

/i² Technology

Next Generation /i² Technology

Beginning in June of 2014, Cooke Anamorphic/i lenses will be delivered with the new /i² lens boards. The release of Cooke S4/i and 5/i lenses with the new /i² lens boards will follow a short time later. Delivery of Cooke miniS4/i lenses with new boards are planned for the end of the year. All Cooke lenses will be field upgradeable to /i² by competent Cooke service technicians.

Cooke's new /i² Squared Technology metadata system (patent pending) builds on the capabilities of Cooke's /i Technology. In addition to lens metadata, the newest functions 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 will help VFX teams better deal with common issues like occlusions, fast camera motion (motion blur) and other known challenges associated with today's fast paced motion capture style.

Please note changes to the **serial number format** and an update to the **N command response for Cooke S4/i lenses** (only). /i² lens boards will use serial number format "NFFF.xxxx". Cooke /i lenses that are upgraded with /i² 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 /i² boards, will now match the N command response for all other Cooke lenses.

Compare /i² and /i² Serial Numbers

Cooke Optics Lenses			
TYPE	/i ² SERIAL #	/i ² SERIAL #	/i ² EXAMPLE
miniS4/i ² Lenses	8FFF-xxxx	8FFF.xxxx	8025.1234 = miniS4/i ² 25mm
S4/i ² Prime Lenses	4FFF-xxxx FF-xxxx	4FFF.xxxx FF.xxxx	4025.1234 = S4/i ² 25mm 25.1234 = S4/i ² 25mm (older)
5/i ² Prime Lenses	5FFF-xxxx	5FFF.xxxx	5025.1234 = 5/i ² 25mm
Anamorphic /i ² Lenses	9FFF-xxxx	9FFF.xxxx	9025.1234 = Anamorphic /i ² 25mm

N Command Response Format

Retrieve **Fixed Data in ASCII Format**

The first command a lens receives must be the N command. All Cooke 5/i, miniS4/i and zoom lenses will continue to use the same N response format (shown below). Cooke S4/i lenses with /i lens boards have used a modified N response format as explained in the Cooke User's Guide and Technical Manual (on page 24 and in Appendix, page 54). Newer S4/i lenses equipped with /i² boards and all S4/i lenses upgraded with the new /i² board will now have the same N response format as the 5/i, miniS4/i and zoom lenses.

Response for all Cooke Prime lenses with /i² boards (same as Cooke 5/i, miniS4/i and zooms):

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)
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 options are available).
T	ff	Transmission factor
	y..y	SPACE characters
B	v.vv	Firmware version number

Example:

(Note: Two spaces before B5.03)

Issue: N[c/r]

Response: NS4025.11830Cooke Optics S4i2 test LPN025M025UIT94 B4.39 [l/f][c/r]

Response of S4/i² Prime lenses with /i boards - versions 0.25 or 0.35 and above:

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

f	xxx	Focal length - $S4/\text{f}$ 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- $S4/\text{f}$ Prime only
s (+/-)	eee	Entrance Pupil Position: + or – sign plus 3 characters - $S4/\text{f}$ 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 $S4/\text{f}$ Primes)
	y..y	SPACE characters
B	v.vv	Firmware version number

Example:

Issue: N [l/f][c/r]

Response: NS4075-01230Cooke Optics

LPf027N077UIE+088B4.22

NEW / f Squared Kdi Command

- Preliminary Specifications

NEW Kdi Command – Release planned for 2014

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.)

Kdi Command

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 T t t t z h h h h n n n n f f f v v e e Z Z S x x x x x x x x	4

		see page 25-29 in Cooke Manual for more details																																																							
<i>section5</i>	time stamp of frame	size=2 bytes; t00-t15; time when Kdi command is received <table border="1" style="margin-left: auto; margin-right: auto;"> <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>		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	1 st	t15	t14	t13	t12	t11	t10	t09	t08	2 nd	t07	t06	t05	t04	t03	t02	t01	t00	42																											
	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0																																																	
1 st	t15	t14	t13	t12	t11	t10	t09	t08																																																	
2 nd	t07	t06	t05	t04	t03	t02	t01	t00																																																	
<i>section6</i>	Magnetometer data	size=6 bytes; X (mx0-mx15), Y(my0-my15), Z(mz0-mz15) <table border="1" style="margin-left: auto; margin-right: auto;"> <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>	1 st	mx15	mx14	mx13	mx12	mx11	mx10	mx09	mx08	2 nd	mx07	mx06	mx05	mx04	mx03	mx02	mx01	mx00	3 rd	my15	my14	my13	my12	my11	my10	my09	my08	4 th	my07	my06	my05	my04	my03	my02	my01	my00	5 th	mz15	mz14	mz13	mz12	mz11	mz10	mz09	mz08	6 th	mz07	mz06	mz05	mz04	mz03	mz02	mz01	mz00	44
1 st	mx15	mx14	mx13	mx12	mx11	mx10	mx09	mx08																																																	
2 nd	mx07	mx06	mx05	mx04	mx03	mx02	mx01	mx00																																																	
3 rd	my15	my14	my13	my12	my11	my10	my09	my08																																																	
4 th	my07	my06	my05	my04	my03	my02	my01	my00																																																	
5 th	mz15	mz14	mz13	mz12	mz11	mz10	mz09	mz08																																																	
6 th	mz07	mz06	mz05	mz04	mz03	mz02	mz01	mz00																																																	
<i>section7</i>	data sample packet ID	size=1 byte; gyro data : 1; accelerometer data : 2	50																																																						
<i>section8</i>	time stamp of data sample packet	size=2 bytes; t00-t15; time when gyro/acc FIFO reaches its water mark <table border="1" style="margin-left: auto; margin-right: auto;"> <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>		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	1 st	t15	t14	t13	t12	t11	t10	t09	t08	2 nd	t07	t06	t05	t04	t03	t02	t01	t00	51																											
	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0																																																	
1 st	t15	t14	t13	t12	t11	t10	t09	t08																																																	
2 nd	t07	t06	t05	t04	t03	t02	t01	t00																																																	
<i>section9</i>	accelerometer or gyro data packet	size of 1 sample=6 bytes; size of 8 samples =48 bytes <table border="1" style="margin-left: auto; margin-right: auto;"> <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>	1 st	bx15	bx14	bx13	bx12	bx11	bx10	bx09	bx08	2 nd	bx07	bx06	bx05	bx04	bx03	bx02	bx01	bx00	3 rd	by15	by14	by13	by12	by11	by10	by09	by08	4 th	by07	by06	by05	by04	by03	by02	by01	by00	5 th	bz15	bz14	bz13	bz12	bz11	bz10	bz09	bz08	6 th	bz07	bz06	bz05	bz04	bz03	bz02	bz01	bz00	53
1 st	bx15	bx14	bx13	bx12	bx11	bx10	bx09	bx08																																																	
2 nd	bx07	bx06	bx05	bx04	bx03	bx02	bx01	bx00																																																	
3 rd	by15	by14	by13	by12	by11	by10	by09	by08																																																	
4 th	by07	by06	by05	by04	by03	by02	by01	by00																																																	
5 th	bz15	bz14	bz13	bz12	bz11	bz10	bz09	bz08																																																	
6 th	bz07	bz06	bz05	bz04	bz03	bz02	bz01	bz00																																																	

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.

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