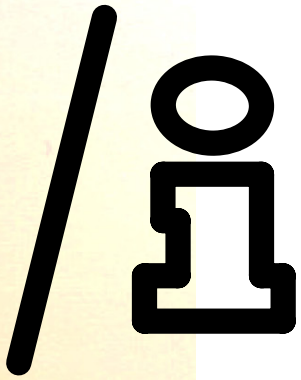
Cooke



Communications Protocols

Version 2.41 (/i firmware versions a.c1)*
(Note: new numbering system. See B-1 for explanation.)
March 2011

Introduction
Addendum A1
Sections: A-B

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Cooke /i Specifications

Index

* Change notice list of specification version

Earlier versions of the Specification were numbered 2.xx, with the latest being 2.29 which covered S4/i and RED products only.

Issue	Cooke /i spec 2.40	First Issue	September 2009
Issue	Cooke /i spec 2.41	Second issue	March 2010

For a detailed explanation on the new numbering system, please refer to Section B, page 1.

The current firmware issues for Cooke I lenses are as follows :

For S4/i Prime 10 ADC bit boards	S4_Prime_10_029
For S4/i Prime 12 ADC bit boards	S4_Prime_12_039
For S4/i Zoom 10 ADC bit boards	S4_Zoom_10_129
For S4/i Zoom 12 ADC bit boards	S4_Zoom_12_139
For RED Zoom	RED_309
For 5/i Prime	S5_Prime_503
For Panchro Prime	Panchro_802

In order to use the new communication protocols described in this document a firmware upgrade to the above is required.

Cooke /i Specifications

The full specification for the Cooke /i range of lenses is separated into sections as follows:

A User information This describes the operation of the lens system and how an external device communicates with, and controls, the lens. This section only includes those commands and details required by a user.

B Firmware versions and Board configurations This sections lists all of the board variants that have been developed and defines which of the possible options described in section A exist for a specific lens board type. There is also a summary of previous and current firmware releases, and what each release change entails.

This specification covers all of the Cooke /i lens range:

S4/i 5/i RED and Panchro

and provides a generalised single document to cover all products, so that similarities and differences are defined to more easily enable an OEM developer to work with the lenses.

Serial Number Protocols

General description -- Serial numbers shall be expressed in the following manner:

Cooke Optics Limited

S4 serial numbers

4FFF-XXXX

Example: 4025-1234 = S4 25mm

Older S4 serial number specification is still valid:

Previous specification: FF-XXXX

Example: 25-1234

5/i serial numbers

5FFF-XXXX

Example: 5025-1234 = 5/i 25mm

CXX serial numbers

800XXX

Panchro serial numbers

8FFF-XXXX

Example: 8025-1234 = Panchro 25mm

==========

Other Manufacturers' Serial Numbers

RED Zooms

600-XXXX 18-50mm

610-XXXX 50-150mm

DigiOptical

620XXXX 18-50mm

630XXXX 50-150mm

Angenieux:

First digit: A for Angenieux

Second digit: A for OPTIMO 15-40
B for OPTIMO 28-76
C for OPTIMO 45-120
D for OPTIMO DP 16-42
E for OPTIMO DP 30-80
F for OPTIMO 17-80
G for OPTIMO 24-290

Digits 3 to 9: product serial number

Example for a 28-76 n°1234567 => AB1234567

Sony

First digit: S for Sony

MMM: Model ID (3 chars)

NNNNN: Serial Number (5 chars)

Example: SMMMNNNNN

F3 Lens Package: 35mm: S01P00001 or higher
50mm: S02P00001 or higher
85mm: S03P00001 or higher

Interconnection Diagrams and Details

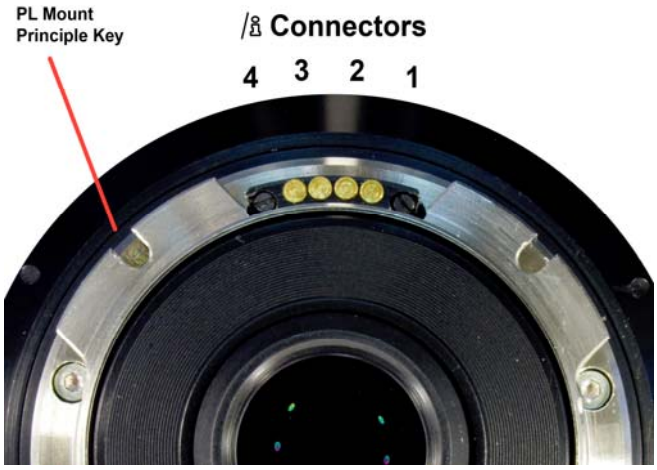
Power can be supplied to the lens from either the Camera or the External device or both. The maximum voltage which can be supplied on either connector is 35 v (DC).

For S4/i lenses the source of the power selects which of the 2 channels has control of the communications activity.

Camera Connector

The signalling voltages on this interface are at TTL levels, where the quiescent state of the data lines is a logic High (i.e. greater than 2.4 volts).

This is a rear view of the lens with PL mount showing the 4 pins:



Viewed from rear of lens:

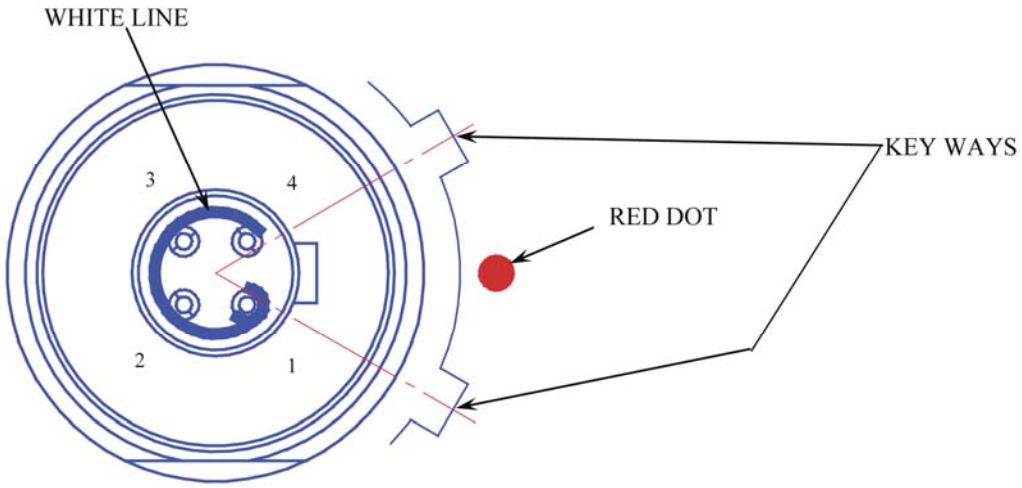
Pin 1	Data From lens	
Pin 2	Data To lens	
Pin 3	0 volts	data and power
Pin 4	+V	Power in

External Connector

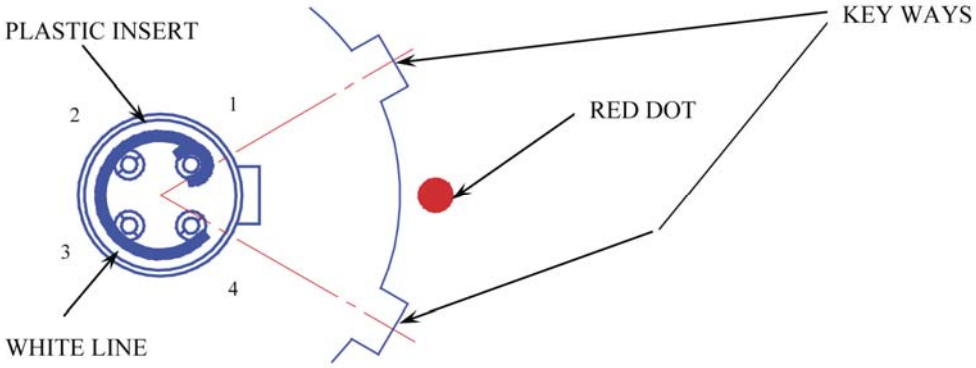
The signalling voltages on this interface are at RS 232 levels (+ and – with respect to 0 v), where the quiescent state of the data lines is at a negative voltage.

This is a standard LEMO mechanical connector, with 4 pins assigned as:

Pin 1	Data From lens	
Pin 2	Data To lens	
Pin 3	0 volts	data and power
Pin 4	+V	Power in



Rear View of LEMO SOCKET EGB00304CLL mounted on the S4/i Lens.
(This is the view of the solder buckets and the red dot marker and key way positions are indicated for clarity).



Rear View of LEMO PLUGS FGB00304CLAD35 or FHB00304CLAD35 used to connect to the S4/i Lens.
(This is the view of the solder buckets and the red dot marker and key way positions are indicated for clarity).

Cooke /i Lens System
(Version 2.41 – March 2011)

Section A
User Information

List of sections:

1 System overview

1.1 A lens system comprises the following parts:

The lens houses two (Prime) or three (Zoom) resistance elements with wipers to sense the position of the FOCUS, APERTURE and, where appropriate, the ZOOM scale positions of the lens.

A main lens electronics board connects to the resistance elements, using either one (Prime) or two (Zoom) connectors as appropriate.

The main lens board also has one or two serial communications interfaces, through which the board will receive commands and issue responses to these commands. These interface connections also provide the power to the lens board.

The 5/i also has two sets of LED's which are used to illuminate the Focus scale. The LED's are connected to a secondary electronics interface board.

1.2 Communications interfaces

A lens board will have one or two communication interfaces, where one of these connectors is used for direct connection to the camera (Camera Interface), and the other is for external devices to be connected (External interface).

The Camera Interface operates at TTL levels, while the External interface operates at RS232 levels.

Each of the communications interfaces provides for a Power supply and serial transmit and receive lines through a separate 4 way connector

1.3 Sensor resistors

These are mounted in the lens body and there is a separate resistor for each of the Focus, Aperture and Zoom movements. These resistors are supplied with power from the logic board and the wiper signal is fed back to the logic board for sensing.

1.4 Illumination (5/i only)

A further 4 way connector connects via a cable to the secondary electronics board, and carries +5v power and also provides 2 PWM current sinking signals, which can be used to control the two sets of LED's which provide scale illumination.

1.5 General

When each lens / electronics board is built, a process is undertaken to ensure that the individual sensors are correctly calibrated for each of the resistance sensors, with respect to the optical ring markings. This information, together with the characteristics / type of lens is then stored into the board.

When in use, the electronics will constantly monitor the settings of the separate resistance elements and use these values, in conjunction with the calibration data tables and other stored information, to generate data about the lens settings and the associated image. The results of this information are available through the communications channels on demand.

2 Potentiometer Connections

Dependant upon the lens configuration, the board will provide suitable connections to the sensors, which consist of resistive sensors. The two ends of each sensor will be connected to the +5v and 0v reference voltages supplied by the board, and the wiper signals will be fed to the board, where the current settings can be interpreted using the Analogue inputs which have 10 bit resolution on early S4/i Prime and Zoom lenses, and 12 bits on all other lenses.

3 Communications channels

The lens operates on the basis of "responses to commands", with the one exception at Power up. The lens will normally respond to all "command messages", including an "error" response to any invalid command, but there are certain circumstances where no reply is sent – (see inhibit errors state).

Where a single communication channel exists, that channel will always have control of the communications. For S4/i lenses, only one channel will be able to issue commands, but replies will be sent out on both channels. For 5/i lenses the two channels will be independent, and can both send commands and receive replies.

For S4/i, the selection of which channel has control is explained in the section "Lens start-up sequences" below.

3.1. Basic Communications

The format for communications will be 8 bit data without parity, and 1 stop bit, and will use ASCII format. However, to reduce the time taken to transmit data from the lens, certain responses from the lens can be requested to be in a packed binary form, but still using the 8 bit no parity format.

All transfers are initiated by the External unit or Camera unit, and the lens electronics will reply with the required information. The exception to this is at Power up when a single automatically generated string is transmitted by the lens to indicate that power up has occurred (this will be sent to both channels).

Messages TO the lens will always be in ASCII format and terminate with a CARRIAGE RETURN character (**c/r**), which has the hex value 0D.

Reply messages from the lens will normally be in ASCII format and terminate with the character pair of LINE FEED **(l/f**) followed by **c/r** [hex 0A hex 0D].

When the response from the lens is in packed binary format, the termination character pair will still be "hex 0A and 0D", and neither of these characters will appear within the string, since when generating packed binary data, all characters will have either bit 7 or bit 6 (or both) set to 1.

An optional checksum can be added to the messages sent from the lens (see relevant section). This checksum is turned on/off by external commands. The power up state is with Checksum OFF. The checksum codes are inserted before the termination sequence, and cannot be confused with the **l/f c/r** termination of strings from the board.

The set of commands recognised by the board, and the corresponding responses are separated into three categories:-

a) Normal operation commands and responses Section A
b) Calibration and configuration commands / responses Section C
c) Program upload commands and responses Section D

Each command will have a specific response, and any invalid command will result in the response of **? l/f c/r**. unless the INHIBIT ERRORS command has been issued.

3.2 For 5/â only, in the event of one channel starting an Upload sequence, then any command issued by the other channel will be ignored. Upon completion of the Upload, a "power on reset" will occur and both channels will then send the power up string (see section 4 below).

If one channel starts a "calibration" or Fixed data update, then the other channel will receive an "unavailable "response to any command it issues. Normal operation will be restored at the end of the sequence.

The "unavailable" response is: **^ l/f c/r**

4 Lens start up sequence

When power is supplied to the board, it will initialise, and then send a power on string on both channels to indicate that it is ready for use. There are various combinations of startup method and baud rate over the /â range. In all cases, the lens MUST receive an N command as the first command, to which it will respond, and after this all other commands are available to the controlling channel(s).

4.1 S4/â Startup

The power inputs on both channel connectors are monitored at startup (and during operation) to select which channel has control.

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 Interface is granted control.

4.1.1 Camera interface granted control -- firmware versions up to 0.28, 0.38, 1.28, 1.38

The startup Baud rate will be 9600 baud. The power up prompt (< l/f c/r) is sent on both interfaces, and the lens will wait until it receives an N command from the Camera interface.

4.1.2 Camera interface granted control --firmware versions up to 0.29 (4.01), 0.39 (4.21), 1.29 (4.41), 1.39(4.61).

The startup baud rate will be 115k2. The power up prompt (< l/f c/r) is sent on both interfaces, and the lens will wait for 1 second to receive a N command from the Camera interface. If this is not received within 1 second, the baud rate is switched to 9600, and the power up prompt (< l/f c/r) is sent on both interfaces. The lens will now wait until it receives an N command from the Camera interface.

This form of start up is standard on all other lenses, giving a common sequence across the whole /i range.

4.1.3 External Interface granted control --firmware versions up to 0.28, 0.38, 1.28, 1.38

The start-up speed will be 115k2 baud, and the standard power-on prompt (<) is sent. The program waits for 1 second to receive a response (N command), and if this is received, the lens will enter normal mode at 115k2 and respond.

If no response is received within 1 second, the data rate is dropped to 9600 baud and a modified power-up string is sent (+++<). This string doubles as a Bluetooth initialisation (+++) or as a standard start-up code (<). The lens at this stage will accept either the N command froma directly connected device or enter a series of exchanges to establish a Bluetooth Connection. If a valid Bluetooth connection sequence (see Bluetooth section 4.4) is received, the baud rate stays at 9600 and the lens waits for the N command.

If the Bluetooth connection sequence is not completed correctly (normally within 1 second this starts), remains at 9600 and the lens will then wait until an N command is received from the External interface.

4.2 RED and Panchro startup

The board will initially start up at 115k2 baud and send the power up string of **< l/f c/r**. It will then wait for 1 second to receive the N command. If no N command is received within 1 second, the data rate will drop to 9600 and the board will issue a new power up string of **< l/f c/r**.

It will now wait, without timeout, to receive an N command.

4.3 5/i startup

The board will initially start up at 115k2 baud and send the power up string of **< l/f c/r** to both channels. It will then wait for 1 second to receive the N command from either channel. If no N command is received within 1 second, the data rate will drop to 9600 and the board will issue a new power up string of **< l/f c/r** to both channels.

It will now wait, without timeout, to receive its first mandatory command (N command) from either channel.

4.4 Bluetooth operation

Only available on S4/i lenses

When attempting startup at 9600 baud with an RS232/External connection, the lens will issue a modified start-up string to try to establish connection with a Blue tooth device.

This string is **+++< l/f c/r** . If the board receives an N c/r command within 1 second, it will continue with normal operation at 9600 baud, and note that there is no Bluetooth device connected.

If after 1 second, there correct Bluetooth start response is not received (see below), then the standard startup string: **< l/f c/r**

will be issued, and the 9600 baud rate retained, and there will be no timeout while waiting for the mandatory N Command. The lens will also note that there is no Bluetooth device connected.

If the correct response to the Bluetooth initialisation is received within the 1 second period, the board will undertake a series of exchanges to initialise the Bluetooth device as follows:

Board sends	Bluetooth sends
+++<	c/r l/f OK c/r l/f followed by: c/r l/f ERROR 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="…(note).."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

Note: The string sent is the lens Serial Number section from the Fixed data.

After this there is a 9600 baud (fixed speed) link established for the communications channel via the Bluetooth device, and normal operation will continue with the standard startup string of > l/f c/r being issued. The lens will note that a Bluetooth device is connected, and will not allow Baud Rate changes.

4.5 Startup established

The first command received by the board MUST be the **N c/r** command. Any other command will cause the startup string to be re-issued.

For 5/i this command can be received from either channel, and the response will be sent only to the channel sending the N command.

For S4/i the command can only be received from the controlling channel, but the response is sent to both.

For RED and Panchro, there is only one interface.

The response will be the FIXED DATA from the board, which gives the basis characteristics of the board / lens combination, and firmware version.

4.6 Loss of program

In the event of a loss of program – which is extremely unlikely, the start-up prompt will be **@** or **@x**. If this occurs, the lens will need to have its program reloaded. Please contact your nearest service point.

5 Valid Commands available for Normal user operation

These commands allow a device connected to a communications channel to obtain data from the board, or to alter certain aspects of the boards operation, by changing some parameters associated with the data calculation process i.e. data rate, data format or checksum.

The channel issuing the command will receive a response and in the case of S4/a, the response is sent to both channels.

The complete set of valid commands listed below, are not **all** available to **all** lenses. Some have been introduced with newer firmware versions, while others only apply to specific lens types. In addition, with 5/a, many of the commands only affect a single channel.

B	Retrieve firmware version installed into the board.	
C	Set Continuous send of data blocks	(***5/a….for this channel***)
D	Request a set of calculated data.	
G	Set checksum mode	(***5/a….for this channel***).
H	Stop “continuous send” modes and clear other optional modes	(***5/a….for this channel***)
Ka	Inhibit error responses	(***5/a….for this channel***).
Kbn	Change baud rate for communication	(***5/a….for this channel***).
Kc	Set continuous mode send of packed binary data	(***5/a….for this channel***).
Kd	send 1 block of packed binary data.	
Kjn	Set scale illumination level for both LED sets	(***5/a only***)
Kkn	Set scale illumination level for one LED set	(***5/a only***)
N	Retrieve Fixed data string	
OS	Request current options set	(***5/a….for this channel***).
OX	Set start-up units IMPERIAL	(***5/a only***).
OY	Set start-up units METRIC	(***5/a only***).
P	Retrieve board temperature	
V	Set film size to 35 mm (default)	
W	Set film size to 16mm	
Wnn	Select alternate Film size / circle of confusion value	
X	Set Display units to imperial	(***5/a….for this channel***)
Y	Set Display units to metric	(***5/a….for this channel***).

Note that other commands exist for special functions.

B c/r Read version number

The lens will retrieve the version of the currently loaded program, and respond with this, thereby enabling a simple verification of the current firmware version in use.

Response: **B a b c d l/f c/r**

Where a b c d will be an ASCII string.

Changes to the operation of the program stored in the board may be required. This can be achieved by “uploading” a new firmware version through the communications channel. This

requires a special process, but it is possible, by means of the B command, to retrieve the currently installed version to know what facilities are included, and thereby take appropriate action.

The format for abcd will be:

For S4/i Prime lenses	0.0x, 0.1x , 0.2x, 4.01	4.19 for 10 bit ADC boards
Or	0.3x or 4.21	4.39 for 12 bit ADC boards
For S4/i Zoom lenses	1.2x or 4.41	4.59 for 10 bit ADC boards
Or	1.3x or 4.61	4.79 for 12 bit ADC boards
For 5/i Prime lenses	5.00…5.49	
For Panchro Prime lens	8.01 8.49	
For RED zoom lenses	3.01 3.09 or 6.xx	
For Angenieux zoom lenses	A.xx	

C c/r Set Continuous send mode

Response is: ! l/f c/r

Once Continuous mode is set the electronics will continually measure, calculate and send the same set of values which would be sent in response to a D command.

***** 5/i Note that this command received from one channel, will only set this mode "for that channel".***

To end Continuous Send mode use the H command.

D c/r Request current calculated values

Data is in true ASCII format.

Response will be:

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 a N b b b b b b b b F c 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

Where

D s s s s s s s	is the actual focus distance – units	
T a a a a	is the actual Aperture setting	
t b b b b b	is the calibration ring Aperture value	
Z f f f f	is the Effective Focal Length –mm	*(Note 1)*
H a a a a a a a	is the HYPERFOCAL setting -units	
N b b b b b b b	is the NEAR FOCUS distance – units	
F c c c c c c c	is the FAR FOCUS distance – units	
V v v v . v	is the Horizontal Field of view - degrees	
E s e e e	is the Entrance Pupil Position – units	*(Note 2)*
z m m m m	is the normalised zoom setting	*(Note 3)*
S xxxxxxxxx	is the lens serial number	*(Note 4)*

The units will depend upon the Display Units selected, but will be multiples of 1mm (Metric) or 0.1 inch (Imperial). The Actual Aperture setting is multiple of 0.01, and the calibration ring Aperture value follow the calibrated ring marks, and use the FULL STOP +n notation to indicate the nearest 1/10 Stop value.

The calculated values for Hyperfocal, Near and Far focus distances will be based upon film size selected.

Note 1: this field will be 0000 for Prime lenses, and will be in mm for Zoom lenses.

Note 2: this field consists of a sign s (+ /-) and value eee

Note 3: this field is NOT present for S4/i prime lenses before version 0.29 and 0.39
For Prime lenses, the field is always 0000
The format is y.yy for S4/i zoom and RED firmware versions up to and including 1.22, 1.30 or 3.02, representing a value in the range 0.00 to 1.00
The format is yyyy for all other firmware versions, and represents value in the range 0.000 to 1.000

Note 4: The field Sxxxxxxxxx is NOT present in S4/i and RED firmware versions before 0.21, 0.34, 1.22, 1.31 or 3.03

The electronics will monitor the current potentiometer settings and from these calculate the corresponding Focus Distance (S), T stop setting (T), Aperture display value (t) and current Zoom setting (Z and z). From these values, calculation parameters and other constants the electronics will calculate the Hyperfocal setting (H), Near (N) and Far (F) distances, Horizontal Field of view (V) and Entrance Pupil Position (E) for transmission. The lens serial number is extracted from the FIXED DATA, which is stored at time of Calibration.

G c/r Set checksum mode

This command, when received will set 'Checksum mode'. In this mode ALL response messages will have a checksum sequence added, which can be used by the external units to validate the contents of a message.

***** 5/i Note that this command received from one channel, will only set this mode "for that channel".***

The checksum consists of two characters which are added to the response string between the contents of the message 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 and EXCLUSIVE OR between the existing checksum value and each character of the response string in turn, until the all characters are processed. The resulting 8 bit checksum is then converted into two separate characters as follows:-

Checksum value: c7 c6 c5 c4 c3 c2 c1 c0

First checksum character for transmission is 0 1 0 0 c7 c6 c5 c4
Second checksum character for transmission is 0 1 0 0 c3 c2 c1 c0

These two characters are appended to the response string and then the terminator characters are appended (**l/f c/r**).

Note that the checksum characters cannot be confused with the termination sequence.

The response to the G command will be: **! M N l/f c/r**

To unset checksum mode, the **H** command is used (for that channel).

The power on state of the lens is with checksum mode OFF.

H c/r Unset Continuous and optional modes

Response is: ! l/f c/r

This command when received will cause that channel to revert to idle mode and cease transmitting continuous data after either a C or Kc command. It will also unset Checksum mode and Inhibit error responses mode.

***** 5/i Note that this command received from one channel, will only set this mode "for that channel".***

Ka c/r Inhibit error responses mode set

Response is: ! l/f c/r

When this mode is set, any bad or invalid message to the board will simply be ignored. To unset this mode, the H command is used.

Note that any "non valid user command" will also be ignored when this mode is set.

***** 5/i Note that this command received from one channel, will only set this mode "for that channel".***

This command is NOT implemented on S4/i and RED lenses before firmware versions:- 0.22,0.35,1.23,1.31 and 3.03

K b n c/r Select revised Baud rate

This command is used when the data transfer speed is required to be altered.

The value of "n" indicated the new baud rate to be adopted.

Values for n:

		MAXIMUM cable length	
0	set to 9600	50 metres	
1	set to 19200	30 metres	
2	set to 38400	10 metres	
3	set to 48000	8 metres	
4	set to 57600	5 metres	
5	set to 96000	2 metres	
6	set to 115200	2 metres	
7	set to 230400	0.5 metres	Note2

Please note that certain data rates will have a minor error compared to the defined rate (maximum 1.3 %). Also there will be cable drive length limitations, which will depend upon speed. See list above for baud rate error and provisional maximum cable length.

When changing the baud rate, a valid speed change will result in the response of:

K b n ! l/f c/r

which will be sent by the lens **BEFORE** the speed is altered.

Once this response has been sent, the lens will change to the new speed.

If an invalid speed is selected, the commands will be treated as invalid and the response:

? l/f c/r will be issued, and the speed will remain at the current setting.

Note 1: this invalid response will NOT be issued if inhibit errors mode is set.

Note 2: this rate only applies to the Camera interface for 5/i.

***** 5/i Note that this command received from one channel, will only set this mode "for that channel".***

K c c/r Set Continuous Send of Full data in packed binary mode

This command is used to alter the displayed data format to packed binary, but with all calculations still being performed. The data content is the same as that for the Kd command, but sent in continuous mode. This mode is unset by using the H command.

** 5/8 Note that this command received from one channel, will only set this mode “for that channel”.

K d c/r Request to Send of Full data in packed binary mode

This command is used to alter the displayed data format to packed binary, but with all calculations still being performed. The data content is the same as that for the D command, but the values are in packed binary form to reduce data transfer time

***** 5/8 Note that this command received from one channel, will only set this mode “for that channel”.***

The format of the data packet is:

d ssss TT tt zz hhhh nnnn ffff vv ee ZZ Sssssssss l/f c/r

Where:

d	is the single character indicating packet start	
ssss	Focus distance	
TT	Aperture value	
tt	Aperture scale setting	
zz	Effective focal length	
hhhh	Hyperfocal distance	
nnnn	near focus distance	
ffff	Far focus distance	
vv	Horizontal field of view	
ee	Entrance Pupil position	
ZZ	Normalised zoom value	(Note 1)
Sssssssss	Lens serial number	(Note 2)

(Total of 39or 41 characters including termination)

Where:

ssss, hhhh, nnnn and ffff are all 24 bit binary values packet into 4 bytes as follows:

0 1 b23 b22 b21 b20 b19 b18
0 1 b17 b16 b15 b14 b13 b12
0 1 b11 b10 b09 b08 b07 b06
0 1 b05 b04 b03 b02 b01 b00
A binary value of all 1’s is treated as infinity.

The value TT is a 12 bit value in 2 characters:

0 1 b11 b10 b09 b08 b07 b06	
0 1 b05 b04 b03 b02 b01 b00	range 144 to 2560 (1.44 to 25.60)

tt is 2 characters which contain the Aperture Ring T stop integer x 10 and the1/10th fraction

1 b6 b5 b04 b03 b02 b01 b00	Range 14 to 220 for integer x 10
1 b7 0 0 b03 b02 b01 b00	Range 0-9 for $1/10^{th}$ fraction.

zz is the 10 bit value in 2 characters

0 1 0 0 b09 b08 b07 b06

0 1 b05 b04 b03 b02 b01 b00 range 0 to 1023 for zoom
b00 …b09 = 0 for prime lenses.

vv is the 11 bit value in 2 characters (multiples of 0.1 degrees):

0 1 0 b10 b09 b08 b07 b06
0 1 b05 b04 b03 b02 b01 b00 range 0 to 1800 (0.0 to 180.0)

ee is the signed 10 bit value in 2 characters.

0 1 s 0 b09 b08 b07 b06 s =0 for positive, s=1 for negative
0 1 b05 b04 b03 b02 b01 b00 range 0 to 1023

ZZ is the 10 bit value packed into 2 characters as follows:

0 1 0 0 b09 b08 b07 b06
0 1 b05 b04 b03 b02 b01 b00 range 0 to 1000 (0.000 to 1.000)
for a prime lens B00..b09 = 0.

Note 1 This field is NOT included in S4/ⅈ Prime lens data string prior to 0.29 (4.01) or 0.39 (4.21)

For prime lenses the values will be:

0 1 0 0 0 0 0 0
0 1 0 0 0 0 0 0

For S4/ⅈ zoom and RED firmware version up to and including 1.21, 1.30 or 3.02:

Z is the 7 bit value
1 b6 b05 b04 b03 b02 b01 b00 range 0 to 100 (0.00 to 1.00)

For all other zoom firmware:

ZZ is the 10 bit value packed into 2 characters as follows:

0 1 0 0 b09 b08 b07 b06
0 1 b05 b04 b03 b02 b01 b00 range 0 to 1023 (0.000 to 1.000)

Note 2**: The field Sxxxxxxxxx does not appear in firmware versions before 0.21,0.34, .22, 1.31 or 3.03**

K j n c/r Set scale illumination level for both LED sets

This command is only available on 5/ⅈ lenses.

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

Response is**: ! l/f c/r**

K k n c/r Set scale illumination level for one LED set

This command is only available on 5/ⅈ lenses.

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

Response is: **! l/f c/r**

N c/r Read Fixed Data

There are a number of different formats of response to this command, but the latest versions of firmware provide the same string length and common content for all lenses. The differences exist in the packing characters and final field.

****

Response for S4/i Prime lens

Early versions of firmware

N S s .. s s s s O u ……u ……..L P f x x x N d d d U b E seee y l/f c/r

Firmware version 0.25 onwards or 0.35 onwards

N S s .. s s s s O u ……u ……..L P f x x x N d d d U b E seee Bv.vv l/f c/r

****

Response for S4/i Zoom lens:

Early versions of firmwar

N S s .. s s s s O u ……u …….. L Z N a a a M c c c U b T f f yyy l/f c/r

Firmware version from 1.26 onwards or 1.36 onwards

N S s .. s s s s O u ……u …….. L Z N a a a M c c c U b T f f yy Bv.vv l/f c/r

****

Response for 5/i Prime lens:

N S s .. s s s s O o ……o …..…..L P N x x x M d d d U b T f f yy Bv.vv l/f c/r

****

Response for Panchro prime lens:

N S s .. s s s s O u ……u …….. L P N x x x M d d d U b T f f yy Bv.vv l/f c/r

****

Response for RED zoom lens:

Firmware version up to 3.02

N S s .. s s s s O u ……u …….. L Z N a a a M c c c U b T f f yyy l/f c/r

Firmware version 3.03

N S s .. s s s s O u ……u …….. L Z N a a a M c c c U b T f f yyy Bv.vv l/f c/r

Firmware version 3.06 onwards

N S s .. s s s s O u ……u …….. L Z N a a a M c c c U b T f f yy Bv.vv l/f c/r

****

The Fixed data fields for ALL lens types are as follows:

sssss..ss	Serial Number	9 characters (any printable ascii character)
uuu..uu	Owner data	31 characters (any printable ascii characters)
y	Packing character (character SPACE) for maintaining the string length	
v.vv	software version issue	

For S4/i Prime lenses:

xxx	Focal length	3 characters 004 to 305
Nddd (or nddd)	Infinity Nodal distance	sign (N/n) and 3 digits (-300 to +300)
seee	Entrance pupil Position	sign (s) plus 3 characters (e e e)
b	Calibration	I if Imperial M if metric B or b if both *(Note 1)*

For S4/i and RED Zoom lenses:

aaa	Minimum Focal length	3 characters 004 to 100
ccc	Maximum Focal Length	3 characters 010 to 500
b	Calibration	I if Imperial M if metric B or b if both *(Note 1)*
ff	Transmission factor	2 digits (00 to 99)

For Panchro prime lenses:

xxx	Focal length	3 characters 004 to 305
ddd	Focal length, same as xxx	
b	Calibration	I if Imperial M if metric B or b if both *(Note 1)*
ff	Transmission factor	2 digits (00 to 99)

For 5/i prime lenses:

xxx	Focal length	3 characters 004 to 305
ddd	Focal length, same as xxx	
b	Calibration	B if Imperial b if metric *(Note 2)*
ff	Transmission factor	2 digits (00 to 99)

Note 1: This character defines which Calibration tables are valid (Imperial or Metric), and where both are valid, which is the current power on selection of units for display (B = imperial) or (b= metric).
Using the X and Y commands will alter this value accordingly.

Note 2: for 5/i lenses both Imperial and Metric Calibration will be valid, so this character will always be B or b, and it defines the start-up units to be used. B will set Imperial, b will set metric.

OS c/r Retrieve settings for this channel

This command is only available on 5/i lenses

Response is: **O r R d U C 0.0ccc W nn i nI Sssssssss Bx.xx l/f c/r**

Where:

R	Defines the currently fitted Focus scale ring type. This will be I if Imperial scale ring fitted Or M if Metric scale ring fitted

U	Defines the currently selected Display Units. This will be I if Imperial Display units selected Or M if Metric Display units selected.
ccc	is the Circle of Confusion value associated with the Currently selected film size----units mm.
nn	Is the numerical value of the selected film size (see Wnn command).
nI	defines the currently set scale illumination level, where : n = 1 or 2 for single or both LED sets And I is the value 0 (min) to 9 (max)
ssssssss	is the lens serial number.
x.xx	is the currently loaded firmware version

OX c/r Set start-up units IMPERIAL

Response is: **! l/f c/r**

This command will alter the "Start-up Units" character in the Fixed data string to B, and will also change the current "display units" selection for both channels to be the Imperial.

OY c/r Set start-up units METRIC

Response is: **! l/f c/r**

This command will alter the "Start-up Units" character in the Fixed data string to b, and will also change the current "display units" selection for both channels to be the Metric.

P c/r Retrieve lens temperature

Response is: **P x x l/f c/r**

Where x x is the current temperature to the nearest degree Celsius.

To read the temperature takes up to 0.5 seconds, and it is recommended that reading the temperature is undertaken relatively infrequently, as the process will inhibit the correct reading / sensing of the Focus, Aperture and Zoom positions, and also inhibit the calculation process.

V c/r Select 35mm film.

Response is V 0 . 0 b b b l/f c/r Note **
Where 0.0 b b b is the 35 mm circle of confusion value in mm.
Note ** See also Film size command interlock below.

W c/r Select 16mm film

Response is W 0 . 0 b b b l/f c/r Note **
Where 0.0 b b b is the 16 mm circle of confusion value in mm.
Note ** See also Film size command interlock below.

W nn c/r Select film sizes (extended)

Where n specifies the desired film size / circle of confusion value:-

Command	film size	circle of confusion value.
W 00	35 mm	0.0250
W 01	16 mm	0.0125
W 02	4096 x 2304	0.0211
W 03	3072 x 1728	0.0159
W 04	2048 x 1152	0.0106
W 05	AATON 3 perf	0.0238
W 06	ATON 2 perf	0.0222
W 07	4480 x 1866, 4.5K	0.0218
W 08	2764 x 2304, 4K Anamorphic	0.0191

Response is: **W 0 . 0 b b b l/f c/r**

Note ** 0.0bbb is the circle of confusion value in mm.

Values other than 00 to 08 will generate a response of ? l/f c/r

Note ** See also Film size command interlock below.

This command was not available on S4/i and RED lenses with firmware version earlier than x.x6.

Film size command interlock – 5/i lenses only

The lens will power up with 35 mm film size selected as default. Either channel may select a film size using V W or Wnn commands. Once the Camera channel has set a film size, the External channel will be INHIBITED from changing the film size. If the External channels issues a command to change film size, the response will be for the currently set film size.

X c/r Set Display units imperial

Response is: X l/f c/r

The current display units will now be set to Imperial.

**** 5/i:- Note that this command received from one channel, will only set this mode "for that channel".**

Y c/r Set Display units metric

Response is: Y l/f c/r

The current display units will now be set to Metric.

**** 5/i: Note that this command received from one channel, will only set this mode "for that channel".**

6 Calculations and Units

Since the lens can be used with a camera body utilising various film sizes, an appropriate parameter value (circle of confusion value) is selected for that film size to be used in the calculations. The External display/control unit or Camera will command the lens electronics the select the desired film size / parameter value.

The values measured are:

Actual Focus distance
Actual Aperture setting
Actual Zoom setting where appropriate.

Calculated and transmitted will be:

Conventional Aperture setting
Effective Focal Length
Hyperfocal setting
Near focus distance
Far focus distance
Horizontal Field of view
Entrance Pupil Position, and
Normalised zoom value (zoom only).

All distance values output by the lens electronics will be in millimetres or multiples of 0.1 inch, except Effective Focal Length, which will always be in mm. The external unit will interpret this data as required, but each value will be with leading zeros included (where appropriate), and be of fixed length with the number of digits specified in the appropriate message format.

The Actual Aperture value will be in multiples of 0.01, and the Conventional Aperture will follow the calibrated ring marks, and use the FULL STOP +n notation to indicate the nearest 1/10 Stop value.

The Effective Focal Length will be zero for a Prime lens.

Horizontal Field of view will be in degrees, to an accuracy of 0.1.

Entrance Pupil Position units will agree with those used for the focus distance.

All internal calculations take place in METRIC units, irrespective of displayed units.

6.1 For non 5/i lenses

A lens Focussing Distance may be calibrated in Imperial Units only, Metric units only, or in BOTH sets of units. The calibration table(s) will be stored into the lens at time of production, and an indicator set to indicate which calibration tables are valid.

Various combinations of valid calibration tables and selected display start-up units (Imperial or Metric) are possible. These are defined by the Units character (I M B or b) in the Fixed data.. The external unit may select to change the Current Display units, and possibly the subsequent Start-up units.

When the display is selected as IMPERIAL, the following will apply:-

a) IF a valid Imperial calibration table exists (I , B or b), the lens will read the Focus distance sensor and use the Imperial calibration table to interpolate an Imperial distance. This value will be included in the display string, retaining the Imperial units.
The Imperial value will then be converted into Metric for the further calculations, and the resultant Metric values converted back into Imperial for display.

b) IF only a Metric calibration table exists (M), the lens will read the Focus distance sensor and use the Metric calibration table to interpolate a Metric distance. This value will be retained for calculations, but converted into Imperial for display.
After the further calculations, the resulting Metric values will be converted into Imperial for display.

When the display is selected as METRIC, the following will apply:-

c) IF a valid Metric calibration table exists (M , B or b), the lens will read the Focus distance sensor and use the Metric calibration table to interpolate an Metric distance. This value will be included in the display string, retaining the Metric units.

This Metric value will then be used for the further calculations, and the resultant Metric values displayed.

d) IF only an Imperial calibration table exists (I), the lens will read the Focus distance sensor and use the Imperial calibration table to interpolate an Imperial distance. This value will be converted into Metric for display, and also retained, as Metric, for further calculations.

After the further calculations, the resulting Metric values will be displayed

6.2 For 5/i lenses

The lens Focussing Distance will be calibrated in both Imperial Units and Metric units. The calibration tables will be stored into the lens at time of production (Calibration).

The focus ring will be dual marked and is reversible. The start-up units will be defined by the setting of a character (B or b) in the Fixed data string. A device attached to the Camera or External interface may require units to be displayed in the alternative units. Each channel may set its own display units.

After reversing the scale the start-up units are changed using the Cooke 5/i Startup Units Utility. This is a stand alone application which runs under windows and is described below :

Cooke 5/i Startup Units Utility:

I. Power up the lens and start the application, check the communication port settings, the standard board rate is 9600 but the Comm port will need to be set in accordance with the PC being used.

II. Press the Read button to display the current active units I or M.

III. Press either Set Metric or Set Imperial to change to the correct Start up units.

IV. Power can now be removed from the lens and the current start up units setting will be stored.

7 Data Throughput

The response time to provide any requested data involving calculations will vary slightly, and the time to transmit that data will depend upon the selected baud rate.

The following sections contain tables which show approximate frame rates for the different types of requested data string, for the different board versions.

7.1 S4/i, RED and Panchro

The 10 bit ADC version of the electronics for the S4/i PRIME lenses has a slower clock speed than the later version with 12 bit ADC, and the length of the Data field varied with firmware issue, so this will affect message transmission time. All Zoom, RED and Panchro lenses use the same faster clock speed, while the early Zoom boards use 10 bit ADC.

10 BIT ADC S4/i Prime

Calculation time is 20 m secs.
D or C command Data length for up to v0.20 is 61 characters and 76 for V0.29 and later.

a) Viewer system sends D c/r command and receives a single response block .

baud rate	repeat rate v0.20	repeat rate v0.29
9600	11	9
115200	39	37

b) Viewer system sends C c/r command, receives response to C, followed by continuous data blocks at the " repeat rate".

baud rate	repeat rate v0.20	repeat rate v0.29
9600	12	10
115200	39	37

c) Viewer system sends Kd C/ret command and receives a Single Binary full data block in response.

baud rate	repeat rate v0.20	repeat rate v0.29
9600	19	16
115200	44	42

d) Viewer system sends Kc c/r command, receives response to Kc, followed by continuous Binary full data blocks at the " repeat rate".

baud rate	repeat rate v0.20	repeat rate v0.29
9600	20	17
115200	44	43

12 BIT ADC S4/i Prime

Calculation time is 10 m secs.
D command Data length for v0.30 is 62 characters, and 76 for V0.39 (4.21).

a) Viewer system sends **D c/r** command and receives a single response block.

baud rate	repeat rate v0.30	repeat rate v0.39 (4.21)
9600	13	11
115200	64	60

b) Viewer system sends **C c/r** command, receives response to C, followed by continuous data blocks at the " repeat rate".

baud rate	repeat rate v0.30	repeat rate v0.39 (4.21)
9600	13	11
115200	65	60

c) Viewer system sends **Kd C/r** command and receives a single Binary full data block in response.

baud rate	repeat rate v0.30	repeat rate v0.39 (4.21)
9600	24	19
115200	79	73

d) Viewer system sends **Kc c/r** command, receives response to Kc, followed by continuous Binary full data blocks at the " repeat rate".

baud rate	repeat rate v0.30	repeat rate v0.39 (4.21)
9600	25	20
115200	80	75

10 OR 12 bit ADC S4/i Zoom lenses, RED and Panchro lens

Calculation time is 12 m secs.

D command Data response string length is 66 characters for early versions and 76 from V1.29 (4.41),1.39 (4.61), 3.09 (6.01) or 8.01 onwards.

a) Viewer system sends D c/r command and receives a single response block.

baud rate	repeat rate (early)	repeat rate (later)
9600	12	11
115200	55	53

b) Viewer system sends C c/r command and receives response to C, followed by continuous data blocks at the " repeat rate".

baud rate	repeat rate (early)	repeat rate (later)
9600	12	11
115200	56	53

c) Viewer system sends Kd C/r command and receives a single Binary full data block in response.

baud rate	repeat rate (early)	repeat rate (later)
9600	22	17
115200	67	63

d) Viewer system sends Kc c/r command, receives response to Kc, followed by continuous Binary full data blocks at the " repeat rate".

baud rate	repeat rate (early)	repeat rate (later)
9600	22	18
115200	68	64

7.2 5/i lenses

When operating in "Continuous" mode for either full ASCII (C command) or packed binary (Kc command) format, calculations are performed concurrently with data transmission to achieve an maximised data flow. After each calculation, the data frame is formatted for each channel independently, and hence with only 1 channel operating, this formatting time will occur only once, but with both channels operating, formatting will occur twice. When operating at 115K2 baud, the total calculation and formatting time is slightly greater than the time to transmit a Packed Binary frame, resulting in a very short gap between frames of less than 0.3 m secs.

The following table shows the relationship between data format, baud rate and effective throughput.

These values are correct at time of writing, but MAY alter as a result of changes to the functionality / calculation within the lens program.

5/i Prime lens

Calculation time is 3.2 m secs.
Format time for 1 channel is 0.3 m secs, for 2 channels is 0.6 m secs.
D or C command response data length is 76 characters,

a) Viewer system sends D c/r command and receives a single response block.

baud rate	total time (m secs)	repeat rate (frames/sec)
9600	85	11.8
115200	10.3	97.1
230400	6.9	144.9

b) Viewer system sends C c/r command, receives response to C, followed by continuous data blocks at the " repeat rate".

1 channels operating in Continuous mode

baud rate	total time (msecs)	repeat rate (frames/sec)
9600	81.3	12.3
115200	6.8	147
230400	3.5	285.7

2 channels operating in Continuous mode
(the second channel can be Full ASCII or Binary)

baud rate	total time (msecs)	repeat rate (frames/sec)
9600	81.3	12.3
115200	6.8	147
230400	3.8	263

c) Viewer system sends Kd C/ret command and receives a single Packed Binary full data block in response of 41 characters.

baud rate	total time (msecs)	repeat rate (frames/sec)
9600	46.2	21.6
115200	7.1	140
230400	5.4	185

d)Viewer system sends Kc command, receives response to Kc, followed by continuous full binary data blocks at the " repeat rate".

1 channel only operating in Continuous mode

baud rate	total time (msecs)	repeat rate (frames/sec)
9600	42.7	23.4
115200	3.6	277
230400	3.5	285.7

2 channels operating in Continuous mode
(the second channel can be Full ASCII or Binary)

baud rate	total time (msecs)	repeat rate (frames/sec)
9600	42.7	23.4
115200	3.8	263
230400	3.8	263

8 Scale Illumination – 5/i only

Two variable drive output signals are available to control the brightness of two sets of LED's, which are used to illuminate the scales, to make them more readable in low light levels. One set can be operated / varied while the other is OFF, or both sets operate in unison.

The mounting and placement of these LED's is dependant upon the mechanical layout of the lens.

Manual Control of the brightness level is achieved using the Aperture Ring. Remote Control is by means of Kjn or Kkn Commands. The current illumination setting can also be remotely accessed (OS command).

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

8.1 To alter the brightness of both sets of LEDs, the operator will need to move the Aperture ring to the aperture setting (T22) and move it away towards T16, then repeat that process twice more within 3 seconds.

This will cause the LED's to be set to fully ON for 0.3 secs, then fully OFF for 0.3 secs and then fully ON. The operator can now adjust the desired level by moving the Aperture scale up (towards T22) or down (towards T 2). If there is a 2 second period during which "no change of Aperture setting" is detected, the "set illumination level" is retained.

During this setting process, the normal lens operation continues.

8.2 To alter the brightness of one set of LEDs, the operator will need to move the Aperture ring to the aperture setting (T1.4) and move it away towards T2, then repeat that process twice more within 3 seconds.

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 adjust the desired level by moving the Aperture scale up (towards T22) or down (towards T 1.4).). If there is a 2 second period during which "no change of Aperture setting" is detected, the "set illumination level" is retained.

During this setting process, the normal lens operation continues.

Cooke /i Lens System
(Version 2.41 – January 2010)

Addendum A1
5/i External Equipment Interface

General description

Additional commands and program facilities have been added to the 5/i lenses, to enable an external unit, connected to the External (Rs232) to perform special operations.

The general term for such a unit will be External Data Source Unit (EDSU).

The normal use of the 5/i lens will be for it to generate data strings which can be sent to the Camera interface, the External interface or both simultaneously. This data can be stored within the camera or external equipment for subsequent use when post processing the film.

A set of additional facilities is added which will allow an EDSU to generate a data stream which it sends TO the lens. This data stream is then appended to the lens generated data stream to the camera, where the combined data string can be stored.

At the same time that the EDSU is sending this data TO the lens, it can also request that the lens sends the normal data stream out to it (single or continuous).

New commands and revised buffering are implemented to allow these facilities to operate, and these are specified in this document.

New lens commands

OT c/r **Retrieve settings for opposite channel**

Response is **O t B b F f U u l/f c/r**

Where :

- b baud rate code for the opposite channel (0-7)
- f data format A for ASCII or B for Binary
- u display units for opposite channel I = imperial, M=Metric

OC c/r **Commence Append of Data**

Response is **! l/f c/r**

OD….. c/r **Data to Append**

O D d d d ……..d d d c/r

Response ! l/f c/r

Where ddd….ddd is a string of up to 60 data values which terminate with the character c/r (hex 0D / decimal 13), and where ddd…ddd can be ANY 8 bit values EXCEPT c/r.

The string “ddd…ddd” is appended to the normal D / C / Kd / Kc generated lens data stream which is sent to the opposite interface, and is added to the end of that string

IMMEDIATELY before the termination characters, which may include a checksum, which will be generated to include the appended data “ddd…dddd”.

Example --- standard data stream

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 a N b b b b b b b b F c 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

Externally generated data stream:-

O D a b c 1 2 3 7 & ^ $ c/r

String actually sent to opposite interface:-

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 a N b b b b b b b b F c 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
a b c 1 2 3 7 & ^ $ l/f c/r

The response will be ! l/f c/r

O H c/r Halt Append.

This command will cause the lens to halt the Append of data to the opposite channel data stream.

The response to this command will be ! l/f c/r

Principle of operation

The EDSU will interrogate the lens to determine the settings for this channel of the lens (OS command) and will then use the OT command to determine the settings for the opposite channel.

The EDSU can now decide how to format any data it generates, and will also be aware of any data rate differences between channels.

Once the EDSU is ready to generate data strings, which are to be appended to the opposite data channel stream, it will issue the OC command and verify the response. An internal EDSU buffer for the EDSU data in the lens will be cleared.

Any data now being sent TO the opposite interface will now have the contents of this EDSU buffer appended. If the buffer remains empty, then no data will be appended.

Each time the EDSU generates new data, it will be sent to the lens using the OD command and the data stored into the EDSU buffer. Each time a new string is received by the lens from the EDSU, it will replace the existing EDSU contents with the new string.

The lens will therefore generate data strings at whatever rate is required (single or continuous) and use the latest EDSU data to append.

Once the EDSU requires the append process to terminate, it will send the OH command.

The EDSU can also set its link to the lens to operate in Continuous data send mode (ASCII or Binary) so that lens data is also available to the EDSU for use internally, or it can be passed through to a secondary unit.

In this mode, the data from the lens will be mixed with the responses to any OD commands issued by the EDSU, but the response will be the first string sent by the lens after receipt of an OD command so will not be confused with the next continuous data string.

Command Blocking by EDSU

This EDSU MAY also have a further (secondary) unit connected, so it would then need to have a "pass through" facility for the data stream, BUT may need to block certain commands from any such "secondary" unit.

If an EDSU has a secondary unit attached, and it allows commands from the secondary unit to be passed through to the lens, and the corresponding response passed back, then certain commands will need to be blocked, to prevent corruption of the communication process.

The list of valid lens commands is marked with what can be allowed, and what should be blocked.

B	Read firmware version	Allowed
C	Start Continuous send of ASCII data. Allowed – unless EDSU using Kd or Kc for binary formats	
D	Request single ASCII data string Allowed – unless EDSU using Kd or Kc for binary formats, or using C for continuous ASCII – unless the EDSU extracts a single block as the response to the D command, and passes that to the secondary unit.	
G	Set checksum mode ON Care to be taken here.	setting or changing a mode
H	Unset optional modes Care to be taken here.	setting or changing a mode
Kbn	Change baud rate. Blocked – unless EDSU follows the baud rate change – difficult to allow.	
Kc	Set continuous send of Binary data strings. Only allow if EDSU not using C or D	
Kd	Request single Binary data string Only allow if EDSU not using C or D	
Kjn	Set both illumination levels.	Allow
Kkn	Set single illumination level.	Allow
N	Request 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	Read temperature.	Allow
V	Change film size Beware of allowing film size changes. Interlock exists for Camera priority.	
Wnn	Change film size. Beware of allowing film size changes. Interlock exists for Camera priority	

X	Change units to Imperial.	Beware of allowing units changes
Y	Change Units to Metric.	Beware of allowing units changes.

Potential problems exist if certain aspects of the operation are allowed to be controlled from multiple sources, unless the EDSU monitors “passed through” commands and follows them according to the lens specification.

In general, it is suggested that if the EDSU is not logging data, only generating OD data, then ASCII or Binary single or Continuous data commands can be allowed as there will be no conflict. Similarly the control of film size, illumination or data appending should be from a single source.

Changes to Baud rate or checksum mode again have “difficult to follow” implications, and it may be simpler to block all such commands.

To block a command, the EDSU will need to respond itself to the command using the standard error response of **? l/f c/r**

Cooke /i Lens System
(Version 2.41 – March 2011)

Section B

Firmware versions and board configurations

Contents:

The command **KF c/r** can be used to retrieve the Base firmware version,
the response being: **fx l/f c/r** where "x" represents the base firmware installed.

The command **B c/r** can be used to retrieve the version of software/firmware installed.
The response is:- **B a b c d l/f c/r** where abcd represents the version installed.

The convention used is that the first character "a" denotes the board type, "b" represents the decimal and "cd" represents the issue. (a.cd)

For S4/i Prime 10 ADC bit boards	"abcd" will be 0.0x,0.1x , 0.2x or 4.01..4.19
For S4/i Prime 12 ADC bit boards	"abcd" will be 0.3x or 4.21…4.39
For S4/i Zoom 10 ADC bit boards	"abcd" will be 1.2x or 4.41…4.59
For S4/i Zoom 12 ADC bit boards	"abcd" will be 1.3x or 4.61…4.79
For RED Zoom	"abcd" will be 3.0x or 6.0x
For 5/i Prime	"abcd" will be 5.0x
For Panchro Prime	"abcd" will be 8.0x
For Angenieux Zoom	"abcd" will be A.xx

Note that the version numbering for S4/i and RED changes from version x.x9 onwards as follows:

0.29	is now	4.01	:last released version is 0.29, same as 4.01. Next will be 4.02
0.39	is now	4.21	:last released version is 0.39, same as 4.21. Next will be 4.22
1.29	is now	4.41	:last released version is 1.29, same as 4.41. Next will be 4.42
1.39	is now	4.61	:last released version is 1.39, same as 4.61. Next will be 4.62
3.0x	is now	6.0x	:last released version is 3.09, same as 6.01. Next will be 6.02

Earlier version x.x9 for each lens type is directly replaced by the new versions, and any future versions will continue using the revised notation.

As seen on viewer:

Summary table of	**base firmware**	**software issues.**
S4/i Prime 10 ADC bit boards	e,f,g	0.05 .. 0.29; 4.01....4.19
S4/i Prime 12 ADC bit boards	h,i,j	0.30 .. 0.39; 4.21....4.39
S4/i Zoom 10 ADC bit boards	v,w	1.21 .. 1.29; 4.41....4.59

S4/i Zoom 12 ADC bit boards	p,q	1.30 .. 1.39; 4.61....4.79
RED boards	r,s	3.02 .. 3.09; 6.xx
(note that 3.08 and 3.09 are identical, 3.09 introduced to keep all issues at x.x9)		
5/i Prime boards	a,b	5.00....5.49
Panchro boards	r,s	8.xx
Angenieux boards	t, u	A.xx

1 S4/i Prime series boards 10 bit ADC

This board has 2 communications channels, the External one being RS232, and the Camera is TTL. The External Interface takes precedence over the Camera interface IF power is supplied through both connectors. If only one connector supplies power, it will be the active channel.

Two potentiometers are connected through a single 4 way connector. This connector supplies +5v and 0v to the potentiometers, which are used to sense Aperture and Focussing Distance.

The start-up sequence depends upon which channel is being used for control.

For firmware versions up to 0.28, if the Camera channel is valid, then start-up will be at 9600 baud without timeout on receiving an N command.

From firmware version 0.29 (4.01) onwards, startup will be at 115k2 baud, with a 1 second timeout to receive an N command. If the N command is received before timeout, operation will continue at this speed. If an N command is not received, the baud rate will drop to 9600 baud.

If the External channel has control, initial start-up will be at the higher speed of 115k2 baud. If an N command is received within 1 second, operation will continue at this speed. If no N command is received, then speed will drop to 9600, and the prompt for Bluetooth operation will be sent. If an N command is received within 1 second, then operation moves immediately to direct connection at 9600 baud. If the correct exchange sequence occurs, then a Bluetooth link at 9600 baud is established, which will be at fixed speed of 9600 baud.

The current versions of the base firmware is version “e”, “f” or “g”

The current versions of the software installed into the boards are as follows:

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
V0.22-25	skipped
V0.26	add board software version to end of Fixed data string for N command
V0.27	allow for further film formats (Wnn commands) and modify responses to P and Kbn commands
V0.28	add extra CoC values W07 and W08
V0.29	add dummy normalised zoom to data field, change startup to a standardised sequence for all prime and zoom lenses
V4.01	new numbering to replace 0.29

2 S4/i Prime series boards 12 bit ADC

This board has 2 communications channels, the External one being RS232, and the Camera is TTL. The External Interface takes precedence over the Camera interface IF power is supplied through both connectors. If only one connector supplies power, it will be the active channel.

Two potentiometers are connected through a single 4 way connector. This connector supplies +5v and 0v to the potentiometers, which are used to sense Aperture and Focussing Distance.

For firmware versions up to 0.38, if the Camera channel is valid, then start-up will be at 9600 baud without timeout on receiving an N command.

From firmware version 0.39 (4.21) onwards, startup will be at 115k2 baud, with a 1 second timeout to receive an N command. If the N command is received before timeout, operation will continue at this speed. If an N command is not received, the baud rate will drop to 9600 baud.

If the External channel has control, initial start-up will be at the higher speed of 115k2 baud. If an N command is received within 1 second, operation will continue at this speed. If no N command is received, then speed will drop to 9600, and the prompt for Bluetooth operation will be sent. If an N command is received within 1 second, then operation moves immediately to direct connection at 9600 baud. If the correct exchange sequence occurs, then a Bluetooth link at 9600 baud is established, which will be at fixed speed.

The Processor on this board has been upgraded from the 10 bit ADC version, and has faster operation and increased resolution for the ADC, but otherwise is functionally identical.

The current versions of the base firmware is version “h”,“i” or “j”

The current versions of the software installed into the boards are as follows:

V0.30/31	See specification issues up to version 2.22
V0.33	Operation as per v0.21 including E command
V0.34	Addition of Serial number to lens data string
V0.35	addition of Ka command
V0.36	add board software version to end of Fixed data string for N command
V0.37	allow for further film formats (Wnn commands) and modify responses to P and Kbn commands
V0.38	add extra CoC values W07 and W08
V0.39	add dummy normalised zoom to data field, change startup to a standardised sequence for all prime and zoom lenses
V4.21	new numbering to replace 0.39

3 S4/i Zoom series boards 10 bit ADC

This board has 2 communications channels, the External one being RS232, and the Camera is TTL. The External Interface takes precedence over the Camera interface IF power is supplied through both connectors. If only one connector supplies power, it will be the active channel.

Three potentiometers are connected through two 4 way connectors. These connectors supply +5v and 0v to the potentiometers, which are used to sense Aperture, Focussing Distance and Zoom.

For firmware versions up to 1.28, if the Camera channel is valid, then start-up will be at 9600 baud without timeout on receiving an N command.

From firmware version 1.29 (4.41) onwards, startup will be at 115k2 baud, with a 1 second timeout to receive an N command. If the N command is received before timeout, operation will continue at this speed. If an N command is not received, the baud rate will drop to 9600 baud.

If the External channel has control, initial start-up will be at the higher speed of 115k2 baud. If an N command is received within 1 second, operation will continue at this speed. If no N command is received, then speed will drop to 9600, and the prompt for Bluetooth operation will be sent. If an N command is received within 1 second, then operation moves immediately to direct connection at 9600 baud. If the correct exchange sequence occurs, then a Bluetooth link at 9600 baud is established, which will be at fixed speed.

The current versions of the base firmware is version “v” or “w”

The current versions of the software installed into the boards are as follows:

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 Normalised zoom resolution
V1.23	addition of Ka command
V1.23-25	skipped
V1.26	add board software version to end of Fixed data string for N command
V1.27	allow for further film formats (Wnn commands) modify responses to P and Kbn commands
V1.28	add extra CoC values W07 and W08
V1.29	Change startup to a standardised sequence for all prime and zoom lenses
V4.41	new numbering to replace 1.29

4 S4/i Zoom series boards 12 bit ADC

This board has 2 communications channels, the External one being RS232, and the Camera is TTL. The External Interface takes precedence over the Camera interface IF power is supplied through both connectors. If only one connector supplies power, it will be the active channel.

Three potentiometers are connected through two 4 way connectors. These connectors supply +5v and 0v to the potentiometers, which are used to sense Aperture, Focussing Distance and Zoom.

For firmware versions up to 1.38, if the Camera channel is valid, then start-up will be at 9600 baud without timeout on receiving an N command.

From firmware version 1.39 (4.61) onwards, startup will be at 115k2 baud, with a 1 second timeout to receive an N command. If the N command is received before timeout, operation will continue at this speed. If an N command is not received, the baud rate will drop to 9600 baud.

If the External channel has control, initial start-up will be at the higher speed of 115k2 baud. If an N command is received within 1 second, operation will continue at this speed. If no N command is received, then speed will drop to 9600, and the prompt for Bluetooth operation will be sent. If an N command is received within 1 second, then operation moves immediately to direct connection at 9600 baud. If the correct exchange sequence occurs, then a Bluetooth link at 9600 baud is established, which will be at fixed speed.

The Processor on this board has been upgraded from the 10 bit ADC version, and therefore has increased resolution for the ADC, but otherwise is functionally identical.

The current versions of the base firmware is version “p” or “q”

The current versions of the software installed into the boards are as follows:

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 Normalised zoom resolution Addition of Ka command
V1.31-35	Skipped
V1.36	Add board software version to end of Fixed data string for N command
V1.37	Allow for further film formats (Wnn commands) Modify responses to P and Kbn commands
V1.38	Add extra CoC values W07 and W08
V1.39	Change startup to a standardised sequence for all prime and zoom lenses
V4.61	New numbering to replace 1.39

5 RED board 12 bit ADC

This board has a single communications channel for the Camera, and operates at TTL levels.

Three potentiometers are connected through a single 5 way connector. This connector supplies +5v and 0v to the potentiometers, which are used to sense Aperture, Focussing Distance and Zoom.

The start-up for this board is at 115k2 baud, and if an N command is received within 1 second, operation continues at this speed. If no N is received, the speed is dropped to 9600 baud, and the board waits without timeout for an N command.

The Processor on this board uses a 12 bit ADC.

The current versions of the base firmware is version “r” or “s”

The current versions of the software installed into the boards are as follows:-

V3.02	See specification issues up to version 2.22 Note that the v2 and v1 fields of the R command response are 0000.
V3.03	Specification issue 2.23 Addition of Serial number to lens data string Increase Normalised zoom resolution Addition of Ka command Addition of software version to the end of the Fixed data string in response to an N command.
V3.04-05	Skipped
V3.06	Remove 1 packing character from N response field (to make same length as all other board responses.
V3.07	Allow for further film formats (Wnn commands) and modify responses to P and Kbn commands.

V3.08	Add extra CoC values W07 and W08
V3.09	Exactly the same as 3.08
V6.01	new numbering to replace 3.09

6 5/i Prime series boards (12 bit ADC)

The Processor on this board has been upgraded from the 4/i series, and has faster operation, has a different method of performing calculations, but otherwise is functionally equivalent.

This board has 2 communications channels, the External one being RS232, and the Camera is TTL, which are totally independent of each other.

The start-up for this board is at 115k2 baud on both channels, and if an N command is received within 1 second from either channel, operation continues at this speed. If no N is received, the speed is dropped to 9600 baud on both channels, and the board waits without timeout for an N command from either channel.

Potentiometers are connected through a single 4 way connector. This connector supplies +5v and 0v to the 2 potentiometers, which are used to sense Aperture and Focusing Distance.

There is provision on the board to drive 2 sets of external LED's via a connector.

The drive to these LED's uses PWM so that the intensity can be varied. The intensity setting is controlled by using the APERTURE ring.

The connector carries +5v, 0v power and can sink up to 20 mA on each of the two PWM outputs.

The current versions of the base firmware is version "a" or "b"

The current versions of the software installed into the boards are as follows:

V5.01	Production Release version with base firmware "b".
V5.02,5.03	Revise start-up units operation

A pre-release version of the firmware was released as 4.xx to be used for demonstration. All of these boards use base firmware version "a". This combination of base firmware / firmware should ONLY be used for initial product evaluation

7 PANCHRO board 12 bit ADC

This board has a single communications channel for the Camera, and operates at TTL levels.

Two potentiometers are connected through a single 5 way connector. This connector supplies +5v and 0v to the potentiometers, which are used to sense Aperture and Focussing Distance.

The start-up for this board is at 115k2 baud, and if an N command is received within 1 second, operation continues at this speed. If no N is received, the speed is dropped to 9600 baud, and the board waits without timeout for an N command.

The Processor on this board uses a 12 bit ADC.

The current versions of the base firmware is version "r" or "s"

The current versions of the software installed into the boards are as follows:-

V8.01	First release to spec 2.40

8 Angenieux

Base firmware versions “t” and “u” are reserved for Angenieux.