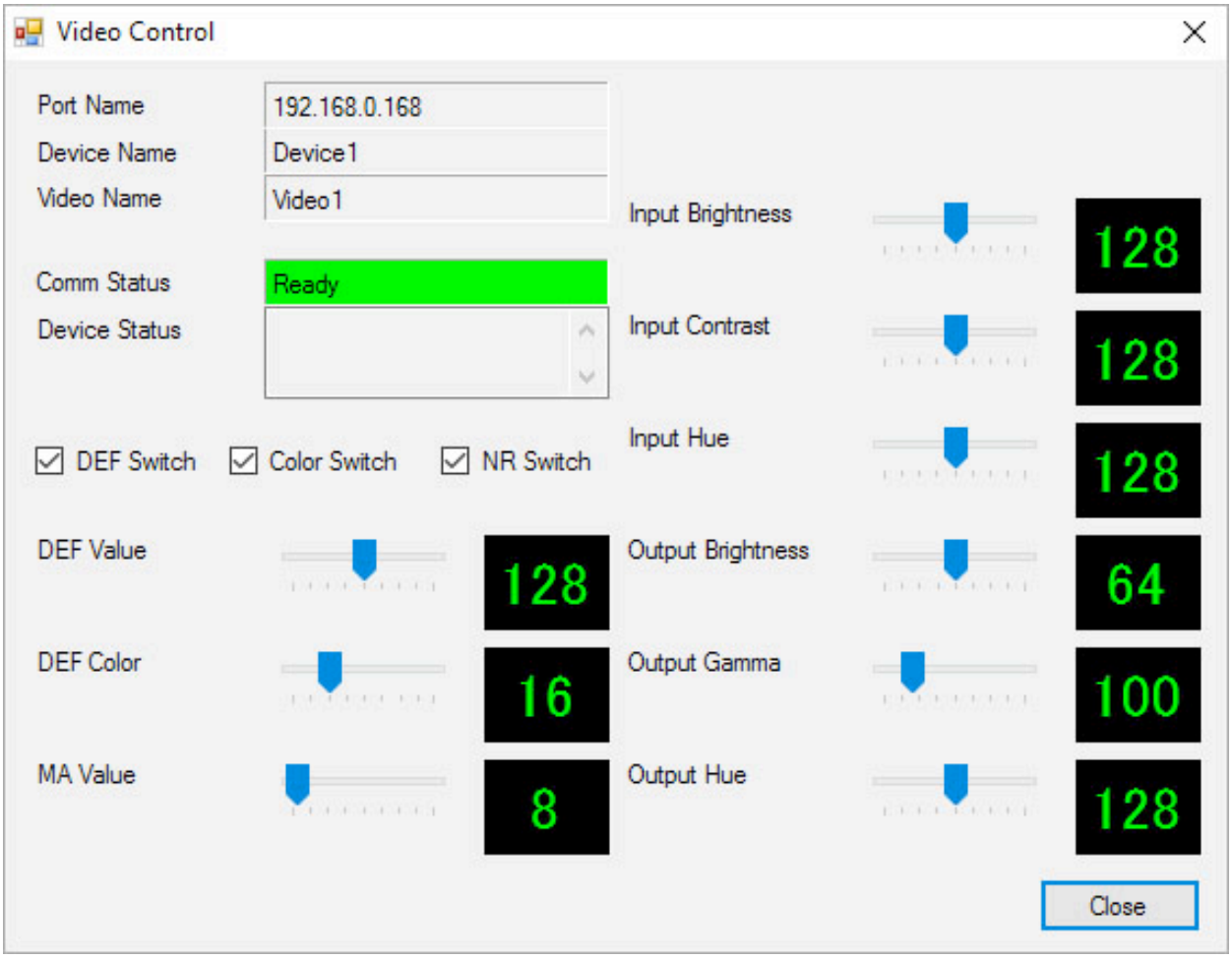
High Level Technical Application Description - DRAFT

Control Parameters for the 4 Channel Analog ProHawk™ Video Processor

The ProHawk 4-Channel Analog Video Processor is a high end video processor used for the enhancement of detail from a video source or video camera compatible with either an NTSC or PAL analog video stream depending on the unit purchased. As the unit supports 4 channels of analog video, the video signal has to be decoded into a digital stream format to allow for the Detail Enhancement Filter (DEF) processor to digitally enhance the video stream content form the analog source. After the processing has occurred, a set of encoders are used to re-encode the digital video information back into an analog stream compatible with the source signal. The unit has the potential to simultaneously and independently process four analog video streams, and will synchronize the timing of all four streams on the output connectors.

The following image is a representation of the available software control for modification of the core video processing parameters. Depending on the application, the level of processing may be modified to best support the monitoring or recording environment in which the device resides.



There are three primary functional groups of parameters that are addressed in the software controller. These include in the order of the input signal path:

The Input (Analog to Digital Decoder) Stage

The Video Enhancement Processor Stage

The Output (Digital to Analog Encoder) Stage

Each of these stages and their functional parameter groups will be addressed below.

The Input (Analog to Digital Decoder) Stage

The input stage is composed of four discrete decoder chips which can be individually controlled to precondition the signal for input into the primary video enhancement processor. These parameters will likely be similar to the parameters that can be set on various video cameras or alternate NTSC or PAL sources, but can be used to adjust or correct a video signal from a source that requires some modification.

Adjustments that are made with the DEF Switch disabled or left unchecked will be representative of how the input signal is being processed through the decoder. Changes that are visually appealing may result in some attenuation of information that can be processed, and any corrections from baseline values should be reviewed with the DEF switch enabled as the parameters will change the source feed to the Video Enhancement Processor. Generally, the input corrections must be reviewed under all potential lighting conditions for the video source, and many of these corrections may be also made within parameters that may be set, automated or addressed in the source device. The input corrections can serve to address issues resulting from video transport and cabling attenuation to some degree, or where it is difficult to correct or modify the video source parameters, or when adverse lighting conditions or coloration from artificial lighting may require some additional temporary or permanent correction.

The default setting for the input parameters are set at the midpoint, or 128 on a range from 0-255. While these settings are not used in the algorithm hosted in the signal processor, they can be used to adjust a video stream that may or may not be beneficial to the Video Enhancement Processor. It is recommended to first attempt to optimize the signal if possible with parameters that can be set in the source hardware to prevent truncating or losing information in the video signal.

Input Brightness (0-255, Default 128)

The input brightness of the device can be adjusted by +-30 IRE, where the general range of black to white levels ranges from 0 to 100 as set by the Institute of Radio Engineers when addressing composite video signals. The brightness adjustment will be relatively neutral (0 IRE adjustment) at a setting of 128. The IRE is a relative measurement. Care should be taken not to offset the brightness or darkness of an image to the point that there may be some clipping of either darker or lighter details in the source image, forcing values that would otherwise be subject to enhancement directly to either black or white. When a video source is operating properly and has been properly calibrated, the output should generally fall within the acceptable ranges where signal attenuation has not occurred in the transmission or wiring of a signal. Care should also be taken not to compensate for lighting conditions where the offset resulting from the use of this parameter may result in unsatisfactory results as lighting conditions change.

Input Contrast (0-255, Default 128)

The gain on the luminance channel can be adjusted through the application effecting contrast. Higher values of this parameter will increase the ratios between the higher luminance and lower luminance levels, and lower values will reduce the ratio. Increases will generally result in a change in the perception of the dark to light areas. Levels lower than the default level are generally not beneficial for input to the video processor as they will attenuate the contrast towards the darker or lower levels. Higher levels may attenuate detail in brighter regions when processed through the main video enhancement processor.

Input Hue (0-255, Default 128)

The Phase of the Chroma signal (color) can be altered by +- 90 degrees with this parameter. The hue offset can be used to correct for color cast issues resulting from the video input from a video source either due to hardware limitations, or adverse lighting conditions. The resulting change in the hue will be fed to the processor, and can address certain color cast issues from the source video. Note that hue can change depending on the source hardware's sensitivity to certain light levels, lighting conditions, or other exogenous factors.

The Video Enhancement Processor Stage

DEF Switch

The DEF Switch is actually a global processing switch that affects all of the algorithms that support the core processing functionality. Enabling or disabling this feature will also enable or disable the Color Switch and NR (Noise Reduction) Switch features that are integrated into the processor. This allows the user to quickly switch between processed and unprocessed enhancement streams within the core video processor. Note however that this does not disable the separate Input and Output sections as these function independently from the Video Enhancement Processor within the unit.

DEF Value (0-255 Default 128)

The DEF value is set by default at a level that balances the amount of detail enhancement within an image. In general, this feature results in contextual histogram enhancement within an image resulting in increased detail between elements within an image. As the value is increased, the luminance component of an image will strongly favor the enhancement of detail in an image. This can however result in increase in artifacts resulting from either signal noise or from technical limitations from an image source. In general, as the values approach zero (0), the process will favor the qualities of the source image, whereas as the value increases towards 255, the process will favor differential lighting qualities of the image resulting in an enhancement of detail. Where a more natural image tending to the original image with some detail enhancement or removal of fog is required, values can generally be set in ranges at or below the default setting of 128, and typically range from 64-128. Where the goal is to derive the most detail from an image with some potential increase in noise levels, and especially in low light conditions, or where the goal may be to gather either structural or forensic detail from a source, higher levels can be used to increase contextual detail in an image. These values can typically range from 128-255 for this parameter. Generally, and given hardware that can adequately support lighting conditions in the monitored environment, it should be possible to set a level and have relatively

consistent performance in enhancement as lighting levels change in the environment being monitored without additional user intervention.

Color Switch

The Color Switch will not function independently of the DEF switch; the DEF switch must be enabled to allow this function to be enabled. If the goal is to enhance color without adding additional detail enhancement from a video signal, it is possible to set the DEF Value to zero (0) with the DEF Switch enabled and then adjust the DEF color levels to enhance the color features of an image.

DEF Color (0-63 Default 16)

The DEF Color parameter is very sensitive and can significantly increase color components in an image to unnatural levels at higher settings. Therefore, the color level may typically be kept within a lower range, where the default is roughly at 25% of the maximum potential value of this parameter. Lower values will decrease color enhancement, while higher values will increase color information. Depending on the application, this function can be used to increase color perception for identification purposes, such as enhancing the color of clothing or of a vehicle in lower lighting conditions. Higher values will generate a visual representation that will be perceived as overly saturated and unnatural.

NR Switch (Noise Reduction) Switch

The NR Switch (Noise Reduction) Switch will not function independently of the DEF switch, the DEF switch must be enabled to allow this function to be enabled. If the goal is to reduce noise without adding additional detail enhancement from a video signal, it is possible to set the DEF Value to zero (0) with the DEF Switch enabled and then adjust the DEF color levels to enhance the color features of an image. The Noise Reduction works closely with the Motion Adaptation setting which allows for control of the reduction in certain types of artifacts within an image.

MA Value (0-255 Default 8)

The Motion Adaptation value can be used to address two primary issues, noise resulting from detail enhancement and especially from camera noise, and from environmental factors. The effect of the MA value is to smooth random features between frames of an image, and low values can have a significant impact on noise in darker images resulting from low signal levels and lower camera efficiencies when Noise Reduction is enabled. Higher MA values can reduce or eliminate environmental factors which include rain, snow, or suspended and moving particulate matter in underwater applications. The general tradeoff is that as the MA value increases, the amount of temporal differences in a video feed will be eliminated which can result in a general smoothing of an image and reduction in detail in non-static components of an image. As an example, this can result in a reduction in rain or snow in an image at higher levels, but may result in some blurring or artifacts when capturing moving images such as in a vehicle, or when panning a camera across the environment. The general recommendation is to always enable Noise Reduction with at least a low MA value around the default value. The value can be increased to suit the application, where slower moving objects or scenes are being captured such as monitoring crowds or slower moving traffic from a distance, if the objective is to eliminate rain or snow from the image as an example.

The Output (Digital to Analog Encoder) Stage

The output stage will affect the image post-detail enhancement, and therefore the parameters are generally used to correct for the monitoring environment, whether direct to screen, or to optimize the signal for digital video or network storage. Where there may be multiple varying displays used, or where the processed signal may be both recorded and monitored, it is generally advisable to control the input parameters and review the results on either the recorded media or on various displays that may be in the monitoring chain. Corrections in the output parameters can be used effectively to correct for display variation or to optionally optimize the recorded output stream for the recording environment and video compression that is being used. As an example, slight changes in the gamma correction may change detail that is recorded on a DVR or NVR, though these gains may be insignificant and are highly dependent on the user environment.

Output Brightness (0-127)

The output brightness of the device can be adjusted above or below standard IRE levels which will result in a general brightening or darkening of the image, where the general range of black to white levels ranges from 0 to 100 as set by the Institute of Radio Engineers when addressing composite video signals. The brightness adjustment will be relatively neutral (0 IRE adjustment) at a setting of 128. Some clipping of the output can result where slight detail may be lost in extreme highlights or shadows, the setting can be customized by application to address various monitoring applications.

Output Gamma (25-400)

Generally, gamma correction is applied to compensate for the nonlinear relationship between signal input and output brightness level as either perceived by a CRT or where nonlinear processing or contrast deficiencies are inherent in certain monitoring environments. Gamma correction is performed on the luma data only. The values of 25-400 correspond to gamma correction coefficients equivalent to the value divided by 100, or in the case of the default value of 100, a coefficient of 1 resulting in a flat or linear gamma correction curve. As implemented, values higher than 100 will result in a generally darker image in the midrange luminance information, whereas values lower than 100 will result in a brightening of the midrange of the image.

Output Hue (0-255 Default 128)

The Phase of the Chroma signal (color) can be altered by +- 22.5 degrees with this parameter. The hue offset can be used to correct for color cast issues post processing and as represented on a video monitoring or recording device where correction is required.