



## Document Information

<b>Title:</b> LightPath Sensor SDK	
<b>Document Number:</b> 17002010	<b>Revision:</b> A
<b>Effective Date:</b> 02/22/2026	
<b>Process Owner:</b> Engineering	

## Document History

Revision	Effective Date	ECN#	Change Description
-	11/15/2024	CM-474	Initial Release
A	02/22/2026	CM-628	Updated GUI. Updated new screenshots and text. Assigned correct document number from 17001001 to 17002010.

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## ESD Notice

This device and components are **Electrostatic Discharge Sensitive (ESD)**. Provisions of the ESD Control Program must be applied when handling or storing this product.



## Warnings

**Radiant Flux Exposure** – The LightPath Sensor is sensitive to exposure to extremely high levels of radiant flux. Never expose the sensor, either powered or un-powered, to the sun or any other source of radiant flux the unprotected human eye cannot tolerate. An electronic power control feature is provided to allow the integrator to ensure the shutter is closed when powering down the system. We recommend the integrator take advantage of this feature to provide protection for the sensor when the LightPath Sensor core is unpowered.

**Hi/Lo Temps** – Exposure to extreme temperatures may cause injury. Use caution.

**Lens Abrasion** – A lens surface is extremely sensitive to contamination and abrasion. Care must be taken to prevent particles on the lens and prevent damage to the surface.

**ESD Workstation** – Electronics handled in this procedure are sensitive to ESD damage. All work must be performed at an ESD-safe workstation. Wrist straps and/or heel straps must be worn when following this procedure.

## Terminology

The document uses these terms interchangeably:

**Camera/Core** – Used interchangeably unless otherwise specified.

**Sensor** – Refers to the thermal detector.

## Notice

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## 1. Purpose

This document describes how to unpack, set up, and use the LightPath 17 $\mu$ m Uncooled Broadband 640x480 Thermal Imaging Core. LightPath Sensor Thermal Imaging Cores are a family of low Size, Weight, and Power (SWaP) supporting multiple optics and interface cards to various LightPath Sensor camera configurations.

The LightPath Sensor customer configuration described in this user guide includes a user interface card to provide Camera Link and NTSC video output with DC power input. The core is also available without the User Interface Card for users who need access to digital video.

## 2. Scope

This guide is intended for OEM users who develop thermal imaging products. Information is intended for engineers who design a package for this core that is appropriate for application and environment. The package must address the environmental and electrical needs of the system as it may be used in a specific application.

## 3. Reference Documents

### 3.1 Parts List

3.1.1 For minimizing system size and weight, housing is not provided for the core. The integrator must protect the core against dust and moisture during assembly and in-system operation.

*Table 1: Parts List in Developer Kit*

Qty	Part Number	Description
1	SFSD-10-28-H-1.00-SR	20 pin flying-lead connector/cable assembly to connect to the User Interface Card
1	5000092-1	Camera Link flex cable assembly
1	DC power input	12VDC 500mA

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## 4. Procedures

### 4.1 Use Electrostatic Sensitive Device (ESD) Protection

4.1.1 The LightPath Sensor provides ESD protection at the connector interface, but it is sensitive to ESD at board surfaces. Observe precautions for handling electrostatic devices, including ESD safe work areas for assembly, ESD straps, etc., in accordance with ANSI/ESD S20.20-2007. The container used to ship the LightPath Sensor core is specifically designed for ESD products.

**Note:** Retain the container if shipping the camera core is required in the future.

### 4.2 External Connector

4.2.1 The external connector, J3, on the Interface card is a Samtec TFM-110-02-S-D-WT. The mating connector housing is Samtec ISDF-10-D-M, and the connector contacts are Samtec CC03M-2830-01-G. A flying-lead mating connector/cable assembly is available, Samtec SFSD-10-28-H-1.00-SR (Digikey SAM8669-ND). See Figure 1: User Interface Card Connector Locations.

4.2.2 Connector pins are oriented as shown in Figure 2: System Connector Pinout.

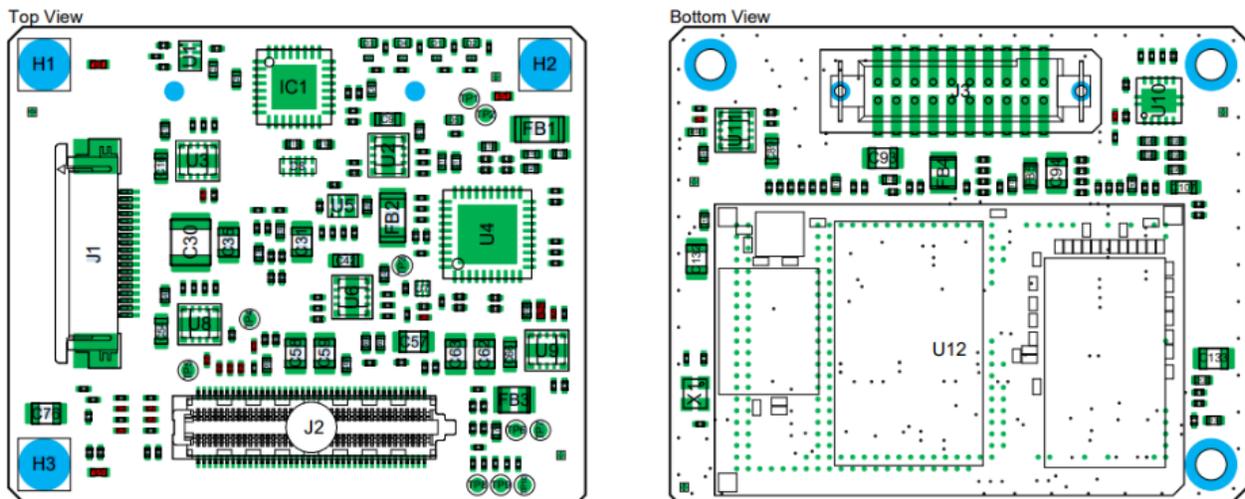


Figure 1: User Interface Card Connector Locations

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	No Connect	Ground	Ground	Ground	USB D +	Spare	External Power In	Spare	Ground	No Connect
	19	17	15	13	11	9	7	5	3	1
	20	18	16	14	12	10	8	6	4	2
	No Connect	Ground	NTSC Video Out	USB VBUS	USB D-	Ground	Spare	External Power In	Spare	No Connect

Figure 2: System Connector Pinout

### 4.3 Flying-lead Cable Configuration

4.3.1 The flying-lead cable assembly, Samtec SFSD-10-28-H-10.00-SR, is shown in Figure 3: Flying-Lead Cable Assembly. Leads are 10 inches long, 28AWG. The following describes how to connect the flying-lead cable assembly for a stand-alone camera initial operation and checkout.

- a. Connect a video receptacle (e.g. BNC or RCA jack) to pin 16, return to pin 15. A short, twisted pair spliced to a coax is recommended but acceptable performance can be achieved with a twisted pair to the receptacle.
- b. Connect external power to pins 6 and 7, return to pin 3, 10, and 18, with the three wires twisted together. The external power source can be any DC voltage from 8 to 16Vdc, with up to 100mV of ripple. The source impedance and voltage drop in the cable to the power source must be low enough to keep the voltage at the input to the core above 12VDC during the initial surge of up to 2A for several milliseconds.
- c. Verify video is present on the output when power is applied to the interface card.
  - **To use the GUI** – a USB or serial port connection is required. For USB, connect a USB connector to pins 11, 12, 13, and 14. The length of the flying leads should be as short as possible. The cable from the connector to the splice to the flying-lead cable should be USB 2.0 High Speed compliant.
  - **For Camera Link** – connect a Camera Link flex cable adapter to the user interface card J1. A Camera Link flex cable adapter is available by contacting LightPath Technologies.



Figure 3: Flying-Lead Cable Assembly

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## 5. Thermal GUI Installation

### 5.1 GUI Installation

- 5.1.1 Locate the [Thermal GUI](#) zip file:
  - a. Download the GUI zip and extract.
  - b. Double-click ThermalGUI\_Setup.exe to start installation.
  - c. Follow the prompts.
  - d. Confirm Installation.

## 6. Thermal GUI

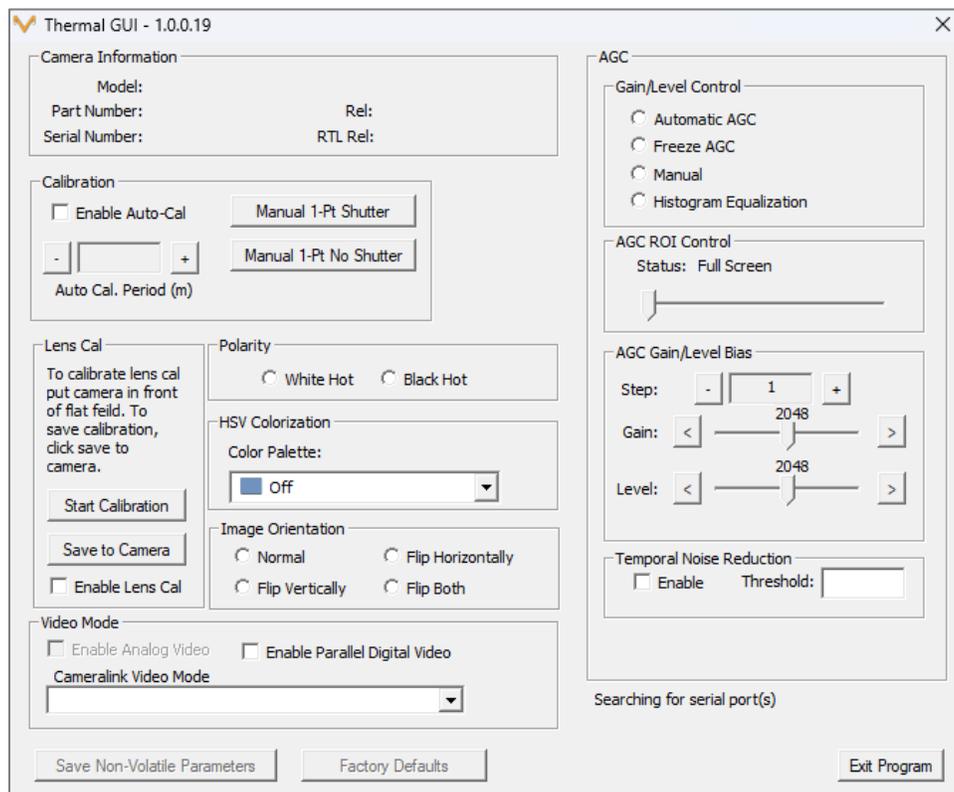


Figure 4: Thermal GUI

### 6.1 Camera Information

- 6.1.1 This feature is available when using a USB cable (not a USB-to-serial RS232 cable).
- 6.1.2 Camera Information is populated when the camera is connected. Information is retrieved from the camera BIOS and identified by the serial number.
- 6.1.3 Information shows the software and firmware versions, the core serial number, and Camera Code, which defines the camera format.

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Figure 5: Camera Information

## 6.2 Camera Communication Status

- 6.2.1 Connection messages are listed below the AGC panel.
- Querying the camera** – GUI talking to core.
  - Searching for Serial Port(s)** – Searching for a connection.
  - Waiting for command completion** – Some commands may take time for completion. Wait for *normal camera communication status* before continuing.
  - Normal camera communication** – Core is connected.

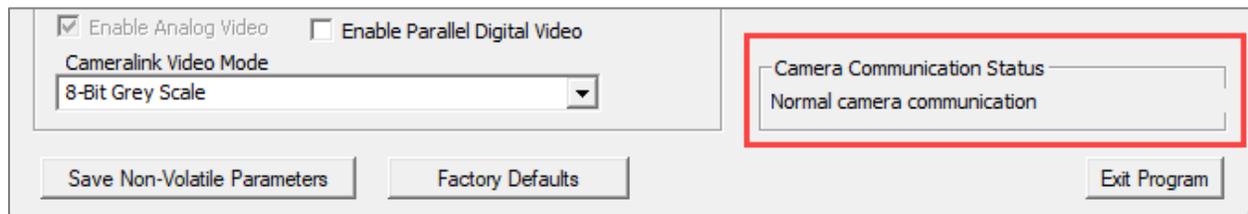


Figure 6: Camera Communication Status

## 6.3 Calibration

- 6.3.1 **Enable Auto-Cal** – Auto Cal. Period (m). Performs a 1 pt shutter per the period set in Auto-Cal. Period.
- 6.3.2 Set **Auto Cal. Period (m)** in minutes +/- **Enable Auto-Cal** must be checked. If unchecked, it won't perform a 1 pt shutter.
- 6.3.3 **Manual 1-Pt Shutter** – Performs a 1 pt calibration/NUC (non-uniformity correction). Shutter is used.
- 6.3.4 **Manual 1-Pt No Shutter** – Performs a 1 pt NUC through the lens. Shutter is not used. Users intended to show flat field to camera. Place camera facing a flat field of one temperature

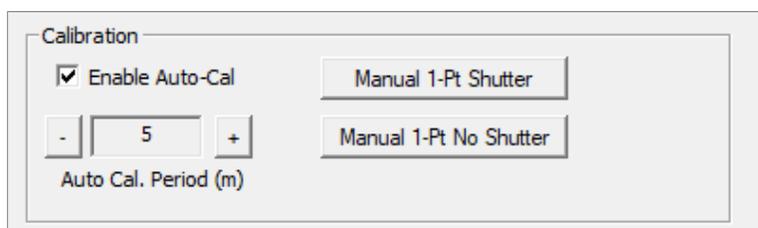


Figure 7: Calibration

## 6.4 Lens Cal

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- 6.4.1 Place camera facing a flat field.
- 6.4.2 Click **Start Calibration** (see [6.2.1 c](#)).
- 6.4.3 Click **Save to Camera** (see [6.2.1 c](#)).
- 6.4.4 **Enable Lens Cal**, if checked, applies the calibration table to the output, and only shows the correction.

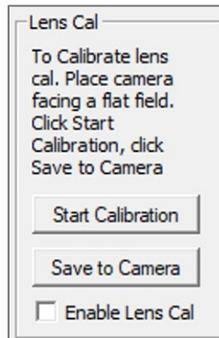


Figure 8: Lens Cal

## 6.5 Polarity

- 6.5.1 Set polarity by checking one:
  - a. **White Hot** – Hot pixels are shown white and cold pixels are black.
  - b. **Black Hot** – Hot pixels are black and cold pixels are white.

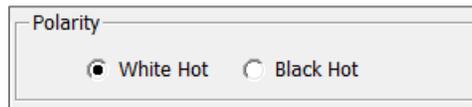


Figure 9: Set Polarity



Figure 10: Black Hot & White Hot Polarity

## 6.6 HSV Colorization

- 6.6.1 Sets scene colors based on thermal intensities. The drop-down menu allows the user to configure display color settings as a function of scene temperature. There are three (3)

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temperature color settings available, independently controlled for each video channel.

1. Off
2. Inferno
3. Soft Light

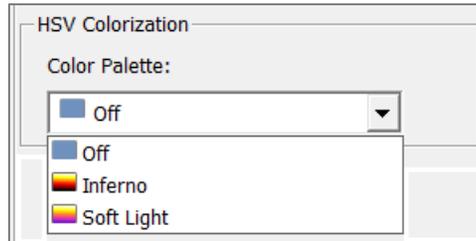


Figure 11: HSV Color Pallet

## 6.7 Image Orientation

Select an orientation

- 6.7.1 Normal
- 6.7.2 Flip Vertically
- 6.7.3 Flip Horizontally
- 6.7.4 Flip Both

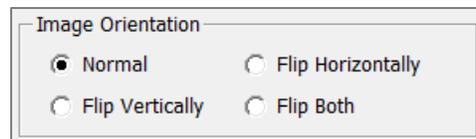


Figure 12: Image Orientation

## 6.8 Video Mode

6.8.1 **Enable Analog Video** is not user controlled. Analog video will be output when parallel digital video is enabled or when digital camera link video is not set to 14-bit grey scale.

6.8.2 **Enable Parallel Digital Video** locks digital camera link to 14-bit grey scale and outputs GUI changes to Analog.

6.8.3 Select **Cameralink Video** color scale from drop-down menu:

- 8-Bit Grey Scale
- 14-Bit Grey Scale
- RGB Color (CameraLink/Grey Scale Symbology (PDVO))



Figure 13: Digital Video Color Scale

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## 6.9 AGC (Automatic Gain Control)

If mode selected:	Then:
Automatic AGC	Real-time updates of gain and level as the controls are changed.
Freeze AGC	Freezes AGC set values.
Manual	Manual Mode Gain and Level controls become active; otherwise, controls are inoperable.
Histogram Equalization	Settings are automatic. Faster response time than auto AGC, lower contrast.

## 6.10 AGC ROI Control

6.10.1 Use the slider to set the region of interest:

Full screen	Top Third
Top Half	Middle Third
Bottom Half	Bottom Third

## 6.11 AGC Gain/Level Bias

6.11.1 The user controls the gain while the core automatically adjusts the level. This keeps the scene content within the display range while allowing the user to control the gain based on scene contrast. This can be useful for viewing low contrast scenes or for testing, such as measuring Minimum Resolvable Temperature Difference (MRTD).

6.11.2 AGC Gain/Level Bias

6.11.3 Enter:

- Step:** – Increment for gain and level
- Gain:** – Use the slider to adjust.
- Level:** – Use the slider to adjust.

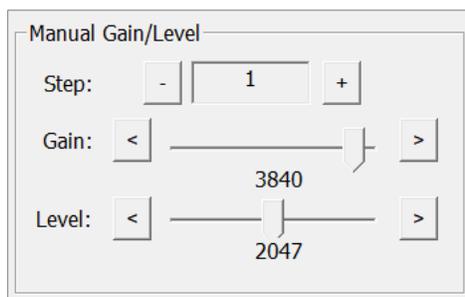


Figure 14: Manual Gain/Level

## 6.12 Temporal Noise Reduction

6.12.1 Click Enable.

6.12.2 Enter Threshold value.

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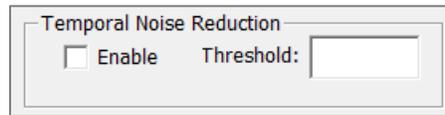


Figure 15: Temporal Noise Reduction Setting

## 6.13 Save/Exit

6.13.1 **Save Non-Volatile Parameters** – Saves configuration. Saved parameters remain set when camera is power-cycled.



Figure 16: Save/Defaults/Exit

6.13.2 **Factory Defaults** – Removes all GUI settings and returns status to factory settings.

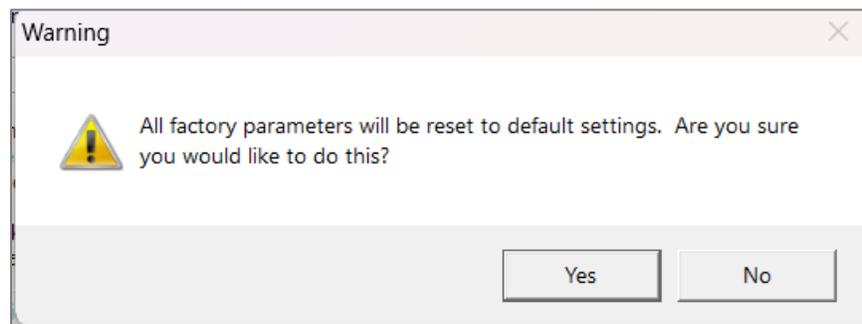


Figure 17: Factory Default Re-Set

6.13.3 **Exit Program** – Closes the application.



Figure 18: Save/Modify GUI Settings

## 6.14 Resource Menu

6.14.1 Click the icon, upper-left corner of the application to expand the menu.

- a. **Close** – Closes the GUI (same as Exit).
- b. **Thermal GUI User's Guide** – Online help.
- c. **About Thermal GUI** – Shows the current installed version.

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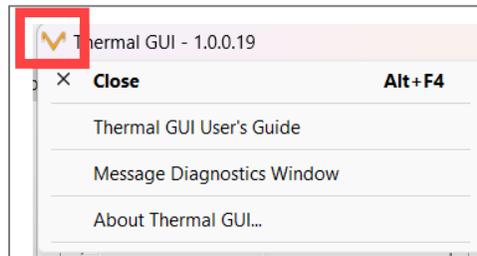


Figure 19: Resource Menu

6.14.2 **Message Diagnostics** – Lists line-by-line diagnostics in the current GUI session. Messages may be sent to the core with options for:

- a. **Prepend Start Byte** – Automatically adds Start Byte to start of message field.
- b. **Postpend Checksum** – Automatically adds Checksum to end of message field.
- c. **Send Message** – Enter message and click Send Message.
- d. **Done** – Closes Message Diagnostics window.

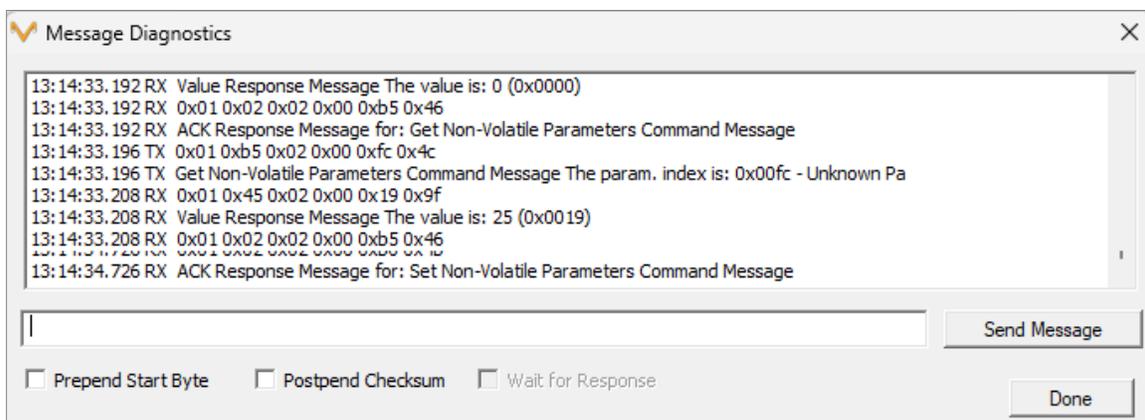


Figure 20: Message Diagnostics

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## 7. Operational Software/Operator Interface

### 7.1 Message Format

7.1.1 The serial protocol allows the user to control the LightPath Sensor Thermal Imaging Camera Core. Every message transmitted or received over the serial interface uses the same message format. The message contains the following components:

1. **Start Character** – This is always 0x01. It identifies the start of a new message. This start character is not unique, as other fields within the message may also contain this value.
2. **Command Byte** – This byte determines the type of command to be performed. For responses, this byte identifies the type of response.
3. **Parameter Length** – This byte specifies the count of any additional parameter bytes included in the message. If the message does not require any additional parameter bytes, this value will be zero. The overall message length is limited by the MTU size (is stated below).
4. **Parameters** – These bytes contain any parameters or other data for the message. Generally, the content and format of this data depend on the specific message type. However, a few general rules apply:
  - When data bytes contain strings, these are typically null-terminated arrays of ASCII codes
  - When data bytes contain integer or floating-point values, these are sent in big-endian order- e.g., the MSB is sent first. This statement is true for both 16 and 32-bit values
5. **Checksum** – This is the frame check sequence for the message. It includes all bytes in the message from the start character to the last parameter byte.
  - The Maximum Transfer Unit (MTU) size of the serial stream is 252 bytes
  - The parameter length for most messages is an even number of bytes (with some exceptions, due to the 16-bit architecture).
  - The message format is illustrated below:

Table 2: General Message Format

Byte	Value/Type	Description
1	0x01 (always)	Start of message
2	Unsigned integer	Command ID
3	0 to 252	Parameter length
4 to (N + 3)	Message dependent	Additional Data (0 to 252 bytes)
(N + 4)	Checksum	Frame check sequence

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## 7.2 Commonly Used Command Examples

This section shows examples of commonly used commands.

*Table 3: Touch-up Command with Shutter*

Byte	Value/Type	Description	Command String
1	0x01	Start of message	0x01 0x27 0x02 0x00 0x03 0xD3
2	0x27	Field Calibrate Command ID	
3	0x02	Parameter length	
4 , 5	0x03	Touch-up Command with Shutter	
(N + 4)	Checksum	Frame check sequence	

*Table 4: Touch-up Command without Shutter*

Byte	Value/Type	Description	Command String
1	0x01	Start of message	0x01 0x27 0x02 0x00 0x04 0xD2
2	0x27	Field Calibrate Command ID	
3	0x02	Parameter length	
4 , 5	0x04	Touch-up Command without Shutter	
(N + 4)	Checksum	Frame check sequence	

*Table 5: Close and Disable Shutter Command*

Byte	Value/Type	Description	Command String
1	0x01	Start of message	0x01 0x81 0x02 0x00 0x01 0x7B
2	0x81	Field Calibrate Command ID	
3	0x02	Parameter length	
4 , 5	0x01	Close and Disable Shutter Command	
(N + 4)	Checksum	Frame check sequence	

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*Table 6: Open and Enable Shutter Command*

Byte	Value/Type	Description	Command String
1	0x01	Start of message	0x01 0xAC 0x02 0x00 0x0000 0x51
2	0xAC	Field Calibrate Command ID	
3	0x02	Parameter length	
4, 5	0x0000	Disables Autocal Command	
(N + 4)	Checksum	Frame check sequence	

*Table 7: Disable Autocal Command*

Byte	Value/Type	Description	Command String
1	0x01	Start of message	0x01 0xAC 0x02 0x00 0x0001 0x50
2	0xAC	Field Calibrate Command ID	
3	0x02	Parameter length	
4, 5	0x0001	Enable Autocal Command	
(N + 4)	Checksum	Frame check sequence	

*Table 8: Enable Autocal Command*

Byte	Value/Type	Description	Command String
1	0x01	Start of message	0x01 0x28 0x00 0xD7
2	0x28	Black Hot Set Command ID	
3	0x00	Parameter length	
(N + 4)	Checksum	Frame check sequence	

*Table 9: Black Hot Set Command*

Byte	Value/Type	Description	Command String
1	0x01	Start of message	0x01 0x29 0x00 0xD6
2	0x29	White Hot Set Command ID	
3	0x00	Parameter length	
(N + 4)	Checksum	Frame check sequence	

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*Table 10: White Hot Set Command*

Byte	Value/Type	Description	Command String
1	0x01	Start of message	0x01 0xD7 0x02 0x00 0x02 0x24
2	0xD7	Video Data Command ID	
3	0x02	Parameter length	
4	0x02	Raw Data Command	
(N + 4)	Checksum	Frame check sequence	

*Table 11: Raw Data Command*

Byte	Value/Type	Description	Command String
1	0x01	Start of message	0x01 0xD7 0x02 0x00 0x06 0x20
2	0xD7	Video Data Command ID	
3	0x02	Parameter length	
4	0x06	Raw Data Command	
(N + 4)	Checksum	Frame check sequence	

*Table 12: NUC and BPR Video Command*

Byte	Value/Type	Description	Command String
1	0x01	Start of message	0x01 0xD7 0x02 0x00 0x06 0x20
2	0xD7	Video Data Command ID	
3	0x02	Parameter length	
4	0x06	Raw Data Command	
(N + 4)	Checksum	Frame check sequence	