

Jon Fauer, ASC

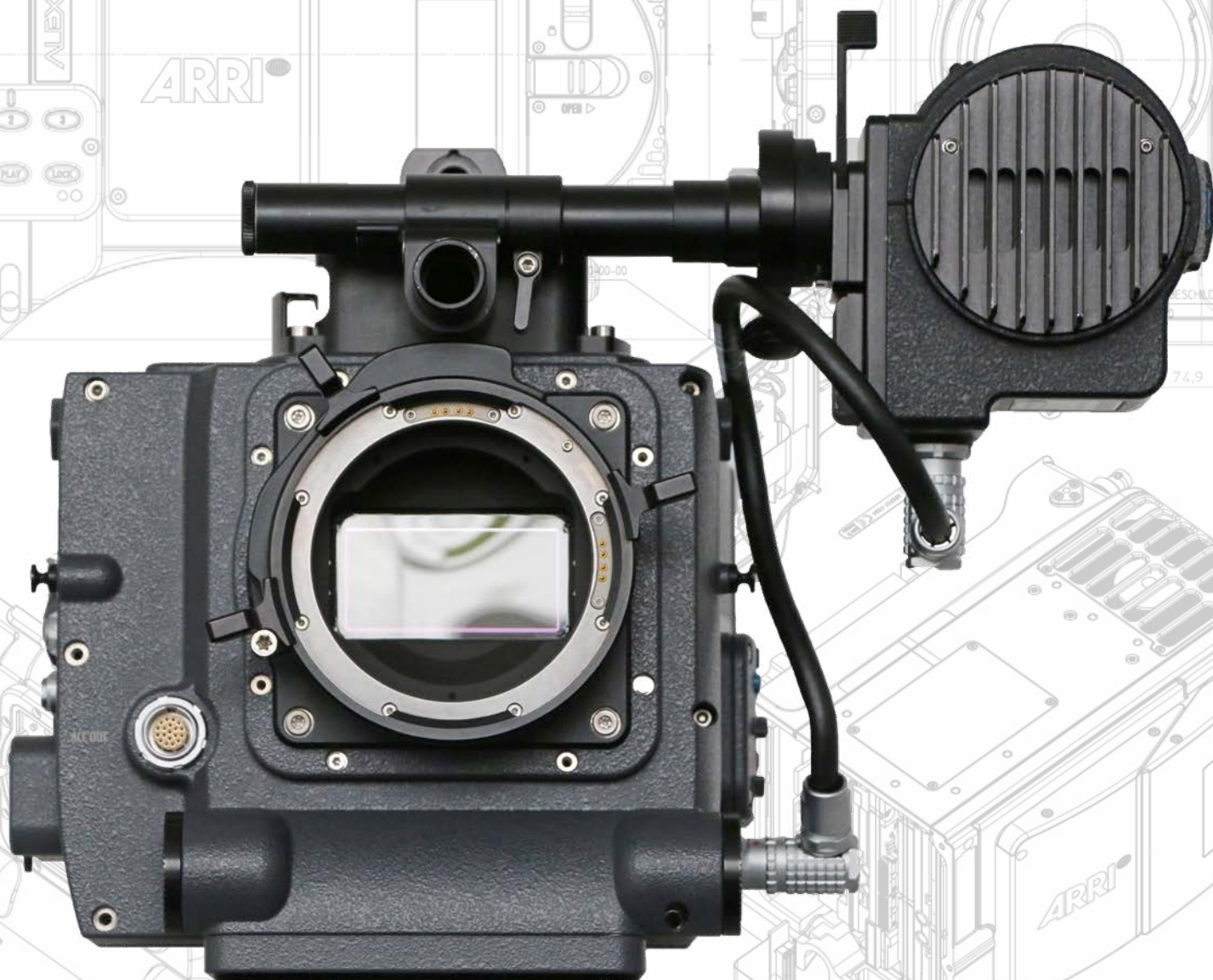
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Art, Technique and Technology in Motion Picture Production Worldwide



ALEXA 65

Film and Digital Times is the guide to technique and technology, tools and how-tos for Cinematographers, Photographers, Directors, Producers, Studio Chieftains, Camera Assistants, Camera Operators, Grips, Gaffers, Crews, Rental Houses, and Manufacturers.

It's written, edited, and published by Jon Fauer, ASC, an award-winning Cinematographer and Director. He is the author of 14 bestselling books—over 120,000 in print—famous for their user-friendly way of explaining things.

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Note: this is an independent report and not an official ARRI publication. Some of the specifications and details are based on prototypes and pre-production models. Errors may lurk and mileage may vary, for which FDTimes is not accountable.

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65mm Rebooted: ARRI ALEXA 65



Imagine this pitch to a studio executive:

“Hamlet meets The Greatest Story Ever Told. Around the World in Eighty Days, South Pacific, Ben-Hur, Exodus, West Side Story, Lawrence of Arabia, Mutiny on the Bounty, It’s a Mad, Mad, Mad, Mad World, Cleopatra, My Fair Lady, The Sound of Music, The Agony and the Ecstasy, Lord Jim, Grand Prix, 2001: A Space Odyssey, Ryan’s Daughter, Patton...”

A litany of the greatest 65/70mm films of all time should be rewarded with an immediate green light. There is, however, one minor setback, a single word, “film.”

These greatest of all films, in their epic 65mm format, demanded epic logistical effort, 70+ pound temperamental cameras whose movements sometimes required oiling after every take, and setups that were not, shall we say, swift. Film, processing and dailies could average around \$2500 for a 10-minute roll.

Nevertheless, large format 65mm cinematography has continued to inspire as the aspirational format, the object of desire, for almost every cinematographer, director and producer. There is magic in it, perhaps in the same way that Richard Avedon once described large format still photography. “It requires you to think, to compose, to slow down and create more carefully,” he said.

Now there’s a new, large format 65mm digital motion picture camera from ARRI, the new ALEXA 65. The aspirational part of that sentence is 65; the enabling part is *digital*.

Imagine an ALEXA (35mm) camera with a sensor that is 3 times larger. It has a familiar ALEXA body style, about the same size and weight, a little bit wider, with a digital 65mm format sensor. And new 65mm lenses.

There will be three groups clamoring to be first in line to try these new rental-only cameras. Creative minds will conjure epic scenes and awesome effects to benefit from the ALEXA 65’s high resolution and large format, shallow depth of field. The images I saw recently were so stunning you felt as if you could reach out and touch them in ways more appealing than any current 3D projection.

Technical types will revel in the ALEXA 65 camera’s 6K resolution and seamless familiarity with existing ALEXA 35mm systems.

Producers, distributors and exhibitors will rejoice in the reboot of a format that historically has enticed audiences out of their living rooms and back into the theaters.

As Lawrence said in the greatest large format film of all time, “I think this is going to be fun.”

ARRI ALEXA 65



65mm digital cinema camera
ARRI A3X CMOS Sensor
Aperture equivalent to 5-perf 65mm film
6560 x 3100 Resolution
54.12 x 25.58 mm Sensor size (active image area)
Sensor image diagonal: 59.86 mm
ARRI XPL Mount (64 mm diameter)



Photos of ALEXA 65 Prototype by David Zucker



LDS metadata

Same accessories as ALEXA XT cameras

Electronic Shutter 5° - 358°, adjustable in 1/10° increments

0.75 to 28 fps (upgrade to 60 fps planned for early 2015)

EI 160 to EI 3200. Base is EI 800

Dynamic Range greater than 14 stops

ALEXA 65 Specifications

Tommy “the Cork” Corcoran, an advisor to FDR, once said you can pretty much learn everything you needed to know about a place by looking at a map. His office was festooned with maps and globes. Wasn’t a leader of New Deal policy supposed to be looking at the big picture instead of big maps?

“Look at this,” he said, stabbing his finger at the map. “Mountains here, desert there, and a river. What do you think that means for trade and commerce? You’re not going to traverse treacherous mountain ranges. You going to follow the river to a port.”

There are two ways to learn about a new camera. Look at the images it produces. And read the map. We’ll do both.

Overview	
Camera	ALEXA 65 65mm Digital Cinema Camera
Sensor type	ARRI A3X CMOS sensor
Image Aperture	5-perf 65mm (full camera aperture)
Sensor active image area	54.12 x 25.58 mm (diagonal 59.86 mm)
Sensor Resolution	6560 x 3100 (maximum recordable)
Size	
Weight	10.5 kg / 23.2 lb
Size (body without mount, EVF, handle, antenna)	L: 338.7 mm / 13.3” W: 208.3 / 8.2” H: 163 mm / 6.4”
Overall length (body with XPL mount)	L: 387.8 mm / 15.3” Mount adds 49.05 mm / 1.9” to length
Power	24 VDC
Lens Mount	ARRI XPL Mount
Lens Mount Contacts	LDS
Optical Center	105 mm / 4.13” from base
Accessories	Same as ALEXA XT range
Shutter	Electronic, 5° - 358° adjustable in 1/10° increments
Frame Rate	20 - 28 fps (full aperture) (sensor capable of 60 fps upgrade planned for Q1/2015)
ISO Settings	200 - 3200 ISO. Base is 800 ISO.
Dynamic Range	>14 stops
Recording System	* Upgrade planned for Q1/2015
Recording File Format	Uncompressed ARRIRAW
Recorder Crop Modes	5-perf 65mm (full aperture, 1.78 extraction), 8-perf 35mm (24x36mm - future)
Storage (type)	Codex XR capture drive
Storage (capacity)	480 GByte capacity 860 MByte per second data rate
Storage (recording time)	11 minutes @ 24 fps

Once we catch our collective breath after screening ALEXA 65 images, the facts and figures helped explain why they look so good. It’s an interesting map: 54.12 x 25.58 mm image area, 6560 x 3100 resolution, more than 14 stops dynamic range, 200-3200 ISO.

After getting our bearings, we’ll look at some of the thought and background that went into the development of the ALEXA 65 large format digital motion picture camera system.

Connectors	
Viewfinder	ALEXA EVF-1
BNC connector	4 x 3G SDI - MON (1) Out: 2 x 3G SDI - MON (2) Out: 2 x 3G SDI
SD card	For software updates and menu settings (like ALEXA) New high speed mode for fast ARRIRAW frame grabs (planned feature)
Other connectors	Focus / Iris / Zoom motor connections
	5 x RS 24V for accessories
	1 x 12V for accessories
	TC I/O (5-pin Lemo)
	1 x LDD, 2 x LCS, ACC
	BAT (pin 1: GND, pin 2: +24 VDC)
	ETHERNET, EXT (multi-pin accessory),
Other	
Camera IP Address	169.254.XXX.123
Synchronization	Like ALEXA, RET IN and EXT: Sensor sync, processing and HD-SDI outputs for 3D and multi-camera
Monitoring	3 independent color outputs: 1. EVF LogC/709/ARRILook 2. MON (1) OUT LogC/709/ARRILook 3. MON (2) OUT LogC/709/ARRILook All with optional overlays. All options are available during playback. MON OUT tools: Zoom, Overscan, Overlay info, Frame Lines, False Color, Peaking
CDL	CDL server support like ALEXA XT
In-camera playback	Playback via EVF, HD-SDI MON OUT including Audio
Audio	Two channel recording and playback, Analog line inputs, Headphone monitor output
Remote UI	Existing RCU-4, Web-Remote via ethernet, WCU

Franz Kraus, Managing Director of ARRI



If Financial Times can have a column "Lunch with the FT," then Film and Digital Times would stake its claim on "Dinner with the FDT." A few weeks ago, Franz Kraus, Managing Director of ARRI, Martin Cayzer, Neil Fanthom and Michael Cielinski invited me to dinner at the delicious and stylish Theresa Grill Restaurant in Munich. This interview began over steaks and chops and continued by phone and email in the weeks that followed.

JON FAUER: Let's begin with the concept for the ALEXA 65 camera. When did the idea originate and why?

FRANZ KRAUS: Following the success of the ALEXA we wanted to build a camera for the most demanding applications in filmmaking and envisioned a true 65mm format camera, sharing as much as possible the technology and imaging attributes of ALEXA. This consideration began shortly after the introduction of the ALEXA but materialized not more than one and a half years ago.

We wanted to maintain the dynamic range, colorimetry and all the successful features of the ALEXA. But we also wanted to add as much resolution as possible and to revisit a format we already had brought to market 25 years ago with the Arriflex 765. And we wanted to have a true 65mm sensor.

I think Vittorio Storaro was one of the first to use the original Arriflex 765 camera on "Little Buddha." Let's go back 25 years. It was very exclusive format. How has 65mm changed in the digital era?

It was sad that shortly after the 765 was introduced, 70mm film projection disappeared from the cinema. 35mm film prints with DTS and DOLBY digital 5.1 sound systems were able to replace the high-quality 70mm print with their magnetic soundtracks. It was a time where the industry focused very much on cost savings like with high-speed film printers, with results not always to the

advantage of the cinema audience. And without 70mm distribution there was limited demand for 65mm film capture.

A digital 65mm capture system is far less complex and expensive than the 65mm film version. It is more or less just the expense for the dedicated 65mm camera and its lenses. No expensive film stock, processing, reduction printing or scanning; only sufficient storage capacity and data handling.

Why is there so much interest in the format, then?

There is probably little demand today, but I think everybody who had shot in the larger format, be it IMAX, 65mm or VistaVision, indulged in the beauty of the large real estate of the format. When you have more of the same good pixels it makes a difference, just as it does when you have a larger area with the same fine grain structure of film.

Size matters in digital times too.

You'll probably remember when we did the experimental film with Bill Bennett, ASC "As Good As It Gets" 10 years back. It was meant to be a reference film to measure and compare where digital capture stands and how it evolves. The footage was used on many early 4K displays all over the world, as digital capture at that time was far inferior and there was no other quality source than large format film. The target for the ALEXA 65 was to meet and surpass 65mm film.

I know you have a great interest in color science and how an image looks with your background in image technology. What parameters did you establish?

Probably the most important factor for ALEXA's success are the wide latitude photosites. We tried to come as close to motion picture film negative, or even exceed it, because we knew about the value of having this wide exposure latitude. It makes shooting easier and it provides better images in the end. Another important factor is color reproduction; both parameters are of equal importance and go hand in hand. Some of the dynamic range needs to be traded for good color reproduction. If you don't do that, you might lose color consistency in the low- and highlight areas.

Because we DPs are always obsessing about look, how would you define the look of this new large-format camera? Is it the fact that it's a different depth of field, that it has greater dynamic range, higher resolution or better color rendition?

It has all the good attributes of the 35mm ALEXA and matches its images perfectly. In addition, it captures lots of fine detail. Aside from the resolution all other imaging attributes are identical to those of the ALEXA camera family.

In terms of resolution our focus was on minimum alias to achieve the most authentic reproduction of complex real world scenery. As film - due its random grain structure - lacks of alias by design, 65mm film images were the reference for the design of the optical low pass filter.

If you have enough photosites you can design an optical low-pass filter where you give away some of the resolution and thereby avoid any aliasing. You could have higher resolution of detail, but that would produce some aliasing.

This is a trade-off each manufacturer needs to address. And if you look at available cameras, you'll see differences in all of them.

Franz Kraus (cont'd)

What about new digital still cameras without low pass filters?

For still images you can get by without an optical low pass filter if you have enough pixels. Capturing stills is far more forgiving than moving images. In a slow camera pan without OLPF over fine detail the sensor could not resolve any structures and would instead generate coarse low frequency patterns that are very obvious and disturbing to the eye. With a static camera, the pattern would be static and difficult to see.

How did you come up with the name for the new camera?

ALEXA 65, that is a simple one, because by its nature and build it is a true ALEXA and 65 because it is a digital replica of a 65mm film camera, where 70mm was the distribution format.

How will this 65mm digital format be distributed?

It's the same file as an ARRI ALEXA (35mm) file. It just has more data. It's very compatible with the ARRIRAW workflow. It will be a RAW-only camera, because we are opting for the highest possible quality, not only highest resolution, but best color rendition and best dynamic range, without any compression artifacts.

The camera will generate a serious amount of data. Handling that will not be easy, will not be inexpensive and that might limit the number of projects that will be able to afford it.

Please explain the workflow.

The ALEXA 65 is a camera system, comprising of a camera body, a dedicated 65mm lens package and a dedicated Codex Vault image processing & storage unit. The Vault will handle RAW data from regular ALEXAs as well as from the ALEXA 65. Offering a complete capture system as a rental package ensures best overall performance and quality of service. We want to provide a complete system rather than offering bare bones camera and then forcing everyone to add various building blocks.

This is a turnkey system?

It needs to be. And for the first productions, there will be an expert on set to make sure that everything works to its best performance level with the minimum amount of technology based distraction.

Will there be an opportunity in the future to add additional lenses, perhaps with different mounts?

I think that all depends on how well this camera system is received by the industry.

Will this larger digital format influence the way digital pictures are projected? Perhaps the DCI specifications may change?

The original DCI Specification, if I remember correctly, were issued in 2005. Although it seems like yesterday, in IT terms this is ages ago. At that time PCs, storage media and data rates were quite different to what they are today. Projection technology has also evolved significantly since then. Also the digital cinema was specified when film was still the predominant reality and its legacy limitations had to be respected.

Concerning resolution, today's specified data rates for 4K are the same as for 2K. That means that fine detail - for which 4K would be required in the first place - is lost in the JPEG 2000 codec due to the limited data rate.

Looking into the future, without the restrictions of film, I think higher screen illumination, larger contrast and higher projection frame rates - as an option but not a general setting - should be revisited. Of course, to accommodate a higher resolution, higher frame rates and higher dynamic range the permissible data rates need to increase.

You said before that this camera would cost more for a production. Is most of this cost in post production and is it a significant amount more?

Most of the DI facilities say they are prepared for 4K. But if there is a lot of CGI and VFX shots, different versions, and everything done in 4K, and if you bring them tons of terabytes, then I think they will ask for some more money to deal with this volume of data.

Is the special effects world changing? Up to now they were mostly saying they wanted to work in 2K, but it seems like there is a lot of interest from the special effects world in this new camera.

The high resolution, low noise image free of artifacts will be very suited for plate shots, because it allows for reframing, zooming or stabilizing. Things that have been done in the past with VistaVision can be done digitally now, and I dare say, with even better quality.

I can imagine some very high end commercials would also like to use this because agency art directors always love to blow up the image.

I am quite confident about this application. I also see good opportunities in special venue productions like launch films for automobiles or in fashion, where perfect images need to fill huge screens.

Will the ALEXA 65mm camera be rented only from ARRI? Are you possibly going to offer it for sub-rental from the major rental houses?

The ALEXA 65 will be marketed as a complete system from the ARRI Rental Group exclusively. There will be a Business to Business rental model, as we also want to service our customers, who usually buy our products. But again it will be the complete system.

You'll never sell this camera?

Never say never. But seriously, when we first started looking into the market for such a camera, the interest in purchasing was very small. Almost all of the rental houses said, "Well, if you do it, and if we have shows, it would be great if we could sub-rent." But the interest from our customers in actually investing in and owning a 65mm camera was non-existent. And that was the reason why we offered the project on an exclusive basis to our rental group. They committed to and financed the project.

How does this camera position ARRI in the current business?

At the risk of repeating myself, the ALEXA 65 is building on the success of the ALEXA, adding in a huge amount of alias-free resolution. If, for example, you want wide opening shots that stay on-screen for a long time, then this camera will truly "show off." Giving directors and cinematographers the ability to create that unique beautiful 65mm look and also to enable extreme VFX - these are the use cases the camera was designed for. We want to make sure that we have an offering for the very high end of filmmaking.

Martin Cayzer and Neil Fanthom



L-R: Martin Cayzer, CEO of ARRI Rental and Neil Fanthom, ARRI Rental Executive for Technical Marketing

At NAB this past April, I received a cryptic text message: “Meet in the back of the ARRI booth at 12 noon.” Usually I welcome any excuse to avoid waiting on line for what passes as lunch at NAB—but this sounded ominous. High noon in a desert city. A disgruntled manufacturer? Had an FDTimes article offended someone in Las Vegas, a city with a certain reputation? The De Niro character beating up a hapless reporter in Luc Besson’s “The Family” came to mind.

I was escorted up the stairs and into the nether regions of the LVCC. Fortunately, Martin Cayzer, Neil Fanthom and Dana Ross had something altogether different in mind. After pledging to zipped lips and NDAs to end all NDAs, I was invited to visit Munich in the summer to learn about a bold new adventure.

Cut to: Türkenstrasse in Munich. A rainy day in July. Interior, top floor attic garret at ARRI, a veritable skunkworks of software, sensors, computers, R&D, wires, models, sleep-deprived engineers and an industrial-strength espresso machine. Martin Cayzer is the CEO of ARRI Rental Group of companies. Neil Fanthom is ARRI Rentals’ Executive for Technical Marketing. The topic was ARRI’s new ALEXA 65, which didn’t even have a name at the time. It was code-named AUSTIN. I think ALEXA 65 is a better camera name than a Texas town or a spy spoof character.

JON FAUER: This is a long way from the back corridors of NAB.

MARTIN CAYZER: When we first started talking about future camera technology we took a step back and said, “What’s the long term future for our ARRI Rental Group of companies and for our

industry? How do we remain relevant in the industry and to our customers? What’s going to change, and what do we need to do to innovate and provide the latest technology and services—to do something special?”

One of the first questions that we asked ourselves was, “What’s going to be the future trend with feature film, TV drama and TV commercial production worldwide?”

There’s been some recent mixed press about box office results. We took a look at where we think the industry is trending and what new technology is driving. It’s been very interesting. In our Rental Group we’re in many more discussions now than ever before with visual effects supervisors, post-supervisors, as well as continuing our traditional relationships with cinematographers, crews and directors. We’re very much being drawn into the technology discussion from a wider perspective than just image capture.

What we see is that there is an increasing demand for large-budget visual effects-led blockbuster feature films.

Will that continue and how are we going to best service the needs of that type of production? We looked at some analysis. If we look back to 2013, 91 of the top 100 films, in terms of global box office, were live-action. The total global box office was up to U.S.\$ 34.9 billion, a 4% increase compared to 2012. The significant trend we can see is that the international, non-USA. box office is now around 70% of the global total.

Of that, U.S. domestic is about 8 billion?

MARTIN: U.S. domestic box office for 2013 was just under U.S.\$ 11 billion.

That seems relatively small. And here’s a scary statistic: I heard breakfast cereals are an \$80-billion industry in the U.S.

MARTIN: China’s box office was up by 27% last year, which is amazing. China’s box office is now the number one international box office. There is huge growth in the BRIC countries (Brazil, Russia, India and China.) Because of that global trend, heavy visual effect blockbusters translate well into international box office. Then, we looked at the IMAX trend. They are certainly, from their results, going from strength-to-strength. Now, with over 860 installed theatre systems globally and 160 IMAX screens in China up from just 9 in 2008.

Overall, the picture that we’re seeing is that there is a lot of strength in large, live-action, visual effects-driven films and we need to be up-to-date with the technology these productions are looking for: a large format, high resolution, and also a seamless integration into current capture and workflow standards.

And not just for theatrical release; the conversations we’re having now is that TV is leading the 4K drive.

What are your thoughts on TV image acquisition?

NEIL FANTHOM: It’s ironic that TV may be driving 4K.

MARTIN: Acquisition, archiving, and visual effects. In terms of sophistication of equipment, technology, as well as the quality of content, we see traditional TV and new content providers such as Netflix and Amazon leading the way in many areas. We’re seeing those key, especially high-end, TV drama markets being critical for ongoing technology development and innovation.

Martin Cayzer and Neil Fanthom (cont'd)

How do we, as a Rental Group, approach this? This was the key question. We need to be globally integrated, and we'll see later that we have a group of very good individual rental companies around the world with the same ethos, and we are all owned by ARRI. We are integrated, but historically probably not as well connected as people would think we are. And that needs to be addressed. Since we do have five different brands, it can be confusing as people say, "Well, is ARRI CSC in the U.S. the same company as ARRI Media in London? Are we all part of the same group?"

And, this is especially important as cinematographers, crew and the post and visual effects community move around the world. We have to be in the right locations. In fact, this month, we just opened an office in Atlanta, because of the predominance of high-end television drama and feature film production in Atlanta.

What are the five brands that you mentioned?

MARTIN: ARRI Rental in Germany, ARRI CSC, ARRI Media and ARRI Lighting Rental in the UK, Illumination Dynamics. Located in 17 offices throughout 7 countries.

From October this year, all our global rental companies - including our lighting and grip rental businesses - will be incorporated under our new brand. Apart from Illumination Dynamics. That's because its rental business is more focused on moving light technology, broadcasting and events. It makes sense that they retain that name, certainly for the immediate future. But, of course it will have an ARRI Rental company brand association as they are still very much part of our group.

When cinematographers turn up somewhere in the world, they need to know that it's an ARRI owned rental company, supported by everything you would expect from ARRI. ARRI brought me on board 2 years ago as the CEO of the ARRI Rental Group of companies to help bring our global rental companies closer together.

How is the ARRI Rental Group structured?

MARTIN: My first move was to create a Rental Group senior management team consisting of myself, Simon Broad, Thomas Loher, and David Everitt. Rather than have a bricks-and-mortar head office we now have a senior team of existing executives already in our global rental businesses operating as a virtual headquarters.

With Thomas Loher (also Managing Director of our Mainland European rental operations), we have the insight of a great operational manager with a vast knowledge of the industry.

David Everitt (Finance Director of our UK operations) has very strong financial and analytical skills.

Simon Broad (President of our US rental operations) has over 3 decades of successful industry experience and specific experience in marketing.

Together we take an overall view of all parts of the ARRI Rental business around the world. We've brought on Neil as the executive for technical marketing to bring together all our technical people around the world in order to advise and help develop new products. We've got a lens team. We have a workflow team. We have a technical marketing team around the world that meets on a regular basis, chaired by Neil, to talk about technology and how it interacts with our clients, what our clients are looking for, and how we can create that.

You can imagine the depth of skills, knowledge and experience of the people we have within our Rental companies. As we bring them together even closer we become capable of developing exciting new technologies. In particular, I have to mention the vital contribution of Manfred Jahn who is a leader in the development of our lens strategy.

We should also remember Bill Lovell, the ARRI Rental technologist behind this project. Bill tragically died the night before the kick-off meeting in 2013. Bill created the original ARRI Rental specification requirement for the camera, which is largely the same today. He was a driving force with Franz Kraus and the rest of the ARRI team behind the D-20, D-21 and ALEXA development. The ALEXA 65 would have been the pinnacle of endeavour over many years for him. Bill's inspiration and influence on the ALEXA 65 system will remain with us for some time to come.

We have just taken on Dana Ross, who is our very first ARRI Rental representative in Los Angeles. His role absolutely is about relationships with the community, the cinematographers and the post and visual effects people.

Dana was every cinematographer's best friend at Technicolor.

MARTIN: Dana is now our Executive of International Marketing. His role is really to be out there and spread the word about what we're doing, talk to people about what we're up to, listen to them, feed that back and create a really strong relationship in a location where we've never been strong as a rental company. And whether you're a cinematographer who is Mexican, Australian, Kiwi, Brit or of any nationality, you're probably going to pass through Los Angeles at some point and we've never had anyone specifically from our rental group there. We are so lucky to have Dana join us with his knowledge, skills and relationships.

And then, behind the scenes we are putting in common integrated operational systems and processes, so it's more than technology and branding. It's much more about having a common way of doing business in all our group companies, as well. We've now set up a Quality Control Group. Previously in our rental group, each individual company would have had its own way of dealing with camera packaging and set-ups. We have to have a common approach and a common quality control. We have a group that's talking about a much more global approach to technology, and how we set it up. So that's another real positive, as well.

The real goal for David, Simon, Thomas, Neil, Dana and me, and for the whole team, is that we really want ARRI Rental to be an innovator as well as a rental company. With the ALEXA 65 camera, ARRI sales had already decided it was not viable to be developed as a product for sale. The quantities would be too small, and therefore the pricing would be prohibitive. Also, it required a complete system to be developed including lensing and workflow.

With whom are you partnering on the ALEXA 65 project?

MARTIN: The camera is built by ARRI and developed through the ARRI R&D Group with Achim Oehler as the project leader. We can't take credit for that! But, ARRI Rental did have significant input into the camera's specifications and to make it into a system. To include Codex as a workflow partner, to have IB/E Optics as a lens partner and for us to develop a system, that's very much part of what we are managing through ARRI Rental. With



the input from all the teams around the world, ARRI Rental as a company is able to bring this project to life.

That's a little bit of background as to how we got to the point of, "Do we develop a major piece of technology such as the ALEXA 65?" The confidence was there.

The first thing we did was put a toe in the water with the ALEXA XT B+W in November of last year. This, once again, was a similar strategy to the ALEXA 65, in that the technology was developed but was not going to be practical to turn into a sales product. The quantities would just be too small. However, it is a unique technology with a unique look and as a rental product the ARRI Rental Group was able to bring it to life. This is exactly the type of innovation and technology the TV commercial clients want to see, as they are often first adopters of new ideas and equipment.

Is ALEXA 65 the only exclusive project that you are developing?

NEIL: It was a product which Rental had to hone, because it was originally sitting in R&D when I was still working for ARRI in Munich, and nobody really knew what to do with it. Bill Bennett, ASC, had shot a very fine Audi commercial with the camera, in infrared, which generated a lot of interest and that prompted some internal debate: "Is it a sales product? Is it something that we'd rent into the market? Is there a market for it, even?"

That was the first product Rental took under its wing in a very limited quantity to test the water on our ability to promote new technology into niche markets. And it worked out very well, particularly with high-end music videos. For example, recent music videos for Kylie Minogue and John Newman looked wonderful in black-and-white, and of course several commercials have been shot with the camera, in black-and-white as well as infrared. The ALEXA B+W infrared look was adopted very successfully by Audi for a while as a high-impact format for their new car commercials.

Cinematic productions have been a little slower to adopt the camera, but because it does have such a resolute and contrasty look I'm sure that a great feature opportunity will present itself in the near future.

For the ALEXA 65, we touched on the question of our initial launch messaging, and the extent of the camera system's capabilities looking to the future. The essential message is quite simple—it's a 65mm large format digital camera based on ALEXA technology. It's exclusive to ARRI Rental. We've commissioned that product from ARRI Munich. ARRI Rental have collaborated with IB/E on the lens development, and the workflow is a Codex collaboration. The whole system is tailor-made to make 65mm capture an obvious and viable choice for high end productions.

The "big chip" really is the beating heart of the camera. The size, you guessed pretty much as soon as you saw it, so impressive estimation skills on your part, Jon.

Tell me more about the new sensor in the ALEXA 65.

NEIL: The new sensor has a larger imaging area than the camera aperture on an Arriflex 765. It is 54.1 x 25.6 mm in fact, very wide, very tall, and of course very high resolution. It is very important for us to have that additional "room" in the image, to cover wide, expansive vistas which will be a look which the cinematographers will love, as well as tall shots where the VFX supervisors need a lot of wiggle room.

Being able to cover both the wide and the tall is certainly a differentiating point, hence the comparison back to a full 65mm film gate. In terms of the camera ergonomics, the size and weight is similar to an ALEXA Studio, it clearly has a major usability advantage over a 65mm film camera. And because we are recording uncompressed Arriraw in-camera, the whole package will appeal to those demanding the best in uncompromised image quality coupled with a much higher degree of flexibility on set than they would get with a 65mm film package.

Overall, to set the perspective, some might consider the camera to be just an ALEXA XT with a 65mm sensor. But to be fair to the R&D team, that is quite an understatement since from a technology perspective it's a very, very complicated camera, as you can imagine. And then, as Martin mentioned, we're introducing a new range of 65mm format prime and zoom lenses, which are based on Hasselblad stills lenses. The lens elements are rehoused in a ground-up-designed set of lens casings with new iris designs and focus/iris/zoom adjustment mechanisms intended to make them perfectly suited to 65mm cinematic capture.

What is the roadmap for the camera?

NEIL: As soon as we launch—day one—we know that the first questions to come back from clients will be, "Will the ALEXA 65 shoot at higher frame rates?" and "What about extended recording times?" We've considered a strategy for that, and we'll just paint a very simple picture to cover those two key points.

ALEXA 65 has a very similar performance sustainability roadmap to ALEXA. And everybody knows what happened with ALEXA over time, in terms of moving to higher frame rate capture and support for larger, faster recording media.

We've got a similar level of modularity in the camera compared to an ALEXA XT. We will be able to, and plan to, exchange the XR capture drive recording module to allow the next level of recording technology to be added to the ALEXA 65, and this will be the first deliverable on a roadmap of feature extensions.

We can't talk about everything at this point in time. But the first

Martin Cayzer and Neil Fanthom (cont'd)

upgrade, to the recorder hardware, will be early in Quarter One 2015. Faster frame rates, longer recording times, larger capacity Capture Drives.

What is the capacity now?

NEIL: Half a terabyte capacity—on a standard XR drive we are all familiar with. The new larger capacity Capture Drives we are considering will provide significant extended recording times. But they will also be much quicker than the current XR capture drive, therefore allowing for uncompressed higher frame rate recording. The camera architecture is capable of supporting a sustained recording data rate over 2 Gigabytes (not bits) per second.

2 Gigabytes per second. What is the data rate now?

NEIL: For XR Capture Drives: 860 Megabytes (not bits) per second.

Is the ALEXA XT is the same? If so, how do you do that?

NEIL: In 16:9 mode, ALEXA XT can record uncompressed Arriraw at up to 120 frames per second. That in itself is quite a feat. Calculating 16:9 Arriraw, 2880 x 1620 resolution at 12 bits per pixel at 120 frames a second, and allowing for a little headroom you get to the 860 figure. If you can imagine running an ALEXA flat out at 120 frames a second, all the time, that's kind of what we're dealing with in the ALEXA 65 in its launch format.

MARTIN: At 24 fps. As Neil said, it's a base launch format. As with ALEXA, we will be adding extended functionality over the coming months addressing frame rates, recording capacity and formats.

NEIL: As far as recording formats go, keeping it simple is going to be important. To start with, the camera will support 5-perf 65mm and 8-perf 35mm (VistaVision) recording modes. These can be cropped in camera, or cropped in post. There will be a white paper which covers best practices for the camera and workflow. We both feel that it is going to be important to offer productions the choice of format, of data footprint.

We'd like to talk about recording formats in terms that cinematographers can relate to, and which are based on film standards. The ALEXA 65 menu selections will relate to standard film formats, not "Ks of resolution. In any mode, the camera will have plenty of "K", so resolution does not need to be a creative consideration when choosing your lens, or framing your shot.

You mentioned Hasselblad optics. How many lenses will you have in time for launch, and what are the plans?

NEIL: We have in development additional primes and zooms for next year. We'll launch with eight primes over a wide spread of focal lengths, and one zoom. But hot on the heels of that zoom will be another zoom and some more primes. To fill out the range, we have the ZEISS Hasselblad lenses used on the Arriflex 765 film camera, which are actually very good lenses, of course. They will provide a subtly different look.

Tell me about the workflow.

NEIL: There are essentially two configurations of the Vault that we're investing in. One is a new turbo-charged version of the Vault S, with new Solid State Device (SSD) storage modules to make the Vault run a lot quicker than before. The write speed to spinning disk will not be a limiting factor in the workflow any more, so the XR Capture Drive offload can be made really quickly. Securing

the digital negative quickly is a big part of the workflow for this camera. It underpins the performance of the rest of the workflow.

And then there is a new version of the Codex Vault XL which Codex are performance testing now. We're going to call it the Lab 65. In addition to faster SSD drives, the vault XL will have 24 cores of CPU power, which will really rip through the processing tasks involved in the ALEXA 65 workflow. The idea being that the new Vault S is a device that you can take on set anywhere, more likely to be for second unit usage in remote locations or for splinter unit work where just one or two cameras are shooting. But for near-set, studio-based productions where several cameras are shooting to a high daily workload, the Vault XL will probably be used near set to really manage the heavy data lifting and we will get close to a real-time workflow with that version of the Vault. We have a very good strategy for dailies, which can be processed faster than real-time during ingest of the XR Capture Drive.

MARTIN: For very high-quality dailies.

NEIL: They will be HD ProRes 4444 "source dailies" which can be used either as they come, or further transcoded down to DNxHD 115, DNxHD 36, etc. Again, giving production the choice to decide what format they want to suit their working needs. And then for our pristine uncompressed images, 6.5K at the highest resolution, processing to generate archive masters will take a little bit longer than, say, ALEXA images would.

MARTIN: I think its important to point out that to get enough cameras in quantity and enough lenses, it is obviously going to take a little bit of time. We also aim for greater functionality of the cameras, and in 2015, we will speak to people who have a genuine interest in a business-to-business relationship with the cameras and have conversations with them.

Would it be sold by ARRI?

MARTIN: The intention might be to have a business-to-business rental or lease arrangement with other rental houses.

Just because it's not in the traditional ARRI service network, in terms of servicing, in terms of lenses, and in terms of packaging and workflow, we couldn't sell just the camera body to someone. It would have to be a relationship for the whole system.

And the ARRI Rental Group would also need to hand-hold that, as well, to a large extent, because of technology, and service, and parts, and all that. It's not an easy question to answer, but it will be possible.

Very exciting. Congratulations.

MARTIN: It's exciting and terrifying at the same time.

NEIL: A labor of love.

MARTIN: But you're right, people are passionate about the format. People are very passionate about the 65mm digital successor.

I'm impressed. I think you have come up with one of the most interesting products in the history of large format cameras. It's really exciting.

MARTIN: I think we need to congratulate Achim Oehler, who was the project leader for this endeavor.



Dr. Achim Oehler

Dr. Achim Oehler was head of the Arriscan project, project manager for the D-20 and D-21 digital cameras, and managed the ALEXA project through first customer deliveries. He is currently the project leader of the new ALEXA 65 camera.

JON FAUER: When did you begin work on the original 35mm ALEXA?

ACHIM OEHLER: The ALEXA camera grew out of the very early Arriflex D-20 and D-21 era. Those were the exciting times when we started to do digital cameras. But ARRI was working in digital even before that time.

The Arrilaser film recorder and the Arriscan film scanner bridged the gap between the analog and digital world. When I was project manager of the Arriscan, I remember having many discussions with customers in Hollywood and around the world to hear their opinion about resolution. We came up with a 6K film scanner and the images were really stunning in resolution and also dynamic range. Even though we did not have a 6K sensor at that time, we developed a unique method to generate true 6K resolution from a 3Kx2K sensor. In addition we implemented 14+ stops of latitude by using double exposure.

Although I do not want to elaborate on the Arriscan now, you can see our motivation always has been to deliver the most impressive images.

You can imagine how our experience in image science, sensor technology, software development, manufacturing and service has moved nicely from the Arriscan to other projects like the ALEXA camera.

When were the first hints of ALEXA 35mm camera? I remember it was introduced at IBC 2009.

Here is the story of the ALEXA. After the Arriscan was finished,

I took over the D-20 project when ARRI decided to prepare it to be sold as the D-21. I remember the financial crisis very well, at the end of 2008. When the D-21 was brought to market in 2007, it was never planned to enter the market that way. (The D-20 was initially a proof of concept camera, and the D-21 was to be for rental only.) Selling it meant we had to squeeze in additional features like on-the-fly pixel correction and really tricky things.

For the next camera, the one that would become ALEXA, we listened to our customers and monitored the economic changes in the industry. Our sales department, product managers and business unit managers around the world discussed how to develop our “next gen” camera. It was concluded that we needed a camera that would do ProRes and many more features that were collected in a wish list. At the same time, we had developed a new sensor based on the experience of our existing products.

The economic crisis required us to rethink some things on the wish list and make a cost-effective camera. That was a challenge because, at that time, we already had decided on our newly developed sensor architecture. So we had to construct a camera that was cost effective to manufacture using that fancy sensor. Additionally, we had to have a viewfinder and a recording element.

We really were very lucky that this big effort was financed because, at the height of the financial crisis, we had to start investing a lot of money, much more than we had ever imagined we would have to put into that camera. The advantage at ARRI was that such things were possible. And I think we succeeded with the ALEXA camera. Later, an idea came up to a do large-format camera based on that sensor. That was the initial idea for the ALEXA 65.

When you say large format, you’re talking larger than 35mm?

Exactly. As large as possible. And especially because Mr. Franz Kraus, our CTO and Managing Director, has wanted to have a large-format camera since forever.

What is interesting, and I am coming back to the Arriscan for a second, we do have a 65mm Arriscan in our ARRI Film & TV services department. It is a unique piece of art and was developed to serve the large format market, because we really love large format. It is like a passion for most of us.

So to be able to capture hi-res large format images, it was clear that we had to develop a new sensor. We love challenges and we decided this would be a new story we could create. Without going into too much into detail, our new large format sensor is produced using a very sophisticated process and has the size of approximately three ALEXA 35mm sensors.

Was the D-21 sensor the same technology as the D-20, and is the ALEXA sensor technology the same as the D-21?

The D-20 and D-21 sensors are the same. The main thing that changed was the processing chain in the D-21.

What is the technology change of the ALEXA sensor ?

The ALEXA sensor is a sophisticated high dynamic range sensor using a relatively large pixel. It is an analog sensor, i.e. the Analog-to-Digital (AD) converters are off-chip. This way, less space is used on the reticle than what you would need if you put the AD converters on the chip. The additional area we gain is used for a larger pixel field.



Is the AMIRA sensor the same as the ALEXA sensor?

The AMIRA sensor is essentially the same as the ALEXA sensor, just slightly modified. It's running at a higher clock rate and faster read-out time, which allows the AMIRA to go 200 fps.

Let's fast-forward to the new ALEXA 65 camera project. When did you first start working on that?

The sensor was started in 2012 as a feasibility study. And then the project was outlined in April 2013, and funded. The camera program started with a sensor proof of concept phase which ran until December 2013, where we just put the sensor into operation with an experimental camera, which you saw in our laboratory.

At the start of 2014, we began working on the complete camera. There was a little bit of overlap, because we began preparation of the main electronic circuit boards in 2013. Otherwise we could not have achieved such a fast time to market.

When you do a proof of concept camera, does the sensor fabricator send you some test samples of sensors?

Yes, the normal thing is that you get 10 to 12 wafers. It's called an engineering run, and these wafers are handled like the production wafers. You just have to dice, or cut, it and to put it into a package. What we do is kind of special. Normally you get good sensors in the package from your design house. They live from putting the sensors in packages and selling you the complete thing. What we buy are just the bare dies, and we put them in our own package. The complete yield tracking and a lot of things that are normally handled by the design house are in our hands.

And you put the cover glasses on in the ARRI clean room as well. I saw that yesterday.

It's very good to have it all in one place. Otherwise, you have to send it back and forth to the assembly house.

Also the direct communication is crucial for our success, instead of having video conferences we just walk over to the department and clarify open questions directly.

Achim, tell us a little about your background? How did you get started in this?

That's a good question. I'm a planetologist.

Excuse me?

I'm a geophysicist who went into planetology. I did six years of comet research.

A rocket scientist?

Rocket scientist. In Hollywood I always announce myself as a rocket scientist. I once had a very nice chat with someone in Hollywood. They thought I was doing something wrong, and they were angry with me. And they said, "What are you, some kind of rocket scientist?" And I said, "Well, yes, before getting into film, as a matter of fact I worked for 6 years in an ESA project dealing with basic research for the Rosetta comet mission and in the course of the Mars Pathfinder project the results of my thesis were used by NASA's Jet Propulsion Lab for a better understanding of the digital images shot by the Mars rover."

That kind of ended the discussion.

Were you also involved in the ARRI/Lockheed Blue Herring Project?

No, I was working on the Arriscan film scanner project at that time.

When did you join ARRI?

September 1999. My career at ARRI has been Arrilaser film recorder, Arriscan film scanner, software group leader, D-20, D-21, ALEXA, and now ALEXA 65.

You probably brought some of that technology and sensibility from the scanner and laser to the camera sensor?

Yes, it's been a coherent kind of "camera-related" career, because when I was doing the planetology stuff I always dealt with remote sensing—using cameras sensitive in the optical and near infrared spectrum.

It started with the Giotto Project, where we had the fancy camera in a robotic spacecraft that flew by Halley's Comet and it was the first time for close-up observations of a comet. That was really fascinating, we also did the Mars camera with Professor Neukum, with really stunning 3D images. That camera was started in the early 1990s. And then I did a few years of free-lance software work for camera and spectrometer manufacturers.

How did you get into "the glamor and excitement" of the film business?

That was one of those things that just happen: by a coincidence I met ARRI's lead color scientist Harald Brendel and finally I started working here.

Working on the large format camera, who's on your team? There is a color scientist, there is a sensor designer...

I work closely together with Michael Cieslinski, who is the inventor of the sensor. I sit next to him, and we kind of manage and coordinate the whole thing. He is an analog expert, and he's able to design sensors from an architectural standpoint. It's really a very rare discipline that people can decide what to put where on a chip, and so on. These are a very small structures, so you have



Opposite: the ALEXA 65 development team. Above: with concept “box” and completed ALEXA 65 camera .

to think in completely different terms than a normal electronics engineer. Michael also designed the Arriscan sensor, by the way. And he's, in a sense, the technical lead.

We have a digital designer, Reiner, and the digital designer is really so important, but most people underestimate the discipline. Digital design means putting code into FPGAs or doing ASICs, so it's one of the most important disciplines here at ARRI. And he's a really great engineer.

Then, we have two more software engineers. One is a specialist for calibration procedures, and the other is a very good hardware engineer.

We have an electronics engineer, and then we've got David, who brings a lot of camera usability expertise into the team. David worked for ARRI Rental before joining our team here.

One engineer, Alois, is doing nothing but sensor optimization, in other words, tweaking the sensors day and night. Sorry for not mentioning all of the team members now even though it is a small team. We are 10 people, but of course we use the complete ARRI infrastructure here. Our service department, manufacturing and QC department are involved from an early point in time in most of the projects.

We work closely with all other R&D teams at ARRI and we exchange ideas and experiences—sometimes simply during a coffee break in our coffee lounge.

Yes, I noticed your industrial strength, incredibly high-tech coffee machine. That's impressive. And I had no idea that you had so much sensor design capability right in house. I was always under the impression that you just farmed it out to some sensor design company, and that was it.

We do both. We try to do some things on our own, to realize our own ideas, which is not easy, because the design houses are not prepared for that. They have their own building blocks. And they want to have customers go there and say, “Okay, I want to have a sensor of a set size, and set speed, and that latitude.”

And then they tell you, “Okay we can do it,” or not. Then they put together their blocks. And eventually, if you're lucky, or unlucky, it depends on the success, they invent a new block, or they modify a block, or they talk to another fab about how they could do it.

But what they don't like is when a guy like Michael shows up and says “Okay, guys, let me tell you how to design the sensor.” It drives them crazy. But it's really hard to design everything by yourself. You would need millions of Euros for the design tools and very experienced designers. And you just can't buy a design team. It's such a special discipline.

Does the big 65mm sensor have a similar high dynamic range technology as current ALEXA cameras?

Yes, it looks like an ALEXA camera. It has the same image characteristics.

And then, what we did was to use the complete ALEXA concept. We enhanced the electronics with modern FPGAs, we updated the electronics with the latest components, so there's nothing old in there. We can use it for another five years. At the same time, we can reuse about 90% of the software. There are about 20 man-years of software design in that camera. You would never be able to fund a project like that or do all that just for a small series of cameras. The image processing chain represents, I would say, another 40 man-years, or so. All in all there is a tremendous amount of ARRI in-house development inside the ALEXA 65.

ARRI ALEXA 65



8 new primes and 1 zoom will be available initially in the new ALEXA 65 XPL mount (64 mm diameter, 60 mm flange focal depth). Image circle is 62 mm.

ARRI ALEXA 65

Antenna for Wireless
Lens Control, Lens Data
and Camera Remote
Control

Focus Tape
Hook

M6 Rosette

ZOOM: to enlarge image
for focus check

EXP: for false color

M6 Rosette



Top Handle

Lever to secure EVF

ARRI ALEXA 65



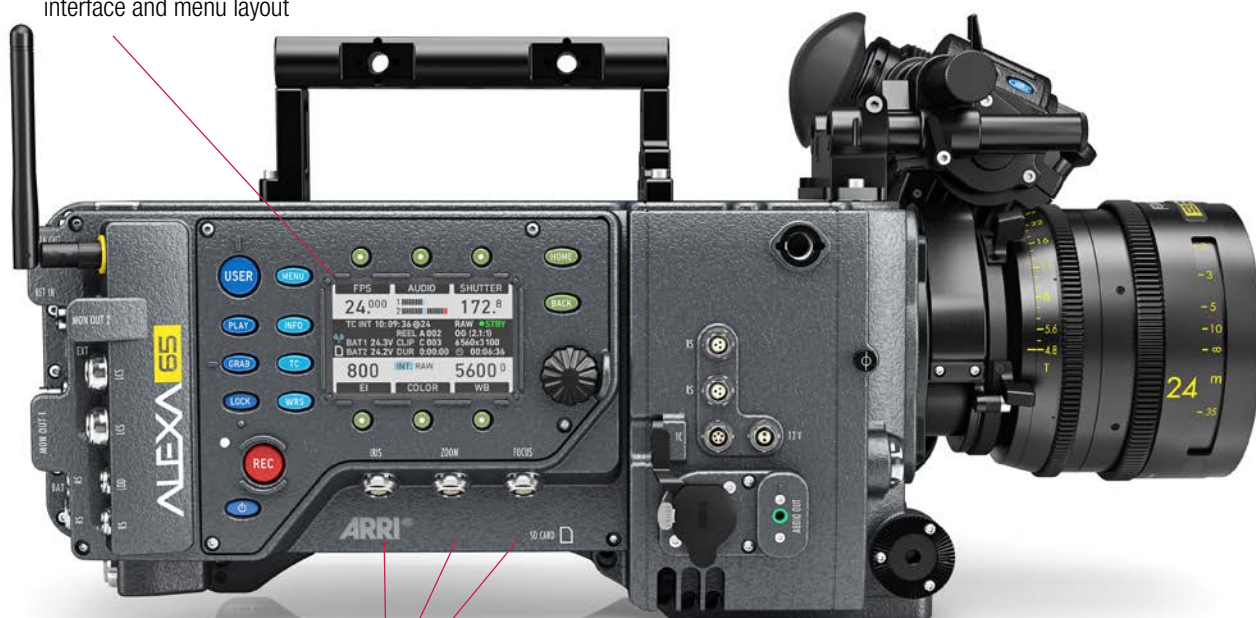
MENU: Access the Main Camera Menu

Jogwheel: rotate to select, push to set

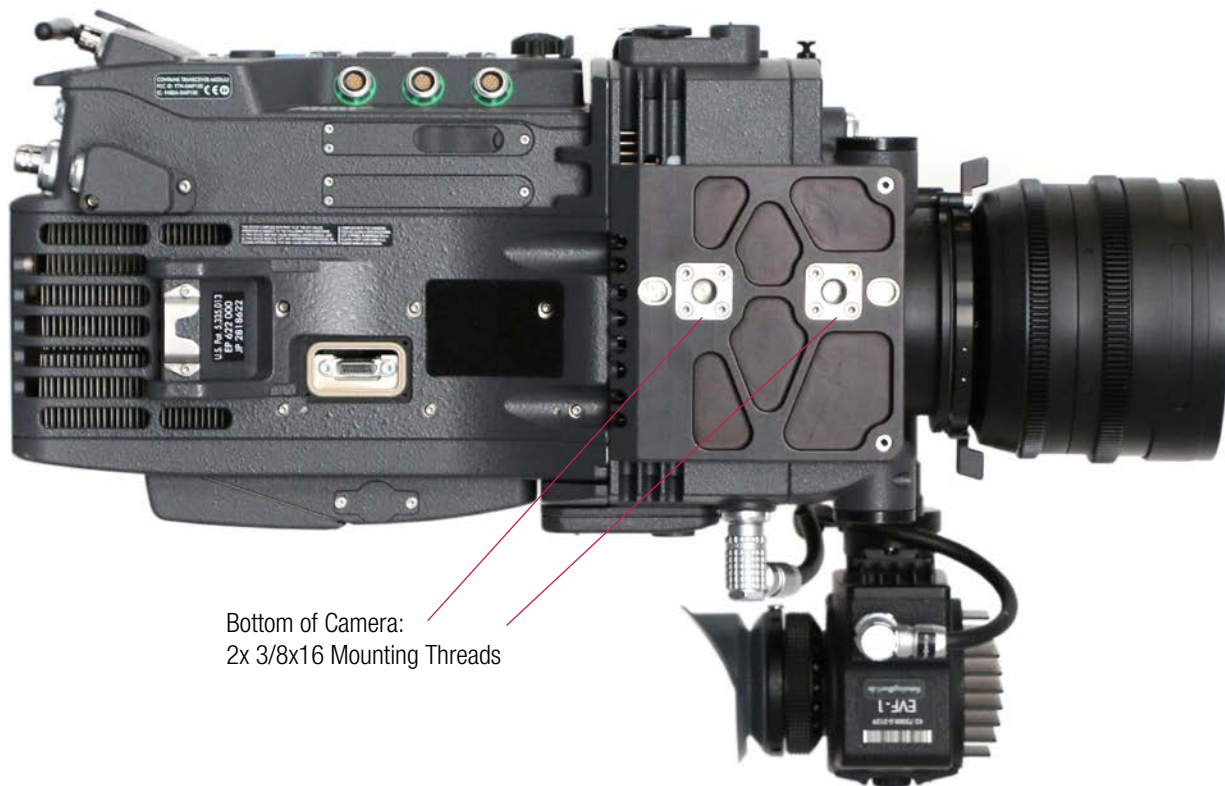
BAT: Power

ON-OFF: Press to turn on. Press and hold for 5 seconds to turn the camera off.

Familiar ALEXA-like user-interface and menu layout



IRIS, ZOOM, FOCUS:
Connectors to ARRI
Lens Motors

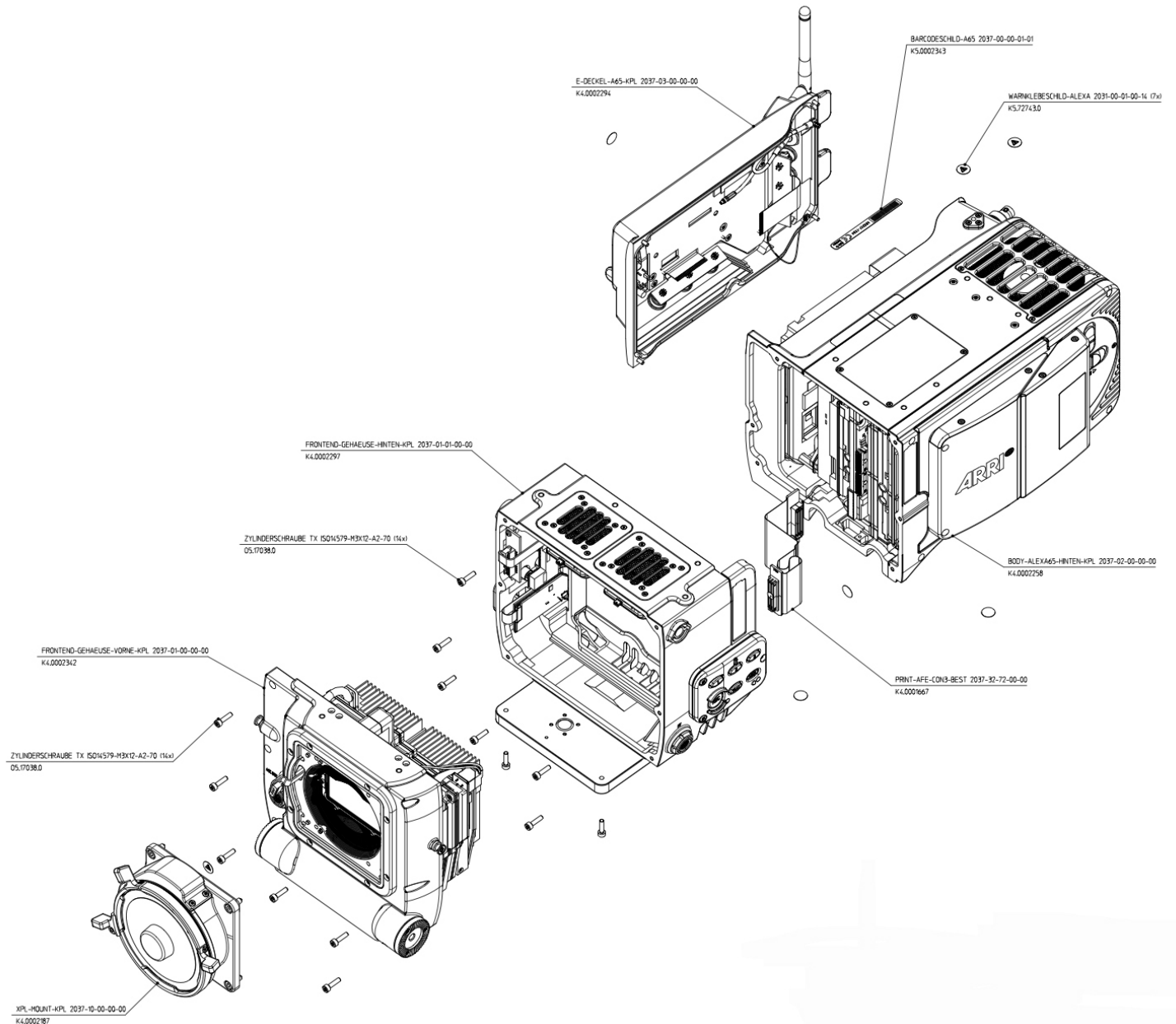
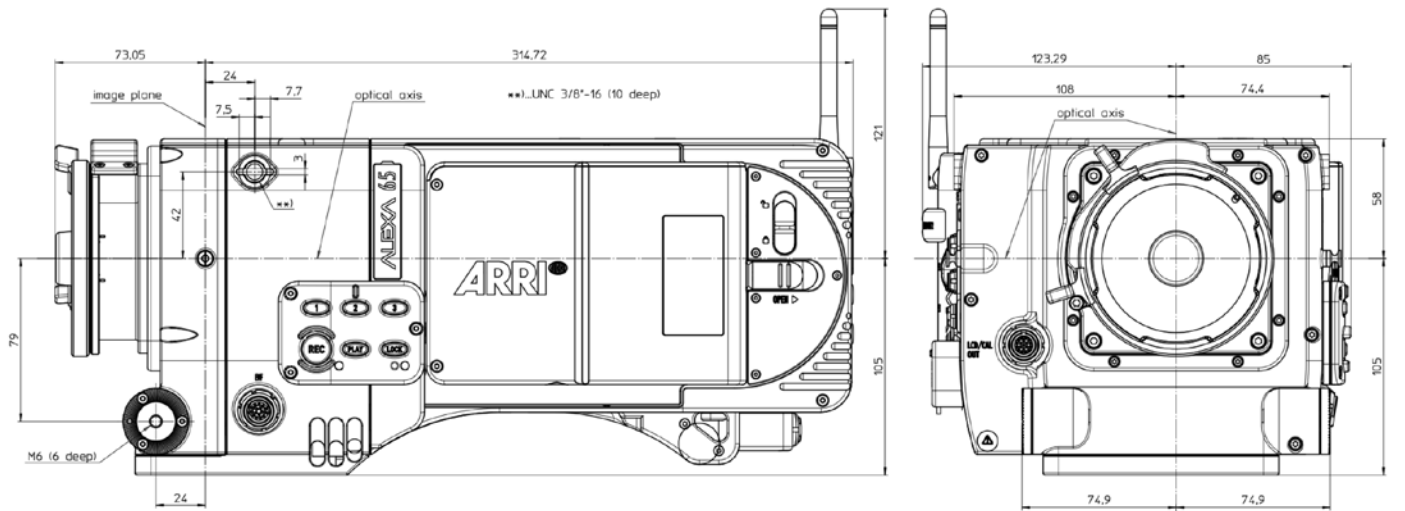


Bottom of Camera:
2x 3/8x16 Mounting Threads

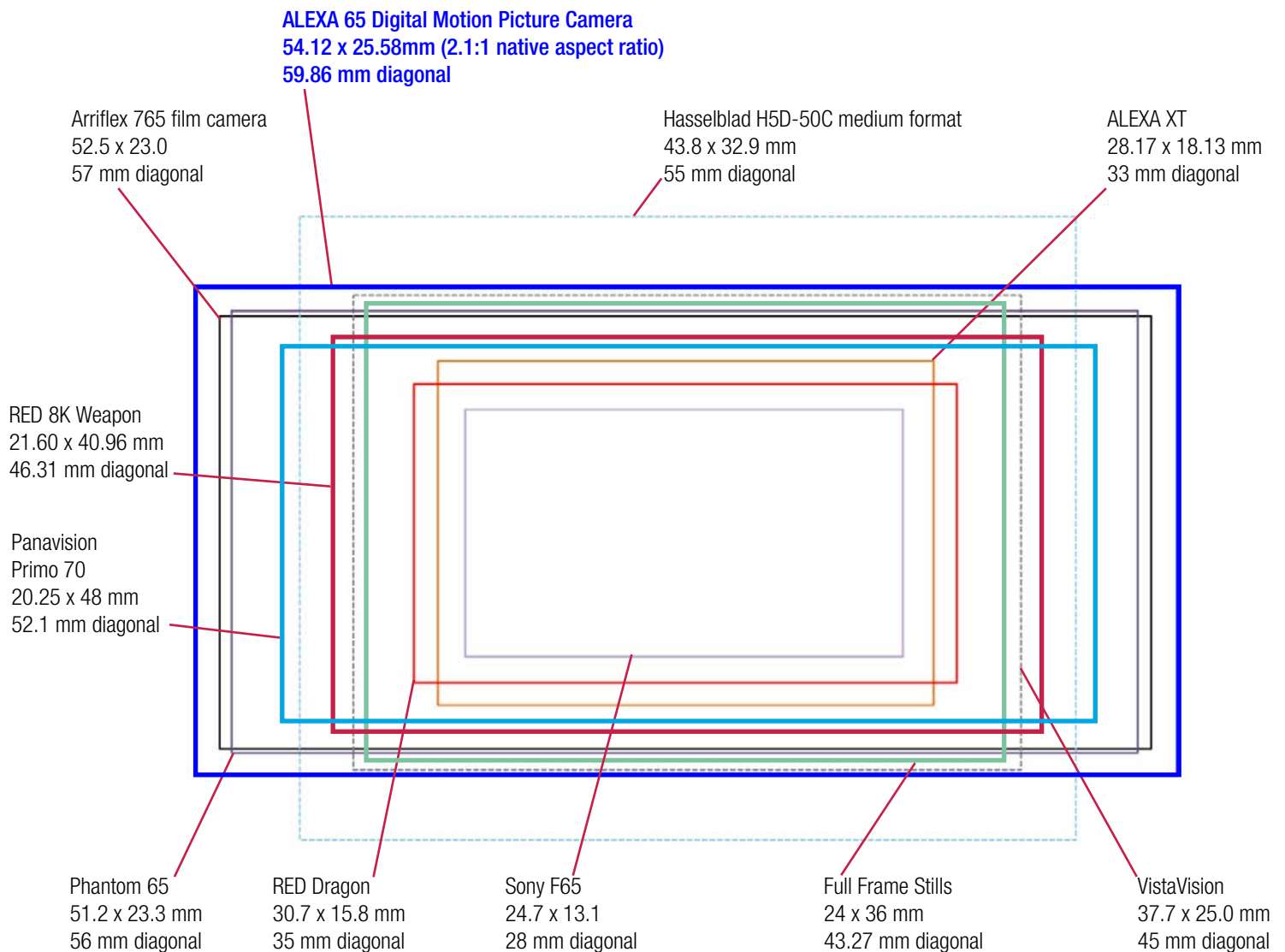


Top of Camera:
5x 3/8x16 Mounting Threads
on Handle

Exterior Dimensions



Sensor Size Comparisons



	Width	Height	Diagonal	Horiz Rez	Vertical Rez	Aspect Ratio
ALEXA 65	54.12	25.58	59.86	6560	3100	2.11:1
Arriflex 765	52.5	23.0	57			2.28:1
Phantom 65	51.2	23.3	56	4096	2440	1.68:1
Hasselblad H5D	43.8	32.9	55	8272	6200	1.33:1
Leica S	45	30	54	7500	5000	1.50:1
VistaVision	37.7	25.0	45			1.50:1
Full Frame Stills	36	24	43.27			1.50:1
RED Dragon	30.7	15.8	35	6144	3160	1.94:1
RED W8K	40.96	21.60	46.31	8,192	4,320	1.89:1
Panavision Primo 70	48	20.25	52.1			
ALEXA XT	28.17	18.13	33	3414	2198	1.54:1
Sony F65	24.7	13.1	28	8192	2160	1.89:1

New ALEXA 65 Lenses

The initial rental package will include a set of 8 primes and 1 zoom. The lenses began life as Hasselblad HC lenses made by Fujinon for the Hasselblad H5D. ARRI and IB/E Optics re-designed, re-mounted and re-housed the lenses in the new ALEXA 65 XPL mount (72mm diameter, 60 mm flange focal depth). The original lenses were completely stripped and basically only the optical elements were used inside the housings. Focus uses a smooth cam mechanism. As Manfred Jahn, ARRI's project leader on the lenses said, "They have to feel as smooth as Master Primes."

Lens	Aperture	Close Focus	Length	Front diameter	Image Circle	Weight
24	T4.8-32	.38 m / 15"	101 mm / 4"	114 mm / 4.5"	62 mm	1.5 kg / 3.8 lb
28	T4-32	0.35 / 14"	101 mm / 4"	114 mm / 4.5"	62 mm	1.5 kg / 3.8 lb
35	T3.5-32	0.5 / 20"	120 mm / 4.7"	114 mm / 4.5"	62 mm	1.8 kg / 4 lb
50	T3.5-32	0.6 / 24"	120 mm / 4.7"	114 mm / 4.5"	62 mm	1.8 kg / 4 lb
80	T2.8-32	0.7 / 28"	120 mm / 4.7"	114 mm / 4.5"	62 mm	1.8 kg / 4 lb
100	T2.2-32	0.3 / 12"	120 mm / 4.7"	114 mm / 4.5"	62 mm	1.8 kg / 4 lb
150	T3.2-45	1.3 / 4'3"	120 mm / 4.7"	114 mm / 4.5"	62 mm	2.2 kg / 4.9 lb
300	T4.5-45	2.45 / 8'	200 mm / 7.9"	114 mm / 4.5"	62 mm	2.6 kg / 5.7 lb
50-110 Zoom	T3.5/4.5-32	0.7 / 28"			62 mm	4 kg / 8.8 lb

- IB/E and ARRI series: totally re-housed Hasselblad/Fujinon HC lenses
- New XPL mount, 72 mm diameter
- Flange focal depth is 60 mm
- Image circle is 62 mm
- Additional primes and zooms are expected



Arriflex 765 Lenses

11 updated, vintage Hasselblad/ZEISS/ARRI lenses are available for the ALEXA 65. They were originally re-housed with a Maxi PL mount for the Arriflex 765. These lenses are familiar to Hasselblad users as V-series (or 500 series) lenses and they cover the analog medium format size of 56 x 56 mm (aka 6 x 6 cm or 2 ¼ x 2 ¼"). The image circle is a whopping 79 mm.

Flange focal depth of the original Arriflex 765 camera was 73.5 mm. These lenses can be used on the ALEXA 65 with a Maxi PL to XPL adapter, which mechanically extends the Alexa 65 XPL mount's 60 mm flange depth to the Arriflex 765 flange depth of 73.5 mm.

65mm format lens	comparable 35mm cine format equivalent
30mm T3.6	
40mm T4.2	18
50mm T3.0	24
60mm T3.6	28
80mm T2.8	35
100mm T3.6	46
110mm T2.1	50
120mm T4.2 Macro (1:4.5)	55
150mm T3.0	70
250mm T4.2	115
350mm T4.2	150
Mutar Doubler (2x)	
Cooke Varotal 38-210mm T6.2 Zoom Lens (close-focus 2 ft)	



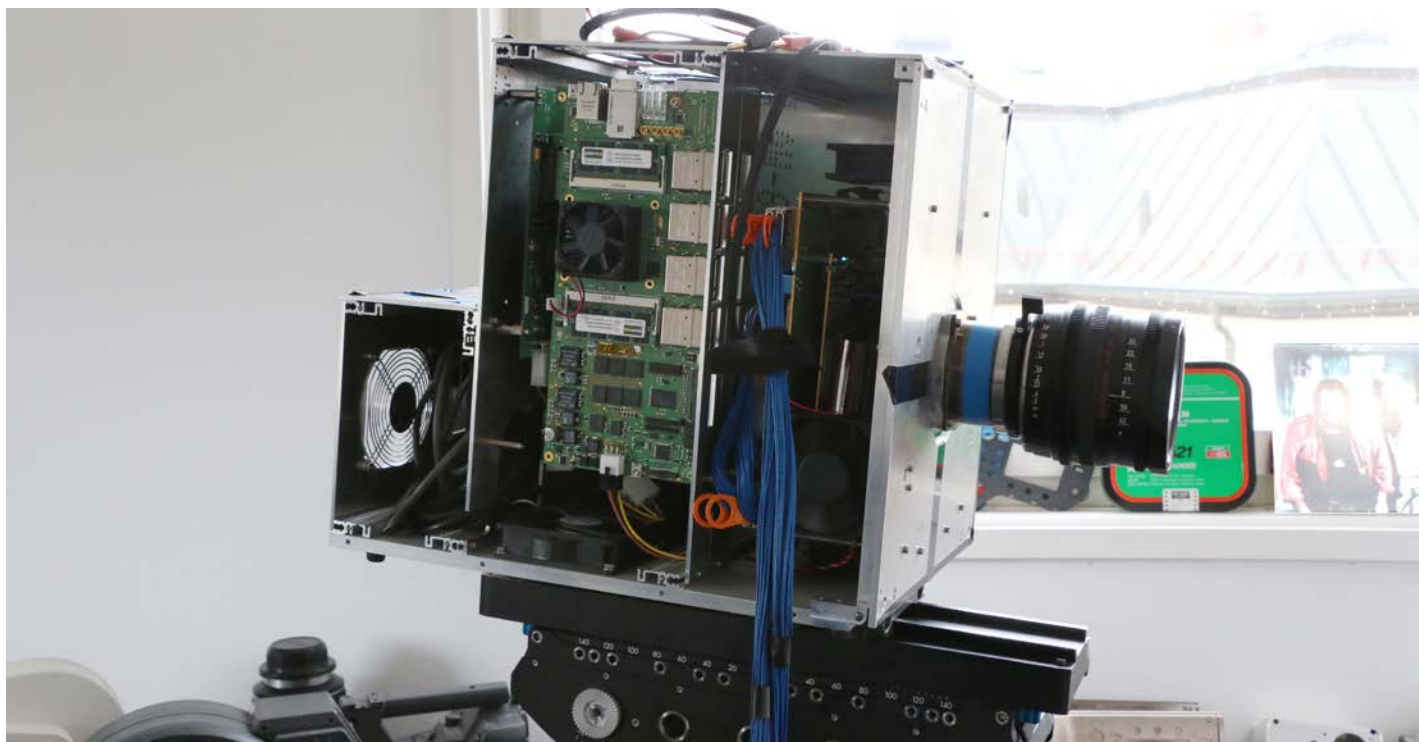
- Maxi-PL mount: 64 mm diameter
- Flange focal depth: 73.5 mm



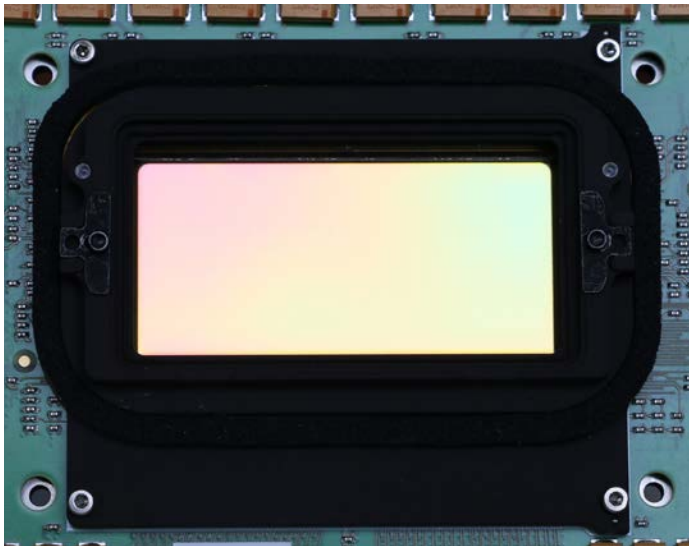
ALEXA 65 Development



Above: Neil Fanthom, Michael Cieslinski, Martin Cayzer. Below: Pre-prototype camera and lens: proof of concept.



ALEXA 65 Construction



ALEXA 65 sensor—actual size: 54.12 x 25.59 mm (6560 x 3100)



Collector's items: ARRI D-20 T-shirt and Arriflex 535



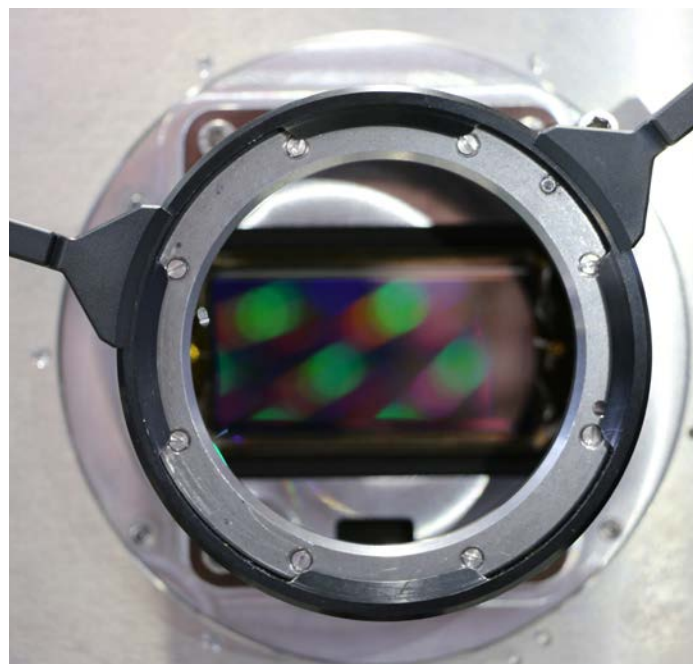
Testing sensor — breadboard phase



XPL mount and gate of ALEXA 65



Sensor optimization



XPL mount and sensor

Klaus Eckerl, IB/E Optics



Klaus Eckerl, Managing Director of IB/E Optics

During that fateful meeting at NAB last April, I asked who was doing the lenses. Neil and Martin wouldn't say, other than to hint that the lenses were based on Hasselblad optics and the modifications were being done in Southern Germany.

"Aha," I said. "Then there's only company I know of who could be doing that: Klaus Eckerl's IB/E Optics."

The Pinteresque pause was enough in the NDA world to suggest I may have been on the right track.

The FDTimes ALEXA 65 scavenger hunt adventure continued in July—to visit the place where the ALEXA 65 lenses are developed. With Neil Fanthom at the wheel of a fast Mercedes, we drove 212 km West from Munich to the Bavarian town of Freyung, about 5 miles from the Czech border.

And there it was: IB/E Optics.

IB/E is an acronym for Ingenieur Büro Eckerl (Eckerl's Office for Engineering), and Klaus Eckerl is the Managing Director. The company occupies a modern 4-story building with the latest CNC and optical machinery, offices, and a James Bond-like screening room in the penthouse. On the day we visited, Klaus was calibrating the ALEXA 65 lenses' focus scales with Manfred Jahn from ARRI Rentals and gentlemen from ARRI Austria.

JON FAUER: Klaus, your company, IB/E Optics, is doing the lenses for the ALEXA 65?

KLAUS ECKERL: The ARRI guys came to us with a very special, very exciting idea: create a set of lenses for the big camera sensor of the new ALEXA 65. It started with a call from Manfred Jahn of

ARRI Rentals. They had a choice of several candidates who had lenses for this big format. The well-known contenders in medium format lenses included Leica S, Schneider, Mamiya, Hasselblad, and others. Together, we tested lenses, did MTF tests and comparisons. We liked the Hasselblad lenses. When we looked at the MTF values; they were really great lenses.

It sounds quite simple to just rehouse some existing lenses, but the Hasselblad lenses, of course, are fully auto-focus. If I sound a little bit negative, that's because I hate automatic controls on lenses. I'm a manual guy and autofocus lenses used to be full of plastic materials, have a completely different mechanical setup because motors inside drive the shutter, iris and the focus movement parts. The new Hasselblad lenses are designed as still lenses, but optically they are very good lenses. We dropped all the mechanical parts of the original lenses. Only the optical elements and some of lens barrels were used.

The challenge was to combine the opto-mechanical needs of the cine world with the good optical elements of the Hasselblad optics. We did a feasibility study with Manfred Jahn. We disassembled the lenses and did a CAD redesign of the lens. We also designed and manufactured new linear irises. We developed a focus mechanism with full 300 degree rotation that camera assistants are familiar with. We needed all the focus and iris barrels to be in the same relative position. This turned out to be more for the zooms: with the focus ring in front, then the zoom ring, and then the iris ring. The original iris was driven electronically. One of the biggest challenges was to get our new iris and its mechanical carrier between the complex zoom mechanism.

These all are commonplace things in the cine world, but not in stills. We were fortunate to have already designed special software to calculate and create CAD models on linear irises. We had invested a lot of resources on this years ago, because we understood the complexity of working on new irises: different diameters, different angles, number of blades, and so on.

Another difficult job was to get good ergonomics for the feel of the focus. The main thing Manfred simply told us was that the focus barrel should feel like a Master Prime to a camera assistant. That may seem to be a quite short specification for mechanical issues, but it was quite a challenging one.

You used cams, then?

Yes, and it's very critical. We do it in-house, along with all the other key parts. We have very special software and hardware tools that to do it, because we are milling in a special way. You can't do it without this unique tooling and we actually created two hardware systems in case one machine breaks down. On this job we had the good cops and the bad cops. Neil and Martin are the tough cops who need it ready right away and to be perfect! Manfred was the good cop who constantly pushed us to do even better. Seriously, they were all a very good influence on this project.

The point is that it's especially critical to pay attention to the small details, choosing the components, assembling hundreds of parts, checking and doing quality control.

Do these lenses have LDS metadata?

Yes. When we were asked to introduce the LDS electronics, we worked with the ARRI Austria guys in Vienna. We wanted to keep

Klaus Eckerl, IB/E Optics (cont'd)

the standard components of existing ARRI/ZEISS LDS lenses so as not to develop new or different components. This also makes sense for serviceability if you have to replace components. These additional electronics had to fit inside the lens housing.

I'm really convinced the lens is very good, especially when you look at the MTF data. We are really proud of having been a part on the project.

You can't just buy the optical elements?

No. We tried. But we have to buy the entire Hasselblad/Fujinon still lenses and then completely take them apart.

What's the image circle of these lenses?

The image circle of these ALEXA 65/HC lenses is 62 mm.

What is the image diagonal of the sensor in the camera?

60 mm. (Maximum sensor size diagonal is 59.87 mm.) So this fits rather well. Remember, these are not the classic Hasselblad V-series lenses with an image circle of 79 mm, which are much larger.

Hasselblad reduced the format when they went digital?

Yes, and it's a pity, because I also have a collection of the old Hasselblad cameras. Also the flange focal depth was reduced to 61.63 millimeters on the new HD5. It was around 74 with the older format, because they needed to have a bigger mirror. So at least it's shrunk down a bit in this area. But for the new ARRI format, it's perfect. I think it was a good choice to take the new Hasselblad lenses. They offer the most complete line of focal lengths and they go as wide as 24 mm, which is really wide lens for medium format.

Manfred and I spent a lot of time doing very critical optical testing of all the possible lenses that were out there. These are very good, they cover the image circle, they have the right range in terms of focal lengths, they're the right size, and they are available.



Manfred Jahn, Head of ARRI Camera Rental and Project Leader of the ALEXA 65 lenses at IB/E Optics.



IB/E Optics in Freyung



Rooftop deck and screening room



IB/E Optics clean room



Barrels for the ALEXA 65 lenses

Lenses for ALEXA 65 (cont'd)



Klaus and Little Buddha. This is appropriate, since the first major feature shot with the Arriflex 765 was "Little Buddha." Bernardo Bertolucci was the director; Vittorio Storaro, ASC, AIC was the cinematographer.

Klaus is almost as passionate about travel to new places as he is about optics, and his office is filled with items from his journeys.



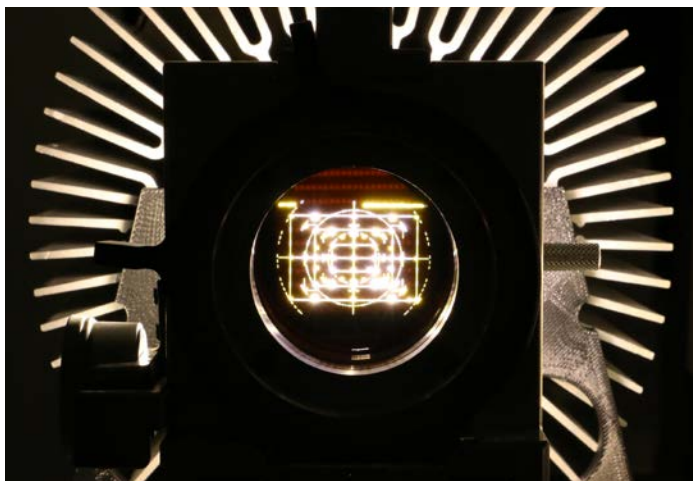
Calibrating focus scale



ALEXA 65 XPL
lens mount



Internal mechanical assemblies



Lens projector at IB/E Optics



CNC machining of mechanical assemblies



Aperture scale

ALEXA 65 Lenses (cont'd)



Klaus, Martin, Neil in IB/E Optics rooftop screening room



Assembling optical elements in the clean room



Mechanical assembly—cleaning



Mechanical assembly



Adjusting the focus cams



Adjusting the focus cams



ALEXA 65 Lens design meeting



Manfred Jahn and Klaus Eckerl

Handling ALEXA 65 Data



Codex Vault S
with 8 TB
Removable
Transfer Storage



Codex Capture
Drive 2TB



Vault S
On-Set Cart

ALEXA 65 In-Camera, On-Set and Near-Set Data management is a collaboration of the usual suspects: ARRI and Codex. Marc Dando, Managing Director of Codex, said, “DPs wanted something different. They wanted to raise the bar for theatrical release and expand the options they have for the look of their project. 65mm is a wonderful format and with the ALEXA 65 system for the first time it becomes affordable.” The ALEXA 65 uses a Codex recording engine similar to the ARRI ALEXA XT.

Existing ALEXA 512 GB XR Capture Drives will support recording up to 24 fps for about 10 minutes in full open gate (full aperture) mode. Next-generation 2TB Capture Drives capable of 20Gb/s data rates will be available in the future. These will also allow for recording times of over 40 minutes.

A typical production scenario would be to have a Vault S for the On-Set cart with 8TB solid state transfer drives supporting about 3 hours of footage. This would be used to create safety copies and allow for playback. The Vault XL would be used Near-Set for dailies, editorial deliverables, camera original archive to LTO, look creation, syncing sound, and other post production work. It also supports high-speed networking and file-transfer to allow for integration with other production workflows. “Anyone familiar with ARRI ALEXA and Codex Vault will be comfortable with the ALEXA 65 workflow,” was Marc Dando’s summary.

We are looking forward to updates to the DCI (Digital Cinema Initiative) specifications that will encompass these now high-end capabilities.



Vault XL

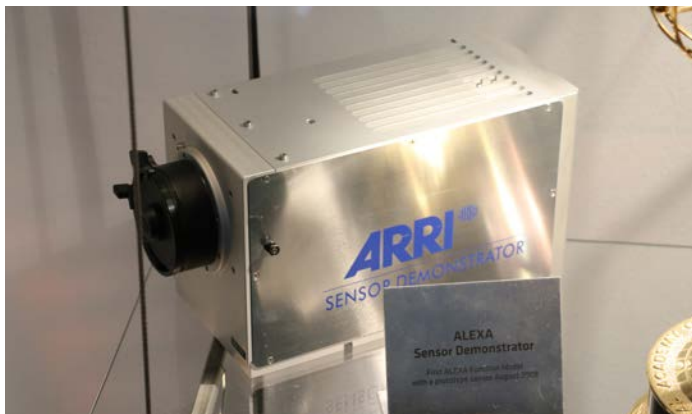


Exploded view of
Codex Vault S
showing modular
and scalable design

ALEXA 65 Prototype Camera and Lens Views



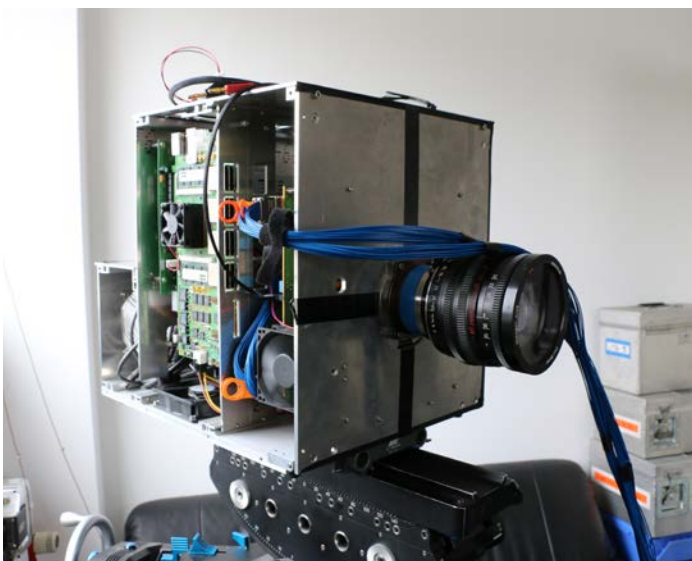
ALEXA, ALEXA 65 and an Early 65mm Project



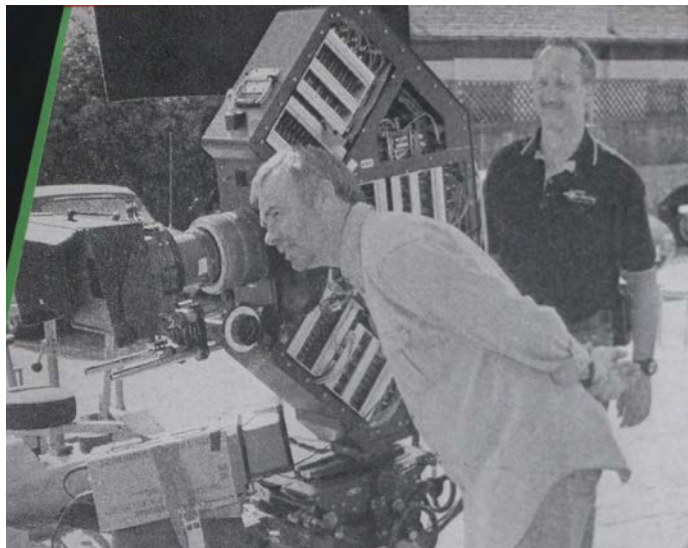
This was the ALEXA prototype, above, used for sensor demonstrations in August 2009. ARRI stopped the FDTimes presses just before IBC with a torrent of announcements. At that time, we wrote, “Stop the presses! Blazing Headlines: Not One but Three New Digital Motion Picture Cameras from ARRI, the company with the Blue Logo. Just when we thought it was safe to consecrate these pages to press, the phone rang amid a torrent, no...a cascade, of pictures, text, and information that not only changes this entire edition but also has the potential for changing the nature of digital production. We had heard cries and whispers about a new camera for a long time. But—bango!—just so!—faster than you can say “Tom Wolfe,” three new cameras, code named ALEXA, make their stunning debut at IBC.

The screenplay of the story would imagine down-to-the-wire meetings in which the corporate tradition of unveiling no camera before its time, or it's time, weighs mightily against the ticking timeline of an arena in which life cycles (not these) may be more like butterflies, and camera specifications, prices, and delivery dates are more enigmatic. I doubt whether ARRI will conduct a competition for cinematographers to name the three new cameras. So, until they get a real name or number (D-31?), perhaps we can call them ALEXA. ALEXA is a good name. It reminds me of Billy Joel's song The Downeaster ALEXA, from his Storm Front album.” The rest is history. The camera was named ALEXA.

Now there's a new, bigger ALEXA. The prototype proof of concept ALEXA 65 looked like this in January 2014, below.



The ALEXA 65 prototype camera, above, in ARRI's Skunkworks lab on Türkenstrasse has a photo of the 1990s ARRI-Lockheed Martin Blue Herring 65mm digital camera taped to the side. The real Skunk Works, of course, was Lockheed Martin's Advanced Development Projects facility, responsible for famous aircraft designs that included the U-2, SR-71 Blackbird, F-117 Nighthawk, and F-22 Raptor. The name “Skunk Works” was taken from the moonshine factory in the comic strip “Li'l Abner.”



Here's a blow-up of the photo. That's Stargate's Sam Nicholson in front of the Fiat 500-size 3-chip ARRI-Lockheed Martin Blue Herring digital test camera in the 1990s. The prototype camera was a 36 megapixels (12 million per chip). Blue Herring was a Lockheed Martin/ARRI project and ARRI brought in Stargate to produce and shoot the proof of concept film.

Sam said, “The Blue Herring camera only had enough RAM to shoot for 8 seconds, followed by a 14 minute download for each take. That, plus no eyepiece, a very shallow depth of field and its 200 lb+ weight made for a challenging shoot.

“We shot a short film, *As Time Goes By*, with the camera. It was shot with both 35mm film on an ARRI 435 and the 4K Blue Herring camera, and then intercut back and forth in editorial. The digital material was a very difficult 4K finish with lots of post production fixes to get an exact match. But, I think it worked. Franz Kraus, Volker Bahnemann, Bill Russell and Steve Stough were very involved with the production. We definitely proved that 4K RGB digital could match the quality of 35mm film. ARRI decided that some basic modifications (like a manageable size and an eyepiece) would be needed for a practical digital motion picture camera. They came out with the D-20 a few years later.”

The Blue Herring 65mm Project

by Steve Stough, SMPTE Board of Editors

The BLUE HERRING project was born when Lockheed and Loral Aerospace (formerly, Ford Aerospace) merged in 1996, which brought the nation of signal processing engineers into close proximity to the nation of image processing engineers. And, every one of them on both sides of the technology canyon came from the intelligence community, building spy gear for the US and other governments.

But what drove them together was the excitement of doing something with commercial, real-world value. Here were all these engineers in Silicon Valley, surrounded by all the glitz and hype that only fevered venture capitalists can conjure up.

I had both venture-capital envy and film school envy. My father was an amateur film-maker, and one who could afford lots of gear and tens of thousands of feet of film. We had a Moviola and a black-and-white 16 mm film processor at home. An Arriflex camera cost half as much as a Rolls Royce at the time. My dad had to have it. When I was 16 he went into the cinema business, among other things, in Sunnyvale and Santa Clara, California. I came from a solid family of film-wannabe-insiders. I ran a lot of 16mm film through the gate in my youth, as well as spent some time working as a photographer for a local newspaper. I loved the smell of the emulsion.

When Elbert Turner, a Lockheed engineer who worked on the earliest days of CCD research in Palo Alto, California, proposed some sort of investment in commercial imaging technology, he found eager ears in the corner office. Surely, this was a way to satiate our film school envy, and on other peoples' money, at that.

Since we were about to spend corporate money, we needed a name. Someone suggested "Red Herring." I didn't like it. It was a bit obvious and it connoted criminality. I blurted out, "Blue Herring" and that project name became immutable.

Volker Bahnemann impressed on us the need to create a show reel for our future camera. An easy sell there. If you cannot make films, after all, why fiddle around with the technology? They introduced us to Sam Nicholson. The company was Stargate Films.

We also had a meeting or two with Denny Clairmont. A camera owner, who had brought in his Angenieux zoom to put it up for rent, was sitting in an overstuffed faux-leather seat in Denny's outer office, asked me how long I expected the market for real film cameras would survive. With no thought, I said "ten years." That was 1998. Those two words resonated with the Clairmont brothers and with many others as well. We soon had everyone from members of the DGA, ASC, Technicolor, to executives from the major studios wanting to look over our shoulders as we developed the camera technology.

On the technology side, the fundamental problem was that none of the electronics needed to support a 36 megapixel, 24p imager existed. We created our storage system from a jumble of commercial, off-the-shelf disk drives.

When combined with a state-of-the-art 4 Gigabyte random access memory, this gave us a whopping eight seconds of image capture time per shot, requiring a room full of disk drives and over a minute to download each take from memory to the disk drives.

But, why 36 Mpix? It was really just 12 Mpix times three color

bands (R-G-B). But, why 12 MPix? It was a number calculated from the resolution of 35 mm black and white film through a near-perfect 50 mm lens operating well above the diffraction limit. That is, a circle of confusion of 6 microns. Nothing more sophisticated than that.

And the sensor itself was the size of a 65 mm frame for another very simple reason: fat pixels were required in order to provide a 12-stop dynamic range with CCD technology.

This work occurred in the technical dark ages before wide availability of gigabit Ethernet and high speed disk drives. The storage and data processing infrastructure simply didn't support a 4K camera system. There was no way to color time a 4K image without making a film print – which is exactly what Stargate Films had to do. And, of course, no 4K digital projectors existed, so the test footage was finished to film.

The camera itself included a few "firsts;" not in a particularly good way. The color-splitting prism system required the construction of the world's-largest (at the time) ophthalmic-quality prism. The glass was formulated and poured in Italy then ground and polished optically flat in Germany. The brass sensor backing plate needed to be ground optically-flat – something apparently never before tried. Our wafer fabrication runs were designed for use with astronomical telescope applications, which required extraordinary contamination controls.

Sam Nicholson and team developed a short film project that could be shot with our 300 pound, 6 kilowatt camera, and do it side-by-side with an ARRI 435, in a practical set no less. And, his poignant story set in World War II was genuinely entertaining while still serving as a rather severe camera test.

Formidable cable wrangling was required. And that was the least of our troubles, which ranged from temperatures approaching 100 degrees while shooting a scene with a live fire in a fireplace, to the prop manager getting in a fight with the smoke machine operator. The shoot consumed four days, but resulted in only about one minute per day of product out of the far end of the post-production pipeline. Down-time between takes accounted for the low efficiency.

Just think about trying to shoot a picture in close-quarters with the equivalent of an 80 mm lens (referenced to a standard 35 mm frame) and no viewfinder. None. Thanks to Denny Clairmont, a digital lipstick camera was gaffer taped to the camera body to provide some means of framing for the camera operator.

But the results were stunning and certainly attracted a lot of attention from the industry. Over time, all that survived of the original engineering were a few design techniques, but nothing of the core technology itself. Ultimately, it was proven that end-to-end image quality and system utility were just as important as the need for high resolution and dynamic range; and all of that technology had to be supported by companies with absolute dedication to the success of the production company's mission, or the economics of digital image capture would never succeed in the market place.

It took another nine years after this test shoot before the ARRI ALEXA was released, and it was not until the ALEXA and similar imaging systems came on the market that a reasonable claim could be made that film had been replaced with digital imaging.

Arriflex 765: 65mm Film



One word may explain why epic 65/70mm films came and went, and why I think the new ALEXA 65 digital format is here to stay. Economics. It's expensive to shoot 65mm film—1000 feet of 65mm negative costs about \$1372 today. Only 45 American features were shot in 65mm between 1955 and 2014. That's not a great business model—fewer than 1 per year. (15 in Europe during that time.) Nevertheless, 65/70mm production was always a desire in the dream factory. The digital ALEXA 65 could expedite those dreams in viable and affordable ways previously unimaginable.

The first 70mm film was probably Birt Acres' 1896 short *The Henley Regatta*, and over the next century, there were many attempts to impress large audiences in big theaters. Todd-AO was introduced in 1955 with *Oklahoma*. Mike Todd's memorable definition was "Cinerama out of one hole." MGM Camera 65, designed by Panavision, arrived in 1956 and in 1959 Panavision released Super Panavision 70.

In 1985, ARRI began work on the Arriflex 765 motion picture camera. They completed 10 cameras by 1988. Otto Blaschek was head of the design team. In an interview with Alexander Felsenberg (in70mm.com), Blaschek said, "Our market research and discussions started in 1983, and it was our US subsidiary, Arriflex Corporation who contributed to this to a great extent."

Volker Bahnemann, former President of the US subsidiary, and current board member of ARRI AG, said, "The 765 camera came out of the ongoing desire in the industry to revive the big-screen blockbuster and David Lean type of large format, epic picture.

"Panavision and ARRI were both interested in doing something. Because there was not sufficient capacity in Munich, the Arriflex 765 camera project got off the ground when I assured funding through an outside group of investors to set up a new R&D facility. Otto Blaschek, ARRI's chief engineer, was charged with the project and set up the new facility in Vienna. That is how ARRI Austria was started. The Arriflex 765 was their first project.

"ARRI realized that a new 65mm camera also required a secure

post chain in place. They supported a group led by Richard Edlund of Boss Film and others, including MGM, the last operating 65mm lab. They financed the building of the COSHARP (Continuous Optical, Slit, High-Speed, Anamorphic Reduction Printer), which was a high speed, high resolution optical film printer. Proposed by Richard, it promised to assure a cost effective dailies process."

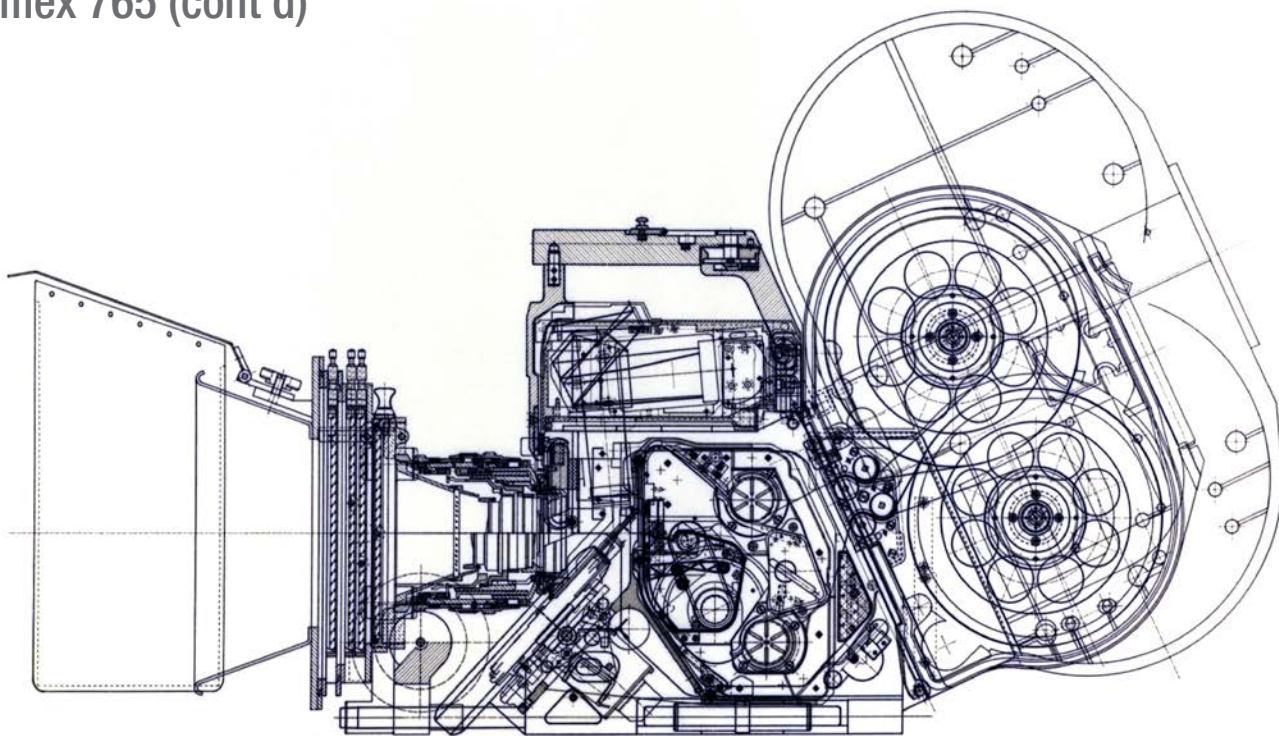
Richard Edlund said, "At the heart of the 765 was a revolutionary new movement design which ran with sealed bearings, didn't require lubrication, and could safely run at high speeds in reverse. The COSHARP produced 35mm anamorphic prints with key numbers. It was tested against the Technicolor step printer and was shown to be far superior, and could run at well over 100 fpm. When Eastman Kodak came out with a new intermediate stock (5244) and Dolby invented a six-track sound system for 35mm prints—these improvements brought the death-knell to 65mm feature production."

The Arriflex 765 made future camera developments possible. It could go to 100 fps, forward and reverse. It had a huge spinning mirror shutter that couldn't be linked mechanically as had been done in the past. Because of the large mass of the mirror, movement and the 65mm film itself, they couldn't use traditional toothed belts. This was the first camera with electronic syncing of independent motors for each of the major functions and became the basis of the Arriflex 435 and other cameras to follow. The movement was a multi-link design, from which the 435 benefited as well. Construction of the Arriflex 765 began in 1985, and three years later, 1988, the cameras were ready.

Otto Blaschek said, "Before starting the new design, it was important to have a close look at [other] 65mm cameras already in existence and on the market. I was able to learn about the problems of (these) earlier models.

"In most cases, the earlier camera models were not completely suitable for sync sound recording. Sometimes, their noise-level was as high as approximately 50 dBA at a frame rate of 25 fps. It

Arriflex 765 (cont'd)



goes without saying that this eliminated simultaneous sync sound shooting. In many cases, these cameras were also extremely heavy and bulky, so filming was not so simple and involved great efforts.

“Another problem [with these other pre-765 cameras] was winding-up of the wider and thus heavier film stock. There were frequent break-downs. Generally speaking, operational dependability was not guaranteed to such an extent as we are used to with today’s professional 35 mm cine cameras. These were some of the reasons why there were no more ‘big films’ shot in the 65 mm format during the past years. Technology was simply not perfected enough. This is where we saw our prospects.”

The Arriflex 765 was designed with what was described as “the user ergonomics of 35mm motion picture cameras” of the time. Never mind that a contemporary Arriflex 35BL-4s was 32 lb without lens or film. The Arriflex 765 had a standard 5-perf 65mm gate, with dual 3-claw pulldown (on each side of the film), and dual single-pin registration. This stabilized the film to less than .1% of picture height at reasonable sound levels.

The projected image had an aspect ratio of 2.2:1, with a film negative area about 3 times larger than a 35mm anamorphic frame and 2.5 times larger than a Super35 frame.

Arriflex 765 Specs

- Format: 65mm - 5 perf Frame: 1:2.2
- Mirror Shutter: 180° - 5° in 15° increments; 172.8°, 144°
- Lens Mount: Maxi PL — 64 mm diameter
- Flange focal depth: 73.5 mm
- Aperture: 52.50 x 23.00 mm (1.91" x 0.87")
- Groundglass /Projection Area: 48.40 x 22.00 mm (1.91" x 0.87")
- Viewfinder: 4x / 8x Noise level: < 25 dbA
- Video assist: 80/20, 50/59, 100% video on request
- Frame rates: 2 - 100 fps forward and reverse
- Run-up time: 0-24 fps in 1 second
- Magazines: 500' (150 m) and 1000' (300 m) displacement
- Movement: dual 3-tooth pull down claw, dual single pin registration
- Motors: 2 crystal controlled DC motors (movement and shutter, electronically synchronized), 2 DC-motors in the magazine)
- Power: 24 V DC
- Dimensions (L-W-H) with 500' (150 m) magazine, without lens: 22.4" x 14.6" x 15.7" (570 x 370 x 400 mm)
- Dimensions (L-W-H) with 1000' (300 m) magazine, without lens: 24.8" x 14.6" x 20.9" (630 x 370 x 530 mm)
- Weight of camera with loaded 500' (150 m) magazine, without lens: about 70 lb (32 kg)



At left: two 765 cameras on location in Bhaktapur, Nepal for *Little Buddha*

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