Reference Monitors 101

Incospec and Tamuz overview

“Content to Distribution 2010 Tour”
Presented by Pierre Louis Landry (Montreal)
March 9th, 2010
Presented by Richard Baker (Toronto)
March 11th, 2010
Executive Summary

• Consumer/Commercial LCD vs Plasma basics
  – What the specs mean
• The Class 1-2-3
• Reference monitor applications
• Features found on reference monitors
• Who is Tamuz, Grades & EBU TECH3320
Plasma PDP (Plasma Display Panel)

- PDP is an array of cells, known as pixels, which are comprised of 3 sub pixels, corresponding to the colors red, green, and blue.
- Gas in a plasma state is used to react with phosphors in each sub-pixel to produce colored light (red, green, or blue).

LCD (Liquid Crystal Display)

LCDs work in a manner similar to a window shutter. Liquid crystal molecules are sandwiched between two glass plates and mounted on a backlit panel.

As an electrical charge is applied, the liquid crystals untwist, allowing specific colours of light to pass through. The location and intensity of light that is permitted to pass through the liquid crystal matrix creates crystal-clear, colourful image.
What’s best?

• Depends on many factors
  – But mass market is affecting
    • Pricing
    • Size
    • Effectiveness of higher resolutions
    • Internal processing
    • Workplace environments

  – What was said 3 years ago, may not be as relevant today
What’s best?

- **Plasma**
  - Larger sizes more economical

- **LCD**
  - Smaller sizes more economical but catching up in size/price
Image Retention (LCD): versus permanent burn-in with Plasma

• With **LCD** you get less image retention when an image is left on screen for extended times (which will happen in Plasma).
  – But newer PDP units have built-in prevention systems so it's less than an issue if you are careful.
    • Setting contrast to high, (to improve images in well-lit rooms) will also invite image retention, since it forces the images to be partially lit at all times.
    • Results in ghosting (whatever image that was on screen before).
    • Many sales reps will say there is no image retention in LCDs but reading manufacturers' operations manuals for LCD displays, warn you of the possibility.
LCD sticking

- LCD example
- Some stories of sticking appeal after only 3 days.
New EBU recommendations on retained images

• Advice to broadcasters and other content providers
• For the broadcaster, ‘static’ images are increasingly encountered in a number of roles, including:
  – on-screen channel identification
  – interactive application flags
  – banner displays
  – screens displayed when radio services are being received,
  – programme guides
  – longer-term text inserts such as sports scores
• This type of content has become more prevalent in recent years, and it is likely to remain an editorial feature of many broadcasts.
EBU clarifications

• An image is deemed to be static if any part of the screen is occupied by any part of the image for more than a total of six hours – in any twelve or more than one occasion in a seven-day period.
EBU clarifications

• To assist in ensuring that images are not static, certain specific practices might be considered, including:
  – Moving the position of images on the screen from time to time in order that the definition of ‘static’ is not met.
  – Instigating a time-out of static images where appropriate.
Concerning the luminance of static images

• The luminance value of any static image should be restricted to a value equal to the average picture level of the screen in order to minimise the risk of forming a retained image.

• Two alternative methods of achieving this are:
  – To use a technique known as ‘Linear–key mixing’ that overlays the static image as a partly transparent image over the picture content.
    • The ‘added image volume’ level that sets the apparent transparency should not be set any higher than a level necessary to make the added image acceptably visible.
  – To limit the luminance/intensity of the static image to 40% of peak white.

• Further, it is recommended that the use of saturated blue or yellow images be avoided wherever possible and particularly where one is laid over the other.
Black Levels

- **Black levels** (or the accuracy of reproducing blacks) are much closer (real) with PDP, but LCD's are getting closer. Due to this fact, contrast will be better reproducing exceptional TV signals.

A LCD display has a backlight which shines through the LCD panels. The panels allow or block light depending on what is required to produce an image or a color. Most, if not all, LCD TV's tend to have difficulty going fully "black". Blacks tend to have a very dark grey. This is especially true on no name units.
3. Faithful Color Reproduction

Comparison of Chromaticity Diagrams

100% compliance with HDTV standards. Virtually the same color reproduction as broadcasting signals.

![Chromaticity Diagram](image)

- **HDTV standard** (broadcasting standard)
- **LCD color reproduction**
- **Plasma color reproduction**

※Simulated images based on actual measurement values obtained by Panasonic.

Courtesy of Panasonic Canada
Colour reproduction

• Perhaps PDP offers higher color gamut – and as other manufacturers may “market” they have wider color gamut
  – These wider gamuts are outside legal colors for broadcast so what’s the point?
  • Now you have to dither more material to get back to 8bit legal colors which requires more processing and possible introduction of errors such as artifacts etc.
  – But, in the case of reference monitors such as Tamuz,
    • internal processing and the use of calibration probes have now surpassed their consumer counterparts
Longevity related to brightness

• **LCD** TV will last as long as its backlight does - and those bulbs can sometimes be replaced! Since this is nothing more than light passing through a prismatic substrate, there is essentially nothing to wear out in an LCD monitor.
  - However, one nasty little known fact about LCD technology is that as the backlight ages it can change colors slightly (think of florescent office lighting). When this occurs the white balance of the entire LCD will be thrown for a loop and the user will need to re-calibrate, or worse, try to replace the backlighting or ditch the unit altogether.

• **Plasma**, on the other hand, utilizes slight electric currents to excite a combination of noble gases (i.e., argon, neon, xenon), which glow red, blue, and/or green. This is an essentially active phenomenon, so the phosphoric elements in plasma displays fade over time. Many manufacturers state a new half life of 60,000 hours. At half life, the phosphors in a plasma screen will glow half as brightly as they did when the set was new.
Technology

• AAC Automatic Alignment and Calibration
Brightness

- LCD is brighter in daylight with less glare, so areas near windows would be better equipped with LCD.

- If your room is very dark, then LCD is not you best choice, since LCD is a backlight display, it is very hard to lower the brightness of the unit. These bright images will create eye fatigue.

  - **Note:** Tamuz is great for dark rooms because our backlighting system allows users to set the brightness of the screen to accommodate for various ambient room conditions – without altering the color of the signal.
  - In fact, EU editors prefer using our lower black levels than their counter parts here in the states. They like foot lamberts to be in the mid twenties while US likes mid thirties. I’m told EU editors prefer darker editing rooms as well.
AAC Automatic Alignment and Calibration Technology

- Illusion or Reality?
  - Is the Center more Bright?
AAC Automatic Alignment and Calibration Technology

• Illusion or Reality?
  – Is the Center more Bright?

NO !!!
Brightness is the intensity of light coming from the image as seen by the eyes. Brightness is purely subjective. Brightness is also defined as perceived luminance.
Resolution

• LCD tend to pack more pixel resolution per screen size as does PDP.
  – When I talk about resolution I mean native screen resolution, not what it can scale to.

• **1080P** PDP have a harder time displaying content in 1080p resolution, thereby making future plasmas more expensive.
  – "Plasma is not going to be able to keep up because it's just too complex of a technology with the glass, the plasma structure and the driver electronics. There's a lot more electronics on the back of a plasma than there is on an **LCD**." says Gene Ornstead, senior LCD TV product manager at ViewSonic.
Viewing angle

- PDP used to have a wider viewing angle (160 degrees). The lower the angle meaning watching from the sides the image would fade.
  - Note: Don't believe everything you read (especially from unreliable manufacturers), since specs can state you see something (a low quality image) at that angle, but in reality it's unwatchable.
Horizontal Viewing angle

• Reality sets in
  – Comparison by 3rd party lab of 6 24” reference monitors.
  – Pretty much the same by each manufacturer

But what do you call acceptable viewing angles?

Do you still have contrast?
Vertical Viewing angle

• Reality sets in
  – Comparison by 3rd party of 6 24” reference monitors.
  – Pretty much the same by each manufacturer

• Off-axis viewing will affect:
  – contrast,
  – black level
  – color balance
  – saturation
  – can be worse with wide-color-gamut displays
Quick highlights

• **Glare:** Incoming light (or room light levels);
  – If you have a lot of room light or windows, **LCD** may be your best choice.
    • The plasma screen is highly reflective since it is a shiny glass, thus light bouncing off the screen.

• **Audible noise:**
  – **LCD** generate less heat, they tend to be a lot more quiet.

• **Power consumption:**
  – **LCD** has a steady backlight, drawing the same power no matter what's on screen, thus the Liquid crystals require little power.
    • Plasma varies depending on the brightness of the images (consumes less if the images are dark).
Guide to Plasma and LCD

• Everything you wanted to know, but don’t dare ask
  – http://www.landrysolutions.com/Plasma_LCD_explanations.htm

• Other specs I talk about
  – Life
  – Response time
  – Longevity related to brightness
  – Motion artefacts
  – Durability (Glass)
  – Native resolution, etc…
Differences Conclusion

• LCD is eye catching, slightly less noise and slightly more resolution (best for computer images and games).

• PDP have more natural colors, blacks are impressive and video playback have less image blur. This is why video (or television) usually looks better on Plasma.

  – So it all depends on where your setting them up.
  – I also recommend sticking to brand names, since some lesser known companies will also have image blurring, dead pixels and lack of color reproduction due to their lack of quality standards.
  – Like the saying goes, you get what you paid for,
  – but just remember, you may be regretting it for 10 years.
Professional Applications

Reference Monitors
Applications

• Control Instrument for Video, in SD and HD
  – Observation Monitors (audio production, commentator, signal presence, ...)
    • Known as **Class 3**
  – Control Monitors (preview, control walls, lighting control, editing suites, ...)
    • Known as **Class 2**
  – Reference Monitors (camera control, color grading, content evaluation, ...)
    • Known as **Class 1**
Class 1 Applications

- OB Van Control Room

OB-Truck Control Room with BCM Monitors
Class 1 Applications

• PostProduction Control Room
Class 1 Applications

• ON-AIR Control with a MultiViewer System

LSM 147W HD
Class 1 Applications

- SNG Van Operation Room

SNG Van with TAMUZ – LCD Video Monitors
Class 1 Applications

• Electronic Film Shooting

Directors View at the set with a TAMUZ HCM 124W HD
Reference Monitors

Tamuz Features sets
Features

• Capable for all Video Standards
  – SD Formats 270 Mbit/s - 480i@60, 576i@50
  – HD Formats 1.5 Gbit/s
    • 1080i@24/25/30/50/60,
    • 1080p@24/25/30,
    • 720p@50/60
  – HD Formats 3 Gbit/s - 1080p@24/25/30
  – Analog Video Formats in Composite and Component
  – MultiSync to accept all vertical Frequencies
  – MultiFormat to accept all common or uncommon signals
  – Analog (VGA) and digital (DVI) Computer Signals
Features

• Perfect Presentation
  – Adjustable Colormetry and Gamma Correction
  – Brightness and Contrast to fulfill the Broadcast Recommendations
  – Pixel-to-Pixel Processing,
  – HighQuality Scaling to fit the Screen
  – HighQuality De-interlacing for i-Signals
  – Displaying the full Active Area, Under-/OverScan selectable
  – Displaying the correct Aspect Ratio
  – Fast-Processing for small Delays to keep “Lip-Sync“
  – Full HD Pixel Resolution
  – State-of-the-Art TFT Performance
Features

• Equipped with
  – Multiple Inputs with Loop or Switched-Out
  – AAC Port for Automatic Color Correction with Probe
  – AutoDetection of WSS (WideScreen Signaling)
  – IP addressable Remote Port
  – GPI/O for Input, Format and Tally
  – MultiColor Tally
AAC Automatic Alignment and Calibration Technology

• Sensitivity of the Human Eye as Function of Wavelength of Light
Technology

• AAC Automatic Alignment and Calibration
  – CIE 1931 RGB Color Matching Function
AAC Automatic Alignment and Calibration Technology

- The native LCD Gamma has to be matched to compensate the 2.2 TV Gamma
AAC Automatic Alignment and Calibration Technology

• Most TAMUZ Monitors are equipped with an AAC Port for a Probe
  – DK PM 5639/T is the recommended
  – THOMA TFM6 is supported
  – Minolta CA-200 is supported

• The Alignment is a Hardware Calibration inside the Monitor

• Calibration Procedure like in the "good-old CRT times"
  – Dark Environment (8 cd/m²) for perfect Alignment recommended
  – Connect the Probe at the front Port
  – Start Calibration from the OSD (hidden item) and wait until ready
AAC Automatic Alignment and Calibration Technology

- A measured LUT (LookUp Table) corrects the reproduced Information
Scaling Video to fit the Screen Technology

• The Pixel Resolution of TFT Panels are mostly related to VESA standards, designed for Computer Applications. – That's the reason why only few compares to Video.
  • Scaling always influences the Sharpness of the Image
  • Down-Scaling reduces the native Video Resolution
  • Up-Scaling blurs always the original Video
Scaling Video to fit the Screen

• Only 1:1 Pixel-to-Pixel Processing didn't effects the Image, when the Display Resolution is equal as the Video

1080i Signal at a 1920x1080 LCD screen
1080i Signal at a 1366x768 LCD screen
Display Format Modes

- De-Interlacing i-Mode Video
  - De-Interlacing always takes Time to do, what delays the Presentation
  - De-Interlacing i-Mode Video is always a compromise

- TAMUZ equips the Monitors with different selectable De-Interlacing Technologies to supports the Video at its best
  - iSport Mode - field based de-interlacing
  - iFilm Mode - frame based de-interlacing
  - sF Mode - frame based-interlacing
  - p Mode - no de-interlacing
De-Interlacing i-Mode Video to be displayed on an LCD

Still picture of an ODD field from a 1080i signal, shows 540 lines of content only
De-Interlacing **i-Sport** Video to be displayed on an LCD

De-interlacer in iSport mode. In each odd and even field all the lines are doubled to build a frame. Fast processing with half vertical resolution in each displayed frame. Good for fast moving images.
De-Interlacing **sF mode** Video to be displayed on an LCD

De-interlacer in sF mode. A compromise mode, melting the odd and even field to be a frame. Shows jaggies when parts of the image moves. Medium processing with full vertical resolution in each displayed frame.
De-Interlacing **iFilm mode** Video to be displayed on an LCD

De-interlacer in iFilm mode. The odd and even field of a frame build a frame, processed with adaptive de-interlacing filter, covering four fields. Slower processing with full vertical resolution in each displayed frame.
De-Interlacing **p-Mode** Video to be displayed on an LCD

De-interlacer in p mode. Progressive signals will be not de-interlaced and displayed in the original 1080 line resolution. Fast processing with full vertical resolution in each displayed frame.
TCP/IP Port for Web access

Software Package - CDROM and Dongle
Monitor Remote Software for Windows
PCs to control TAMUZ monitors within a network up to 254 devices

Used for set-up, anti-sticking, Test signal generator, User Gamma, UMD, etc…

individual MAC address and can get any IP address
# VGA Mode

<table>
<thead>
<tr>
<th>Signal Format</th>
<th>Aspect Ratio</th>
<th>Pixel Clock / Mhz</th>
<th>Phase</th>
<th>X-Position</th>
<th>Y-Position</th>
<th>Pixel</th>
<th>Lines</th>
<th>Interlace</th>
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<td></td>
<td>1920</td>
<td>1080</td>
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<td></td>
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</table>
Capable with non-standard signals

- Vivaldi Barco, BVE-900 Sony
OLED
Different technologies dominate the market

- **Plasma**
  - a self-lighting principle - mostly used for large screens;

- **TFT-LCDs**
  - a concept that always needs a backlight - most common in the display industry for tiny up to huge screens;

- **OLED**
  - another self-light-emitting principle - up-coming technologie for small and larger displays in any industry.

**OLED** stands for “organic light emitting diode” and physically its like an array of extremely small LEDs. Does this technology have the power to conquer the broadcast monitor market?
OLED vs. Plasma/LCD

• Advantages
  – Wide color gamut
  – Brighter, clearer picture
  – Contrast ratio better than 100,000:1
  – No viewing angle limitation
  – Thinner, lighter in weight
  – Low powered
  – Can be printed on various surfaces
  – Temperature independent response time of less than 50 µs,
  – Better outdoor readability

Courtesy of Matt Vicini, Michigan State University
Sony pulls plug on OLED TV in Japan

Tue Feb 16, 2010

- Sony said it had stopped production of ultra-thin TVs using organic light-emitting diode (OLED) technology for Japan,
  - just a little over 2 years since it launched its first set.
  It plans to keep selling the TVs in overseas markets, a spokesman said.

- It is still technologically difficult to make large OLED panels and to produce them cheaply, limiting their potential as a mass-market product.

- Sony said it would end sales of OLED TV in Japan when inventory runs out.
  - DisplaySearch said it estimates worldwide shipments of about 2,000 Sony OLED TVs in 2009

DisplaySearch said it estimates worldwide shipments of about 2,000 Sony OLED TVs in 2009
Reference Monitor Features

Tamuz range of feature sets
Built-in Test Patterns

- All Eagle monitors have built-in test patterns

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Help</th>
</tr>
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<tbody>
<tr>
<td>SMPTE</td>
<td>Color Bars corresponding to SMPTE</td>
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<tr>
<td>SMPTE 100%</td>
<td>Color Bars SMPTE with 100% white</td>
</tr>
<tr>
<td>SMPTE +1</td>
<td>Color Bars SMPTE with +1 field</td>
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<tr>
<td>SMPTE -1+Q</td>
<td>Color Bars SMPTE with -1+Q field</td>
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<tr>
<td>Pathological</td>
<td>Pathological test pattern</td>
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<td>Color Bars</td>
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# Interlace Menu at Video Signals

<table>
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<tr>
<th>SCALING</th>
<th>Signal</th>
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<tbody>
<tr>
<td>4 : 3</td>
<td>sF</td>
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</tr>
<tr>
<td>16 : 9</td>
<td>iSport</td>
<td></td>
</tr>
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<td>Aspect</td>
<td>iMovie</td>
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</tr>
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<td>Scan</td>
<td>iOdd</td>
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<td>Signal</td>
<td>iEven</td>
<td></td>
</tr>
<tr>
<td>Interlace</td>
<td>p</td>
<td></td>
</tr>
</tbody>
</table>

- **sF**: segmented frames; good for graphic footage
- **iSport**: field based de-interlacer, best for fast moving footage
- **iMovie**: frame based de-interlacer, best for slow moving footage
- **iOdd**: field based de-interlacer, only the odd field will be displayed, the even field is blanked off
- **iEven**: field based de-interlacer, only the even field will be displayed, the odd field is blanked off
- **p**: frame based de-interlacer, both odd and even field will be displayed
Mirror Menu

- This feature may be helpful to turn the displayed image when the monitor is used in tele-prompter situation or head-over. The table below illustrates the visual effects.

<table>
<thead>
<tr>
<th>Standard 4:3 monitor, 1024x768 LCD panel</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Standard monitor in NORMAL color mode, 576i signal at input" /></td>
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</table>

www.incospec.com
# Zoom Mode

<table>
<thead>
<tr>
<th>Zoom Setup</th>
<th>Help</th>
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<td>x-Factor</td>
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<td>y-Factor</td>
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<td>x-Position</td>
<td>0</td>
</tr>
<tr>
<td>y-Position</td>
<td>0</td>
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</table>

**Help**

Adjust the horizontal ZOOM factor to magnify the image on screen.

**Note:** Selecting this menu step with the PLUS (V+) or MINUS (V-) key for an individual setting. Values between 0 to 100 are possible.

Adjust the vertical ZOOM factor to magnify the image on screen.

**Note:** Selecting this menu step with the PLUS (V+) or MINUS (V-) key for an individual setting. Values between 0 to 100 are possible.

Adjust the horizontal position on the screen.

**Note:** Selecting this menu step with the PLUS (V+) or MINUS (V-) key for an individual setting. The value is limited to the native panel resolution.

Adjust the vertical position on the screen.

**Note:** Selecting this menu step with the PLUS (V+) or MINUS (V-) key for an individual setting. The value is limited to the native panel resolution.

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[Image of a monitor showing a standard test pattern]
RGB Mode

Standard 4:3 monitor, 1024x768 LCD panel

Standard monitor in NORMAL color mode, 576i signal at input
Standard monitor in RED color mode, 576i signal at input

Standard monitor in GREEN color mode, 576i signal at input
Standard monitor in BLUE color mode, 576i signal at input
# Marker Area

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
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<th>Aspect Ratio HD 720</th>
<th>Aspect Ratio SD</th>
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<td>absolute center</td>
<td>absolute center</td>
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<tr>
<td>B</td>
<td>SAFE AREA</td>
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<td>1216 x 684</td>
<td>4:3 -5% all sides</td>
</tr>
<tr>
<td>C</td>
<td>SAFE TITLE</td>
<td>1728 x 972</td>
<td>1152 x 678</td>
<td>4:3 -10% all sides</td>
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<td>D</td>
<td>4:3</td>
<td>1440 x 1080</td>
<td>960 x 720</td>
<td>720 x 576 / 720 x 480</td>
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<tr>
<td>E</td>
<td>4:3 at SD 16:9</td>
<td>-----</td>
<td>-----</td>
<td>540 x 576 / 540 x 480</td>
</tr>
<tr>
<td>F</td>
<td>ACADEMY</td>
<td>1920 x 796</td>
<td>1280 x 524</td>
<td>720 x 420 / 720 x 350</td>
</tr>
<tr>
<td>G</td>
<td>CINE SCOPE</td>
<td>1920 x 1040</td>
<td>1280 x 692</td>
<td>720 x 519 / 720 x 433</td>
</tr>
<tr>
<td>H</td>
<td>User</td>
<td>min. 192 x 108</td>
<td>min. 128 x 72</td>
<td>min. 72 x 58 / 72 x 48</td>
</tr>
</tbody>
</table>

Other markers may be added on request.
Adjustable Color Temperature

- Values between 9500 to 3200 or USER are possible.
- The menu toggles in steps of 100 through the list.
- The aligned default value is 6504 Kelvin.
# Power On Management

<table>
<thead>
<tr>
<th>Power On</th>
<th>Help</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last</td>
<td>monitor powers up with the last selected input</td>
</tr>
<tr>
<td>CCVS 1</td>
<td>monitor always powers up with the CCVS 1 input</td>
</tr>
<tr>
<td>CCVS 2</td>
<td>monitor always powers up with the CCVS 2 input</td>
</tr>
<tr>
<td>CAV</td>
<td>monitor always powers up with the CAV input</td>
</tr>
<tr>
<td>SDI</td>
<td>monitor always powers up with the SDI input</td>
</tr>
<tr>
<td>SD/HD-SDI</td>
<td>monitor always powers up with the SD/HD-SDI input</td>
</tr>
<tr>
<td>VGA</td>
<td>monitor always powers up with the VGA input</td>
</tr>
<tr>
<td>DVI</td>
<td>monitor always powers up with the DVI input</td>
</tr>
</tbody>
</table>
VTR Shuttle Mode

<table>
<thead>
<tr>
<th>Options</th>
<th>Help</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asynchronous</td>
<td>Selects the time window how fast the interface will react when the incoming signal is not valid or the sync is not continuously any more.</td>
</tr>
<tr>
<td>VBI &amp; ANC</td>
<td>Typical situation at VTRs when shuttling the tape.</td>
</tr>
<tr>
<td>WSS</td>
<td>Available selections are FAST - 0.5s - 1s - 2s</td>
</tr>
<tr>
<td>VTR Shuttle</td>
<td>Fast</td>
</tr>
</tbody>
</table>

The VTR SHUTTLE mode is helpful when signal from non-stable sources, like VTR’s, Air-Links, etc., are displayed on the monitor. If the signal fails or is interrupted the monitor will show the destroyed signal and waits before detecting „no signal at the input“.
IMD - Timecode

• Digital video signal may carry an embedded timecode information.
  – There are two different standards in the industry.
    • VITC is a binary information within the blanking area, mostly used in SD standards.
    • The HD standards carries timecode as an ancillary information in the data stream.

• The timecode will be detected automatically, when the reader is enabled.
The acronym UMD stands for Under-Monitor-Display. In the past times video sources was indicated by additional character display units mounted mostly under the monitor.

Using high resolution LCD monitors makes it possible to combine this external function with the monitor.

The UMD will be displayed underneath the video image. The monitor detects UMD commands following the TSL protocol 3.1 from its serial command line.
Tally Red-Green-Yellow

- User define
- Contact Closure
Who is Tamuz

Different offerings,
Grades and EBU TECH 3320 specifications
Tamuz History – Cont.

• **2007: **Concept of LCD as Replacement for CRT
  
  - Erwin Lissy, the CEO of Tamuz presented a concept paper at IBC Amsterdam which realized the potential of LCD’s as a replacement for CRT’s. The first evaluation of these LCD concepts were successfully tested at Munich’s IRT (a Broadcast Technology Institute collaborating with a consortium of government and public broadcast stations in the EU). Tamuz was further directed by the IRT to develop these concepts into a LCD monitor confirming the EBU 3320 recommendations. This was the first development toward the production of a LCD monitor -- the “Imperial Eagle”, as a class one reference monitor to replace CRT’s!

• **2007: **Launched the BLACK MILAN series at NAB Las Vegas. A hybrid monitor with built-in MultiView functionality for four analog or digital signals. Presented as 24” and 47” monitor.
Tamuz To Date

• 2008: Presenting the first release of the IMPERIAL EAGLE class 1 reference monitor at NAB Las Vegas to American broadcasters.

• Launched the QCM 119W monitor from the BLACK MILAN family, a 19“ rack mountable MultiView monitor with four multiview inputs plus an additional fifth input for displaying a SDI signal without multiview processor delays in 1:1 mode.

• IBC Amsterdam - the official launch of the IMPERIAL EAGLE in Europe. Displayed in comparison with a class-1 CRT. A prototype of a 32” FullHD monitor was shown. Both RLM 124W & 132W HD monitors achieve deeper blacks than the EBU 3320 recommendation.

• Introduction of the GREY OWL SL series following EBU 3320 Class-2 recommendations. The monitor is aligned to 80 cd/m2 brightness and can achieve the same low black levels of a class one monitor!

• 2009 April: NAB Las Vegas – Tamuz presents our Vidre Series and the first OLED 7.6” field monitor to the marketplace with great fanfare.
Installation of SparrowHawks in NYC
Tamuz Monitors

All Monitors are Custom Designed

Over 150 Monitors

Grey Owl SL

IMPERIAL EAGLE
Class-FullHD Broadcast Monitors

VIDRE
Budget Series Monitors

OLED
Matrix Panel

MultiScreen
PreView Series

3G SDI
Equipped

SPARROWHAWK
BigScreen Digital Signage Monitors

From your content to its distribution, we deliver solutions...
User requirements for Video Monitors in Television Production:

Definition of a Grade 3 monitor:

- Grade 3 (observation or presence) monitors are devices equivalent in many respects to high end domestic/consumer displays. For television production applications, important considerations include the availability of professional interfaces, mechanical robustness (including the ability to mount in racks or stacks) and transportability, as well as electromagnetic compatibility and acoustic noise.

- Application areas for Grade 3 monitors are for example audio production, dialogue dubbing, signal presence monitoring, commentator positions and displays for the audience in a studio.
Vidre Series

Budget Monitors

Grade 3 (observation or presence)
Definition of a Grade 2 monitor:

- A Grade 2 monitor may have wider tolerances on its specification than a Grade 1 monitor, for the benefit of a significantly lower price, or smaller size or weight in comparison to Grade 1.
- Grade 2 monitors are used in applications where tighter tolerances of colour reproduction and stability are not as critical.
- Areas of application for Grade 2 monitors are for example: preview, control walls, edit suites, and control rooms where no picture quality manipulation is carried out.
- It should be possible for Grade 2 and Grade 1 monitors to be used together, for example in television production control walls.
GreyOwl SL – Studio Line

Grade 2 monitor may have wider tolerances on its specification than a Grade 1 monitor.
SPARROWHAWK HD & DVI

SPARROWHAWK HD - Info

SPARROWHAWK DVI - Info
Quad MultiScreen OLED

Quad 4.3” MultiScreen OLED Monitor

OCM 404W Info
Definition of a Grade 1 monitor:

- Grade 1 monitors are devices for high-grade technical quality evaluation of picture capturing, postproduction, transmission and storage.

- Have the ability to reproduce the scanning mode of the signal in the native way (i.e. progressive or interlaced) or as it is intended to be viewed (e.g. 50 Hz presentation as 25p material).

- Typical applications are for camera control, colour grading and quality control, and possibly lighting control where video technical quality parameters are evaluated, controlled, and corrected.
Imperial Eagle – Reference Monitor

• Grade 1 monitors are devices for high-grade technical quality evaluation of picture capturing, postproduction, transmission and storage.
Luminance ranges:

- When a luma signal of 100% white is input, the display should provide an adjustable preset including the ability to produce a reference luminance level, for example of 80 cd/m². However, it should be adjustable so that the 100% luminance on the screen can be set to provide luminance levels within the ranges:
  - Grade 1 Monitor: 70 to at least 100 cd/m²
  - Grade 2 Monitor: 70 to at least 200 cd/m².
  - Grade 3 Monitor: 70 to 250 cd/m² or to 400 cd/m² in adverse conditions.
  - **Automatic brightness limiters shall not be used for Grade 1 or Grade 2 Monitors.**
**Black levels:**

- With a Luma signal at black level (digital level 64 in 10-bit), the luminance level measured from the screen should be adjustable to be:
  - Grade 1 Monitor: below 0.1 cd/m².
  - Grade 2 Monitor: below 0.4 cd/m².
  - Grade 3 Monitor: below 0.7 cd/m².

- It must be possible to adjust black level with a PLUGE test signal (incl. sub-black) according to the procedure outlined in ITU-R BT.814.
Contrast ratio:

- Depending on the luminance level set for 100% white, the following full screen contrast ratio may be achieved in relation to the appropriate minimum black level.
  - Grade 1 Monitor: above 1000 to 1
  - Grade 2 Monitor: above 500 to 1
  - Grade 3 Monitor: above 300 to 1
**Gamma characteristics:**

- The luminance gamma characteristic (electro-optical transfer function) of the screen should be equivalent to those of a reference CRT with the rendering intent (dim-surround) expected of a TV system. It is believed that a nominal value of 2.35 is appropriate.

- Alan Roberts indicated a method of performing such gamma measurements, and has yielded results which indicate that the gamma of a grade 1 CRT monitor is typically in the region of 2.3 to 2.4.

- The conclusion must be that any new monitor technology should retain the same electro-optical transfer function as has historically been followed for gamma tolerance in Grade 1 and Grade 2 monitors.
Grey scale reproduction:

For Grade 1 and Grade 2 Monitors, grey scale tracking between colour channels shall be within ellipses defined:

- Grade 1 Monitor: ±0.0010 Δu', ±0.0015 Δv' (CIE 1976 chromaticity differences) for luminances from 1 cd/m² to 100 cd/m² and deviation from grey should not be visible for luminances below 1 cd/m²

- Grade 2 Monitor: ±0.003 Δu', ±0.004 Δv' for luminances from 1 cd/m² to 200 cd/m² and deviation from grey should not be visible for luminances below 1 cd/m²

- When a luma signal of black level (digital level 64 in 10-bit systems) through 109% white (1019) is input, grey scale tracking should be maintained.
Colour gamut and colour reproduction:

- The intention is that colours within the relevant system gamut should be reproduced such that the human eye perceives them to be identical to the presentation on an ideal CRT monitor, that is, a metameric match should be achieved.

Color temperature

- The monitor should present pictures with a reference white colour D65 when feeding the monitor with primary signals of equal amplitude.

- Monitors to be used on set in a production must be able to be adjusted to approximately 3200 K.
  - Grade 1 Monitor: Default D65
  - Grade 2 & 3 Monitors: Default D65 and optionally switchable to 3200K.
Viewing-angle dependency

1) For Grade 1 and Grade 2 Monitors, deviations in reproduced colour on the screen should not be visible to a human observer when viewing the screen from an angle of up to ±45° horizontally or ±20° vertically in any direction from the perpendicular axis to the centre of the screen.

2) As a guide to an acceptable numerical value, Δu', Δv' (CIE 1976 chromaticity differences) should be less than 0.003 for 3% and 50% grey-scale, white, and with any of the EBU test colours when measured from viewing angles in the range described above.

3) The contrast ratio on the screen, when measured from viewing angles in a rectangle of ±30° horizontally and ±15° vertically should drop by no more than 20% of the contrast measured along an axis perpendicular to the centre of the screen. When measured from viewing angles in a rectangle of ±45° horizontally and ±20° vertically, the contrast ratio should drop by no more than 50%.
Image scaling, de-interlacing and overscan

• Image scaling should be done in such a way as to avoid the introduction of artifacts, such as excessive ringing, aliases or banding, etc.

• Monitors should offer a choice of de-interlacing modes. Progressive (segmented field or film-mode) material should be detected and not passed through a de-interlacer.

• Monitors must have the ability to expose 'field dominance' problems, which occur when the fields of an interlaced signal are presented in the wrong order.
Pixel Defects

• Defects are classified according to the severity of their visual impact. ISO 13406-2 provides more information and a classification of different types of pixel defects.

• Grade 1 monitors shall have no visible pixel defects (defined as pixel defect category Class I in ISO 13406-2).

<table>
<thead>
<tr>
<th>ISO 13406-2</th>
<th>Type 1</th>
<th>Type 2</th>
<th>Type 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Class II</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Class III</td>
<td>5</td>
<td>15</td>
<td>50</td>
</tr>
</tbody>
</table>
Tamuz Imperial Eagle - Class 1

Performance Spec’s

Meets mandatory EBU t3320 & BT 709 Spec’s

❖ Luminance adjustable in all Tamuz monitors
  • Factory set at 80 cd/m2
  • Monitors adjustable: 60 cd/m2 to 120 cd/m2 prior to leaving the factory

❖ Black Level – below EBU Spec <0.1cd/m2.
  • <0.08 cd/m2 to 0.02cd/m2

❖ Contrast of Imperial Eagle >1000:1

❖ Pixel Quality
  • Meets ISO 13406-2 spec
  • 1:1 Pixel Resolution – no rescaling
  • Tamuz grantees delivery of Imperial Eagle from factory with “0” pixel errors
Tamuz Imperial Eagle - Class 1

Performance Spec’s

• Gamma selectable 1.8, 2.2, 2.3, 2.4
  – Factory 2.3

• Color Temperature adjustable:
  – D65 adjustable: Auto and manual
  – 3200K to 9500K in steps of 100K while maintaining proper alignment.

• Back Light Meets EBU “Low level Rest Light” criteria:
  – Customized CCFL balanced for daylight.
  – Adjustable while maintaining perfect color temperature to balance for differences in studio/working environment.
  – No ND Glass filter needed. Our protection glass allows 98% passage of visible image.
Tamuz Imperial Eagle - Class 1

Performance Spec’s

❖ Grey Scale Tracking Meets (CIE 1976)
  o White Peak at 109% is visible

❖ Video Signal Processing
  o Integrated headroom of 9% for setting black and white levels.-- making sub black possible.

❖ Auto Alignment & Calibraton
  o Internal processor – no computer connection necessary

❖ User Defined Settings:
  o Store up to four user settings as individual LUT’s
  o Access monitor via TCP/IP from user’s computer or network

❖ De-Interlacing – six modes exceed EBU Rec.
  o User selectable for P, sF, iMovie, iSport, iOdd, and iEven modes.
Tamuz Imperial Eagle - Class 1

Performance Spec’s

- 12 bit 4:4:4: and 10 bit 4:2:2 dithering to 8 bit
  - Video without artifacts – software designed by Tamuz engineers.

- De-intelacing & Field Dominance of video.
  - Detects Progressive frames to avoid de-interlacing
  - Identifies segments with improper field dominance order.

- MRC Anti-Sticking software designed by Tamuz – no competition
  - Tamuz MRC software is a robust application designed to remotely control up to 250 monitors through TCP/IP.

  - Competitors range in Class 1 is 170w, 180w, 200w as a result of implementing LED backlighting.
Thank You

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pllandry@incospec.com
Richard Baker
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Incospec Communications