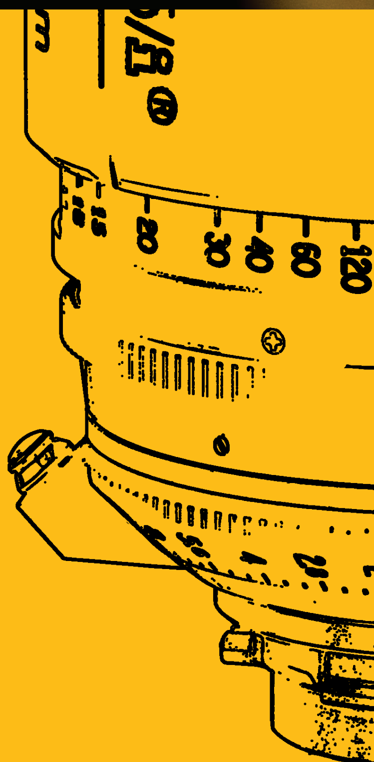
Cooke /i Technology



User's Guide & Technical Manual

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Cooke /i Communication Protocol: User's Guide & Technical Manual

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Introduction

Cooke Optics Limited developed the /i Technology system to enable film and digital cameras and equipment to automatically record and display key lens data for every frame shot. Lens metadata includes information such as focal length, focus distance, T-stop, Zoom, depth of field, horizontal field of view, entrance pupil position and frame rate. Script supervisors no longer need to manually write down lens setting for every frame shot. Power and data are transmitted through a camera interface, an external interface or both.

Cooke's new /i2 Technology (/i Squared Technology) metadata system builds on the capabilities of Cooke's /i Technology. In additional to lens metadata, the newest features provide inertial tracking data to be used by applications such as matchmoving and 3D camera tracking. The position and orientation data along with the lens data make it easier for VFX teams to deal with common issues like occlusions, fast camera motion (motion blur) and other known challenges associated with today's fast paced motion capture style.

1.1 Purpose

This document is both a User's Guide and a Technical Manual. It contains instructions on how to control and communicate with Cooke /i lenses along with additional information about current /i Technology and /i2 (/i Squared) Technology protocol standards.

1.2 Intended Audience

- Sections 1 through 10 and Appendices A through C of this document are available on the Cooke Optics Website and can be downloaded at http://www.cookeoptics.com/s/technicaldocumentation.html. It is an /i Technology Communications Protocol User Guide and Manual for Cooke lens users, Technicians, /i Technology partners and anyone interested in learning more about the /i Technology protocols.
- Appendix D is available by special request to /i Technology partners.

1.3 Contact Information

Please email info@cookeoptics.com with questions or if you need additional information.

1.4 References

Cooke /i Communications Protocols Version 3.0.1 – May 2013

2. Cooke /i "Intelligent" Technology Overview

/i Technology is a registered trademark of Cooke Optics Limited. It is a metadata protocol system that enables film and digital cameras to automatically record key lens data for every frame shot. Equipment identification is by serial number, lens type and manufacturer.

The /i Technology system records lens settings and performs a series of calculations to provide continuous remote readout of focal length, focusing distance, aperture, zoom, depth of field, hyperfocal distance, horizontal field of view, entrance pupil position, and normalized zoom in both metric and imperial units. The information is digitally recorded for every frame and stored as metadata, accessible via cable connector near the lens mount and/or contacts in the PL mount that sync with /i compatible cameras and other equipment.

2.1 /i^2 (/i Squared) Technology

The newest /i^2 Technology metadata system builds on the capabilities of Cooke's /i Technology. In additional to lens metadata, the newest functions provide inertial tracking data. The position and orientation data along with all other lens data will greatly aid VFX teams with their post-production work.

The /i^2 Technology system is backward compatible with the original /i Technology software. An inexpensive board upgrade is available for Cooke /i lenses.

2.2 /i Technology Open Protocol

The goal behind /i Technology is to provide an open standard that will streamline and enhance the process of filmmaking by making equipment digitally compatible from production through post. Any product that displays the "/i" logo, from acquisition through post, is compatible with all other /i Technology embedded products. This means an /i lens from Cooke can be used with any other products that conform to the /i Technology standards.

Within the /i Technology Communication protocol standard, there are two types of commands as shown in Figure 1: CORE commands and EXTENDED commands. CORE commands are used to communicate between different brands of equipment and are supported by ALL /i Technology partners. The /i Technology protocol platform also allows for brand specific commands known as EXTENDED commands. EXTENDED commands are considered brand specific and are not supported by all lenses, cameras or /i Technology partners. Users should rely on the CORE command set.

EXTENDED command sets may include unique brand specific commands used for tasks such as calibration, software updates, or communication between brand specific equipment. EXTENDED commands should be considered hidden commands not used by a typical operator. A list of EXTENDED commands is available by request to /i Technology Partners.

/i Technology CORE Commands and EXTENDED Commands

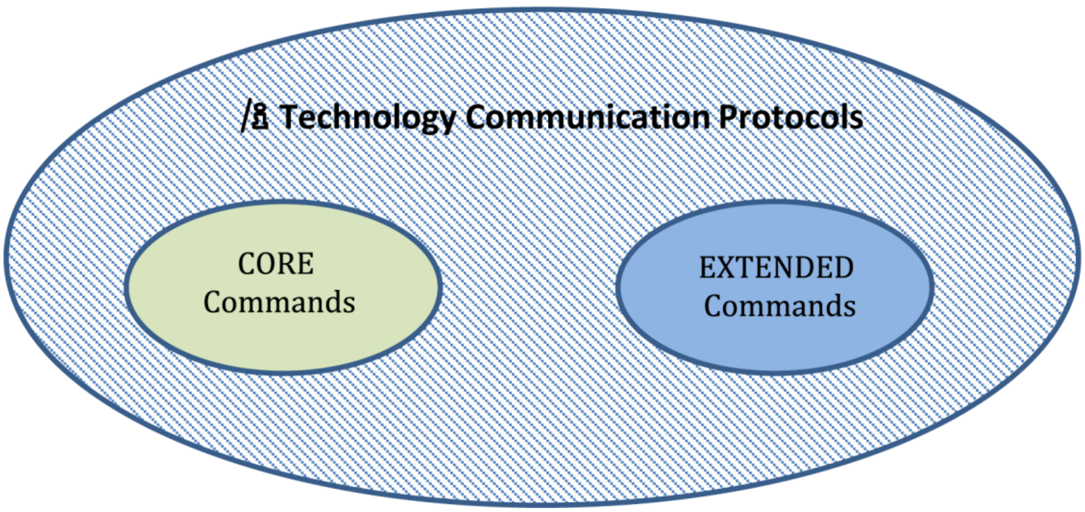


Figure 1

2.3 /i Technology Partners

Digital cameras that are /i equipped (ARRI Alexa, RED, Sony F35, F3, F5, F55, F65) and film cameras (Arricams) talk to /i lenses directly via contacts in their lens mounts. Transvideo monitors have built-in /i Technology that can display lens data in real time along with a graphic representation of the iris, focus and depth-of-field. Metadata is passed through to post-production through cameras or recorders like the Codex Data Logger One which captures Cooke's /i[2] inertial tracking metadata. In partnership with Pixel Farms, inertial and lens data is converted into common 3D formats that can be used across the multitude of compositing and 3D animation packages used in everyday VFX work. A more extensive list of current /i Technology partners can be found in Appendix B.2.

2.4 Table 1: Lens Types with /i Technology

TYPE	SERIAL No.	EXAMPLE
Cooke Optics Lenses (see Section 2.5 Serial No. format change for /i2)		
miniS4/i Prime Lenses(**)	8FFF.xxxx 8FFF-xxxx	8025-1234 = miniS4/i 25mm
S4/i Prime Lenses	4FFF.xxxx 4FFF-xxxx FF-xxxx	4025.1234 = S4/i 25mm (with /i2) 4025-1234 = S4/i 25mm (without /i2) 25-1234 = S4/i 25mm (without /i2)
5/i Prime Lenses	5FFF.xxxx 5FFF-xxxx	5025.1234 = S4/i 25mm (with /i2) 5025-1234 = S4/i 25mm (without /i2)
S4/i CXX Zoom Lens	800xxx	800123 = CXX 15-40mm (without /i2)
Anamorphic /i Prime Lenses	9FFF.xxxx	9025.1234 = Anamorphic/i 25mm (with /i2)
Anamorphic /i Zoom Lens	9641.xxxx 9691.xxxx	9641.1234 = 35mm-140mm (with /i2) 9691.1234 = 45mm-405mm (with /i2)
Other Manufacturers' Lenses		
RED Zoom 18-50mm	600xxxx	6001234
RED Zoom 50-150mm	610xxxx	6101234
DigiOptical 18-50mm	620xxxx	6201234
DigiOptical 50-150mm	630xxxx	6301234
Angenieux OPTIMO 15-40mm	AAxxxxxxx	AA1234567
Angenieux OPTIMO 28-76mm	ABxxxxxxx	AB1234567
Angenieux OPTIMO 45-120mm	ACxxxxxxx	AC1234567
Angenieux OPTIMO DP 16-42mm	ADxxxxxxx	AD1234567
Angenieux OPTIMO DP 30-80mm	AExxxxxxx	AE1234567
Angenieux OPTIMO 17-80mm	AFxxxxxxx	AF1234567
Angenieux OPTIMO 24-290mm	AGxxxxxxx	AG1234567
Angenieux OPTIMO STYLE 25-250 (*)	AHxxxxxxx	AH1234567
Angenieux OPTIMO STYLE 16-40mm	AIxxxxxxx	AI1234567
Angenieux OPTIMO STYLE 30-76mm	AJxxxxxxx	AJ1234567
Angenieux OPTIMO 30-72 A-2Smm	AKxxxxxxx	AK1234567
Angenieux OPTIMO 56-152 A-2Smm	ALxxxxxxx	AL1234567
Angenieux OPTIMO 28-340mm	AMxxxxxxx	AM1234567
Angenieux OPTIMO 19.5-94mm	ANxxxxxxx	AN1234567
Fujinon 19-90mm	F0700****	F07001234
Fujinon 85-300mm	F0701****	F07011234
Sony F3 35mm	S01Pxxxxx	S01P00001
Sony F3 50mm	S02Pxxxxx	S02P00001
Sony F3 85mm	S03Pxxxxx	S03P00001
Sony F3 Wide Zoom 11-16mm	S04Zxxxxx	S04Z00001

Sony F3 Power Zoom 18-252mm	S05Zxxxxx	S05Z00001
Canon	Qxxxxxxxx	Q93810250
Zeiss	Zxxxxxxxx	Zxxxxxxxx

(**) Panchro/i Rebranded **miniS4/i**

(*) The **Angenieux OPTIMO STYLE 25-250** has internal /i Technology. For other Angenieux lenses, /i technology is supported via external motorization.

2.5 Cooke Lenses: Serial Numbers with /i2 Technology

Please note changes to the **serial number format** and an update to the **N command response for Cooke S4/i lenses**. Lenses with /i2 Technology will use serial number format “NFFF.xxxx“. Cooke /i lenses that are upgraded with new /i2 Technology boards will have serial numbers stored in memory in the new format even though the engraved serial numbers on the lens body remain in the “NFFF-xxxx” format. The N command response for S4/i lenses equipped with the newer boards, will now match the N command response for all other Cooke lenses.

3. Hardware

3.1 Interface Requirements

Most /i lenses have both a camera communication connector (four contacts built in the PL mount as shown in figure 2) and an external communication connector (figures 3 and 4). miniS4/i lenses without /i2 Technology have only the camera communication interface. Each interface is described in detail in Sections 3.1.2 and 3.1.3.

3.1.1 Power

Power can be supplied to the lens through either the camera connector or an external connector (if available) or both. The maximum voltage which can be supplied on either connector is 35V (DC). Minimum voltage to run older /i boards is 8 volts and minimum voltage to run /i2 boards is 5 volts.

/i Lens Power Comsumption [without /i2 Technology]					
Voltage	**S4/i(mA)**	**5/i (mA)**	**5/i (mA)**	**Anamorphic /i (mA)**	**miniS4/i (mA)**
		Lights off	Lights On		
10	32	49	80	49	64
12	32	49	80	49	64
14	33	49	80	49	64
16	33	49	80	49	64
18	33	50	80	50	64
20	33	50	80	50	64
22	33	50	80	50	64
24	34	50	81	50	64
26	34	50	81	50	64
28	34	50	81	50	64
30	34	51	81	51	64
32	34	51	81	51	64

/i2 Technology					
Voltage	**S4/i(mA)**	**5/i (mA)**	**5/i (mA)**	**Anamorphic /i (mA)**	**miniS4/i(mA)**
		Lights off	Lights On		
10	26	26	67	26	TBD
12	22	22	67	22	TBD
14	19	19	63	19	TBD
16	17	17	57	17	TBD

18	16	16	51	16	TBD
20	15	15	46	15	TBD
22	14	14	43	14	TBD
24	13	13	40	13	TBD
26	12	12	38	12	TBD
28	12	12	36	12	TBD
30	11	11	34	11	TBD
32	11	11	34	11	TBD

3.1.2 Camera Connector

Signal voltages on the camera interface are at TTL levels where the quiescent state of the data line is a logical high (greater than 2.4 volts).

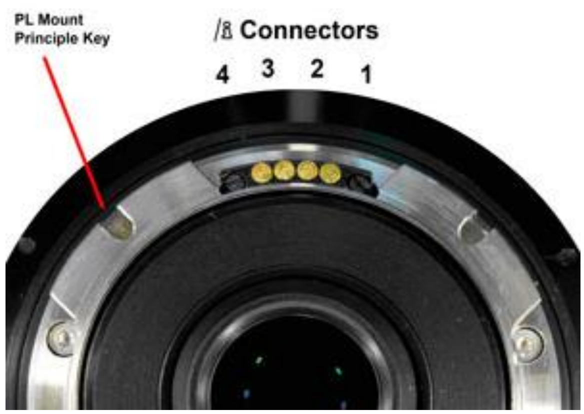


Figure 2: Viewed from rear of lens

Pin 1	**Data from Lens**	
Pin 2	**Data to Lens**	
Pin 3	**0 volts**	**Data and Power**
Pin 4	**+V**	**Power in**

Note: A pull up resistor may be needed to successfully establish communication with an ARRI camera. To detect a lens during start-up, an ARRI camera first applies a 5V test voltage and measures the voltage between RX and TX. If the voltage level is in the range of 10-80% of the applied test voltage, communication is successfully established and the camera switches on the 24V supply voltage. The pull-up resistor value will differ depending on lens hardware. Cooke /i2 lenses use pull-up resistors in the range 300K-400K ohms. Older Cooke /i boards do not need a pull-up resistor. In addition, ARRI cameras require the startup time for lens to be less than or within the range 400-500ms after power has been applied.

3.1.3 External Connector

Signal voltages on external connector are at RS 232 levels (+ and – with respect to 0 volts) where the quiescent state of the data line is at a negative voltage. The external connector is a standard LEMO mechanical connector with 4 pins. Maximum cable length depends on baud rate. (Refer to Table 2 on page 14.)

3.1.3.1 Standard LEMO Connector

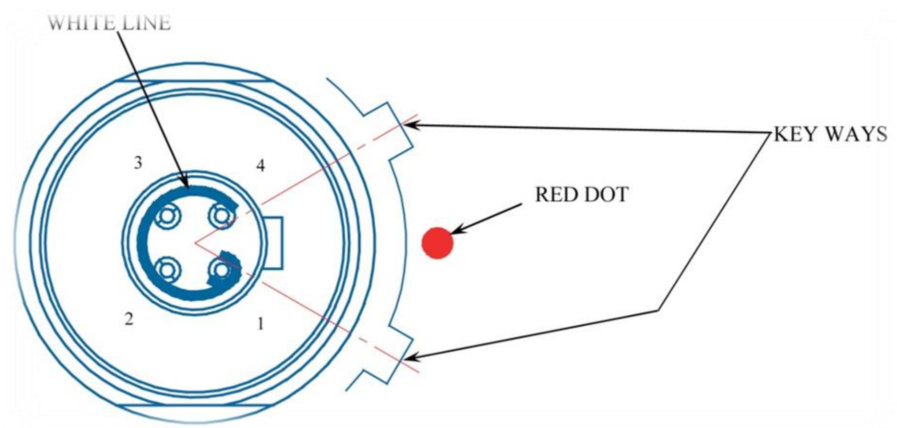


Figure 3: Rear View of LEMO socket EGB00304CLL. (This is the view of the solder buckets and the red dot marker and key way positions indicated for clarity.)

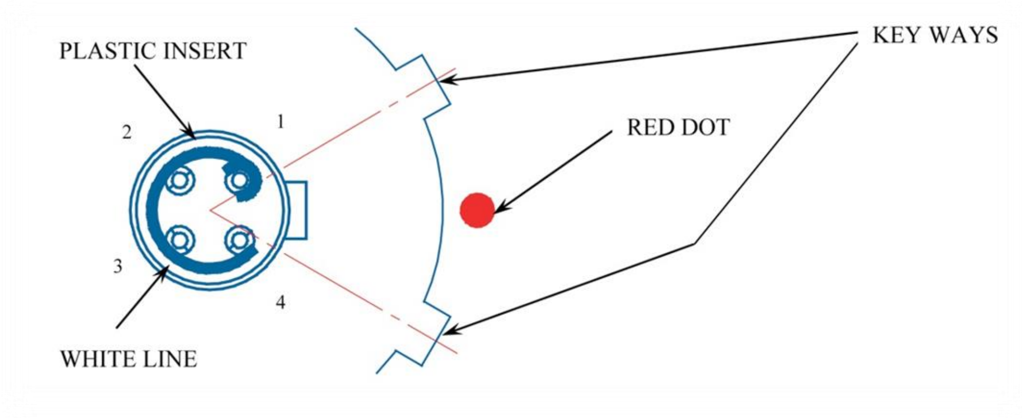


Figure 4: Rear View of LEMO PLUGS FGB00304CLAD35 or FHB00304CLAD35. (This is the view of the solder buckets and the red dot marker and key way positions are indicated for clarity.)

Pin 1	**Data from Lens**	
Pin 2	**Data to Lens**	
Pin 3	**0 volts**	**Data and Power**
Pin 4	**+V**	**Power in**

3.1.3.2 Table 2: Maximum Cable Length versus Baud Rate

Baud Rate	Max Cable Length
9600	50 meters
19200	30 meters
38400	10 meters
48000	8 meters
57600	5 meters
96000	2 meters
115200	2 meters
230400	0.5 meters

The RS-232 maxium cable length depends upon baud rate.

3.2 Lens System Components

3.2.1 Lens System Overview

The Cooke /i Technology lens system contains resistance elements to sense ring positions, an electronics board to process and calculate lens information, and one or two serial communications interfaces to receive and send commands and data to a camera and/or other external device. Cooke 5/i lenses also have two sets of LEDs used to illuminate the focus scale. The LEDs are connected to a secondary electronics interface board.

The lens electronics board has a communication interface which connects directly to the camera and may also have a second communication interface that can be connected to an external device such as a monitor, recorder or External Data Source Unit. The camera interface operates at TTL levels and the external interface operates at RS232 levels. Each communication interface provides power supply and serial transmit and receive lines through separate 4 way connectors. See Sections 3.1.2 and 3.1.3 for details.

3.2.2 Potentiometer Connections

Cooke Prime lenses house two sensor resistance elements with wipers to sense the ring positions for focus and aperture. Cooke Zoom lenses house three sensor resistance elements, with wipers to sense the ring positions of focus, aperture and zoom. The lens electronics board connects to the resistance elements using one connector for Prime lenses and two connectors for Zoom lenses. They are supplied with power from the board and the wiper signals are fed back to the board for sensing. These current settings are interpreted using analog inputs which have 12 bit resolution. (Some of the earliest S4/i lenses had only 10 bit resolution.)

3.2.3 Illumination Ring

The 5/i Prime lens logic boards have an additional 4-way connector which connects to a secondary electronics board via a cable. This connector carries power plus 2 PWM current sinking signals to control the two sets of LED's and provide scale illumination. Lighting control instructions are described in Section 8.1.

3.2.4 Inertial Components

Lenses with /i2 Technology have a 3D digital linear acceleration sensor, a 3D digital magnetic sensor and a 3D digital angular rate sensor. Sensor calibration is performed at the factory when the lenses are built. The inertial calibration coefficients are constant values unique to each lens. This data is necessary for post-production processing of the inertial data and should be retrieved once and stored with the frame-by-frame inertial data and lens metadata.

4. System Communications

4.1 Basic Communications Format

Standard serial communication is 8 bit data without parity, 1 stop bit, in ACSII format. The lens also transmits a packed binary format response when requested, using the 8 bit no parity format, to reduce the time taken to transmit data from the lens.

Inertial data, distortion map and illumination data is transmitted using pre-defined binary data packets described in Sections 5.5 and 5.6.

The camera or external unit will initiate all data transfers from the lens except during Power-Up. At Power-Up, a single automatically generated string is transmitted by the lens to both channels indicating that a power-up has occurred.

All commands sent to the lens must be in ASCII format and terminate with a carriage-return character [c/r]. The carriage return character has hex value “0x0D”. Lens reply responses in ASCII format terminate with the character pair, linefeed followed by carriage return [l/f][c/r]. The linefeed carriage return pair have hex values “0x0A” and “0x0D”.

4.2 Communicating with an /i Lens

All Cooke Anamorphic /i Prime lenses, 5/i Prime lenses, Cooke S4/i Prime and Zoom lenses have two communications channels. Cooke miniS4/i Prime lenses (previously branded Panchro/i) built prior to 2016 have one communication channel. miniS4/i lenses with /i2 Technology will have two communications channels.

Power inputs on the S4/i communication channels are monitored at startup and during operation to determine which channel has control. Lenses that have a single communication channel will be controlled by the camera interface. For all 5/i and Anamorphic /i Prime lenses, the two channels function independently and can both receive commands and send replies at different baud rates. S4/i and miniS4/i lenses with /i2 Technology also have two independently functioning channels. However, the channels on S4/i Prime and Zoom lenses with older electronics boards (without /i2 Technology), do not function independently. For these S4/i lenses, if power is present on the external interface, then the external interface is granted control. If power is not present on the external interface, then the camera is granted control. S4/i lenses with older electronics boards (installed prior to 2016) can receive commands on only one channel, but responses will be sent out on both channels.

Typically, a lens will start-up at a baud rate of 115k2 and send the *powerup string*, <[l/f][c/r/], (less-than symbol followed by a linefeed and carriage return), when power is on. The lens will then wait for one second to receive an N command from a controlling channel. If this command is not received within one second, the baud rate will drop to 9600 and the lens will issue a new power up string of <[l/f][c/r/]. The lens then waits until the N command is received. The lens must receive an N command as the first command. Once the lens has received and responded to this command, all other commands (valid for that lens type) are available to the controlling channel(s). For example, the Kbn command can be sent to the lens to revise the baud rate.

4.2.1 Connecting an /i Lens to an /i Camera

Film and digital cameras which are /i Technology compliant can automatically retrieve and record key lens data for each frame through the four contact pins built into the PL mounts. The extent of camera data made available is the choice of the camera manufacturer via their software, so check with the camera manufacturer for details. Cameras use different film sizes or Circle of Confusion values. The lens' default film size is 35 mm with Circle of Confusion value equal to 0.0250 mm. You can use the V, W or Wnn command to set the appropriate film size to match any camera. See Section 5.15 – 5.17 for details.

4.2.2 External Remote Readout of /i Lens Data

Continuous remote readout of the precise lens data can be obtained by connecting the lens to an external device such as the Cinematography Electronics /i Lens Display Unit or Codex Data Logger One. Lens data can be displayed on an externally connected//i compatible monitor, such as Transvideo's CineMonitorHD.

4.3 Viewer Software for Cooke /i Lenses

The Cooke Viewer program can be used to display lens data through both the camera and external interface. Use the Cooke /i Technology to RS-232 Power Supply Adapter & Cable to connect an /i lens to a computer via the lens' lemo connector. The Cooke /i Update Base in combination with the RS-232 Power Supply Adapter & Cable can be used to connect an /i lens to a computer via the lens' PL mount. (See Appendix B.3 for additional information on /i accessories.)

The program runs on a Windows or MAC OS X platform and can be downloaded from the Cooke Optics website at: http://www.cookeoptics.com/cooke.nsf/technical/downloads.html The lens is connected to the PC or MAC through a serial port. If the computer does not have a serial port, use a USB-Serial port adapter and install the correct driverA Java Runtime Environment (JRE) is required to run the program. If it is not already installed on your computer, it can be downloaded for free from www.java.com. (See Appendix C.2 for additional details on how to use the Viewer Software.)

4.4 Update Ownership Program for Cooke /i Lenses

The Cooke Owner Update program can be used to change the owner name stored in the lens through its external interface. The program runs on Windows and MAC OS X platforms and can be downloaded from the Cooke Optics website at:
http://www.cookeoptics.com/cooke.nsf/technical/downloads.html

The lens is connected to the PC or MAC through a serial port. If the computer does not have a serial port, use a USB-Serial port adapter and install the correct driver. We recommend using FTDI chipset high speed USB 2.0 to Serial RS-232 DB-9 converter.

A Java Runtime Environment (JRE) is required to run the program. If it is not already installed on your computer, it can be downloaded for free from www.java.com.

See Appendix C.1 for additional details on how to use the Ownership Update Software.

4.5 Hyper Terminal / HTerm / PuTTY - Serial Terminal Emulators for COM Ports

HyperTerminal, HTerm or PuTTY can be used to communicate with a lens by connecting the external connector of the lens to a serial port on a PC.

HyperTerminal is an application that allows terminal emulation in Windows for certain types of devices. HyperTerminal communicates over serial connections (like RS-232) and provides access to a text based application console. If there are no serial ports on the PC, you can use a USB-to-Serial port converter and use device manager to determine which COM port is emulated by the USB converter. We recommend using FTDI chipset high speed USB 2.0 to Serial RS-232 DB-9 converter.

If there is no HyperTerminal preinstalled on your PC, it can be downloaded from the Internet or retrieved from a Windows XP computer. [Note: Windows Vista, Windows 7 and newer versions no longer provide HyperTerminal.] Alternatively, HTerm or PuTTY can be downloaded from http://www.der-hammer.info/terminal/ and http://www.putty.org/ and configured as a terminal emulator.

More detailed instructions can be found in Appendix C.3.

4.6 External Data Source Unit (EDSU)

Cooke Anamorphic /i and 5/i lenses, (plus S4/i and miniS4/i lenses with /i2 Technology), have additional facilities and commands which enable an external device, (called an External

Data Source Unit or EDSU,) connected to the lens' external RS232 channel, to perform special operations.

Under normal operation, a command is sent to a lens to request information. The lens generates a data string and sends this information to the camera interface, the external interface or both. This data can then be stored by the camera or external device for post processing. Lenses with EDSU capabilities have the additional facility to collect a data stream from an External Data Source Unit (EDSU) and then append this data to the normally generated data string of the lens. This combined data string is then sent to the camera. At the same time that the EDSU is sending data to the lens, it can also request that the lens send the normal data stream back to it. (Commands and instructions for using the EDSU are described in Section 9.)

4.7 /i Lens Types – CORE Commands and EXTENDED Commands

Within the /i Technology Communication protocol standards, there are two types of commands: CORE commands and EXTENDED commands. CORE commands are used to communicate between different brands of equipment and are supported by all /i Technology partners. Any equipment from a manufacturer who adopts the /i Technology protocols and agrees to implement all /i CORE commands, can communicate directly with any /i lens. An /i lens accepts specific commands that control the data output, including a continuous mode that can send a constantly updated data stream at up to 285 frames per second. This data can be embedded as metadata. For cameras with /i capability, the data can be stored as metadata with the image file.

The /i Technology open protocol platform also allows for brand specific commands known as EXTENDED commands. EXTENDED commands are considered brand specific and are not supported by all lenses, cameras or /i Technology partners. Users should rely on the CORE command set.

When each lens is built, a careful process is undertaken to ensure each individual sensor is calibrated so that the resistance elements map correctly to their respective optical ring markings and inertial sensor coefficients are stored for post processing. This information is stored in the electronics board along with other unique lens characteristics. There is a set of EXTENDED commands, unique to Cooke lenses, used for this purpose only. These *hidden* commands are considered confidential.

In addition to the set of EXTENDED commands associated with calibrating a lens, there is also a set of EXTENDED commands associated with lens program updates. These commands are confidential.

4.7.1 miniS4/i Prime Lenses T2.8 [Note: Panchro/i Rebranded miniS4/i]

miniS4/i Prime lenses built prior to 2016 (do not have /i2 Technology) will have a single channel interface for direct communication with a camera. The start-up baud rate will be 115k2 if an N command is received within one second. If no N command is received within one second, the speed will drop to 9600 baud and the lens will issue a new power up string of <[l/f][c/r]. It will then wait without timeout for an N command. Baud rate can be adjusted using the Kbn command. The CORE commands described in Sections 5.1 through 5.1.18 are available for miniS4/i lenses. miniS4/i lenses with /i2 Technology also have available CORE commands described in Sections 5.4.

4.7.1.1 miniS4/i Prime Lenses T2.8 with /i2 Technology

miniS4/i lenses with /i2 Technology have two communications channels which can receive commands and send responses independently. These channels can operate at different baud rates up to 230.4K. Start-up baud rate is at 115k2 on both channels if an N command is received within one second from either channel. If no N command is received within one second, the speed will drop to 9600 baud and the lens will issue a new power up string of <[l/f][c/r]. It will then wait without timeout for an N command from either channel. Baud rate can be adjusted using the Kbn command.

A set of additional functions are available to miniS4/i lenses (equipped with /i2 Technology) which allow them to receive an externally generated data string and then append this received data to the normally generated data stream of the lens before it is sent to the camera. A unit which sends data to a miniS4/i lens (equipped with /i2 Technology) through its external interface is called an "External Data Source Unit" or EDSU. Operation with an EDSU is described in Section 9. Section 5.4 defines the commands associated with the EDSU functionality.

miniS4/i lenses that are equipped with /i2 Technology also provide inertial tracking data in addition to all lens metadata.

4.7.2 S4/i Prime and CXX 15-40mm Zoom T2.0 Lenses - Power

S4/i lenses have two communications channels. The channels operate independently for S4/i lenses equipped with /i2 Technology. Older S4/i lenses (without /i2 Technology) do not have independent channels. These lenses send the same response to both channels and can receive commands only from a single controlling channel. If power is present on the external interface, the external interface takes precedence over the camera interface and will have control. If only one interface supplies power, it will be the controlling channel. The CORE commands described in Sections 5.1 through 5.1.18 are available for S4/i lenses. S4/i lenses with /i2 Technology also have available CORE commands described in Sections 5.4.

4.7.2.1 S4/i Prime and CXX 15-40mm Zoom T2.0 Lenses without /i2 Technology

Older S4/i lenses have two communications channels that can operate at baud rates up to 115k2. If the external interface has control, start-up will be at 115k2 baud and the standard power-on prompt, "< [l/f][c/r]", is sent. If no N command is received within one second the data rate is dropped to 9600 baud and a modified power-up string in sent, "+++<". This is a unique Bluetooth feature built into older S4/i lens only (without /i2 Technology). The modified power-up string doubles as both a Bluetooth initialization prompt, "+++", and a standard start-up prompt. Additional details on establishing a Bluetooth connection are described in Appendix A.2. Baud rate can be adjusted using the Kbn command.

4.7.2.2 S4/i Prime T2.0 Lenses with /i2 Technology

S4/i lenses with /i2 Technology have two communications channels which can receive commands and send responses independently. These channels can operate at different baud rates up to 230.4K. Start-up baud rate is at 115k2 on both channels if an N command is received within one second from either channel. If no N command is received within one second, the speed will drop to 9600 baud and the lens will issue a new power up string of <[l/f][c/r]. It will then wait without timeout for an N command from either channel. Baud rate can be adjusted using the Kbn command.

Under normal operation, an S4/i lens equipped with /i Technology will receive commands to generate and then send the requested data string to the camera interface, the external interface or both. This data can be stored by the camera or external equipment for recording and subsequent post processing.

A set of additional functions are available to S4/i lenses (equipped with /i2 Technology) which allow them to receive an externally generated data string and then append this received data to the normally generated data stream of the lens before it is sent to the camera. A unit which sends data to an S4/i lens (equipped with /i2 Technology) through its external interface is called an "External Data Source Unit" or EDSU. Operation with an EDSU is described in Section 9. Section 5.4 defines the commands associated with the EDSU functionality.

S4/i lenses that are equipped with /i2 Technology also provide inertial tracking data in addition to all lens metadata.

4.7.3 5/i Prime Lenses T1.4

All 5/i lenses have two communications channels which can receive commands and send responses independently. These channels can operate at different baud rates up to 230.4K. Start-up baud rate is at 115k2 on both channels if an N command is received within one second from either channel. If no N command is received within one second, the speed will drop to 9600 baud and the lens will issue a new power up string of <[l/f][c/r]. It will then wait without timeout for an N command from either channel. Baud rate can be adjusted using the Kbn command.

There are two unique commands, (OX, OY), associated with 5/i's dual marked focus ring. These allow the user to change the Start-Up units to imperial or metric and are described in Section 5.3. See Section 6.2.2 for a more detailed description of the dual marked focus ring.

5/i lenses are equipped with a scale illumination feature not found on any other lenses. The LED's are driven using Pulse Width Modulation to vary the intensity. Intensity settings can be controlled either by using the Aperture ring or a separate Lighting Control Unit. Section 8.1 describes different methods for controlling the scale illumination. Section 5.2 defines commands specific to the 5/i illumination feature.

Under normal operation, a 5/i lens will receive commands to generate and then send the requested data string to the camera interface, the external interface or both. This data can be stored by the camera or external equipment for recording and subsequent post processing.

A set of additional functions are available to 5/i lenses which allow them to receive an externally generated data string and then append this received data to the normally generated data stream of the lens before it is sent to the camera. A unit which sends data to a 5/i lens through its external interface is called an "External Data Source Unit" or EDSU. Operation with an EDSU is described in Section 9. Section 5.4 defines the commands associated with the EDSU functionality.

5/i lenses that are equipped with /i2 Technology also provide inertial tracking data in addition to all lens metadata.

4.7.4 Anamorphic /i Prime Lenses T2.3

Anamorphic /i lenses have two communications channels which can receive commands and send responses independently. These channels can operate at different baud rates up to 230.4K. Start-up baud rate is at 115k2 on both channels if an N command is received within one second from either channel. If no N command is received within one second, the speed will drop to 9600 baud and the lens will issue a new power up string of <[l/f][c/r]. It will then wait without timeout for an N command from either channel. Baud rate can be adjusted using the Kbn command.

There are two unique commands, (OX, OY), associated with 5/i's dual marked focus ring. These allow the user to change the Start-Up units to imperial or metric and are described in Section 5.3. See Section 6.2.2 for a more detailed description of the dual marked focus ring.

Under normal operation, an Anamorphic /i lens will receive commands to generate and then send the requested data string to the camera interface, the external interface or both. This data can be stored by the camera or external equipment for recording and subsequent post processing.

A set of additional functions are available to Anamorphic /i lenses which allow them to receive an externally generated data string and then append this received data to the normally generated data stream of the lens before it is sent to the camera. A unit which sends data to an Anamorphic /i lens through its external interface is called an "External Data Source Unit" or EDSU. Operation with an EDSU is described in Section 9. Section 5.4 defines the commands associated with the EDSU functionality.

Anamorphic /i lenses (equipped with /i2 Technology) provide inertial tracking data in addition to all lens metadata.

4.7.5 DigiOptical, Angenieux, Fujinon, Sony and Canon Lenses

As /i Technology partners, DigiOptical, Angenieux, Fujinon, Sony and Canon have agreed to support all CORE /i Technology commands. Each manufacturer may also have unique EXTENDED command features which are considered hidden to the general user. Depending on the manufacturer, some EXTENDED commands may be available by request to /i Technology partners.

4.8 CORE Command / Response Structure

Communication with a lens is initiated by the Camera or External device and a lens replies with the requested information and/or to acknowledge the command. The only exception to this sequence is at Power-Up. A lens will automatically transmit a data string to each existing channel to indicate a power-up has occurred. The lens will then wait to receive an N command. The lens must receive the N command as its first command, after which all other commands are available to the controlling channel(s).

Each command has a specific lens response. A lens will respond with *the error response string*: "? [L/F][C/R]" to any unrecognized command, unless the *Inhibit Errors* command "Ka" has been issued.

Each of the two communication channels on Anamorphic /i and 5/i lenses (plus S4/i and miniS4/i lenses equipped with /i2 Technology) function independently. S4/i lenses without with /i2 Technology send the same response to both channels and can receive commands only from the controlling channel. For these S4/i lenses, when power is present on the external interface, the external interface will have control. Thus, the camera interface will have control only when there is no power supplied to the external interface. miniS4/i lenses prior to 2016 have only one communication channel.

Some commands were introduced with newer firmware versions and may not be available if their firmware has not yet been upgraded. Firmware and Software Version numbers are listed in Appendix B.1. Note that commands to control scale illumination pertain only to 5/i lenses. The Kdi and K61 commands to retrieve lens data plus inertial data are only available on lenses equipped with /i2 Technology.

4.8.1 Table 3: CORE Command - Function - Lens Type Table

/i Technology CORE Commands						
Command	Function	S4/i	miniS4/i	Cxx	5/i	Anamorphic/i
N	Retrieve Fixed Data – Required first Command	x	x	x	x	x
D	Retrieve one set of ASCII Calculated Data	x	x	x	x	x
Kd	Retrieve one set of Packed Binary Calculated Data	x	x	x	x	x
K3	Retrieve name of Lens Manufacturer	x	x		x	x
K4	Retrieve name of Lens Type	x	x		x	x
P	Retrieve board Temperature	x	x	x	x	x
B	Retrieve board Firmware Version	x	x	x	x	x
Kbn	Set Baud Rate to n *(where n = 1-7 See Chart*) default = 115k2 or 9.6k	x	x	x	x	x
C	Set "Continuous Send" mode & begin transmission of ASCII Calculated Data	x	x	x	x	x
Kc	Set "Continuous Send" mode & begin transmission of Packed Binary Calculated Data	x	x	x	x	x
G	Set "Checksum" mode	x	x	x	x	x
Ka	Set "Inhibit Error Response" mode	x	x	x	x	x
X	Set Display Units to Imperial	x	x	x	x	x
Y	Set Display Units to Metric	x	x	x	x	x
V	Set "Film Size" to 35mm (default value)	x	x	x	x	x
W	Set "Film Size" to 16mm	x	x	x	x	x
Wnn	Set "Film Size" to nn (*where nn = 00 - 09 refers to specified film size/circle of confusion. See chart.*)	x	x	x	x	x
H	Stop "Continuous Send"; clear "Checksum"; clear "Inhibit Error Response" mode	x	x	x	x	x
5/i ILLUMINATION COMMANDS						
Kjn	Set "Scale Illumination" for both LED sets				x	
Kkn	Set "Scale Illumination" for one LED set				x	
START-UP UNITS COMMANDS						
OX	Set Start-Up Units to Imperial				x	x
OY	Set Start-Up Units to Metric				x	x
EXTERNAL INTERFACE COMMANDS [EDSU]						
OS	Retrieve Channel Settings for This Channel	x	x		x	x
OT	Retrieve Baud Rate, Data Type, Display Unit for Opposite Channel	x	x		x	x
OC	Commence Append of Data String	x	x		x	x
OD	Append Data String (up to 60 8-bit data values)	x	x		x	x
OH	Halt Append of Data String	x	x		x	x
INERTIAL DATA COMMANDS						
Kdi	Retrieve one Set of Packed Binary Lens Data + Inertial Data	x	x		x	x
K61	Retrieve Inertial Calibration Coefficients	x	x		x	x

x: These commands are available only for lenses equipped with /i² Technology.

4.9 Start-Up Sequence

Most lenses will start-up at a baud rate of 115k2 and send the *powerup string*, <[l/f][c/r/], (less-than symbol followed by a linefeed and carriage return), when power is detected. The lens will then wait for one second to receive an N command from a controlling channel. If no N command is received within one second, the speed will drop to 9600 baud and the lens will issue a new power up string of <[l/f][c/r]. It will then wait without timeout for an N command from either channel. The lens must receive an N command as the first command. Once the lens has received and responded to this command, all other commands (valid for that lens type) are available to the controlling channel(s).

Variations are shown in the table below.

4.9.1 Table 4: Controlling Channel and Start-up Baud Rate

Lens Type	Interface with Power		Controlling Channel	Start-up Baud Rate
	External	Camera		
miniS4/i - up to 8.02	N/A	YES	Camera	115k2
S4/i – 0.29, 0.39, 1.29, 1.39	YES	YES	External	115k2
S4/i 0.29, 0.39, 1.29, 1.39	YES	NO	External	115k2
S4/i - 0.29, 0.39, 1.29, 1.39	NO	YES	Camera	115k2
S4/i - up to 0.28, 0.38, 1.28, 1.38	YES	YES	External	115k2
S4/i - up to 0.28, 0.38, 1.28, 1.38	YES	NO	External	115k2
S4/i - up to 0.28, 0.38, 1.28, 1.38	NO	YES	Camera	**9600**
5/i	YES	YES	Both	115k2
5/i	YES	NO	External	115k2
5/i	NO	YES	Camera	115k2
Anamorphic/i	YES	YES	Both	115k2
Anamorphic/i	YES	NO	External	115k2
Anamorphic/i	NO	YES	Camera	115k2

Note: For Anamorphic /i, 5/i and all /i^2 Technology lenses, both channels function independently.

4.9.2 Bluetooth Operation – S4/i Lenses with 1st Generation /i Boards Only

S4/i lenses with 1st generation /i lens boards (no inertial data) are Bluetooth capable (if the external interface has control), although this feature has been dropped from the rest of the Cooke /i lens' series and has been retired in the next generation S4/i lenses with i boards. If an S4/i lens is controlled by the external interface, its start-up baud rate will be 115k2 and the standard power-on prompt, <[l/f][c/r/], is sent to both channels. The lens will wait for one second to receive an N command from the external channel. If no response is received within one second, the data rate will drop to 9600 baud and a modified power-on string is sent: +++<[l/f][c/r/]. This string doubles as a Bluetooth initialization prompt, "+++" and a standard start-up prompt, "<". The lens at this stage will accept either the N command directly through the external interface or it will enter a series of exchanges to establish a Bluetooth connection. If the N command is received on the external interface, the lens will skip further Bluetooth operation and enter normal startup mode.

If a valid Bluetooth connection is established, the baud rate will remain at 9600 and the lens will wait for the N command. The Baud rate must remain at 9600 once a Bluetooth link is established, so any command to change baud rate at this point will receive the *error response*. In the event a Bluetooth connection is not established correctly within one second, the lens will issue a standard startup string (<) and wait until an N command is received from the external interface.

The series of command and responses to establish a Bluetooth communication exchange is outlined in Appendix A.2.

4.9.3 Table 5 Basic Lens Response Types

Basic Lens Response	What It Means
< l/f c/r	Standard Power-On
+++< l/f c/r	Look for Bluetooth Initialization – not supported in /i^{2}
^ l/f c/r	Channel temporarily locked out
@ l/f c/r *or* @x l/f c/r	Loss of Program - not supported in /i^{2}
? l/f c/r	Invalid command (Note: Will not be sent if Inhibit Error Command has been issued.)
[Tag]…..*data string* …… l/f c/r	Echo command that was sent followed by the requested data.
! l/f c/r	Acknowledge the command was received and implemented.

5. CORE Command Set

5.1 CORE Commands – All Lenses

Commands to a lens are in ASCII format and terminate with a carriage return character. Responses from a lens are in either an ASCII format, a packed binary or a pre-defined binary data packet format and terminate with the character pair, linefeed carriage-return: [l/f][c/r].

5.1.1 N Command:

Retrieve **Fixed Data in ASCII Format: Typical Response** *(see exceptions by Lens type)*

Lenses must receive either an N command as the first command. Once the lens has received and responded to the start-up command, all other commands (valid for that lens type) are available to the controlling channel(s).

Note: Some older lenses (S4/i lenses without /i2 Technology) have N command responses that vary slightly from what is shown below. Please see Appendix A.1 for details. All 5/i, miniS4/i, Anamorphic /i, CXX Zoom and S4/i (with /i2 Technology) provide the following N command response. This will remain consistent for all lenses in all future development cycles.

Issue	N[C/R]	Tag = N
Response – Prime Lens	NSs..sssOu..uuuLPNxxxMdddUbTffyyBv.vv [L/F][C/R]	
Response-Zoom Lens	NSs..ssssOu..uuuLZNxxxMdddUbTffyyBv.vv [L/F][C/R]	

Tag	Value	Definition
S	s .. sss	Serial Number – 9 characters
O	u.. uuu	Owner Data – 31 characters
L	t	Lens Type: t=P for Prime, Z for Zoom
N	xxx	Focal length (Primes) or minimum focal length (Zooms) [Tag=f for S4/i Primes
M	ddd	Unspecified (Primes) or maximum focal length (Zooms)
U	b	Start-up units: I=imperial, M=metric, (b=metric or B=imperial when both available).
T	ff	Transmission factor *(not yet available in S4/i Primes-see Appendix)*
	yy	2 SPACE characters
B	v.vv	Firmware version number

Example:

Issue: N[c/r]

Response: NS5100-0001OCooke Optics Electronic Lenses!LPN100M100UbT92 B5.03 [l/f][c/r]

The N command returns maximum focal length=999mm (tag M) when the maximum focal length equals or exceeds 999mm.

5.1.2 D Command:

Retrieve **Pre-Defined Set of Calculated Data in ASCII Format**

Please see Appendix A.1 for variations in response to D command.

Issue	D[C/R]	Tag = D
Response	D s s s s s s s T a a a a t b b b b b Z f f f f H a a a a a a a N b b b b b b b F c c c c c c c V v v v . v E s e e e z m m m m S x x x x x x x x x [L/F][C/R]	

Tag	Value	Definition
D	s s s s s s s	Actual focus distance – units*
T	a a a a	Actual Aperture setting
t	b b b b b	Actual Aperture setting – conventional notation**
Z	f f f f	Zoom – EFL (mm) [0000 for Prime lenses]
H	a a a a a a a	HYPERFOCAL Setting –units*
N	b b b b b b b	NEAR FOCUS distance – units*
F	c c c c c c c	FAR FOCUS distance – units*
V	v v v . v	Horizontal Field of view - degrees
E	s e e e	Entrance Pupil Position – units* [Tag: s is a + or - sign]
z	mmmm	Normalized Zoom Setting
S	xxxxxxxxx	Lens Serial Number

All distances are actual distances measured from the focal plane.

Example:

Issue: D[c/r]

Response: D0000402T0195t1.4+8Z0000H0087250N0000400F0000404V006.8E+039z0000S5100-0009[l/f][c/r]

The units* depend on which *Display Units* have been selected. (See commands X and Y) Metric units will be in multiples of 1mm and Imperial units will be in multiples of 0.1 inch.

The Actual Aperture setting is a multiple of 0.01 (typical values range from 1.xx to 22.xx) The Actual Aperture setting - conventional notation** is intended for display purposes and follows the ring marks using FULL STOP + n notation to indicate the nearest 1/10th STOP value.

The reference frame size used for the Horizontal Field of View is based on the dimensions for 35mm film and is specified as 12.446mm (24.892/2).

The aperture values returned by the D and Kd commands reflect the actual iris ring position.

The zoom values returned by the D and Kd commands reflect the actual zoom ring position.

5.1.3 Kd Command:

Retrieve **Pre-Defined Set of Calculated Binary Data Packets**

Please see Appendix A.1 for variations in response to Kd command.

Issue	Kd[C/R]	Tag = d
Response	d s s s s TT t t z z h h h h n n n n f f f f v v e e Z Z S x x x x x x x x x [L/F][C/R]	

Response Values	**Definition**
d	Tag
ssss	Focus Distance
TT	Aperture Value – Actual Aperture Setting
tt	Aperture Ring T Stop Integer x 10 & the 1/10th fraction
zz	Zoom - EFL (mm) [0000 for Prime lenses]
hhhh	Hyperfocal Setting
nnnn	Near Focus Distance
ffff	Far Focus Distance
vv	Horizontal Field of View
ee	Entrance Pupil Position
ZZ	Normalized Zoom Value [0000 – 10000] *[This field not included in S4/i Prime lenses prior to 0.29 (4.01) or 0.39 (4.21)]*
Sxxxxxxxxx	S followed by Lens Serial Number [ASCII format]

All distances are actual distances measured from the focal plane.

Example:

Issue: Kd[c/r]

Response: d@@FRCCŽˆ@@@USR@@FP@@FTADA¢@@S5100-009[l/f][c/r]

(Typically 41 characters including termination)

Response Values Defined as Follows:

Note: None of these 8 bit data patterns correspond to any Control character codes.

Focus Distance:

ssss: Current Focus Distance units [1 mm] or [0.1 inch] depending on Display Units selected.

ssss represents packed binary response - 24 bits in 4 bytes (characters)

ssss	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1st	0	1	b23	b22	b21	b20	b19	b18
2nd	0	1	b17	b16	b15	b14	b13	b12

3rd	0	1	b11	b10	b09	b08	b07	b06
4th	0	1	b05	b04	b03	b02	b01	b00

Range: 0 to (2^^{24} -1) = 16777215[mm] or 0.0 to (2^^{24} -1) = 1677721.5[inch]
Infinity: b00 … b23 = 1 (a binary value of all 1's represents infinity)

Aperture Value

TT: Actual Aperture Setting (T Number x 100)

12 bits in 2 bytes (characters)

TT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1st	0	1	b11	b10	b09	b08	b07	b06
2nd	0	1	b05	b04	b03	b02	b01	b00

Range: 144 to 2560 (1.44 to 25.60)

Aperture Ring T Stop Position

tt: Aperture Ring T Stop Integer x 10 & the 1/10th fraction

12 bits in 2 bytes (characters)

tt	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1st	1	b06	b05	b04	b03	b02	b01	b00
2nd	1	b07	0	0	b03	b02	b01	b00

Range 1st: 14 to 220 for Integer x 10
Range 2st: 0 – 9 for 1/10th fraction

Zoom - EFL

zz: Current Focal Length in mm for Zoom Lenses and 0 for Prime Lenses

10 bits in 2 bytes (characters)

zz	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1st	0	1	0	0	b09	b08	b07	b06
2nd	0	1	b05	b04	b03	b02	b01	b00

Range 1st : 0 – 1023 [mm] for Zoom Lenses
Range 2st: b00 …b09 = 0 for Prime Lenses

Hyperfocal Distance

hhhh: Hyperfocal Distance [1 mm] or [0.1 inch] depending on Display Units selected.

24 bits in 4 bytes (characters)

hhhh	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1st	0	1	b23	b22	b21	b20	b19	b18
2nd	0	1	b17	b16	b15	b14	b13	b12
3rd	0	1	b11	b10	b09	b08	b07	b06
4th	0	1	b05	b04	b03	b02	b01	b00

Range: 0 to ($2^{\wedge 24}$ -1) = 16777215[mm] or 0.0 to ($2^{\wedge 24}$ -1) = 1677721.5[inch]
Infinity: b00 … b23 = 1 (a binary value of all 1's represents infinity)

Near Focus Distance

nnnn: Near Focus Distance [1 mm] or [0.1 inch] depending on Display Units selected.

24 bits in 4 bytes (characters)

nnnn	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1st	0	1	b23	b22	b21	b20	b19	b18
2nd	0	1	b17	b16	b15	b14	b13	b12
3rd	0	1	b11	b10	b09	b08	b07	b06
4th	0	1	b05	b04	b03	b02	b01	b00

Range: 0 to ($2^{\wedge 24}$ -1) = 16777215[mm] or 0.0 to ($2^{\wedge 24}$ -1) = 1677721.5[inch]
Infinity: b00 … b23 = 1 (a binary value of all 1's represents infinity)

Far Focus Distance

ffff: Far Focus Distance [1 mm] or [0.1 inch] depending on Display Units selected.

24 bits in 4 bytes (characters)

ffff	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1st	0	1	b23	b22	b21	b20	b19	b18
2nd	0	1	b17	b16	b15	b14	b13	b12
3rd	0	1	b11	b10	b09	b08	b07	b06
4th	0	1	b05	b04	b03	b02	b01	b00

Range: 0 to (2^{24} -1) = 16777215[mm] or 0.0 to (2^{24} -1) = 1677721.5[inch]
Infinity: b00 … b23 = 1 (a binary value of all 1's represents infinity)

Horizontal Field of View

vv: Horizontal Field of View in Degrees x 0.1

11 bits in 2 bytes (characters)

vv	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1st	0	1	0	b10	b09	b08	b07	b06
2nd	0	1	b05	b04	b03	b02	b01	b00

Range: 0 to 1800 (0.0 to 180.0)

Entrance Pupil Position

ee: Entrance Pupil Position signed 10 bit value. s=0 for positive, s=1 for negative

ee	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1st	0	1	s	0	b09	b08	b07	b06
2nd	0	1	b05	b04	b03	b02	b01	b00

Range: 0 to 1023 (signed)

Normalized Zoom Value (Note: Response depends on Lens Version #)

ZZ: Normalized Zoom Value – 0.000 to 1.000 for S4/i® Zoom versions after 1.21, 1.30 and all miniS4/i® (Panchro/i®) and 5/i® versions *(See Appendix A.1 for variations in response to Kd command.)*

10 bits in 2 bytes (characters)

ZZ	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1st	0	1	0	0	b09	b08	b07	b06
2nd	0	1	b05	b04	b03	b02	b01	b00

Range: 0 – 1000 for Zoom Lenses
b00 …b09 = 0 for Prime Lenses

5.1.4 K3 Command: (New for /i Technology)

Retrieve **Name of Lens Manufacturer in ASCII Format**

Note: Lens will respond with the Unknown Response string: ?[L/F][C/R] if this command has not been implemented in firmware version.

Issue	K3[C/R]	Tag = K3
Response	K3 xxxxxxxxxxxxxxx [L/F][C/R]	
Response(Unknown)	?[L/F][C/R]	

Tag	Value	Definition
K3	xxxxxxxxxxxxxxx	Name of Manufacturer

15 character response string

Example:
Issue: K3[c/r]
Response: K3Cooke Optics Ld[l/f][c/r]

5.1.5 K4 Command: (NEW for /i Technology)

Retrieve **Name of Lens Type in ASCII Format**

Note: Lens will respond with the Unknown Response string: ?[L/F][C/R] if this command has not been implemented in firmware version.

Issue	K4[C/R]	Tag = K4
Response	K4 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx [L/F][C/R]	
Response(Unknown)	?[L/F][C/R]	

Tag	Value	Definition
K4	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx	Name of Lens Type

30 character response string

Example:
Issue: K4[c/r]
Response: K45i T1.4 Prime 100mm [l/f][c/r]

5.1.6 P Command:

Retrieve **Lens Temperature in ASCII Format**

Issue	P[C/R]	Tag = P
Response	P x x [L/F][C/R]	
Response(Unknown)	?[L/F][C/R]	

Tag	Value	Definition
P	a b	Current Temperature in degrees Celsius

Example:
Issue: P[c/r]
Response: P24 [l/f][c/r]
Note: The temperature reading process takes approximately 0.5 seconds.
During this time period, all other processes are suspended.

5.1.7 B Command:

Retrieve **Version Number in ASCII Format**

Issue	B[C/R]	Tag = B
Response	B a b c d [L/F][C/R]	

Tag	Value	Definition
B	a b c d	Firmware Version Number – format X.XX

Example:
Issue: B[c/r]
Response: B 5.03[l/f][c/r]

Note: One space between B and 5.03

5.1.8 Kbn Command:

Set **New Baud Rate**

Issue	Kbn[C/R]	Tag = B
Response	Kbn ! [L/F][C/R]	
Response(Unknown)	?[L/F][C/R]	

n	Baud Rate	Maximum Cable Length
0	9600	50 meters
1	19200	30 meters
2	38400	10 meters
3	48000	8 meters
4	57600	5 meters
5	96000	2 meters
6	115200	2 meters
7	230400	.5 meters Note: This rate for Camera interface only – not supported by all I lenses

Example:
Issue: Kb1[c/r]
Response: Kb1! [l/f][c/r]

Note: The Unknown response string will be issued if the value of “n” exceeds the valid range.

5.1.9 C Command:

Set **Continuous Send Mode of Data Packet in ASCII Format**

Issue	C[C/R]	
Response	! [L/F][C/R]	

Once Continuous Send Mode is set, the lens will continually measure, calculate and send values in the D command format.

Example:
Issue: C[c/r]
Response:

D0001021T0195t1.4+8Z0000H0290024N0001018F0001024V006.8E+098z0000S5100-009[l/f][c/r]
D0001021T0195t1.4+8Z0000H0290024N0001018F0001024V006.8E+098z0000S5100-009[l/f][c/r]
D0001021T0195t1.4+8Z0000H0290024N0001018F0001024V006.8E+098z0000S5100-009[l/f][c/r]
D0001021T0195t1.4+8Z0000H0290024N0001018F0001024V006.8E+098z0000S5100-009[l/f][c/r]
D0001021T0195t1.4+8Z0000H0290024N0001018F0001024V006.8E+098z0000S5100-009[l/f][c/r]
D0001021T0195t1.4+8Z0000H0290024N0001018F0001024V006.8E+098z0000S5100-009[l/f][c/r]
D0001021T0195t1.4+8Z0000H0290024N0001018F0001024V006.8E+098z0000S5100-009[l/f][c/r]
D0001021T0195t1.4+8Z0000H0290024N0001018F0001024V006.8E+098z0000S5100-009[l/f][c/r]
....

5.1.10 Kc Command:

Set **Continuous Send Mode of Data Packet in Packed Binary Format**

Issue	Kc[C/R]	Tag = d
Response	d s s s s TT t t z z h h h h n n n n f f f f v v e e Z Z S x x x x x x x x x [L/F][C/R]	

Once Continuous Send Mode is set, the lens will continually measure, calculate and send values in the Kd command format.

Example:
Issue: Kc[c/r]
Response:

d@@O}CCŽˆ@@AFsh@@Oz@@P@ADA¢@@S5100-009[l/f][c/r]
d@@O}CCŽˆ@@AFsh@@Oz@@P@ADA¢@@S5100-009[l/f][c/r]
d@@O}CCŽˆ@@AFsh@@Oz@@P@ADA¢@@S5100-009[l/f][c/r]
d@@O}CCŽˆ@@AFsh@@Oz@@P@ADA¢@@S5100-009[l/f][c/r]
d@@O}CCŽˆ@@AFsh@@Oz@@P@ADA¢@@S5100-009[l/f][c/r]
d@@O}CCŽˆ@@AFsh@@Oz@@P@ADA¢@@S5100-009[l/f][c/r]
……

This command sets the retrieved data format to packed binary (as described by the Kd command) and sends data in continuous mode. The data content and format is the same as the Kd command data content and format. This mode is unset by using the H command.

Each data packet is defined under the Kd command above.

5.1.11 G Command:

Set **Checksum Mode**

Issue	G [C/R]	No Tag
Response	!MN [L/F][C/R]	

The checksum consists of two characters which are added to the response string between the contents of the message and the termination character pair: [L/F]{C/R].

The checksum is formed by setting an 8 bit checksum value to all 1's and then performing an "exclusive or" operation between the existing checksum value and each character of the response string in turn, until all the characters are processed. The resulting 8 bit checksum is then converted into two separate characters. (See appendix A.3 for additional details.)

Example:
Issue: G[c/r]
Response: !MN[l/f][c/r]

Responses of N and B commands when Checksum mode is on:
Issue: N [c/r]
Response: NS5100-009OCooke Optics Electronic Lenses!LPF100N100UBt92 B5.03LJ[l/f][c/r]
Issue: B [c/r]
Response: B 5.03HE[l/f][c/r]

5.1.12 Ka Command:

Set **Inhibit Error Response Mode**

Issue	Ka[C/R]	No Tag
Response	! [L/F][C/R]	
Response(Unknown)	?[L/F][C/R]	

Once the Error Response Mode is set, the lens will simply ignore any bad or invalid message it receives rather than send the ?[L/F][C/R] response to a command it does not recognize.
Note: The response unknown: ?[L/F][C/R] will be issued by some early lens (S4/i® versions prior to 0.22, 0.35, 1.23, 1.31) which did not implement this command.

Example:

Issue: Kb9 [c/r] *before Ka sent*
Response: ?[L/F][C/R]

Issue: Ka[l/f]
Response: ! [l/f][c/r]

Issue: Kb9 [c/r] *after Ka sent*
Response: *no response sent*

5.1.13 X Command:

Set **Display Units to Imperial**

Issue	X[C/R]	Tag = X
Response	X [L/F][C/R]	

Note: This command will change the display units on both channels for older S4/i® lenses with the original /i® Technology but will change only the display units for the channel which issued the command for all other two channel lenses, including all /i2 Technology lenses. See Sections 6.1 and 6.2 for additional information regarding operation of X and Y commands.

Example:
Issue: X[c/r]
Response: X[l/f][c/r]

5.1.14 Y Command:

Set **Display Units to Metric**

Issue	Y[C/R]	Tag = Y
Response	Y [L/F][C/R]	

Note: This command will change the display units on both channels for older S4/i lenses with the original /i Technology but will change only the display units for the channel which issued the command for all other two channel lenses, including all /i2 Technology lenses. See Sections 6.1 and 6.2 for additional information regarding operation of X and Y commands.

Example:
Issue: Y[c/r]
Response: Y[l/f][c/r]

5.1.15 V Command:

Set **35mm Mode**

Issue	V[C/R]	Tag = V
Response	V 0.0 b b b [L/F][C/R]	

Tag	Value	Definition
V	b b b	Circle of Confusion value in mm for a 35mm

Example:
Issue: V[c/r]
Response: V0.0250[l/f][c/r]

5. 1.16W Command:

Set **16mm Mode**

Issue	W[C/R]	Tag = W
Response	W 0.0 b b b [L/F][C/R]	

Tag	Value	Definition
W	b b b	Circle of Confusion value in mm for a 16mm

Example:
Issue: W[c/r]
Response: W0.0125[l/f][c/r]

5.1.17 Wnn Command:

Set **Film Size Extended Mode**

Issue	Wnn[C/R]	Tag = W
Response	W 0.0 b b b [L/F][C/R]	
Response(Unknown)	?[L/F][C/R]	

Tag	Value	Definition

W	b b b	Circle of Confusion value in mm

Example:
Issue: W08[c/r]
Response: W0.0191[l/f][c/r]

nn	Film Size	Circle of Confusion Value
00	35 mm	0.0250
01	16 mm	0.0125
02	4096 x 2304	0.0211
03	3072 x 1728	0.0159
04	2048 x 1152	0.0106
05	AATON 3 perf	0.0238
06	ATON 2 perf	0.0222
07	4480 x 1866, 4.5K	0.0218
08	2764 x 2304, 4K Anamorphic	0.0191
09	Sony APS-C01	0.0105

Note: The Unknown response string will be issued if the value of "nn" exceeds the valid range.

5.1.18 H Command:

Unset **Continuous Mode**

Issue	H[C/R]	No Tag
Response	! [L/F][C/R]	

This command causes received channel to stop transmitting continuous data after a C or Kc command. It also unsets the Checksum Mode and the Inhibit Error Response Mode.

Example:
Issue: H[c/r]
Response: ![l/f][c/r]

5.3 5/i CORE Illumination Commands

Additional details for operating the 5/i Illumination feature are described in Section 8.

5.2.1 Kjn Command: 5/i Lenses Only

Set **Scale Illumination Level for Both LED Sets**

Issue	Kjn[C/R]	No Tag
Response	! [L/F][C/R]	

Response(Unknown)	?[L/F][C/R]	

The value of n is between 0 and 9, where 0 sets illumination to OFF and 9 is at maximum brightness.

Example:
Issue: Kj5[c/r]
Response: ![l/f][c/r]

Note: The Unknown response string will be issued by all non-5/i lenses or if the value of "n" is any character that is not 0 to 9.

5.2.2 Kkn Command: 5/i Lenses Only

Set **Scale Illumination Level for One LED Sets**

Issue	Kkn[C/R]	No Tag
Response	! [L/F][C/R]	
Response(Unknown)	?[L/F][C/R]	

The value of n is between 0 and 9, where 0 sets illumination to OFF and 9 is at maximum brightness. (The second LED set is turned off.)

Example:
Issue: Kk5[c/r]
Response: ![l/f][c/r]

Note: The Unknown response string will be issued by all non-5/i lenses or if the value of "n" is any character that is not 0 to 9.

5.3 Start-Up Unit Commands for 5/i, Anamorphic /i and All /i2 Technology Lenses

5.3.1 OX Command: 5/i, Anamorphic /i and All /i2 Technology Lenses

Set **Start-Up Units to Imperial**

Issue	OX[C/R]	No Tag
Response	! [L/F][C/R]	
Response(Unknown)	?[L/F][C/R]	

This command will set the Start-Up Units character to B, changing the current “Display Units” selection for both channels to Imperial. See Section 6 for additional details.

Example:
Issue: OX[c/r]
Response: ![l/f][c/r]

Note: The Unknown response string will be issued if by all non-5/i lenses.

5.3.2 OY Command: 5/i, Anamorphic /i and All /i2 Technology Lenses

Set **Start-Up Units to Metric**

Issue	OY[C/R]	No Tag
Response	! [L/F][C/R]	
Response(Unknown)	?[L/F][C/R]	

This command will set the Start-Up Units character to b, changing the current “Display Units” selection for both channels to Metric. See Section 6 for additional details.

Example:
Issue: OY[c/r]
Response: ![l/f][c/r]

Note: The Unknown response string will be issued by all non-5/i lenses.

5.4 CORE Commands for External Interface [EDSU]

All Cooke Anamorphic /i and 5/i lenses, (plus S4/i and miniS4/i lenses with /i2 Technology), allow users to append additional external data (up to 60 8-bit values) onto the data stream normally generated inside the lens. External data is retrieved through the external communication interface and then appended to the D, C, Kd or Kc response stream. The appended string must consist of 8 bit characters which do not include the [l/f] or [c/r] character, and preferable no other ASCII control character (hex 00 to hex 1F).

Additional details describing the 5/i® EDSU operation are provided in Section 9.

5.4.1 OS Command: [EDSU]

Retrieve **Current Channel Settings**

Issue	OS[C/R]	Tag = O
Response	OrRdUC0.0cccWnninlSssssssssBx.xx[L/F][C/R]	
Response(Unknown)	?[L/F][C/R]	

Tag	Value	Definition
O		Tag
r	R	Focus Scale Ring Type currently fitted on lens: I = Imperial M = Metric
d	U	Display Units currently selected: I = Imperial M = Metric
C	0.0ccc	Film Size/ Circle of Confusion (CoC) Value (mm)
W	nn	Number Associated with Film Size (CoC) Value – *see Wnn Command*
i	nl	Illumination Level [n=1 for 1 LED, n=2 for 2 LEDs, l = 0(min) – 9(max)
S	sssssssss	Lens Serial Number
B	x.xx	Firmware Version Number

Example:
Issue: OS[c/r]
Response: OrIdIC0.0250W00Si105200-090 B4.90 [l/f][c/r]

Note: The Unknown response string will be issued by all non-5/i® lenses.

5.4.2 OT Command: [EDSU]

Retrieve **Baud Rate, Data Type, Display Units for Opposite Channel**

Issue	OT[C/R]	Tag =Ot
Response	OtBbFfUu [L/F][C/R]	
Response(Unknown)	?[L/F][C/R]	

Tag	Value	Definition
Ot		Tag
B	b	Baud Rate of Opposite Channel: b=0 -7 [see Kbn Command]
F	f	f = A (ASCII), f = B (Binary)
U	u	Display Units currently selected: u=I (Imperial), u=M (Metric)

Example:
Issue: OT[c/r]
Response: OtB0FAUI [l/f][c/r]

Note: The Unknown response string will be issued by all non-5/i® lenses.

5.4.3 OC Command: [EDSU]

Commence **Append of Data String**

Issue	OC[C/R]	No Tag
Response	! [L/F][C/R]	
Response(Unknown)	?[L/F][C/R]	

Example:

Issue: OC[c/r]
Response: ! [l/f][c/r]

Note: The Unknown response string will be issued by all non-5/i® lenses.

5.4.4 OD Command: [EDSU]

Append **this Data String (dddd……d) to the D, C, Kd or Kc Response String**

Issue	ODddd…….d[C/R]	No Tag
Response	! [L/F][C/R]	
Response(Unknown)	?[L/F][C/R]	

ddd…..d = a string of up to 60 data values which terminate with the [C/R] character. These can be any 8 bit values <u>except</u> a [C/R] or [L/F].

Example:
Issue: OD abc1237&^$ [c/r]
Response: ! [l/f][c/r]

Note: The Unknown response string will be issued by all non-5/i® lenses.

5.4.5 OH Command: [EDSU]

Halt **Append of Data String**

Issue	OH[C/R]	No Tag
Response	! [L/F][C/R]	
Response(Unknown)	?[L/F][C/R]	

Example:
Issue: OH[c/r]
Response: ! [l/f][c/r]

Note: The Unknown response string will be issued by all non-5/i lenses.

5.5 NEW /i2 Technology Commands

The response to the Kdi command includes new inertial data plus all the same lens metadata returned when issuing the Kd command. (To reduce transmission time, use baud rate 115,200 or above.)

5.5.1 Kdi Command to Retrieve Lens plus Inertial Tracking Data

Retrieve **Pre-Defined Set of Binary Data Packets**

Issue	KdiX[C/R]
Response	[section1][section2][section3][section4][section5][section6] [section7][section8][section9][L/F][C/R]
Response (Unknown)	?[L/F][C/R]

Response	**Values**	**Description**	**Offset**
section1	i	size=1 byte	0
section2	X	size=1 byte; 00-ff : sequence number of Kdi command used for synchronization	1
section3	nn	size=2 bytes; 0000-ffff : length of Kdi response, excluding [l/f][c/r]	2
section4	lens metadata	size=38 bytes; (same response as Kd response) s s s s TT t t z z h h h h n n n n f f f f v v e e Z Z S x x x x x x x x x see page 25-29 in Cooke Manual for more details	4
section5	time stamp of frame	size=2 bytes; t00-t15; time when Kdi command is received | | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |	42

<table>
<tr><td></td><td></td><td><table><tr><td>1st</td><td>t15</td><td>t14</td><td>t13</td><td>t12</td><td>t11</td><td>t10</td><td>t09</td><td>t08</td></tr><tr><td>2nd</td><td>t07</td><td>t06</td><td>t05</td><td>t04</td><td>t03</td><td>t02</td><td>t01</td><td>t00</td></tr></table></td><td></td></tr>
<tr><td>section6</td><td>Magnetometer data</td><td>size=6 bytes; X (mx0-mx15), Y(my0-my15), Z(mz0-mz15)<table><tr><td>1st</td><td>mx15</td><td>mx14</td><td>mx13</td><td>mx12</td><td>mx11</td><td>mx10</td><td>mx09</td><td>mx08</td></tr><tr><td>2nd</td><td>mx07</td><td>mx06</td><td>mx05</td><td>mx04</td><td>mx03</td><td>mx02</td><td>mx01</td><td>mx00</td></tr><tr><td>3rd</td><td>my15</td><td>my14</td><td>my13</td><td>my12</td><td>my11</td><td>my10</td><td>my09</td><td>my08</td></tr><tr><td>4th</td><td>my07</td><td>my06</td><td>my05</td><td>my04</td><td>my03</td><td>my02</td><td>my01</td><td>my00</td></tr><tr><td>5th</td><td>mz15</td><td>mz14</td><td>mz13</td><td>mz12</td><td>mz11</td><td>mz10</td><td>mz09</td><td>mz08</td></tr><tr><td>6th</td><td>mz07</td><td>mz06</td><td>mz05</td><td>mz04</td><td>mz03</td><td>mz02</td><td>mz01</td><td>mz00</td></tr></table></td><td>44</td></tr>
<tr><td>section7</td><td>data sample packet ID</td><td>size=1 byte; gyro data : 1; accelerometer data : 2</td><td>50</td></tr>
<tr><td>section8</td><td>time stamp of data sample packet</td><td>size=2 bytes; t00-t15; time when gyro/acc FIFO reaches its water mark<table><tr><td></td><td>Bit7</td><td>Bit6</td><td>Bit5</td><td>Bit4</td><td>Bit3</td><td>Bit2</td><td>Bit1</td><td>Bit0</td></tr><tr><td>1st</td><td>t15</td><td>t14</td><td>t13</td><td>t12</td><td>t11</td><td>t10</td><td>t09</td><td>t08</td></tr><tr><td>2nd</td><td>t07</td><td>t06</td><td>t05</td><td>t04</td><td>t03</td><td>t02</td><td>t01</td><td>t00</td></tr></table></td><td>51</td></tr>
<tr><td>section9</td><td>accelerometer or gyro data packet</td><td>size of 1 sample=6 bytes; size of 8 samples =48 bytes<table><tr><td>1st</td><td>bx15</td><td>bx14</td><td>bx13</td><td>bx12</td><td>bx11</td><td>bx10</td><td>bx09</td><td>bx08</td></tr><tr><td>2nd</td><td>bx07</td><td>bx06</td><td>bx05</td><td>bx04</td><td>bx03</td><td>bx02</td><td>bx01</td><td>bx00</td></tr><tr><td>3rd</td><td>by15</td><td>by14</td><td>by13</td><td>by12</td><td>by11</td><td>by10</td><td>by09</td><td>by08</td></tr><tr><td>4th</td><td>by07</td><td>by06</td><td>by05</td><td>by04</td><td>by03</td><td>by02</td><td>by01</td><td>by00</td></tr><tr><td>5th</td><td>bz15</td><td>bz14</td><td>bz13</td><td>bz12</td><td>bz11</td><td>bz10</td><td>bz09</td><td>bz08</td></tr><tr><td>6th</td><td>bz07</td><td>bz06</td><td>bz05</td><td>bz04</td><td>bz03</td><td>bz02</td><td>bz01</td><td>bz00</td></tr></table></td><td>53</td></tr>
</table>

The total length of one accelerometer/gyro data packet is 51 bytes.

Number of inertial packets in KdiX response (includes Magnetometer data)	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Length of Kdi response (excluding [l/f][c/r])	50	101	152	203	254	305	356	407	458

Each time the lens receives a KdiX command, it reads out the data from the buffer and clears it. The total length of the KdiX response string varies according to the frame rate. The maximum depth of the inertial data buffer is currently set to 8. It holds the latest 8 inertial data packets if the buffer overflows.

The ' X ' in KdiX acts as a tag to synchronize command and response. The ' X ' is a byte value ranging from 0x00 to 0xff. It is assigned by the requester and is included in the response so that the response can be tied to the command that prompted it. To receive the inertial data, a recorder or camera can issue command sequence: Kdi0, Kdi1, Kdi2, …Kdi255, continually.

5.5.2 K61 Command

Retrieve **Inertial Calibration Coefficients**

Inertial calibration coefficients are constant values unique to each lens. This data is necessary for post-production processing of the inertial data. It should be issued once and then stored with all Kdi data retrieved from the lens. This data is in the same binary format as the Kdi response.

Issue	K61[C/R]
Response	K61nndd…L/F][C/R]
Response(Unknown)	?[L/F][C/R]

Value	Definition
nn	size=2 bytes; 0000-ffff: length of K61 response excluding [l/f][c/r]
dd…dd	size=180 bytes; inertial calibration coefficients

6. Measurement and Calculation Units

6.1 Measured Values and Calculated Values

Cooke /i lenses measure the lens settings (focus, aperture, zoom) and use these values to calculate focal length, hyperfocal distance, near focus distance, far focus distance, horizontal field of view, entrance pupil position, normalized focus distance and normalized zoom setting. Distance values are expressed in either millimeters or in multiples of 0.1 inch with the exception of the Zoom – EFL value, which is always expressed in millimeters. All distances are actual distances measured from the focal plane.

Every Cooke /i lens stores a unique set of calibration tables, individually determined by a special calibration process, and preloaded into the lens before it leaves the Cooke factory. The calibration tables provide reference values that correspond to the focus, aperture and zoom (if applicable) ring. Some lenses are calibrated in both imperial and metric units, while others are calibrated only in metric or only in imperial units. The N command response string provides information to indicate which calibration table(s) is stored in the lens and which units are defaults for display purposes. (See Section 5.1)

Users can request metric units (by issuing Command Y) or imperial units (by issuing Command X) regardless of how the lens was calibrated. Note that the two channels on all Anamorphic /i and 5/i lenses (plus S4/i and minis4/i lenses with /i2 Technology) function independently while the two channels on S4/i lenses without the inertial data are not independent. These commands will change the display units on both channels for older S4/i lenses but will change only the display units for the channel which issued the command for lenses with fully independent channels.

To make use of the inertial tracking data for post-processing, users should retrieve the Inertial Calibration Coefficients using the K61 command. See Section 5.5.

6.2 Start-Up Units – How to Interpret the Value after Tag 'U' in the N Command Response

6.2.1 Cooke Anamorphic /i, miniS4/i (Panchro/i), S4/i Prime & Zoom Lenses

If the value after Tag U in the N command response is an 'I', the calibration table stores focus distances in imperial units only. If the value after Tab U is an 'M', the calibration table stores focus distances in metric units only. If the value after Tag U is a 'B', the calibration table stores focus distances in both imperial and metric units with the default display units set as imperial. If the value after Tag U is a 'b', the calibration table stores focus distances in both imperial and metric units with the default display units set as metric.

6.2.2 Cooke Lens Units - Special Start-Up Units Commands

Anamorphic /i and 5/i lenses have a dual marked focus ring that can be reversed to show either imperial or metric units. These lenses have been factory calibrated in both imperial and metric units and the factory set Start-Up Units should match the focus ring units.

The Start-Up Units can be checked by issuing the N Command or the OS Command. The value after Tag U in an Anamorphic /i or 5/i lens response will always be either a 'B' or 'b', where B indicates the default focus distance values are in imperial units and b indicates the default units are metric. (See also Commands X and Y and specific commands, OS, OX and OY.)

Commands OX and OY will change the default units on both channels (by changing the 'B' to a 'b' or changing the 'b' to a 'B') which also change the display units. Commands X and Y will change only the current display units on the channel the command was sent.

Anamorphic /i, 5/i and all /i2 Technology lenses implement the OX and OY commands. miniS4/i and S4/i lenses without /i2 Technology do not recognize the OX and OY commands.

7. Baud Rates and Response Times

7.1 Implementation – Cooke /i Lenses without /i2 Technology

Message transmission time is affected by the length of the data stream and baud rate. Earlier S4/i Prime and Zoom lenses with 10-bit ADC have slower clock speeds than the later S4/i Primes lenses with 12-bit ADC.

7.1.1 Table 6: Compare Calculation Time to Lens Type - Cooke /i Lenses without /i2 Technology

Lens Type	ADC Type	Calculation Time
5/i Prime	ALL	3.2 msec
miniS4/i (Panchro/i) Prime	ALL	12 msec
S4/i Prime	12-bit	10 msec
S4/i Prime	10-bit	20 msec
S4/i Zoom	12-bit	12 msec
S4/i Zoom	10-bit	12 msec

7.1.2 Table7: Compare Repeat Rate (frames/second) to Lens Type - Cooke /i Lenses without /i2 Technology

Lens Type	Command	Repeat Rate (Frames/sec)		
		Baud Rate 9600	Baud Rate 115200	Baud Rate 230400
5/i Prime	D	11.8	97.1	144.9
	Kd	21.6	140	185
miniS4/i (Panchro/i) Prime	D	11	53	N/A
	Kd	17	66	N/A
S4/i Prime (12-bit)	D	11	60	N/A
	Kd	19	73	N/A
S4/i Prime (10-bit)	D	9	37	N/A
	Kd	16	42	N/A
S4/i Zoom	D	11	53	N/A
	Kd	17	63	N/A

Lens Type	Command	Repeat Rate (Frames/sec)		
		Baud Rate 9600	Baud Rate 115200	Baud Rate 230400
5/i Prime-1 channel	C	12.3	147	285.7
	Kc	23.4	277	285.7
5/i Prime -2 channel	C	12.3	147	263
	Kc	23.4	263	263
miniS4/i (Panchro/i) Prime	C	11	53	N/A
	Kc	18	64	N/A
S4/i Prime (12-bit)	C	11	60	N/A
	Kc	20	75	N/A
S4/i Prime (10-bit)	C	10	37	N/A
	Kc	17	43	N/A
S4/i Zoom	C	11	53	N/A
	Kc	18	64	N/A

7.1 Implementation – Cooke Lenses with /i2 Technology

TBD

8. Illumination Scale – 5/i Lenses

8.1 Overview

5/i lenses are equipped with two sets of LED's which can controlled to illuminate the scales in low light situations. The brightness level of one set can be altered while the other is OFF, or both sets can be altered in unison. Manual Control of the brightness levels is achieved using the Aperture Ring. The brightness levels can also be controlled remotely by using the 5/i Lighting Control Unit or issuing the Kjn or Kkn Commands.

8.1.1 5/i Lighting Control Unit Instructions

STANDARD MODE

1) Connect the unit to a DC source of 9-35V, then connect the serial cable to the lens. See fig.5
2) During startup, the module performs an auto-test and the LEDs blink (Yellow 1, Yellow 2, Red/Green) See Fig.5
3) After the auto-test, the green LED will light up. (A red LED means a connection failure with the lens; in this case check the connection and the cable. See Fig.5)
4) Press " **+** " or " **–** " to adjust the illumination of the scales on the lens. The brightness of the unit's LEDs vary with the adjustment.
5) ZONE selects the illuminated scales on the lens. Three positions are available:
   a) Operator scale ON and Assistant scale ON
   b) Operator scale OFF and Assistant scale ON
   c) Both scales OFF

RESET - Sets the unit to the factory preset values.

1. While pressing ZONE, connect the power cable.
2. All LEDs are highlighted.
3. Release ZONE.
4. The unit starts normally with 50% brightness on the OPERATOR and ASSISTANT scales.

SPECIAL MODE- 5/i Lighting Control Unit LEDs Off

This mode allows user to switch off the LEDS on the control unit. The control unit operates the brightness levels on the lens normally, but both LEDs on the control unit are off.

1. While pressing “ **–** “ , connect the power cable.
2. All LEDs are highlighted.
3. Release “ **–** “
4. The module starts normally with LEDs off on the unit.

SPECIAL MODE: Adjust The Maximum Brightness Of The Yellow LEDs

1. During normal use, press ZONE until the green LED brightness increases.
2. By keeping ZONE pressed, the Green LED becomes very bright.
3. Press “ **+** “ or “ **–** “ to adjust the maximum brightness of the LEDs
4. Release ZONE to exit the SPECIAL MODE

UNIT SELECTION MODE: Select Inch or Metric Unites

1. While pressing “+”, connect the power cable.
2. All LEDs are highlighted. Status LED shows Red.
3. Release “+”.
4. Press “**-**“ to select Metric or “**+**” to select Inches.
5. Status LED shows Green and unit reverts to normal operation.

Figure 5: 5/i Lighting Control Unit

8.1.2 5/i Manual Scale Illumination Instructions

At Power up, the LED's will be OFF and consume minimum power.

To alter the brightness of both sets of LEDs, move the Aperture ring to the aperture setting T22 end-stop and move it away towards T1.4, then repeat that process twice more within 0.5 second.

This will cause the LED's to be set to fully ON for 0.3 sec, then fully OFF for 0.3 sec and then fully ON. The operator can now adjust the desired level by moving the Aperture scale up (towards T22) or down (towards T 1.4). If there is a half second period during which "no change of Aperture setting" is detected, the "set illumination level" is retained.

During this illumination setting process, /i lens operations continue to function normally.

To alter the brightness of one set of LEDs, move the Aperture ring to the aperture setting T1.4 end-stop and move it away towards T22, then repeat that process twice more within 0.5 second.

This will cause the LED's to be set to OFF for 0.3 sec, then ON for 0.3 sec, then OFF again. The operator can now adjust the desired level by moving the Aperture scale up (towards T22) or down (towards T 1.4). If there is a half second period during which "no change of Aperture setting" is detected, the "set illumination level" is retained.

During this illumination setting process, /i lens operations continue to function normally.

To turn off LEDs, move the Aperture ring to the aperture setting T1.4 end-stop and move it away towards T22, then repeat that process twice more within 0.5 second.

This will cause the LED's to be set to OFF for 0.3 secs, then ON for 0.3 secs, then OFF again. The operator can now wait a half second and the "off-set illumination level" is retained.

During this illumination setting process, /i lens operations continue to function normally.

9. External DATA Source Unit (EDSU)

9.1 Overview

All Cooke Anamorphic /i and 5/i lenses and all Cooke lenses with /i2 Technology have additional capabilities and commands which enable an external device, (called an External Data Source Unit or EDSU,) connected to the external RS232 channel of the lens, to perform special operations.

Under normal operation, when a command is sent to a lens requesting information, the lens generates a data string and sends this information to the camera interface, the external interface or both. This data can then be stored by the camera or external device for post processing. EDSU capable lenses have the additional facility to collect a data stream from an External Data Source Unit (EDSU) and then append this data to the lens' normally generated data string.

During the "append" operation, the EDSU generated data stream is stored within the lens and then appended to every data block that is sent to the Camera. The EDSU can turn the append operation "ON" and "OFF". The lens has space to store a single EDSU STRING, and this same string is used for every data block until it is updated by the EDSU or the append function terminated. The data rate from the EDSU does not need to match the data rate between camera and lens. If data strings from the EDSU (which are to be appended) arrive slower than the rate of data strings being generated by the lens for the camera, then multiple strings to the camera will have the same EDSU append string added.

At the same time that the EDSU is sending data to the lens, it can also request that the lens send the normal data stream back to it.

9.2 Principals of Operation

1. EDSU issues OS command to determine settings for current channel.
2. EDSU issues OT command to determine settings for opposite channel.
3. EDSU establishes format of data and data rate to send to lens.
4. EDSU issues OC command and verifies response from lens. (An internal EDSU buffer for the EDSU data in the lens will be cleared.)
5. Data sent to the opposite (camera) interface will now append the contents of EDSU buffer to the normal data stream. (If buffer remains empty, no data will be appended.)

6. Each time EDSU generates new data, it issues OD command to send data. This data is stored in lens in EDSU buffer. (When new string is received by lens, it replaces existing EDSU contents with new string.)
7. The lens generates data strings at whatever rate is required (single or continuous) and uses the latest EDSU data to append.
8. To terminate the process, the EDSU sends OH command.
   EDSU can also request lens operate in Continuous data send mode (ASCII or Binary) so lens data is available to EDSU for use internally or passed through to secondary unit.
9. In this mode, data from lens is mixed with responses from OD commands issued by the EDSU, (response will be first string sent by lens after receipt of any OD command so will not be confused with next continuous data string.)

9.3 EDSU Dependencies – Blocking Requirements for Pass-Through Operation

If EDSU has a secondary unit attached, and it allows commands from the secondary unit to be passed to the lens, (and corresponding response passed back), certain commands should be blocked to prevent corruption of the communication process.

Table 8: Valid Commands - Allowed & Blocked Recommendations with EDSU

Command	Function	Recommendation
B	Retrieve firmware version	Allowed
C	Set Continuous send ASCII data	Allowed (unless EDSU using Kd or Kc)
D	Retrieve single ASCII data string	Allowed (unless EDSU using C or Kd or Kc)
D	Retrieve single ASCII string	Allowed (unless EDSU extracts single block and passes through to secondary unit)
G	Set checksum mode ON	Beware
H	Unset optional modes	Beware
Kbn	Set/Change baud rate	Blocked (unless EDSU follows baud rate change)
Kc	Set continuous send Binary data	Allow (unless EDSU using C or D)
Kd	Request single Binary data string	Allow (unless EDSU using C or D)
Kjn	Set both illumination levels	Allow
Kkn	Set single illumination level	Allow
N	Retrieve Fixed data block	Allow
OC	EDSU only command	Block
OD	EDSU only command	Block
OH	EDSU only command	Block
OS	EDSU only command	Block
OT	EDSU only command	Block
P	Retrieve board temperature	Allow

V	Set/Change film size	Beware (Interlock exists for Camera priority)
Wnn	Change film size	Beware (Interlock exists for Camera priority)
X	Change units to Imperial	Beware
Y	Change Units to Metric	Beware

To avoid potential conflicts that may arise if commands are issued by multiple sources, the EDSU should monitor any commands allowed to pass-through to the lens to verify commands meet lens specifications and do not cause conflict with current EDSU operation.

If the EDSU is not logging data but only generating OD data, then Commands D, C, Kd, Kc can be allowed without conflict. In general, control of film size and data append functions should come from a single source to avoid conflicts. Similarly, changes to Baud rate or checksum mode have “difficult to follow” implication and it may be simpler to block all such commands. To block a command, the EDSU should respond to the command from the secondary device using the standard error response “?[l/f][c/r]”.

The EDSU data string can be made up of any 8 bit values (up to 60 values total) which terminate with the [c/r] character. These can be any 8 bit values except [c/r][l/f]. Care should be taken if the string includes any other ASCII control characters, (Hyperterminal , PuTTY or other data interpretation programs might recognize them as formatting commands and attempt to implement them).

10. Troubleshooting – Possible Errors and How to Fix Them

10.1 Loss of Program – Cooke Lenses without /i Technology

In the unlikely event that a lens experiences a loss of program, the start-up prompt will appear as a @[l/f][c/r] or @x[l/f][c/r] . If this occurs, the lens will need its program to be reloaded. Please contact your service provider.

10.2 Loss of Program – Cooke Lenses with /i Technology

If there is no power-up string from a lens with /i Technology, it will need its program to be reloaded. Please contact your service provider.

A.1 Command/Response VARIATIONS - earlier software versions

Note: You can retrieve the version number by issuing the B command.

A.1.1 D Command Variations:

Retrieve Pre-Defined Set of Calculated Data in ASCII Format

Note: Data length for v0.30 is 62 characters while data length for v0.39 and v4.21 is 76 characters.

S4/i Prime Lens versions [0.21 – 0.28 (10 bit) 0.34 - 0.38 (12 bit)]

Issue	D[C/R]	Tag = D
Response	D s s s s s s s T a a a a t b b b b b Z f f f f H a a a a a a a N b b b b b b b F c c c c c c c V v v v . v E s e e e S x x x x x x x x x [L/F][C/R]	

Tag	Value	Definition
D	s s s s s s s	actual focus distance – units
T	a a a a	actual Aperture setting
t	b b b b b	calibration ring Aperture value
Z	f f f f	Zoom – EFL (mm)
H	a a a a a a a	HYPERFOCAL setting -units
N	b b b b b b b	NEAR FOCUS distance – units
F	c c c c c c c	FAR FOCUS distance – units
V	v v v . v	Horizontal Field of view - degrees
E	s e e e	Entrance Pupil Position – units [Tag: s is a + or - sign]
S	xxxxxxxxx	Lens Serial Number

Note: The Zoom – EFL value = 0000 for all Prime lenses.

S4/i Zoom Lens versions up to and including [1.22, 1.30]

Issue	D[C/R]	Tag = D
Response	D s s s s s s s T a a a a t b b b b b Z f f f f H a a a a a a a N b b b b b b b F c c c c c c c V v v v . v E s e e e S x x x x x x x x x [L/F][C/R]	

Tag	Value	Definition
D	s s s s s s s	actual focus distance – units

T	a a a a	actual Aperture setting
t	b b b b b	calibration ring Aperture value
Z	f f f f	Zoom – Effective Focal Length (mm)
H	a a a a a a a	HYPERFOCAL setting -units
N	b b b b b b b	NEAR FOCUS distance – units
F	c c c c c c c	FAR FOCUS distance – units
V	v v v . v	Horizontal Field of view - degrees
E	s e e e	Entrance Pupil Position – units [Tag: s is a + or - sign]
Z	mmm	Normalized Zoom Setting
S	xxxxxxxxx	Lens Serial Number

Note: The normalized zoom setting value resolution was [0.00 to 1.00] for S4/i Zoom lens versions up to and including 1.22, 1.30 and is displayed as 000 to 100. The resolution for all subsequent versions is [0.000 to 1.000] and is displayed as 0000 to 1000.

A.1.2 N Command Variations:

Retrieve **Fixed Data in ASCII Format –** The first command a lens receives must be the N command.

Response for all Anamorphic /i, 5/i, miniS4/i Prime lens and for S4/i lenses with /i2 Technology:

Issue	N[C/R]	Tag = N
Response – Prime Lens	NSs..sssOu..uuuLPNxxxMdddUbTffyyBv.vv [L/F][C/R]	

Response for S4/i Prime lens versions 0.25 – 0.29 (10-bit board) and 0.35 – 0.39 (12-bit board):

Issue	N[C/R]	Tag = N
Response – Prime Lens	NSs..sssOu..uuuLPfxxxNdddUbEseeeBv.vv [L/F][C/R]	

Example:
Issue: N [l/f][c/r]
Response: NS4050-0001OCooke Optics LPf050N027UIE0056B0.39

Response for S4/i Prime lens versions before 0.25 (10-bit board) and 0.35 (12-bit board):

Issue	N[C/R]	Tag = N
Response – Prime Lens	NSs..sssOu..uuuLPfxxxNdddUbEseee y [L/F][C/R]	

Response for S4/i Zoom lens versions 1.26 – 1.29 (10-bit board) and 1.36 – 1.39 (12-bit board):

Issue	N[C/R]	Tag = N
Response – Zoom Lens	NSs..sssOu..uuuLZNxxxMdddUbTff yy Bv.vv [L/F][C/R]	

Example:
Issue: N [l/f][c/r]
Response: NS8000123 OCooke Optics LZN015M040UIT92 B1.39

Response for S4/i Zoom lens in earlier versions:

Issue	N[C/R]	Tag = N
Response – Zoom Lens	NSs..sssOu..uuuLZNxxxMdddUbTff yyy [L/F][C/R]	

Tag	Value	Definition
S	s .. sss	Serial Number – 9 characters
O	u.. uuu	Owner Data – 31 characters
L	t	Lens Type: t=P for Prime, Z for Zoom
N	xxx	Focal length (Primes) or minimum focal length (Zooms)
f	xxx	Focal length - *S4/i Prime only Tag = f (instead of N)*
M	ddd	unspecified (Primes) or maximum focal length (Zooms)
N or n	ddd	Infinity Nodal distance: N or n indicates sign plus 3 digits-*S4/i Prime only*
s (+/ -)	eee	Entrance Pupil Position: + or – sign plus 3 characters - *S4/i Prime only*
U	b	Start-up units: I=imperial, M=metric, b (metric start) or B (imperial start) [both available]
T	ff	Transmission factor *(not yet available in S4/i Primes)*
	y..y	SPACE characters
B	v.vv	Firmware version number

A.1.3 Kd Command Variations:

Retrieve **Pre-Defined Set of Calculated Binary Data Packets**

Response for lens versions <u>BEFORE</u> 0.21, 0.34, .22 and 1.31:

Issue	Kd[C/R]	Tag = d
Response	d s s s s TT t t z z h h h h n n n n f f f f v v e e Z Z [L/F][C/R]	

Response Values	Definition
d	Tag
ssss	Focus Distance
TT	Aperture Value – Actual Aperture Setting
tt	Aperture Ring T Stop Integer x 10 & the 1/10th fraction
zz	Zoom - EFL (mm) [0000 for Prime lenses]
hhhh	Hyperfocal Distance
nnnn	Near Focus Distance
ffff	Far Focus Distance
vv	Horizontal Field of View
ee	Entrance Pupil Position
Z or ZZ	Normalized Zoom Value – (see version #s below for format) [This field not included in these early versions of S4/i Prime lenses]

Response Values: d, sss, TT, tt, zz, hhhh, nnnn, ffff, vv, ee are the same as those described in **Section 5.1.3.**

Normalized Zoom Value ZZ: (Note: Response depends on Lens Version #)

ZZ: Normalized Zoom Value – 0.000 to 1.000 for S4/i Zoom versions after 1.21, 1.30.

10 bits in 2 bytes (characters)

ZZ	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1st	0	1	0	0	b09	b08	b07	b06
2nd	0	1	b05	b04	b03	b02	b01	b00

Range: 0 – 1000 for Zoom Lenses
[This field not included in these early versions of S4/i Prime lenses]

Normalized Zoom Value Z: (Note: Response depends on Lens Version #)

Z: Normalized Zoom Value – 0.00 to 1.00 for S4/i Zoom versions up to and including 1.21, 1.30

7 bits in 1 byte (character)

Z	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1nd	1	b06	b05	b04	b03	b02	b01	b00

Range: 0 – 100 for Zoom Lenses

[This field not included in these early versions of S4/i Prime lenses]

Response for lens versions <u>AFTER</u> 0.21, 0.34, .22 and 1.31:

Issue	Kd[C/R]	Tag = d
Response	d s s s s TT t t z z h h h h n n n n f f f f v v e e Z Zxxxxxxxxx [L/F][C/R]	

Response Values	**Definition**
d	Tag
ssss	Focus Distance
TT	Aperture Value – Actual Aperture Setting
tt	Aperture Ring T Stop Integer x 10 & the 1/10th fraction
zz	Zoom - EFL (mm) [0000 for Prime lenses]
hhhh	Hyperfocal Distance
nnnn	Near Focus Distance
ffff	Far Focus Distance
vv	Horizontal Field of View
ee	Entrance Pupil Position
Z or ZZ	Normalized Zoom Value – (see 10 bit and 12 bit ADC versions below for format) [This field not included in these early versions of S4/i Prime lenses]
xxxxxxxxxx	Lens Serial Number [ASCII format]

Response Values: d, sss, TT, tt, zz, hhhh, nnnn, ffff, vv, ee are the same as those described in **Section 5.1.3.**

Normalized Zoom Value ZZ: (Note: Response depends on Lens Version #)

ZZ: Normalized Zoom Value – 0.000 to 1.000 for S4/i Zoom versions after 1.21, 1.30

10 bits in 2 bytes (characters)

ZZ	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1st	0	1	0	0	b09	b08	b07	b06
2nd	0	1	b05	b04	b03	b02	b01	b00

Range: 0 – 1000 for Zoom Lenses
[This field not included in these early versions of S4/i Prime lenses]

Normalized Zoom Value Z: (Note: Response depends on Lens Version #)

Z: Normalized Zoom Value – 0.00 to 1.00 for S4/i Zoom versions up to and including 1.21, 1.30

7 bits in 1 byte (character)

Z	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1nd	1	b06	b05	b04	b03	b02	b01	b00

Range: 0 – 100 for Zoom Lenses
[This field not included in these early versions of S4/i Prime lenses]

A.2 Bluetooth Communication Exchange

The series of command and responses to establish a Bluetooth communication exchange as described in Section 4.7.2.1. [Note: The **string** sent is the lens Serial Number.]

BOARD SENDS:	BLUETOOTH SENDS:
+++< c/r	l/f OK c/r l/f or c/r l/f ERROR c/r l/f
AT c/r	c/r l/f OK c/r l/f or c/r l/f ERROR c/r l/f
ATZ c/r	c/r l/f OK c/r l/f
AT+BTNAME="…**string**…"c/r	c/r l/f OK c/r l/f
AT+BTSCAN c/r	c/r l/f OK c/r l/f followed by: c/r l/f CONNECTED c/r l/f

A.3 Checksum Mode – G command

Use the G command to turn on the checksum mode. In checksum mode, two characters are added to the response string between the message string and the termination sequence, (l/f)(c/r). The checksum is formed by setting an 8 bit checksum value to all 1's and then performing an exclusive or operation (XOR) between the existing checksum value and each character of the response string in turn, until all the characters are processed. The resulting 8 bit checksum is then converted into two separate characters as shown below.

Checksum value: c7 c6 c5 c4 c3 c2 c1 c0
First checksum character to be transmitted: 0 1 0 0 c7 c6 c5 c4
Second checksum character to be transmitted: 0 1 0 0 c3 c2 c1 c0

These two characters are appended to the response string followed by the termination sequence. Use the H command to turn the checksum mode off.

B.1 Firmware and Lens SoftwareVersion Numbers

Lens Type	Base Firmware Version	Software Version Number
S4/i Prime – 10 bit ADC	e,f,g	0.05 …0.29
S4/i Prime – 12 bit ADC	h,i,j	0.30 …0.39
S4/i Prime – with /i² Technology		4.20 …4.29
S4/i Zoom – 10 bit ADC	v,w	1.21 …1.29
S4/i Zoom - 12 bit ADC	p,q	1.30 …1.39
S4/i Zoom – with /i² Technology		4.60 …4.69
5/i Prime – 12 bit ADC	a,b	5.00 …5.19
5/i Prime – with /i² Technology		5.20 …5.29
miniS4/i [Panchro/i] Prime – 12 bit ADC	r,s	8.00 …8.19
miniS4/i – with /i² Technology		8.20 …8.29
Anamorphic /i Prime Lens	b	5.03
Anamorphic /i Prime - with /i² Technology	A2	9.20 …9.29
Angenieux	t,u	A.xx
Sony Prime		6.20 … 6.29
Sony Zoom		6.30 … 6.59
Canon		Q.xx

The Viewer Software displays both the base firmware and software version numbers. The base firmware defines the board type and is that part of the program code (stored on the electronics board in the lens) which is fully protected and cannot be erased or altered when a new program is uploaded. New firmware is occasional offered by the manufacturer to update data processing facilities in the lens. Uploading new firmware should only be conducted by authorized lens service providers using Cooke software (Program Uploader). This software ensures updates are correctly managed and verified. Software allows earlier versions of the firmware to be uploaded if circumstances require a previous version.

Evolution of S4/i Prime 10 bit ADC Upgrade SW Versions	
V0.05 to 0.19	Early versions: most do not exist
V0.20	See specification issues up to version 2.22
V0.21	Specification issue 2.23. Addition of Serial number to lens data string
V0.22	addition of Ka command
V0.22 to 25	skipped
V0.26	Addition of board SW version to end of N command response string
V0.27	Addition of more film formats (Wnn command + modify responses to P & Kbn commands
V0.28	Add CoC values W07 and W08
V0.29	Add dummy normalized zoom to data field & change startup to standardized sequence. Start-up Baud increase from 9600 to 115k2.

Evolution of S4/i Prime 12 bit ADC Upgrade SW Versions	
V0.30/31	See specification issues up to version 2.22
V0.33	Operation as per v0.21
V0.34	Addition of Serial number to lens data string
V0.35	Addition of Ka command
V0.36	Addition of board SW version to end of N command response string
V0.37	Addition of more film formats (Wnn command) + modify responses to P & Kbn commands
V0.38	Add CoC values W07 and W08
V0.39	Add dummy normalized zoom to data field & change startup to standardized sequence. Start-up Baud increase from 9600 to 115k2.

Evolution of S4/i Prime -/i2 Technology	
V4.2x	New lens board – /i2 Technology

Evolution of S4/i Zoom 10 bit ADC Upgrade SW Versions	
V1.21	See specification issues up to version 2.22
V1.22	Specification issue 2.23. Addition of Serial number to lens data string + Increase Normalized zoom resolution
V1.23	Addition of Ka command
V1.23 to 25	skipped
V1.26	Addition of board SW version to end of N command response string
V1.27	Addition of more film formats (Wnn command) + modify responses to P & Kbn commands
V1.28	Add CoC values W07 and W08
V1.29	Change startup to standardized sequence. Start-up Baud increase from 9600 to 115k2.

Evolution of S4/i Zoom 12 bit ADC Upgrade SW Versions	
V1.30	See specification issues up to version 2.22
V1.31	Specification issue 2.23. Addition of Serial number to lens data string. Increase Normalized zoom resolution. Addition of Ka command
V1.31 to 35	Skipped
V1.36	Addition of board SW version to end of N command response string
V1.37	Addition of more film formats (Wnn commands) Modify responses to P and Kbn commands
V1.38	Add CoC values W07 and W08
V1.39	Change startup to standardized sequence. Start-up Baud increase from 9600 to 115k2.

Evolution of 5/i 12 bit ADC Upgrade SW Versions	
V5.01	Factory Test version with base firmware "b"
V5.02 & 5.03	Software start-up units operation

Evolution of 5/i Prime - /i2 Technology	
V5.2x	New lens board – /i2 Technology

Evolution of miniS4/i [Panchro] 12 bit ADC Upgrade SW Versions	
V8.01	Factory Test version
V8.02	Production Release version to spec 2.40

Evolution of miniS4/i Prime - /i2 Technology	
V8.2x	New lens board – /i2 Technology

Evolution of Anamorphic /i Prime – 12 bit ADC Version	
V5.03	First release - /i Technology

Evolution of Anamorphic /i Prime -/i2 Technology	
V9.2x	New lens board – /i2 Technology

B.2 /i Technology Partners

Aaton
Andra
Angenieux
Arri
Atmos
Avid
Berger Engineering
Canon
Cinematography Electronics
CMotion
Codex
Element Technica
Fujinon
Global Boom International
IB/E
Mark Roberts Motion Control
Optitek
Ovide
Panavision

Preston Cinema Systems
RED
Service Vision
Sony
The Foundry
The Pixel Farm
Transvideo
Vision Research – Ametek Materials Analysis
Zeiss

B.3 /i Accessories

AC Power Supply for /i lenses
with external connector (from Cooke)

XLR Power Connection for /i lenses
with external connector (from Cooke)

Cooke /i Update Base (from Cooke, lens not included)

Cooke 5/i Lighting Controller

The Cine Tape Measure system is a small and quiet ultrasonic range finder that is easy to set up and easy to use.

Appendix C

C.1 Update Ownership Program for Cooke /i Lenses

The Cooke Owner Update program is to update the owner name of a lens through its external interface. It is implemented in Java so it runs on Windows and Mac OS X, and can be downloaded from Cooke Optics Limited website.

The lens and PC or MAC is connected through a serial port. If the machine doesn't have a serial port, use a USB-Serial port adapter and install a correct driver.

To run the program, Java Runtime Environment (JRE) is required. It comes with MAC OS X. For Windows, it can be downloaded here if not installed.

Installation of Software

Windows XP/VISTA/7/8/10

- Download JRE here and install if it is not already installed.
- Double click the Owner Update installer *Cooke Ownerupdate_Win_setup_V3.00.msi* , follow the instruction and complete installation.

Mac OS X

- Setup Serial Port

  Run *SerialPort_Config* first so that the application can access the serial port. Only need to run *SerialPort_Config* ONCE if you have both programs, *Cooke Viewer_J* and *Cooke Owner Update* on the machine. Your account needs to be Administrator to run it. After successful configuration, your user ID should be displayed after [GroupMembership] and [Process completed] appears on the Terminal.
- No *Owner Update for MAC* program installation needed. Just download and place it at the Desktop or any directory.

Hardware Setup

- Connect the lens to a PC or MAC through the serial port cable, and power it on.

Run Cooke Owner Update

- Make sure the lens is powered on before running the program
- For Windows: Run *Cooke Owner Update* from Desktop or from Start->Programs->
- For MAC OS X: Double click *Cooke Owner Update*, the screen as shown in Figure 1 appears. It lists all of the available serial ports on the machine. Select one which the lens is connected to.

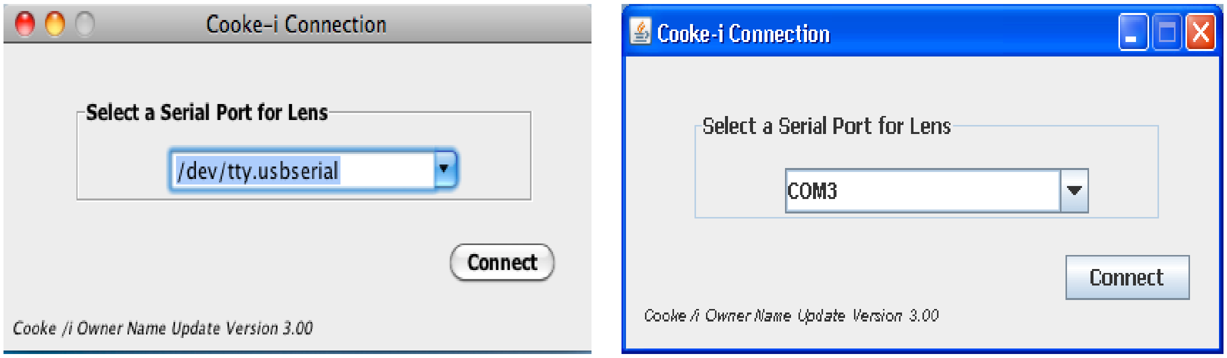


Figure 1 Select Serial Port on MAC and on Windows

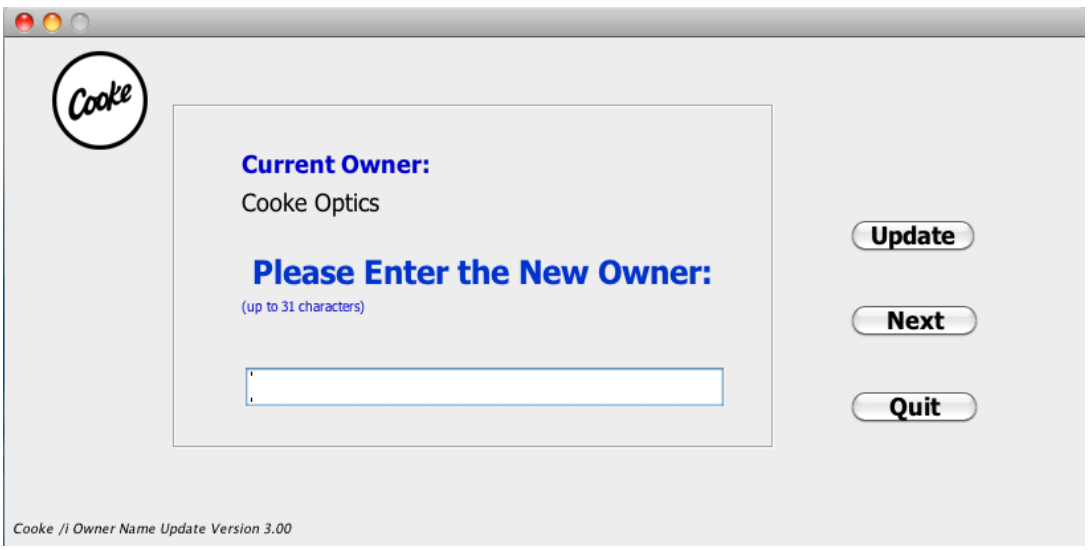


Figure 2 Enter the New Owner

- Click the Connect button, the second screen as shown in Figure 2 appears. The current owner is displayed.
- Input the name of the new owner, and then click the **Update** button, the newly input owner name is displayed at the top of the screen as shown in Figure 3.
- If updating more than one lens, disconnect the updated lens, connect the new lens, and then click Next button. The owner name of the new lens is displayed, and the previously inputted name stays in the text field. If the owner of the next lens is the same as the previous one, just press Update button.
- There is Copy and Paste menu by right click the mouse, shown in Figure 4.
- Click  or Quit button to finish the updating process.

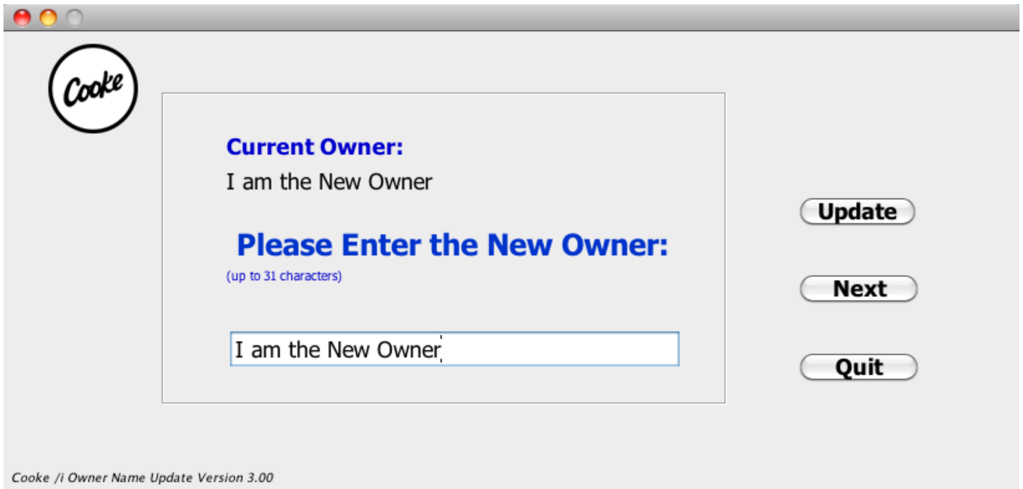


Figure 3 Owner Updated

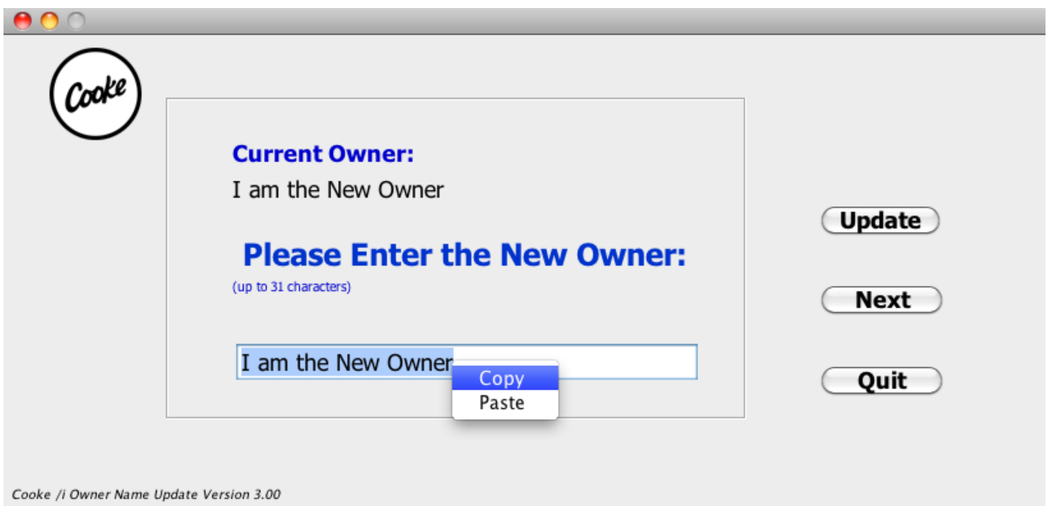


Figure 4 Copy and Paste Menu

Notes:

If any error messages turn up, please check the followings:

- Accessibility to the Serial Port on MAC
- Updated Driver of USB-Serial Port Adaptor
- Lens is correctly connected to the selected serial port and powered on
- Any program running which is using the same serial port, such as HyperTerminal
- Close the program, power off the lens and start it again if everything checks out okay

C.2 Viewer Java Program for Cooke /i Lenses

The Cooke Viewer Java program is to view the information of a lens through its external interface. It is implemented in Java so it runs on Windows and Mac OS X, and can be downloaded from Cooke Optics Limited website.

The lens and PC or MAC is connected through a serial port. If the machine doesn't have a serial port, use a USB-Serial port adapter and install a correct driver.

To run the program, Java Runtime Environment (JRE) is required. It comes with MAC OS. For Windows, it can be downloaded here if not installed.

Installation of Software

Windows XP/VISTA/7/8/10

- Download JRE 6 or above for Windows x86 here and install if it is not already installed.
- Double click the *Viewer* installer *CookeViewer_Win_setup_V3.04 .msi* , follow the instruction and complete installation.

Mac OS X

- Setup Serial Port

  Run *SerialPort_Config* first so that the application can access serial ports. Only need to run *SerialPort_Config* ONCE if there are both programs, *Cooke_Viewer* and *Cooke OwnerUpdate* on the machine. Your account needs to be Administrator to run it. After successful configuration, your user ID should be displayed after [GroupMembership] and [Process completed] appears on the Terminal.
- No *Cooke Viewer for MAC* program installation needed. Just download and place it at the Desktop or any directory.

Hardware Setup

- Connect the lens to a PC or MAC through the serial port cable, and power it on.

Run Cooke Viewer

- Make sure the lens is powered on before running the program
- For Windows: Run *Cooke Viewer* from the Desktop or from Start->Programs->
- For MAC OS: Double click *Cooke Viewer,* the screen as shown in Figure1 appears. It lists all of the available serial ports on the machine. Select one which the lens is connected to.
- Click the Connect button, the second screen as shown in Figure2 appears.
- Click ☒ or **Quit** button to end the program.

Figure 1 Select Serial Port on MAC and on Windows

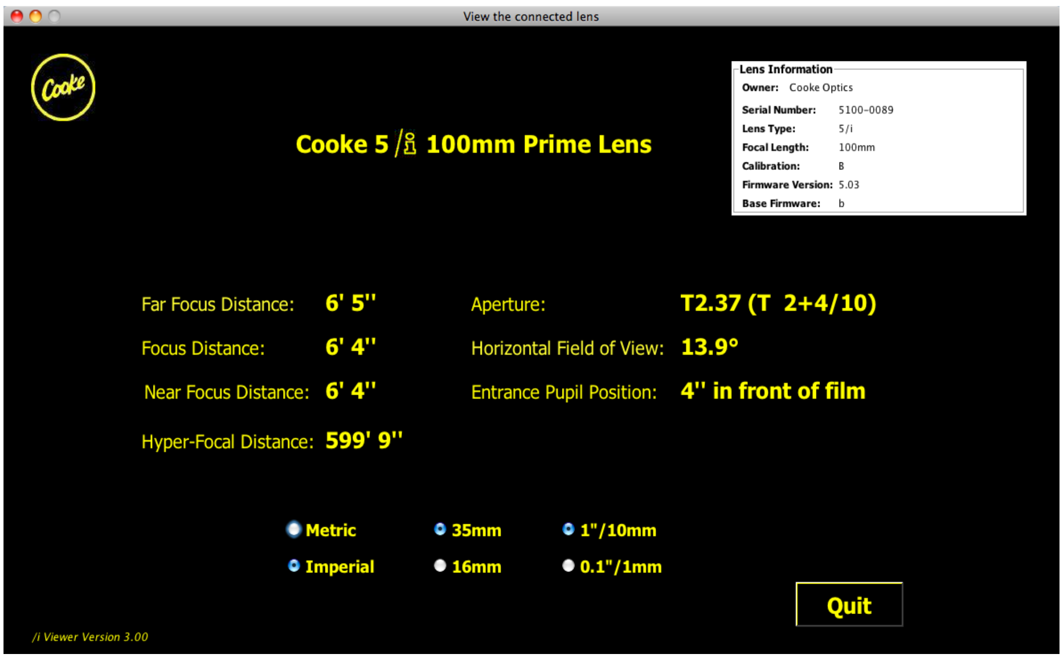


Figure 2 View the lens information

Notes:

If any error messages turn up, please check the followings:

- Accessibility to the Serial Port on MAC
- Updated Driver of USB-Serial Port Adaptor
- Lens correctly connected to the selected serial port and powered on
- Any program running which is using the same serial port, such as HyperTerminal
- Close the program, power off the lens and start it again if if everything checks out okay

C.3 Using HyperTerminal or PuTTY to Communicate with Cooke /i Lenses

The HyperTerminal or Putty programs can be used to view the information of a lens through its external interface.

Launch HyperTerminal by running the hypertrm.exe file. From Windows XP it can be found under Programs -> Accessories -> Communications -> HyperTerminal.

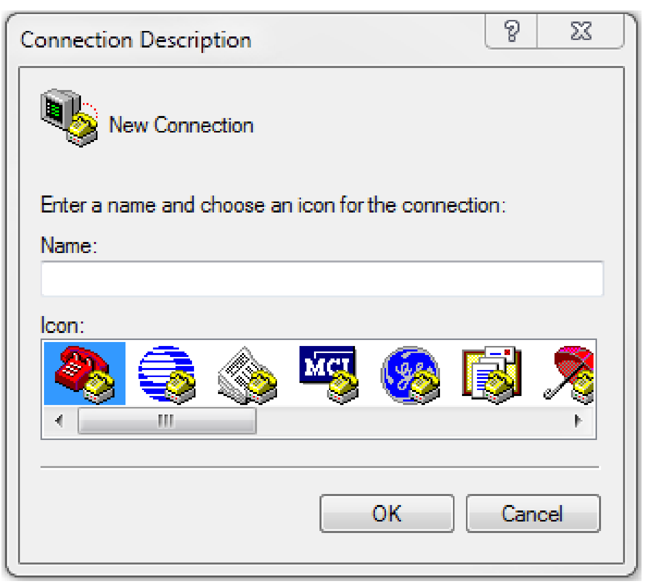
If there is no HyperTerminal preinstalled on your PC, it can be downloaded from the Internet or retrieved from a Windows XP computer. [Note: Windows 7 and Vista no longer provide HyperTerminal but it can easily be installed. The two files you need are hypertrm.dll and hypertrm.exe. They are typically found from the Windows XP installation:

c:\Program Files\Windows NT\Hypertrm.exe
c:\Windows\System32\hypertrm.dll

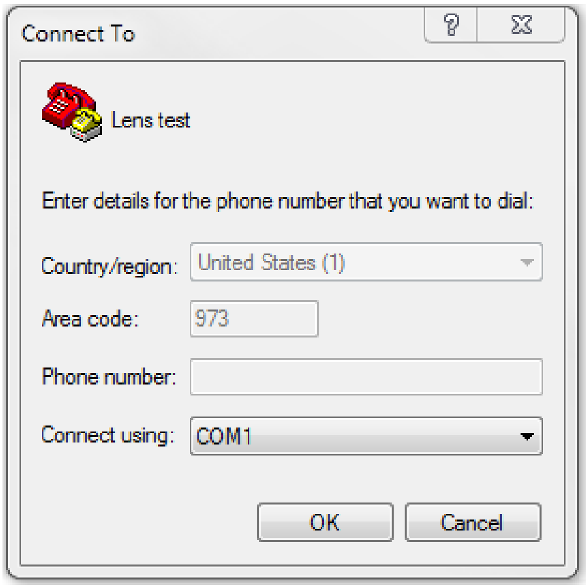
Copy these files into the same directory on the target Windows PC and launch HyperTerminal by running the hypertrm.exe file.

Select the serial port to which the lens is connected and specify the connection settings, (speed=9600, data bits=8, stop bits=1, parity=no, flow control=no), so the connected lens can be accessed.

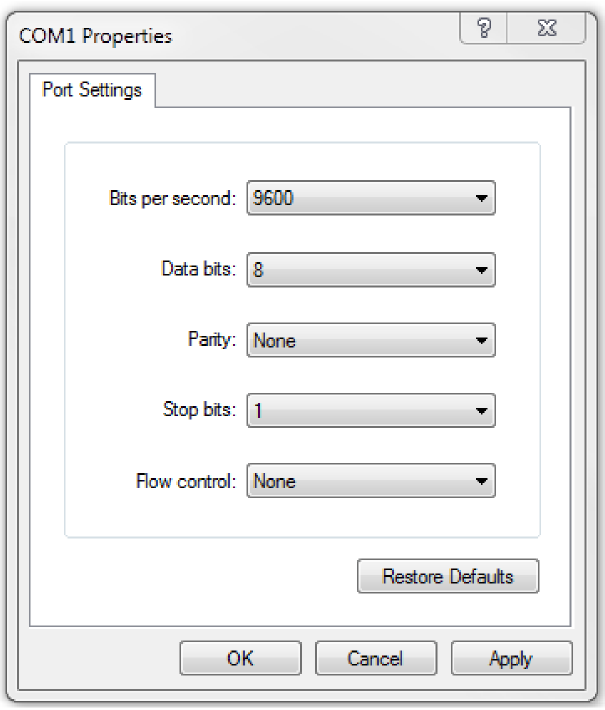
Enter a name:



Select the port to which you are connected:



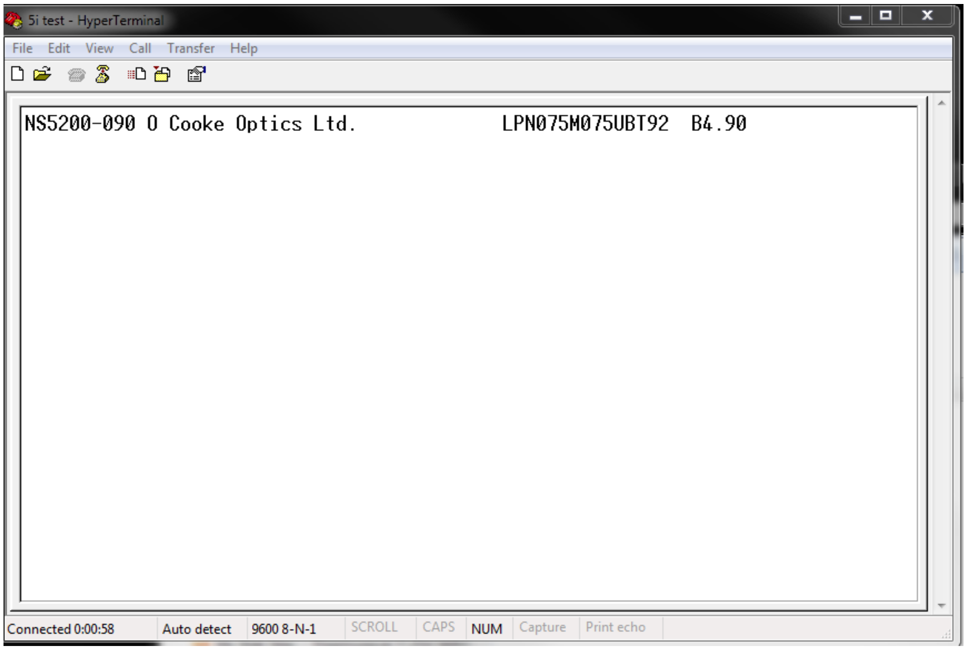
Select the serial port parameters as shown below:



Apply and press OK.

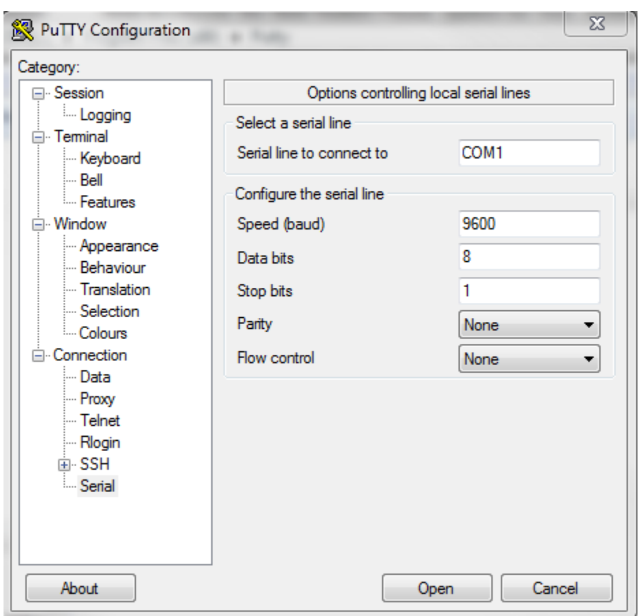
The HyperTerminal is now connected. To activate communication with the lens, type N and press <enter>. [Note: This is an upper case letter N]

All other commands are now available.

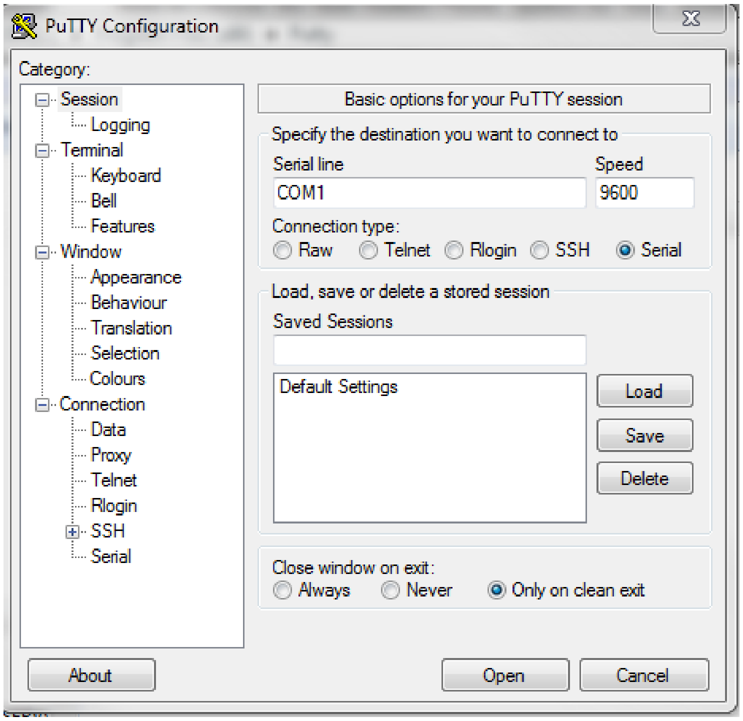


If you do not have access to HyperTerminal, PuTTY can be downloaded from http://www.putty.org/ and used to access serial devices. Running the program will bring up the PuTTY Configuration window shown below.

Configure Putty as a serial client by opening the serial node in the category view and specifying serial as the connection type.



Open the session node, click on the serial radio button and then click **Open**.



Check to make sure you have specified the COM port to which you are connected. Device Manager can help you determine the correct COM port.