

## POYNTON'S VECTOR 1 CONTRAST, BRIGHTNESS, and the naming of things

Video professionals face a serious, long-term issue: Consumers don't know what knob to turn to make their pictures brighter!

For more than half a century, the two primary image controls have been called CONTRAST and BRIGHTNESS. That these controls are misnamed was observed half a century ago by the preeminent electronics engineer Donald Fink:

FINK, DONALD G. (1952), *Television Engineering*, Second Edition (New York: McGraw-Hill)

"Unfortunately, in television systems of the present day, ... the separate manipulation of the receiver brightness and contrast controls (both of which are misnamed, photometrically speaking) by the nontechnical viewer may readily undo the best efforts of the system designers and the operating technicians."

In the 1950s, CONTRAST (which controlled video gain, as it does now) was apparently recognized by CE engineers as an important operational control – the CONTRAST knob was often concentric with VOLUME. On the other hand, BRIGHTNESS (which introduced an offset or bias) was apparently recognized as being an unfortunate technical necessity: On several television sets from that era, the BRIGHTNESS knob was placed between FOCUS and VERTICAL HOLD! I don't know if consumers in 1950 knew the difference between BRIGHTNESS and CONTRAST, but today the consumer that wants a brighter picture is just as likely – perhaps even more likely – to crank up BRIGHTNESS as CONTRAST, and thereby impair contrast ratio. This is the crux of Fink's complaint.

Fink also complained parenthetically about misnamed controls. It seems to me that if we retain the BRIGHTNESS control, we should relabel it as BLACK LEVEL, the term that is used on processing equipment and on many professional displays. However, with the functions of FOCUS and VERTICAL HOLD today taken care of by design, and those two controls abolished, we have to ask whether it is time for BRIGHTNESS to be abolished.

Consider a digitally encoded signal that is conveyed to the consumer in digital form – ATSC digital broadcast, DVD, or Blu-ray physical media. We must assume that black is correctly mastered, because we cannot distinguish creative intent from faulty production. No black level impairments are introduced by modern transmission systems,

and the intrinsic display circuitry doesn't impair black or induce drift. BLACK LEVEL is not required to correct any of these historical issues.

One remaining potential justification for a display BLACK LEVEL control arises from the degradation of black-level luminance caused by ambient light. The degree of that degradation is determined by the diffuse faceplate reflectance. Considering the screen as a passive reflector, luminance is the ambient illuminance (in lux), divided by  $\pi$ , times the diffuse reflectance factor. Ambient illuminance of 10 lx reflected from a perfect diffuse surface produces luminance of about 3 nt. Twenty years ago, with a 20% reflective CRT faceplate, ambient reflectance would have produced 0.6 nt. With 100 nt white – bright at the time – faceplate reflectance limited contrast ratio to 100/0.6, or 160:1. Diffuse reflectance declined from perhaps 20% two decades ago to 10% one decade ago (at the pinnacle of CRT display technology); with the introduction of plasma displays it declined to about 2%, and for today's LCDs the value is about 1%. Today, ambient illuminance of 10 lx produces black luminance of about 0.03 nt. With white at 100 nt, diffuse reflectance alone can't reduce contrast below 3,000:1. Delivered contrast ratio is no longer dominated by diffuse faceplate reflectance.

Apple has apparently concluded that ambient-induced black shift is so insignificant today that they have abolished the BLACK LEVEL control entirely. Apple avoids the naming problem by labelling the control with a symbol and no words! However, some confusion remains because Apple uses the historical BRIGHTNESS icon to label the sole remaining control.

With an Apple display, it's clear to the consumer what knob to turn to make the display brighter: There's only one knob! I suggest that we consider the same idea in the video and HDTV arena, and abolish BRIGHTNESS (OR BLACK LEVEL) from consumer displays. For the remaining control, I've been thinking about a better name than CONTRAST. My tentative suggestion is WHITE LEVEL.

It's another topic what luminance should be produced for an encoded zero-unit signal level. Perhaps I'll tackle that question in a future column. Meanwhile, I welcome your comments and suggestions! ■

*p.s. After first publication of this note, my colleague Cam Morrison pointed out my implicit assumption that faithful image portrayal is the goal. Cam correctly points out that manufacturers of television receivers do not usually have that goal: Their goal is typically to succeed in selling television receivers. Manufacturers have found that consumers respond to attributes other than faithful portrayal; manufacturers distort tones and colours according to what they think is most effective in attracting consumers. Among home theater enthusiasts, an important use of the BLACK LEVEL adjustment is to dial-out the manufacturers' preference in order to achieve the content creator's intent. Apple was able to abolish the BLACK LEVEL adjustment because Apple's products portray imagery rather faithfully, with a minimum of signal processing.*