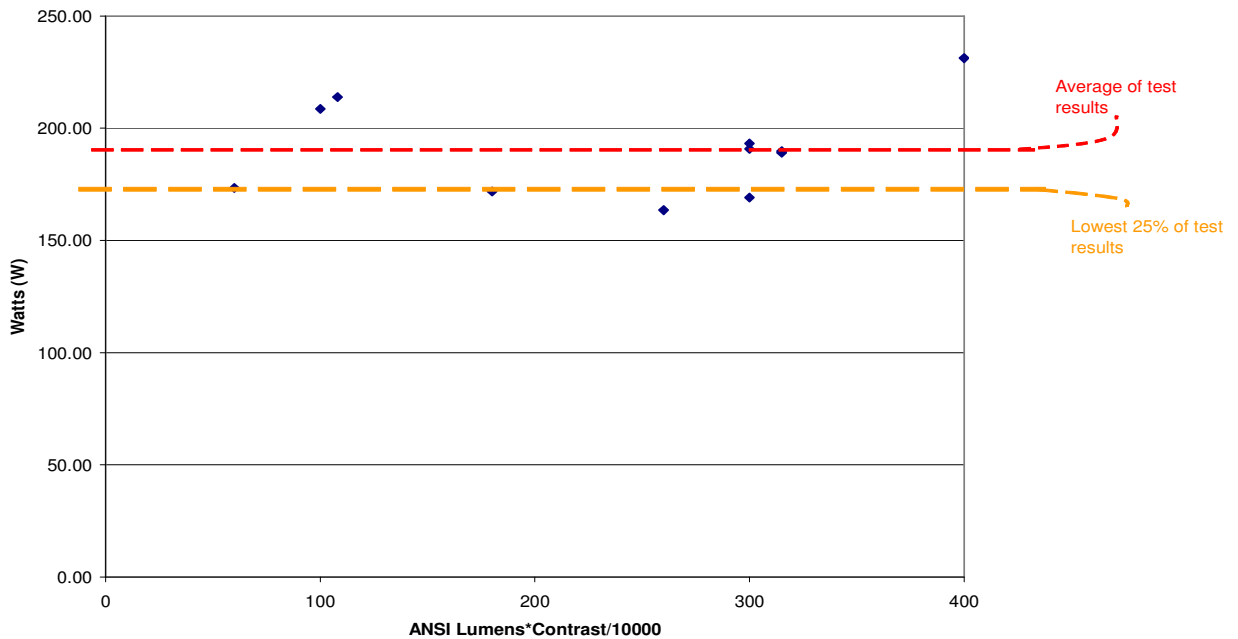
Here, a broad correlation between power consumption and brightness can be seen (with a few exceptions).

Figure 5.1 On-mode power consumption vs. brightness (ANSI lumens) chart



The following scatter chart indicates a power consumption range of between 163 W and 231 W in on mode. The average consumption in this mode was 190 W with the best 25% performing samples achieving around 170 W or fewer.

Figure 5.2 On-mode power consumption scatter chart



5.1.2 Eco mode

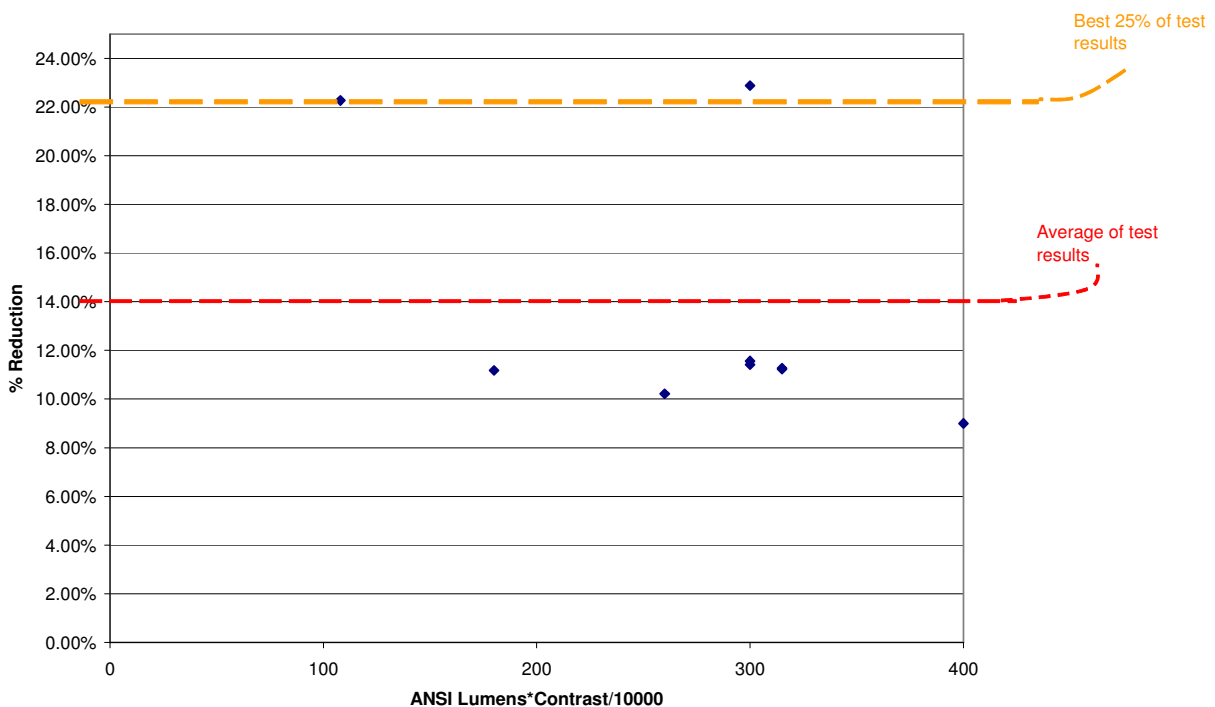
All of the samples except one had an eco mode. Most eco modes extend lamp life significantly by reducing the lamp brightness. All samples consumed less power in eco mode than in on mode.

Table 5.3 Eco-mode results summary

Eco-mode		
	Measurement	Observations
Lowest power consumption	131.47 W to 167.86 W	The sample measuring the lowest value was a DLP model. At 1,500 ANSI lumens, it was the third dimmest rated projector (two lowest rated at 1,200 and 1,300 ANSI lumens). The same sample had the highest standby (off mode) power consumption.
Average power consumption	165.11 W	
Highest power consumption	168.44 W to 210.44 W	The sample measuring the highest value was a DLP model. At 2,000 ANSI lumens, it was the brightest rated projector with a high contrast ratio of 2,000:1. This sample had the lowest sleep mode and standby (off mode) consumption, but the highest on-mode consumption.

The following scatter chart indicates a power consumption reduction in eco mode. The average consumption reduction using this mode was 14% with the best 25% performing samples achieving around 22% or more reduction in power consumption.

Figure 5.4 Eco-mode power consumption scatter chart



5.2 Sleep mode

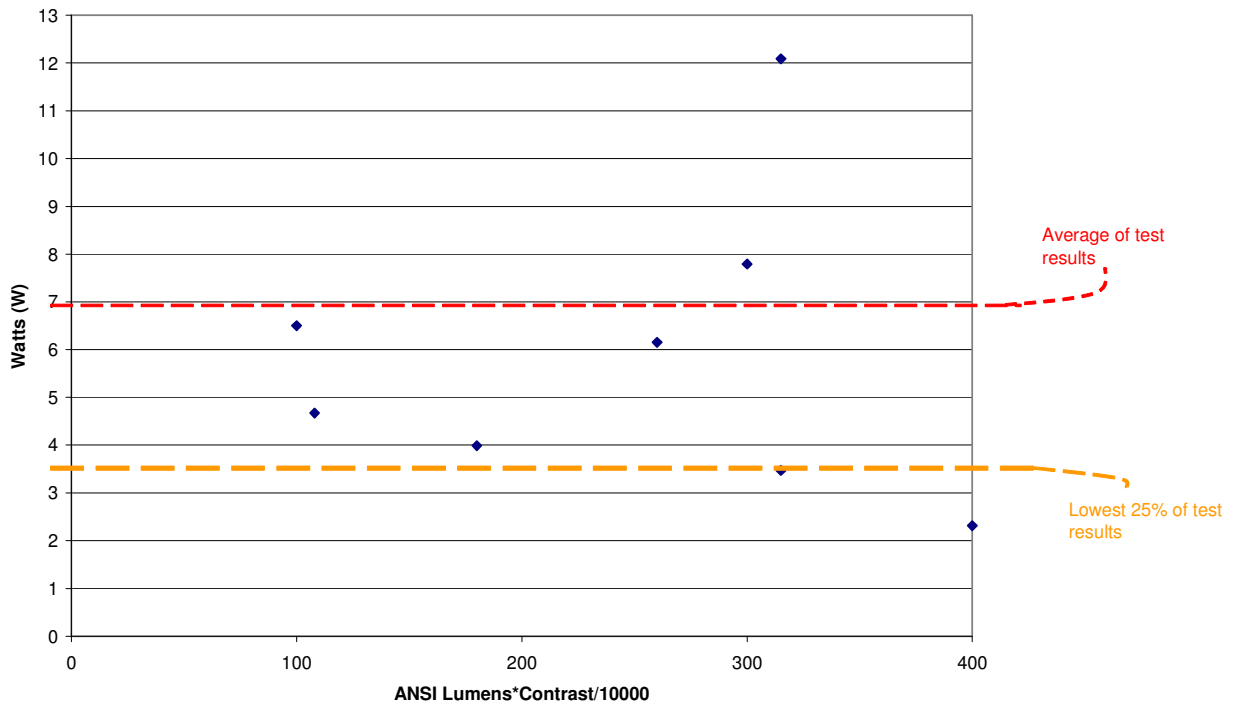
This is a low power state that the projectors would enter after a certain time of inactivity (i.e. if no input signal is detected). Three of the samples did not have a sleep mode. Three samples took a while (5.5, 13 and 30 minutes) to automatically switch to sleep mode.

Table 5.2 Sleep-mode results summary

Sleep mode		
	Measurement	Observations
Lowest power consumption	2.31 W to 6.15 W	The sample measuring the lowest sleep-mode consumption also had the lowest standby (off mode) consumption, but the highest on-mode and eco-mode consumption.
Average power consumption	5.87 W	
Highest power consumption	3.99 W to 12.09 W	The sample with the highest sleep-mode power consumption was a DLP model.

The following scatter chart indicates a power consumption range of between 2.3 W and 12.1 W in sleep mode. The average consumption in this mode was 5.9 W with the best 25% performing samples achieving 3.5 W or fewer.

Figure 5.5 Sleep-mode consumption scatter chart



5.3 Standby (off mode)

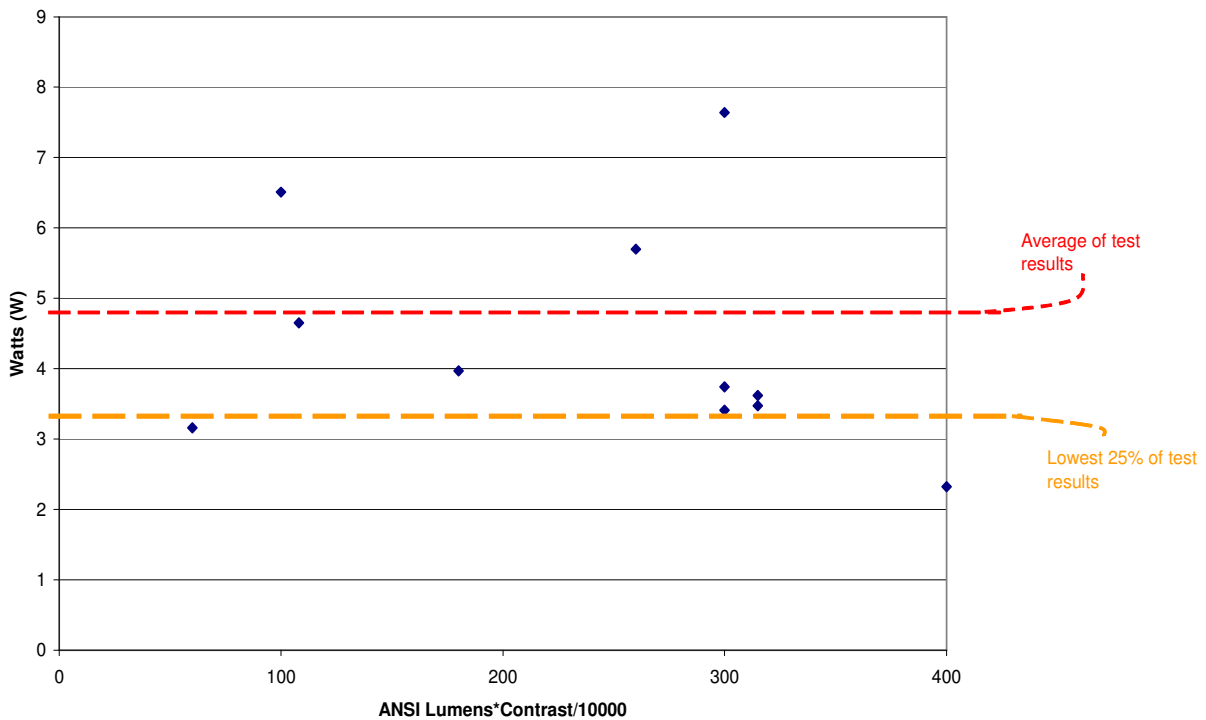
This is the mode that the projectors would enter when the standby button on the device or remote control was activated. Only three samples seemed to have a distinct difference in power consumption between sleep mode and standby (off/mode). One measured a reduction when going from sleep to standby (off/mode) of 8.47 W and the others by 0.45 and 0.15 W.

Table 5.3 Standby (off mode) results summary

Standby (off mode)		
	Measurement	Observations
Lowest power consumption	2.32 W to 3.62 W	The sample that measured 2.32 W was a 2,000 ANSI lumens DLP model. This also had the lowest sleep-mode consumption, but the highest on-mode and eco-mode consumption.
Average power consumption	4.38 W	
Highest power consumption	3.97 W to 7.64 W	The projector with the highest measured standby (off mode) level was also a DLP model, rated 1,200 ANSI lumens.

The following scatter chart indicates a power consumption range of between 2.32 W and 7.64 W in standby (off mode). The average consumption in this mode was 4.4 W with the best 25% performing samples achieving around 3.4 W or fewer.

Figure 5.6 Standby (off mode) consumption scatter chart



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Table 5.4 Desktop multimedia projectors - full table of results

Date tested	Voltage (V)	Standby/off (W)	Sleep - (W)	On-mode full power (W)	Eco mode (W)	ANSI lumens	Contrast ratio	Technology
04/09/2006	230	2.32	2.31	231.26	210.44	2,000	2,000:1	DLP
04/09/2006	230	3.47	3.47	189.83	168.44	1,500	2,100:1	DLP
04/09/2006	230	3.97	3.99	171.78	152.57	1,200	1,500:1	DLP
04/09/2006	230	4.65	4.67	213.93	172.73	2,700	400:1	LCD
04/09/2006	230	5.70	6.15	163.46	146.76	1,300	2,000:1	DLP
04/09/2006	230	6.51	6.50	208.64	160.91	2,000	500:1	LCD
04/09/2006	230	7.64	7.79	169.13	131.47	1,500	2,000:1	DLP
04/09/2006	230	3.62	12.09	189.10	167.86	1,500	2,100:1	DLP
04/09/2006	230	3.41	N/A	190.84	168.77	1,500	2,000:1	DLP
04/09/2006	230	3.74	N/A	193.22	171.17	1,500	2,000:1	DLP
04/09/2006	230	3.16	N/A	173.42	N/A	1,500	400:1	LCD

	On mode (W)	Eco mode	Sleep mode (W)	Off mode (W)
Average	190.4 W	165.1 W	5.9 W	4.4 W
Top performing 25%	170 W	22% improvement in on mode	3.5 W	3.4 W

6 Conclusions

This study has not aimed to cover the full range of the desktop multimedia projectors. However, these tests cover samples over a wide range of prices and specifications, and some valuable conclusions can be drawn from the test result data – which could inform future labelling and standards specifications (there are no energy efficiency standards or labels for desktop projectors in the EU).

The cheapest products examined at the time of testing were between £500 and £600 (+VAT). Projectors have come down in price dramatically since testing and can now be purchased for around £350. These devices can also be used in domestic situations (e.g. to project a picture from a connected DVD player onto a large screen or light coloured wall), so compare favourably with conventional large-screen television technology in price.

In summary:

- The on mode measurements showed some correlation to the brightness (ANSI lumens) and contrast ratio of the projectors, although some samples with equivalent brightness and contrast ratios consume less power than others. All samples with an eco mode consumed less power in this mode, sometimes up to almost 23% less, but sometimes as little as 9% less. An ENERGY STAR specification could require eco mode as standard on all projectors and set a threshold for eco mode of around 20% of on-mode consumption. Procurement to the top performing 25% level (rather than at average levels) could save potentially 20 W in on mode alone.
- In sleep mode, consumption was reasonably low, but variable (between 2.3 W and 12.1 W) and seemed to not relate to either brightness or contrast levels. However, this could be related to the time required for the projectors to enter the on-mode state from sleep mode (i.e. the level at which the projector components are powered). A timed measurement was not made as it did not feature in the ENERGY STAR test methodology and was not initially expected to be of any importance. This measurement could be considered as an option in further testing. The best performing 25% products would indicate ENERGY STAR criteria could initially be set at around 3.5 W for sleep mode. It is worth noting that nearly a third of products tested did not have a sleep mode. The difference between the sleep and eco mode could be around 160 W for an average product. Sleep mode is around 4% of consumption in eco mode. Therefore, considerable savings could potentially be achieved if this was required on all products as part of a labelling scheme.
- There was little difference between standby (off mode) power consumption and sleep-mode consumption - only three samples seemed to have a distinct difference in power consumption between the two modes. Further research is required to assess if this standby consumption is really necessary while the projector is carrying out no useful function, i.e. what components are consuming power when the projector is in standby. The poor off-mode consumption figures suggest inefficient power supplies and potentially unnecessary powering of components. Discussion with industry could identify potential strategies to improve consumption in off mode to bring a potential ENERGY STAR threshold closer to the 1W level.

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