EAN-NUC and DPR

⚠ **CAUTION:** Alerts to a potential hazard that may result in personal injury, or an unsafe practice that causes damage to the equipment if not avoided.

ⓘ **IMPORTANT:** Identifies crucial information that is important to setup and configuration procedures.

📖 *Used to emphasize points or remind the user of something. Supplementary information aids in the use or understanding of the equipment or subject, which is not critical to system use.*

1 Overview

SightLine software has the capability of performing Non-Uniformity Correction (NUC) and Dead Pixel Removal (DPR), also known as bad pixel replacement. Both NUC and DPR help to improve the video and imaging quality from an IR camera. This function is useful for cameras that do not have this feature built-in from the manufacturer.

The calibration process should be performed for every camera and lens. It may need to be done again in the future if quality noticeably degrades. Due to the natural drifting of the detector, there is not a specific timeframe for this calibration process. For the best results, NUC/DPR will run on raw digital video output from the camera.

SightLine software uses a nearest neighbor replacement algorithm to replace bad pixels. The software can replace any pixel if there is a good pixel within an offset of five pixels from a pixel defined as bad.

1.1 Additional Support Documentation

The Panel Plus User Guide provides a complete overview of settings and dialog windows. It can be accessed from the Help menu of the Panel Plus application.

The Interface Command and Control (IDD) describes the native communications protocol used by the SightLine Applications product line. It is also available as a PDF from the Software Downloads page.

Additional Engineering Application Notes (EANs) and ICDs are available on the Documentation page.

1.2 SightLine Software Requirements

ⓘ **IMPORTANT:** The Panel Plus software version should match the firmware version running on the OEM. Firmware and Panel Plus software versions are available on the Software Download page.

Table 1: SightLine OEM Software Requirements

OEM	Initial Software Release	Provisions
4100-OEM	3.7.x	
1750-OEM	3.6.x	Dual channel processing is available in 3.7.x and above.
4000-OEM	3.00.xx	
Legacy OEMs		
1500-OEM	2.20.xx	Legacy OEMs are supported up to 3.5.x. Some features in 3.6.x and
3000-OEM	2.22.xx	above may not be available on these platforms.

1.3 Application Bit Requirements

The functions described in this EAN require Application Bits (app bits) purchased from SightLine. App bits are enabled with a license file provided by SightLine at initial unit purchase or during a license upgrade process. License files use a hardware ID that is applicable to a specific hardware serial number. For questions and upgrade support contact Sales.

Table 2: Application Bits Requirement Table

Function	Initial Software Release	Required Application Bit(s) v7 License	Notes
NUC/DPR	3.00.xx	NUC/DPR + High Bit Depth/Temp Telemetry 0x0006 0000*	NUC/DPR was enabled with the Blending app bit in 2.25.xx.
		Optional/recommended: Recording 0x0000 0400.	Snapshot recording for troubleshooting raw image capture requires the Recording app bit.

High Bit Depth/Temp Telemetry is a prerequisite for NUC/DPR.

1.4 Performance

NUC and DPR add a latency of less than 5 milliseconds. See EAN-Performance-and-Latency for tools on measuring performance.

1.5 Max Resolution

The following table shows the max resolution for the NUC/DPR process on each OEM board.

Table 3: Max Resolution Requirement Table

Max Resolution					
SW Version	1500-OEM	3000-OEM	3000-OEM Rev C	1750-OEM	4000-OEM / 4100-OEM
2.25.xx	640x512	640x512			
3.0.x	640x512	Rev B: 640x512	1280x1024		1920x1080
3.1.x - 3.3.x	640x512	Rev B: 1280x1024	1280x1024		2560x1440
3.6.x				1920x1440	

2 NUC and DPR Process

The system acquires a fixed number of raw unprocessed still images from the IR camera. A set of images is collected at two temperatures. The first set is collected at a temperature representing the operational high temperature (e.g., 50°C). The second temperature represents the operational low temperature (e.g., 25°C). This provides a sufficient sample behavior of the camera over a range of temperatures that will be experienced in the field. From these images, the software then determines which pixels are non-operational (dead) and may need to be replaced at run time.

Non-Uniformity Correction is performed by accumulating statistics from the collected images and calculating a gain and offset for each pixel in the image that will be applied at run time. The NUC and DPR tables are saved as files on the hardware and can be loaded at run time. Multiple tables can be created to accommodate different operational scenarios for a given camera. For example, a NUC/DPR table may be created that represents an ocean flyover, and another table for operations in the mountains.

A 1-Point field NUC is an efficient way to update the offset of each pixel to improve image quality with less calibration hardware.

Non-operational pixels use a distance formula to determine the replacement pixel to use. Preference is given to smaller distances and the max offset for both X (column) and Y (row) coordinates is 5 pixels.

ⓘ **IMPORTANT:** A NUC calibration must be performed at the scene temperature range where the unit will be operating. The detector pixels are non-linear with scene temperature, and the NUC process seeks to linearize these over a small temperature range. For example, using a NUC calibration taken at a scene temperature of ~40°C while imaging a scene temperature at 20°C will result in poor image quality. In this example, applying a 1-Point NUC correction only updates the offset table and not the gain table. The correct procedure would be to take a new set of NUC calibrations centered at ~20°C.

2.1 Requirements

- MicroSD card installed on OEM boards.
- 16-bit or 14-bit gray scale capability.
- SWIR, LWIR, MWIR imaging capability.
- Ability to output unaltered pixel values.
- Two different uniform temperature targets. (~20°C apart). For example, a thermal black body and associated power supply capable of maintaining temperatures approximating expected operational high and low temperatures.

3   Panel Plus Configuration Settings

Before connecting with the Panel Plus software, the OEM board should be powered up and connected through:

- a network switch or directly to the host PC (preferred) or,

- Direct serial connection (for troubleshooting or if a network connection cannot be established).

📄 *See the one of the corresponding OEM startup guides for connection and video streaming instructions:*

- EAN-Startup-Guide-1500-OEM
- EAN-Startup-Guide-1750-OEM (Supported in software versions 3.6.x and above.)
- EAN-Startup-Guide-3000-OEM
- EAN-Startup-Guide-4000-OEM
- EAN-Startup-Guide-4100-OEM (Supported in software versions 3.7.x and above.)

ⓘ **IMPORTANT:** This procedure assumes that the customer has read the OEM startup guide(s) and has a basic understanding of the following fundamentals:

- Completed a functional connection between the SightLine video processing board and Panel Plus application.

- Familiar with Panel Plus controls

- Successfully streamed video in Panel Plus

📄 *For questions and additional support regarding basic system setup and streaming, please contact SightLine Support.*

3.1 Acquisition Settings

See the camera configuration tables for supported cameras settings.

From the main menu in Panel Plus go to *Configure » Acquisition Settings*. For information about acquisition fields in Panel Plus see EAN-Digital-Video-Configuration.

📄 *Save parameters and reset the board when changing parameters. Cycle system power when changing resolution. If video is not present, cycle system power.*

3.2 Enable Warning Types

New in 3.2.x software.

SightLine software communicates status messages for NUC and DPR through the *User Warning* dialog window. To enable warning message types, from the main menu in Panel Plus » *View* » *User Warnings*.

Informational: Displays status messages that valid successful actions. Examples include:

- Successfully loading or saving a NUC or DPR table.

- All frames have been added successfully.

- The number of dead pixels that were calculated after performing the dead pixel operation.

Critical: Displays errors during any process type functions. Examples include:

- Errors that occur during normal NUC and DPR processes.

- Error saving a NUC or DPR table.

- Error loading a NUC or DPR table.

General: Other non-error messages that convey unsuccessful actions.
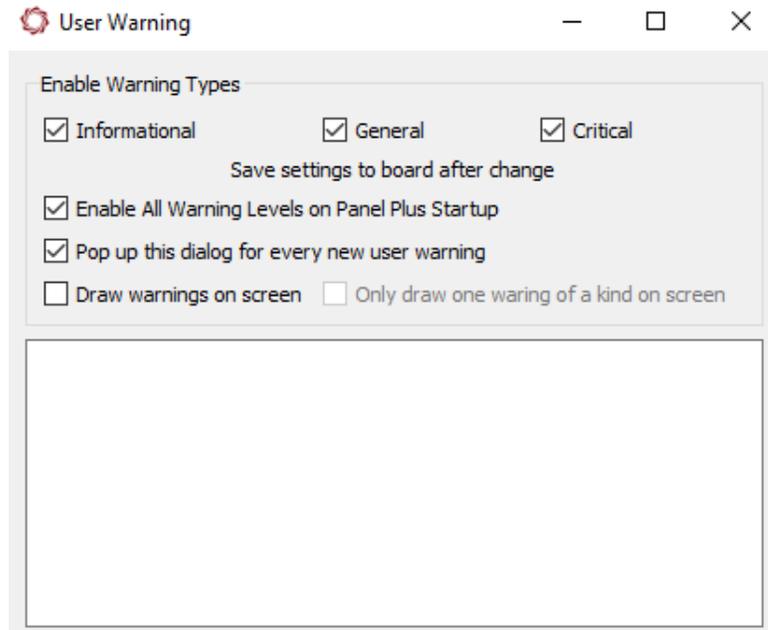

Figure 1: User Warning Messages

3.3 Disable Stabilization

ⓘ **IMPORTANT**: In the *Video* tab of Panel Plus, *Stabilization* should be set to *OFF* before starting the NUC and DPR process.
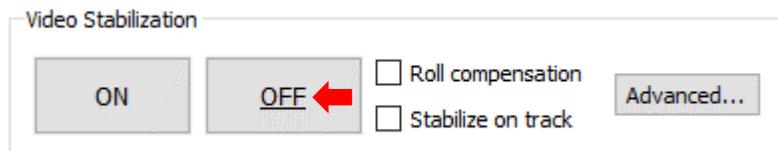

Figure 2: Stabilization OFF

3.4 Calculate NUC Tables

1. From the main menu in Panel Plus » *Configure* » *NUC/DPR*.

2. Click *Reset All*. This will put the system in a known state for calculating NUC/DPR.

3. Point the camera at the temperature source that is being used for operational high temperature.

📄 *The target plate should fill the entire field of view of the camera to provide a uniform image at this temperature.*

4. Set the *Add Frames* field to 30 (default), and then click *Add*. The frames will be captured within a few seconds.
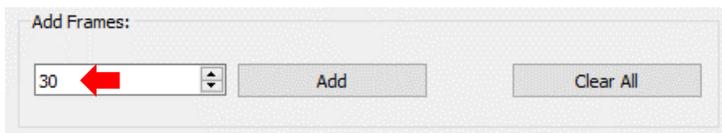
ⓘ **IMPORTANT:** A user warning will be displayed that indicates when frames have been added.

5. Point the camera at an operational low temperature source.

📄 *The target plate should fill the entire field of view of the camera to provide a uniform image at this temperature.*

6. Click *Add*. This completes the data needed for NUC and DPR calculations.

7. Click *2 Point NUC* to perform the non-uniformity correction process.

This step will automatically enable the NUC and DPR image processing. The result should be a grayscale image similar to the example shown in Figure 3.
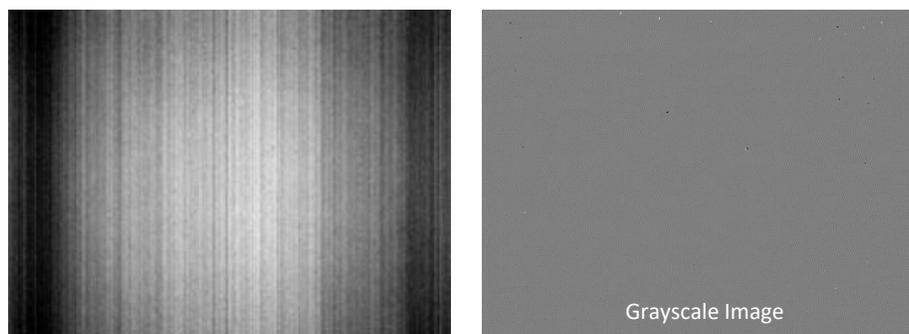

Figure 3: NUC and DPR Process Resulting Grayscale Image

8. To save the NUC table to the microSD card, enter a filename in the *NUC Table Filename* field and click *Save*. The *.nuc* extension will automatically be added to the filename.

📄 *Optional: To set the NUC table see Setting Default NUC and DPR Table.*

3.5 Dead Pixels Replacement

To perform a dead pixel replacement, use the following steps:

1. In the *Show* section, use the *Gain* and *Offset* selections to see the results of each.

The image will change to black and white. Numbers are shown in the upper left corner with a histogram drawn over the top of it. The histogram displays the statistical values of the image shown in Figure 4.
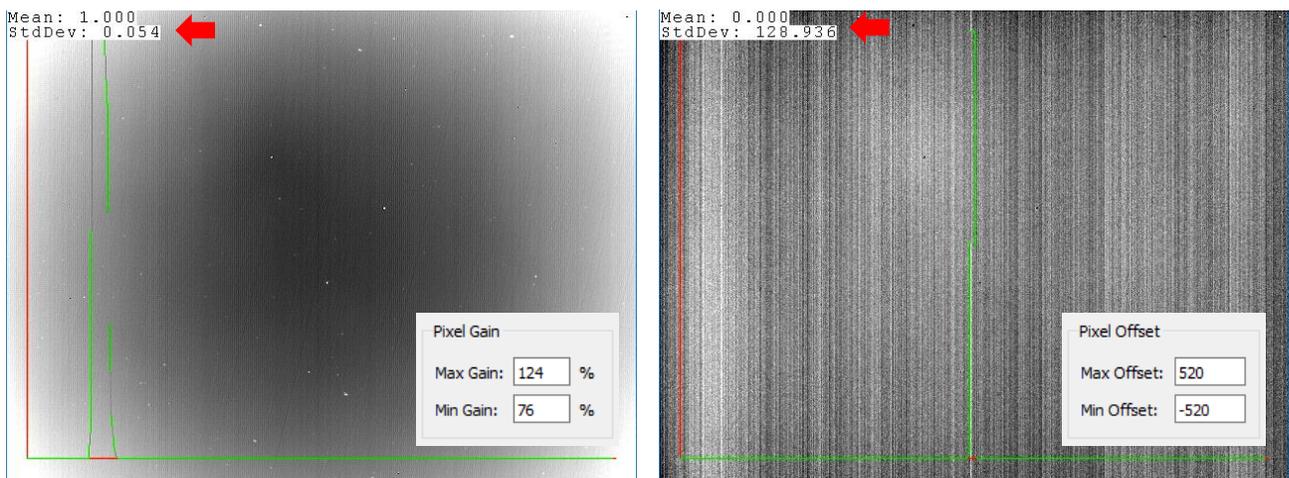
Figure 4: Fine Tuning Dead Pixel Replacement Parameters

2. Use the *Pixel Gain* and *Pixel Offset* to adjust the max and min values to help fine tune the dead pixel replacement parameters.

📄 *There should be only one peak on the graph. The Mean should be near 1.00. The standard deviation (StdDev) can vary. The max and min values should be set to at least 4 standard deviations above and below the mean. This is not a fixed value and will vary depending on the application.*

3. For the example on the left shown in Figure 4, round up the standard deviation to .06 and multiply by 4. This results in 124% and 76% for the max and min *Pixel Gain* values, respectively.

4. For the example on the right, this can be repeated for the *Pixel Offset* values. The mean and the standard deviation appear in the upper left. Round up the standard deviation to 130.00 and multiply by This results in a max and min offset of 520 and -520 values, respectively.

5. In the *DPR - Dead Pixel Replacement* section, click *Calculate*.

Calculate	Reset	Manual	Auto

The video may freeze or disappear briefly while the calculation happens. When the image returns, the dead pixels should be gone (Figure 6). If dead pixels persist adjust the parameters to a narrower range.
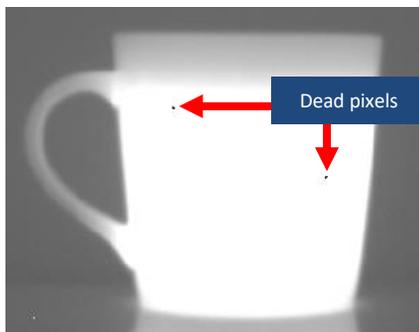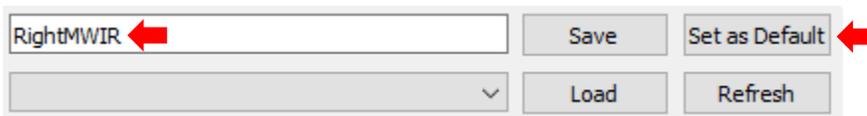

Figure 5: NUC without DPR   **Figure 6: NUC with DPR**

📄 Also see the Dead Pixel Issues section and Appendix sections A1 and A4 for alternate solutions.

6. To save the dead pixel table to the microSD card file system, enter a filename in the *Dead Pixel Table Filename* field and click *Save*.

📄 *Optional: To set the DPR table see Setting Default NUC and DPR Table.*

ⓘ **IMPORTANT:** Once the NUC/DPR process is completed and the system rebooted, the *Dead Pixel* map cannot be updated by loading the NUC *Gain* and *Offset* tables and changing the dead pixel calculation parameters. The statistics required are currently not saved in the *Gain* and *Offset* tables inside the NUC file.

ⓘ **IMPORTANT:** Before completing the NUC/DPR process and rebooting the system, make sure to view the *Gain*, *Offset* and *Dead Pixel* maps outlined in the Debugging section.

By using narrow constraints, it is possible to create a dead pixel map with large clusters of dead pixels in the corners. Since the dead pixel operation consists of replacing dead pixels with neighboring pixels, large clusters of dead pixels can lead to blocky imagery in the corners.

3.6 Test Settings

1. Point the camera at representative real-world scene. From the main menu in Panel Plus » *Configure* » *NUC/DPR*.

2. In the *Show* section, toggle the *Apply NUC* checkbox. The video should be smoother, and less streaked with NUC enabled. Toggle the *Apply Dead* checkbox. If any dead pixels are visible when inactive, they should look better when set to active.
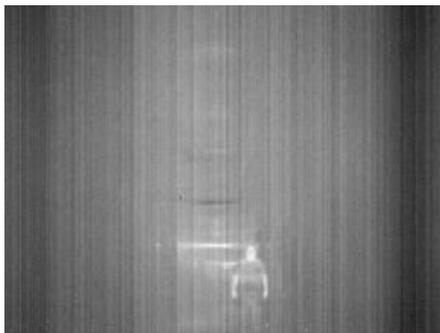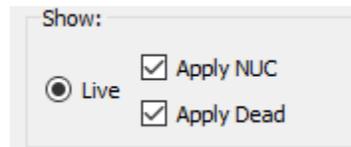

| **Figure 7: Without NUC/DPR** | **Figure 8: With NUC/DPR** |

Additional NUC and DPR files can be created by repeating the steps above for various lens positions, integration times, or other metrics for which new calibrations may be required.

3.7 Setting Default NUC and DPR Table

To automatically load a NUC table or dead pixel table when the system is booted up, a single NUC table and a single dead table can be set as default. These settings are saved in the parameter file and can be set or deleted using Panel Plus or command and control packets.

3.8 Storage of NUC / Dead Table

The filenames shown in Table 4 are specified in the NUC and DPR Panel Plus window when saving.

When saving tables, the file extension will be appended to the end of the filename provided. SightLine software will treat *<filename>.nuc* the same as *<filename>* when it is entered into the NUC and DPR Panel Plus window.

The NUC and DPR tables are listed in the *Files* on the SD section of the *Record* tab along with any associated files (e.g., screenshots).

Table 4: NUC and DPR File Storage

Filename Format	Description
<filename>.nuc	The NUC table is stored in binary.
<filename>.dead	The dead pixel table is stored in binary.

4   Additional Features

4.1 Debugging

📄 *For debugging purposes, the Gain, Offset, and Dead Pixel calculations can be viewed as images.*

1. To view these images, click on the corresponding radio button in the *Show* field to replace the live image feed from the camera with a calculation image of choice.

📄 *The whiter the pixel is the larger the corresponding calculation is.*

2. When finished, click on the *Live* button to return to the live image feed.

3. After calculation both the NUC and DPR are automatically active. To turn one or both off, uncheck the boxes.

4.2 Using Multiple Calibration Tables

For some applications more than one NUC or dead pixel calibration may be needed. To help facilitate this, SightLine systems have the capability of saving and loading calibration files.

ⓘ **IMPORTANT:** These tables are currently saved to the microSD card.

An FTP client can be used to review the calibration tables that are already on the system as shown in the example in Figure 9.

Figure 9: Managing NUC and DPR Tables with FTP Client

4.3 1-Point NUC

The 1-Point NUC is an efficient way to update the offset of each pixel to improve image quality with less calibration hardware. This calibration process updates the offset values stored in the NUC table currently applied to the image. To persist the 1-Point NUC calibration through subsequent restarts, save the NUC table.

📄 *This replaces the current NUC table offsets with the new adjusted table offsets.*

If the imager is pointed outside or placed in a different temperature location after performing a 2-Point NUC calibration and there appears to be more dead or hot pixels, perform a 1-Point (field) NUC to update the calibration.

📄 *Substituting 1-Point NUC for the 2-Point NUC calibration process is not recommended. Use it as an additional option if a reduction in pixel quality is noticed over time during normal camera use.*

The standard practice for this type of calibration is to close the shutter of the camera to obtain a flat field during designated periods, perform a 1-Point NUC, and then open the shutter. This is normally used in non-cooled IR cameras since the function that dictates NUC varies with time more often than with cooled cameras.
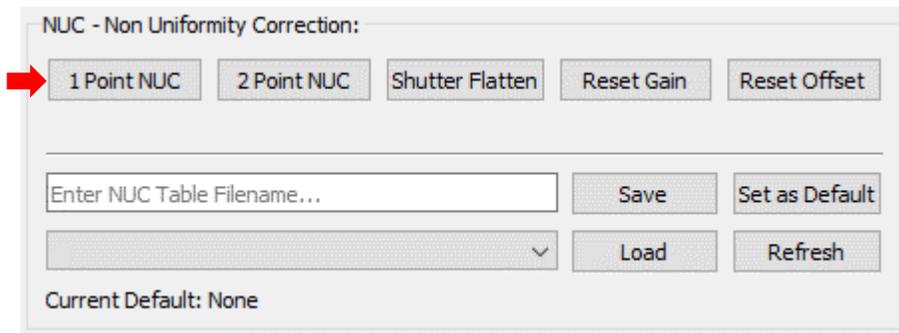
Figure 10: 1-Point NUC Configuration

📄 *This can also be performed through the NucParameters (0x35) Command and Control packet described in the Command and Control Packets section. See Appendix section A5 for an example.*

📄 *If performing a 1-Point NUC after performing the 2-Point NUC calibration without cycling the power on the SightLine board, it is important to clear the frames added. This can be done by clicking the Clear All button in Panel Plus.*

4.4 Shutter Flattening

New in 3.3.x software.

Shutter flattening is another way to update the offsets for each individual pixel when the imager has no way to use a flat field to perform the 1-Point NUC operation.

To perform shutter flattening the lens should be defocused to the point where there are no distinguishable features in the field of view. A collection of frames is collected, averaged internally, and then ran through the algorithm, which removes the high frequency features providing a smoother image.

This feature should only be used if the user cannot perform a 1-point NUC properly.

5   Command and Control Packets

NucParameters (0x35)   Set NUC and DPR parameters y=mx+b line of best fit calculated for NUC and DPR.

ReadWriteNuc (0x36)   Used to save or load NUC/DPR tables as well as set a table to be applied on startup.

DeadPixelStats (0xA1)   Statistics from DPR calibration process.

DeadPixel (0xA8)   Perform a designated mode of operation on a specified pixel.

5.1 Manual Dead Pixel Replacement Mode

New in 3.3.x software.

📄 *This feature may not function correctly if any modifications that alter the coordinate system of the display image, such as panning, tilting, rolling correction, or digital zooming, are being used.*

1. To enable the point-and-click manual dead pixel replacement mode click on *Manual* in the *DPR - Dead Pixel Replacement* section.
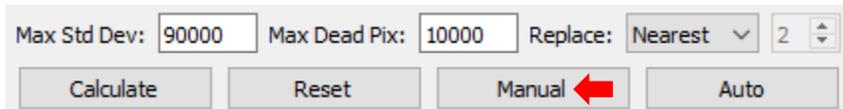
📄 *This opens the Manual DPR List dialog window, which will remain open and indicate that the Manual Dead Pixel Replacement mode is active.*
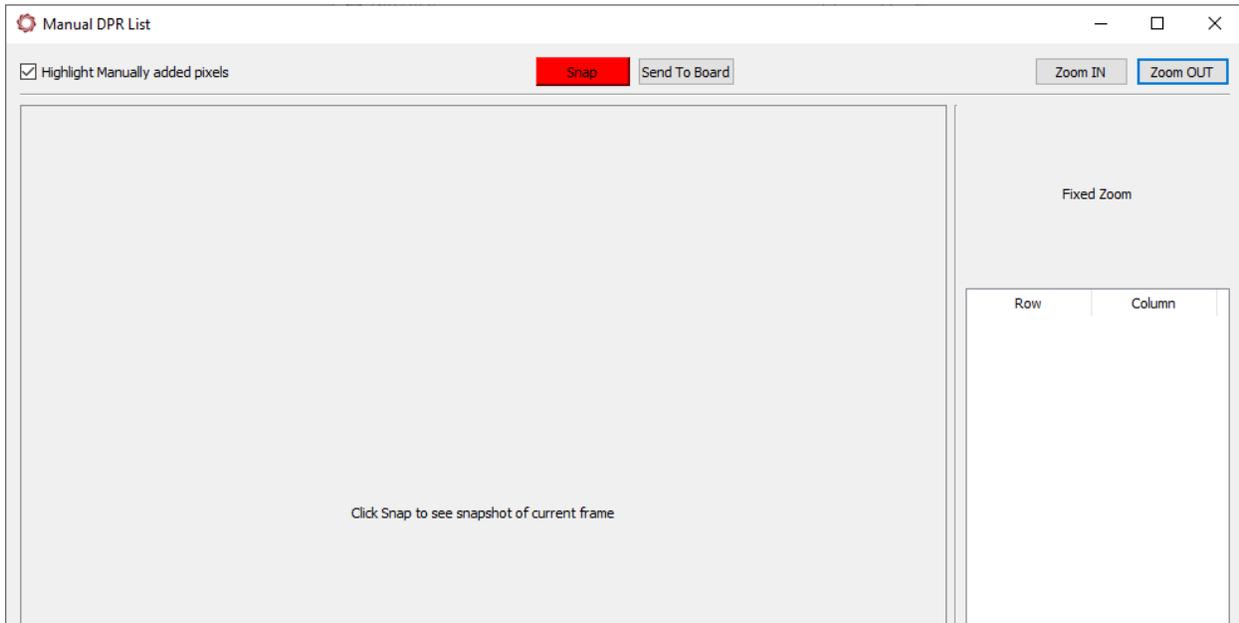
Figure 11: Manual DPR List Dialog Window

2. In the *Manual DPR List* window click *Snap* to take a still snapshot of the current camera that is being streamed to Panel Plus.
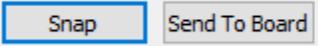
3. Locate and click on a dead pixel. Use the *Zoom* and *Pan/Tilt* buttons in the *Video* tab to help click on them. After clicking on a pixel, it will turn to a magenta color and a row will be added to the table to the right showing the *Row* and *Column* of the pixel (Figure 12).

📄 *The Manual DPR List dialog window will populate in order of pixels that are added. As the list grows a scroll bar appears allowing the user to scroll through the manually added dead pixels.*

📄 *Click Snap at any point to update the current snapshot.*

Row	Column
285	376
279	432
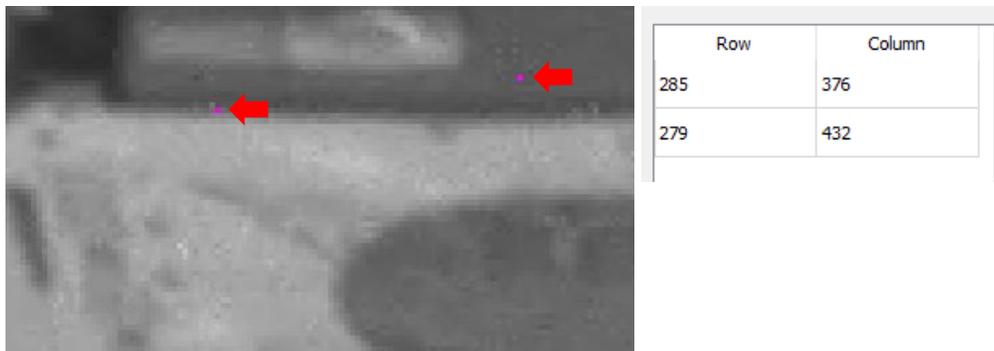
Figure 12: Example - Locating Dead Pixels

4. To delete or remove any of the selected pixels (magenta pixels) from the current list click on them again, they will turn blue in color (Figure 13).

5. Click *Delete* to remove them from the list.

📄 *Depending on the number of pixels selected there may be a delay in pixel removal after the Delete button is clicked.*

Row	Column
245	390
313	411
291	321
235	343
242	433

Delete
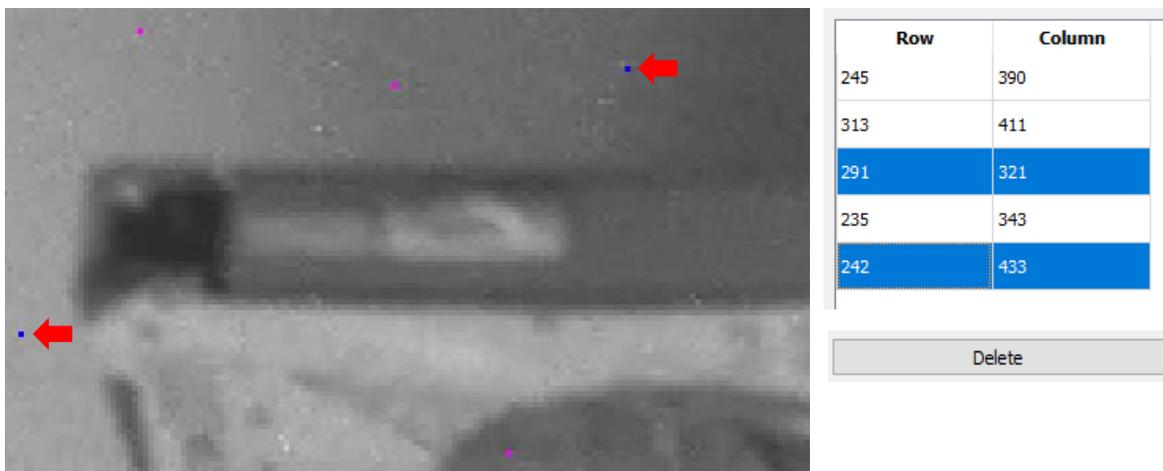
Figure 13: Example - Removing Dead Pixels from Current List

6. When finished click the *Send To Board* button to send the pixels listed in the table to the SightLine board. The current snapshot will disappear, and these pixels will be added to the current dead list.

📄 *To see the newly applied dead table, click Snap.*

📄 *Saving the dead pixel table adds the dead pixels to the current dead table. This file can be loaded on future power cycles or set as default like any other dead table.*

5.2 Auto DPR

New in 3.3.x software.

The *Auto DPR* feature uses an automatic detection on a single frame to designate pixels as dead based on the difference between a given pixel and the area around it.

This feature will perform better if a pixel that is designated as dead is not on a boundary between hot and cold in the image.
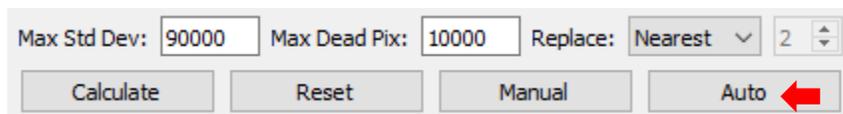
Figure 14: Auto Dead Pixel Replacement

📄 *Due to the automatic nature of the algorithm, it is more prone to false positives. It may identify more pixels as being dead than there actually are. Click Manual to fine tune the process.*

## 5.3   Modifying Dead Pixel Replacement Table

It is possible that the NUC and DPR process will not replace every dead pixel. If this occurs, try using the command and control packet DeadPixel (0xA8) to add additional dead pixels to the dead pixel replacement table.

To remove a dead pixel from an existing dead replacement table, use mode (0x01), the row of the pixel, and the column of the pixel to remove from the table.

ⓘ **IMPORTANT:** Do not remove dead pixels that have been determined dead through the automatic NUC and DPR process. Only remove dead pixels that were added manually to the table.

For advanced users SightLine has provided the format for both the NUC and DPR tables in Appendix sections A2 and A3 for manual entry and modification.

ⓘ **IMPORTANT:** Due to the complexity of this process, technical support for this method is limited.

5.4   Dynamic Dead Filter

New in 3.3.x software.

The dynamic dead filter is an algorithm that is applied on a per frame basis that compares each individual pixel to the surrounding pixels. If the pixel under question is outside the given threshold the pixel will be replaced based on the mode selected.

In the min max mode, the dead filter compares each pixel to the min and the max of a 3x3 area around the pixel. If the value is higher than the max + threshold, or lower than min – threshold, the pixel is replaced.

In the near far mode, the dead filter compares each pixel to the to the min and max of the nearest pixels in a 3x3 window (row ± 1 and col ± 1) and the min and max of the furthest pixels in a 3x3 window (i.e., the corners) and a threshold. If a pixel is determined as dead, it replaces that pixel with a median of the nearest pixels.

5.5   3D Noise Stats

New in 3.4.x software.

Calculating the noise metrics can help evaluate the effectiveness of the NUC/DPR process. The calculations are based on Finite Sampling Corrected 3D Noise with Confidence Intervals, and ImageJ plugin Calculate_3D_Noise.java, though the calculations have some important differences from those in the plugin.

ⓘ **IMPORTANT:** The SightLine calculation results may not match those calculated by the ImageJ plugin. The ImageJ plugin makes modifications to the data cube as it goes through its sequence of calculations. The SightLine calculation acts on an unmodified version of the sampled data.

To calculate the noise metrics:

1. Perform NUC/DPR calibration process.

2. From the Panel Plus main menu go to » *Configure* » *NUC/DPR* to open the NUC/DPR dialog window.

📄 *Keep the NUC/DPR dialog window open during this process.*

3. Click the *Noise Stats* from the *DPR - Dead Pixel Replacement* section to open the *Noise Stats* dialog window.

4. Is the *NUC/DPR* dialog window. Set the number of frames to use in the calculation in the *Add Frames* field.
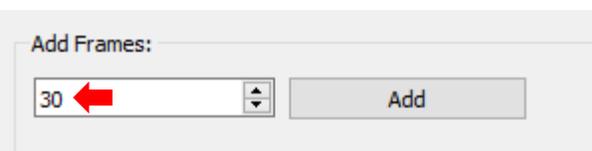
5. To calculate with raw images without NUC or DPR make sure the corresponding boxes in the *NUC/DPR* window are unchecked.

6. Click the *Calculate* button in the *Noise Stats* window. The *Update* button will turn red. When calculations are complete, the following user warning will display: *Warning: NUC: Noise stats calculation complete*.

7. Click the update button to retrieve and display the results.

8. To calculate with processed images (with NUC and DPR) verify the corresponding boxes in the NUC/DPR window are checked. Repeat the calculation and retrieval steps.

9. The results are shown in the *Noise Stats* window. If NUC/DPR has been effective, this set of numbers should be lower than the first set.

SIGt	104
SIGv	6
SIGh	7
SIGvh	11
SIGtv	102
SIGth	102
SIGtvh	104
Noise_temporal	105
Calculate	Update

5.5.1 Interpreting Results

As described in the paper, the calculations apply to a data cube of dimensions {T, V, H}, where T is the number of processed frames, V is the height of the image, and H is the image width.

All the results except SIGtvh and Noise_temporal are standard deviations of sets of averages.

The values with 1 subscript (SIGt, SIGv, SIGh) apply to averages over planes in the time, vertical, or horizontal direction, respectively. For example, if $AVGt[t]$ is the average pixel value of frame t, then SIGt is the standard deviation of the set of all $AVGt$.

The values with 2 subscripts (SIG*vh*, SIG*tv*, SIG*th*) apply to 2 dimensional sets of averages of 1 dimensional lines of pixels in the time, horizontal, or vertical direction. For example, if $AVGvh[v,h]$ is the average value of pixels at (v,h) over time, then SIGvh is the standard deviation over all $AVGvh$.

The value SIG*tvh* is the standard deviation over all pixels in the cube.

The value Noise_temporal is average over all (v,h) of the standard deviation of each pixel over time.

Table 5: Results Summary

Result Name	Description
SIGt	Standard deviation of average pixel value in each frame. (Iterating across time dimension)
SIGv	Standard deviation of average pixel value in each horizontal plane.
SIGh	Standard deviation of average pixel value in each vertical plane.
SIGvh	Standard deviation of average pixel value over time.
SIGtv	Standard deviation of average pixel value of each row.
SIGth	Standard deviation of average pixel value of each column.
SIGtvh	Standard deviation of all pixel values in the cube.
Noise_temporal	Average of all standard deviations of pixel values over time.

6 Troubleshooting

6.1 Dead Pixel Issues

In most cases the default values for DPR ensure that dead pixels are detected and replaced. If a dead pixel is still visible after performing the DPR process it may require adjusting the *Min* and *Max* values in the *Pixel Offset* section of the NUC and DPR configuration window in Panel Plus.

Example:
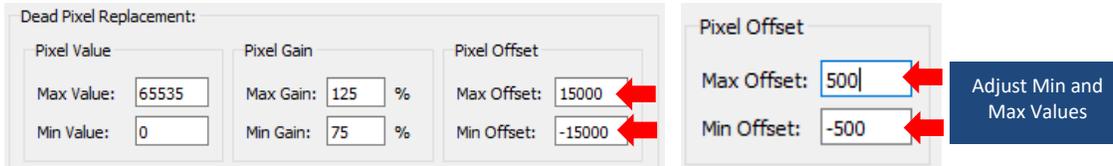
Figure 15: DPR Pixel Offset Adjustment

Figure 16: Before and After Min and Max Adjustment

6.2 Number of Dead Pixels Replaced Per Parameter

To see the number of dead pixels that are being replaced, click on the *Get Dead Pixel Stats* button in the NUC and DPR window. The window will show the current number of dead pixels being replaced and the number of dead pixels per parameter.

This can be useful when the values are adjusted to determine if there are any changes, or if the adjustment caused a significant number of pixels to be replaced.

Continue to reset and recalculate dead pixels by adjusting the *Min* and *Max* parameters until the dead pixels are removed.

Figure 17: Dead Pixels Replaced

6.3 Capture Raw Images

When capturing image snapshots of 16-bit images, the selection of whether the NUC and/or Dead function is being applied will be visible in the resulting snapshot.

📄 *To get raw snapshots make sure to uncheck the Apply NUC and Apply Dead boxes.*
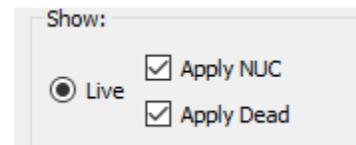
Figure 18: Apply NUC / Apply Dead Function

To facilitate additional troubleshooting, generate the following image:

- 30 snapshots of blackbody source at HOT temperature.
- 30 snapshots of blackbody source at COLD temperature.
- PNG snapshots (the more the better) of any scene without calibration applied. SightLine can then generate and apply the NUC and DPR to verify the calibration.

📄 *Send the images along with any other relevant details to SightLine Support.*

This following process requires the Recording license feature to be enabled. See the EAN-File-Recording document for additional information regarding file recording.

1. Prepare camera with a hot calibration target.
2. Insert microSD card into the OEM.
3. Power up the OEM, and then connect with Panel Plus.
4. In Panel Plus select the *Record* tab. Click the *Advanced Settings* button.
5. Configure the snapshot settings as shown. Leave all other settings as default. When complete click *Send* and close the dialog window.
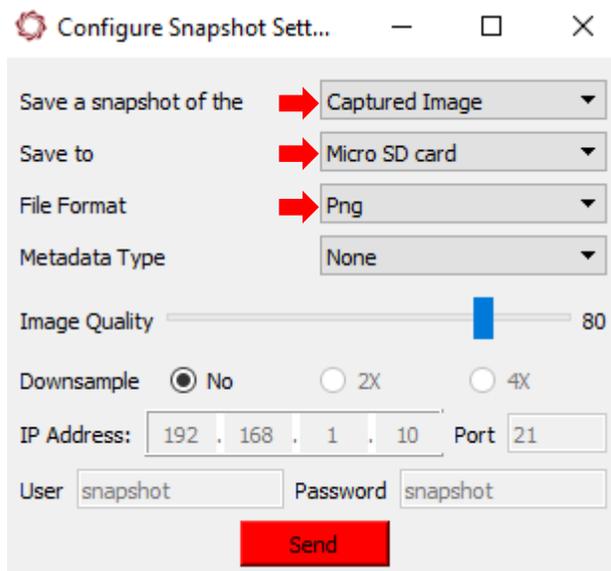
6. Enter a filename for the snapshot. The PNG extension is added automatically.
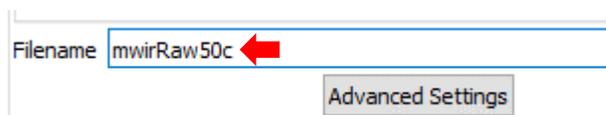
7. Click *Start* to capture the image.

8. Click *Refresh List* to verify the images were collected.

📄 *It is not important if all the images were not captured. A sample of images over time is all that is necessary.*

9. Repeat the procedure with a cold calibration target.

10. Repeat procedure again pointing the camera at a normal scene, with correction disabled.

11. Transfer files from microSD card to the PC.

6.4 Pixel Grey-Level Wrap

Problem: Very bright regions wrap around to appear as dark regions on 1500 or 3000.

Solution: Verify that Bit Depth is set to 16 (not 15 or less) in the Acquisition Parameters.

7 Questions and Additional Support

For questions and additional support, please contact SightLine Support. Additional support documentation and Engineering Application Notes (EANs) can be found on the Documentation page of the SightLine Applications website.

Appendix

New in 3.01.xx software.

A1   Adding Dead Pixels Using Command and Control

1. In Panel Plus open the *Send Raw Message* dialog window, main menu *File » Send Command*.
2. Check *Insert Header*, *Insert Len*, and *Insert Checksum* (Figure A1).
3. In the dialog window type *DeadPixel*. Select the *DeadPixel* drop-down option when it appears.
4. Fill in the parameters using the IDD. This example designates the pixel at column 1 and row 256.

📖 *This is a serial command. The lower byte is listed first when a parameter is larger than 1 byte. In this example parameter a and b are both two bytes.*

📖 *The parameters for this command are shown in the verbose area in the dialog window.*

5. Click *Send*. After sending the command the designated dead pixel will be added to the dead pixel table.
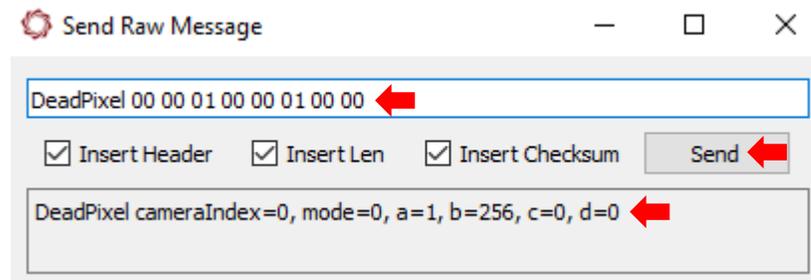
Figure A1: Adding Dead Pixels Using Command and Control

6. From the NUC/DPR dialog window, save the DPR table to the microSD card file system. Enter a filename in the dead pixel table field. Click *Save*. Click the *Set as Default* button to apply the file at bootup.

A2   NUC Table File Structure

The following format applies to the newest version (Version 1) of the NUC table. Previous versions are still readable by current firmware but may vary in structure. The NUC table is written in binary format in the following order:

1. Unsigned 32-bit integer - Table version.
2. Unsigned 32-bit integer - Magic number (0x51acd00d).
3. Signed 16-bit integer - Height of table/image.
4. Signed 16-bit integer - Width of table/image.
5. Gain and Offset Struct for every pixel.
6. Gain and offset struct:
    a. Unsigned 16-bit integer - Gain (shifted up by 13).
    b. Signed 16-bit integer - Offset.

Table A1: NUC Table Versions

Version	Initial Software Release	Description
1	2.25.xx	Initial NUC table

A3   Dead Table File Structure

The following format applies to the newest version (Version 3) of the dead table. Previous versions are still readable by current firmware but may vary in structure.

The dead table is written in binary format in the following order:

1. Unsigned 32-bit integer - Table version.
2. Unsigned 32-bit integer - Magic number (0x51acd00d).
3. Signed 32-bit integer - Number of dead pixels.
4. Dead pixel calculation parameters (version 2 and later):
   a. 32-bit floating point number - max gain.
   b. 32-bit floating point number - min gain.
   c. Signed 32-bit integer - max offset.
   d. Signed 32-bit integer - min offset.
   e. Unsigned 16-bit integer - max pixel value.
   f. Unsigned 16-bit integer - min pixel value.
   g. Unsigned 32-bit integer - max standard deviation.
   h. Signed 32-bit integer - max number of dead pixels.
5. Dead table version 3 and later:
   a. Signed 32-bit integer replacement method. See NucParameters (0x35) in the IDD.
   b. Unsigned 8-bit integer number of neighboring pixels to use for average/median dead replacement.
6. Dead list structure per pixel:
   a. Unsigned 16-bit integer - row location of pixel (Y-coordinate).
   b. Unsigned 16-bit integer - column location of pixel (X-coordinate).
   c. Signed 8-bit integer - row offset to pixel replacement (Y-coordinate, version 2 and earlier).
   d. Signed 8-bit integer - column offset to pixel replacement (X-coordinate, version 2 and earlier).

   📄 *(0,0) is top left increasing in number to bottom-right.*

ⓘ **IMPORTANT:** The dead list must be placed in ascending order. Row location (Y-coordinate) followed by column location (X-coordinate).

Table A2: Dead Table Versions

Version	Initial Software Release	Description
1	2.25.xx	Initial dead pixel replacement table
2	3.1.xx	Added saving of dead pixel calculation parameters (pixel max/min, gain max/min, etc.)
3	3.3.xx	Added average/median replacement. Removed offset to pixel replacements in per pixel list structure.

A4   1-pt NUC Command and Control Example

The following is an example of using command and control to perform a 1-pt NUC.

1. In Panel Plus open the *Send Raw Message* dialog window, main menu *File » Send Command*.

2. Check *Insert Header*, *Insert Len*, and *Insert Checksum* (Figure A2).

3. In the dialog window type *NucParameters*. Select the *NucParameters* drop-down option when it appears.

Figure A2: 1-pt NUC Command and Control Example

4. Close shutter or obtain a flat field.

5. Add a single (1) frame:

    NucParameters <XX>,01,01,<YY>,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00, 00,00,00,00,00,00,00

    <XX> = camera index (e.g., 00 for cam0)

    <YY> = number of frames in Hex (e.g., 01 for 1 frame)

📄 *The cameraIndex, numFrames, nucShow, and nucRunMode are the only fields that are used during the Add Frames function. The remaining fields can be set to 0x00 since they are not used.*

Adding a single frame will only use the information provided by that frame to adjust the offset values. Depending on the situation, this may accomplish the intended outcome.

IR cameras have a natural noise from frame to frame. To get an accurate result add more than one frame (5-10). The 1-Point NUC will use the average of these frames to adjust the offsets.

6. Perform 1-point NUC:

    NucParameters <XX>,01,07,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00, 00,00,00,00

     <XX> = camera index (e.g., 02 for cam2)

📄 *The cameraIndex, nucShow, and nucRunMode are the only fields that are used during the calculate 1-point correction. The rest of the fields can be set to 0x00 since they are not used.*

After performing a 1-Point NUC the information from the added frames will persist in the system. To clear this information, perform a power cycle or click the *Clear All* button in the *Non-Uniformity Correct*ion dialog window. If performing a 1-Point NUC again within the same power cycle, these frames will continue to average the information as more frames are added. Clear the frames before adding more if this information does not need to be included.