

Jon Fauer ASC

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Feb 2018 Special Report

# FILM AND DIGITAL TIMES

## ARRI Large Format Camera System





- ALEXA LF Camera
- ARRI Signature Primes
- Large Format 36.70 x 25.54 mm Sensor
- 4448 x 3096 Maximum Resolution
- Up to 150 fps

- New LPL Lens Mount
- Also works with all PL Mount Lenses
- ARRIRAW and ProRes, Same ARRI Workflow
- Capture Drives and SxS PRO+ cards
- Integrated wireless



Top



Bottom



Camera Left (Operator Side)



Left Front



Camera Right



Right Rear

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Front



Right Front



Left Rear



Media Bay

# ARRI ALEXA LF



Thousands attended ARRI 100th anniversary parties in Munich, Amsterdam, LA, and Asia this past September. But there was one guest who skipped the festivities. ARRI's rumored next big camera stayed home in Munich.

To paraphrase Orson Welles, "We will show no camera before its time." Maybe "it's" has an apostrophe, as in "...it is time." ARRI was adamant about introduction only if delivery was imminent. Now it is.

A new round of events ripple around the world as ARRI rolls out their new, Large Format system: ALEXA LF camera accompanied by astonishingly alluring Large Format ARRI Signature Primes. The premiere is at BSC Expo in London on Feb 2, followed by events in Paris, Beijing and Los Angeles.

ALEXA LF was a closely guarded secret. It didn't even have a name until a few weeks ago. A couple of demo units were on location in November, carefully camouflaged as ALEXA SXT W cameras.

A choice of new lens mounts made the NDA rounds in Hollywood and New York this summer. Surely you don't make a new mount as an exercise for your metal shop apprentices, I thought.

It was not until a visit to ARRI Austria that the whispers became louder at the end of September. There were new lenses on the workbenches with a new LDS-2 system inside. Surely you don't make new lenses with a new mount and data system without a new camera in the works.

Readers of the November FDTimes may have wondered why it arrived in January—hopelessly. Hopefully you enjoyed the factory tours in Vienna and Italy. But weren't the stories of Schnitzel and Sacher Tortes sounding suspicious and the fantasies of a Fiat 500 navigating mountain passes seem diversionary? Yes they were.

In the beginning of December, I was summoned to Munich under stricter vows of silence than a Cistercian to see the secret new

ALEXA LF and its system of Large Format lenses. What followed were two weeks of total immersion in Large Format technique and technology, factory tours, meetings with engineers, executives, designers and fabricators of a big new system.

What follows in this Special Report is an overview of the ALEXA LF Large Format System, with an inside view of how it's made, who makes it, what's inside and behind it, and how to use it.

As we'll hear from the engineers, this was probably the fastest design-to-delivery of any camera ever made by the company on Tuerkenstrasse in Munich. This has also been the fastest turnaround from non disclosure agreement to full disclosure article for a writer on York Avenue in New York.

My thanks to Joerg Pohlman, Franz Kraus, Stephan Schenk, Walter Trauninger, Marc Shipman-Mueller, Thorsten Meywald, Susanne Mayer, Frederic Merten, Thomas Feuchtmann, Henning Rädlein, Achim Oehler, Harald Brendel, Tamara Seybold, Matthias Pesch, Klemens Kehrer, Christoph Beckmerhagen, Andreas Moeller and at least 30 more people who patiently spent hours and days unveiling the mysteries of concept, design, manufacturing and testing.



16 Large Format ARRI Signature Prime Lenses



## ALEXA LF 2-Minute Pitch

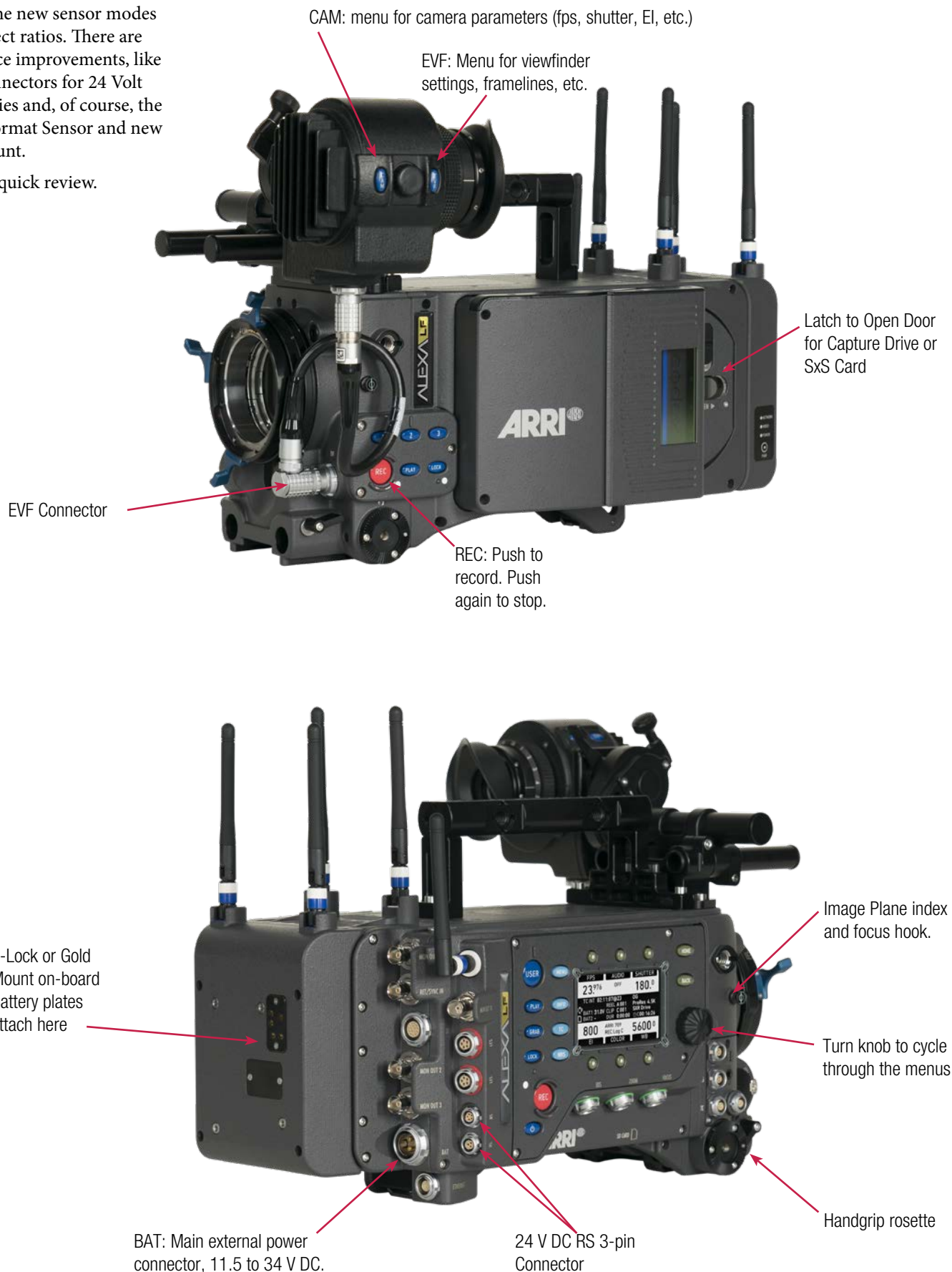
- “LF” in the ALEXA LF name was derived from “Large Format” because it’s bigger than 36 x 24 mm Full Frame.
- The Large Format sensor is 36.70 x 25.54 mm, 44.71 Ø
- You can switch sensor modes quickly — no reboot needed.
- 3 Sensor Modes:
  - LF Open Gate full aperture 4448 x 3096, 36.70 x 25.54 mm, up to 90 fps.
  - LF 2.39:1 Full width spherical widescreen 4448 x 1856, 36.70 x 15.31 mm, up to 150 fps.
  - LF 16:9 4K UHD 3840 x 2160, 31.68 x 17.82 mm, up to 90 fps.
- Anamorphic desqueezing : 1.25x, 1.3x, 1.5x, 2x.
- Latest A2X revision of ALEXA ALEV 3 sensor has same 8.25 micron photosite size and familiar look.
- Same user interface as previous ALEXA cameras.
- New LPL (Large Positive Locking) lens mount. The flange focal depth is 44 mm. Inside Diameter is 62 mm.
- There was a mechanical reason for 44 mm FFD. That was the minimum distance to retrofit the new LPL mount onto Super35 ALEXA (except ALEXA Studio because of its spinning mirror), ALEXA Mini and AMIRA cameras.
- The LPL mount is available for ALEXA Classic, XT, SXT, SXT-W.
- LPL Mount for ALEXA Mini also fits AMIRA.
- I expect most rental houses will retrofit their mounts with LPL.
- All PL mount lenses will fit with ARRI’s PL-to-LPL adapter. You can continue to shoot S35 as if you were working with an ALEXA SXT—just crop the S35 image in post.
- Record ARRIRAW and ProRes internally. No external processing required.
- View the playback of ARRIRAW or ProRes on the EVF-1 viewfinder and via 3 independent Monitor OUTs.
- Record uncompressed ARRIRAW Large Format Open Gate 0.75 - 90 fps internally.
- Record uncompressed ARRIRAW Large Format spherical widescreen 2.39:1 0.75 - 150 fps internally.
- Record ProRes LF Open Gate 0.75 - 60 fps internally.
- Exposure Index : 800 EI.
- Exposure Latitude is greater than 14 stops from EI 160 to 3200. Lower noise at higher EI than previous cameras.
- Rule of 1.5x: ALEXA LF sensor is 1.5 times larger than ALEXA SXT. ALEXA 65 sensor is 1.5 times larger than ALEXA LF.
- Resolution follows similar 1.5x math, approximately:
  - ALEXA SXT W maximum resolution: 3424 x 2202
  - ALEXA LF maximum resolution: 4448 x 3096
  - ALEXA 65 maximum resolution: 6560 x 3102
- The 1.5x rule does not apply to ARRI Signature Prime Large Format lenses, which are amazingly smaller than Master Primes and about 2/3rd the weight.
- Built-in wireless video transmitter, WiFi, Wireless lens control.
- 4x Fischer 3-pin RS 24V DC accessory power connectors.
- 1x Fischer 2-pin 12 V DC accessory power connector.
- 2x 6G SDI and 1x 1.5G HD-SDI Monitor Outputs.
- Familiar ALEXA workflow: 16-bit linear internal image processing in full ALEXA Wide Gamut / Log C color space. Target output color spaces: Log C, Rec 709 or Rec 2020.

*In this ALEXA LF Report, “Large Format” and “Full Frame” are used pretty much interchangeably.*

# ALEXA LF 2-Minute Guide

It works pretty much like an ALEXA SXT W camera, so there's not much to learn except the new sensor modes and aspect ratios. There are some nice improvements, like 4 RS connectors for 24 Volt accessories and, of course, the Large Format Sensor and new LPL mount.

Here's a quick review.



# ALEXA LF 2-Minute Guide

USER: Displays a screen to access and assign user buttons on camera left (operator's side)

GRAB: Framegrab (during standby, record or playback) and store onto SD card

LOCK controls

REC: Push to record. Push again to stop.

Main Power Switch for Camera

24 V DC RS 3-pin Connector

12 V DC 2-pin Connector

MENU

HOME: up to top menu page

BACK: previous menu page



Wireless Camera & Lens Control WCU-4

Handgrip rosette

# Comparing ALEXA LF to ALEXA 65

ALEXA LF



Top ALEXA LF



Bottom ALEXA LF

ALEXA 65



Top ALEXA 65

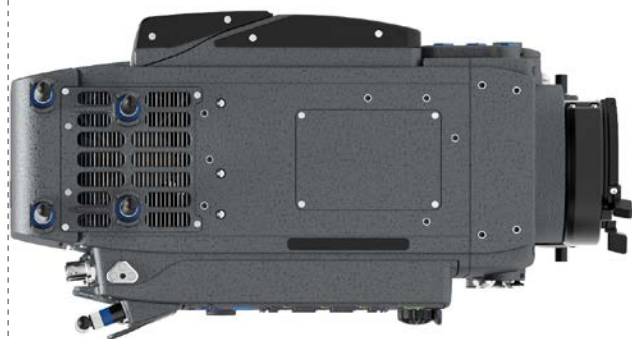


Bottom ALEXA 65



## Top Views

### ALEXA SXT W - Super35



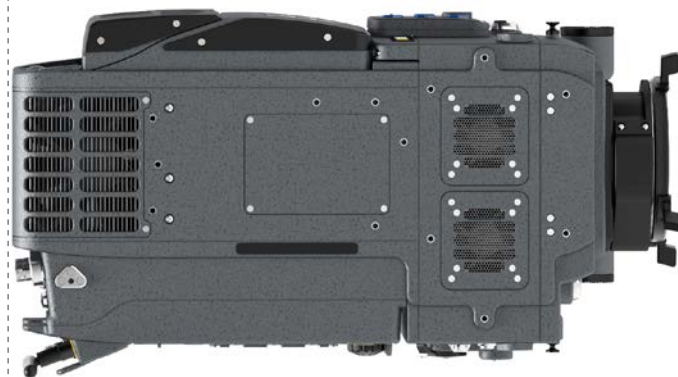
ALEXA SXT W body with PL mount  
length: 351 mm / 13.82"      width: 189 mm / 7.44"  
height: 158 mm / 6.22"      weight 7.4 kg / 16.3 lb

### ALEXA LF - Large Format



ALEXA LF body with LPL mount  
length: 364 mm / 14.33"      width: 201 mm / 7.91"  
height: 158 mm / 6.22"      weight: 7.8 kg / 17.2 lb

### ALEXA 65 - 65mm



ALEXA 65 body with XPL mount  
length: 388 mm / 15.28"      width: 208 mm / 8.20"  
height: 163 mm / 6.42"      weight: 9.3 kg / 20.5 lb

## Sensor Sizes and Mounts



ALEXA SXT sensor: 28.17 x 18.13 mm, Ø 33.50 mm  
3424 x 2202 photosites. PL Mount 52 mm FFD, Ø 54 mm



ALEXA LF sensor: 36.70 x 25.54 mm, Ø 44.71 mm  
4448 x 3096 photosites. LPL Mount 44 mm FFD, Ø 62 mm



ALEXA 65 sensor: 54.12 mm x 25.58 mm, Ø 59.86 mm  
6560 x 3100 photosites. XPL Mount 60 mm FFD, Ø 72 mm

# Why Large Format?



Why is the big picture of Large Format such a big deal?

As the poet Elizabeth Barrett Browning said, “Let me count the ways.” She also said, “How do I love thee?”

1. Speaking of counting, ALEXA LF Large Format is .7 mm wider and 1.54 mm taller than classic 36 x 24 mm Full Frame. The two formats are used pretty much interchangeably here.
2. Full Frame is a familiar format — a worldwide standard of still photography for more than 100 years.
3. Large Format images have a much more natural perspective and magnification than their Super 35mm counterparts.
4. Fewer distortions at wide angle.
5. More natural depth of field.
6. Large Format shares many characteristics of 65mm format, but the lenses are generally smaller and lighter and faster.
7. There’s an existing infrastructure for Large Format — probably more than 300 million Full Frame still photography lenses in the world.
8. Many new Large Format and Full Frame lenses were introduced recently—including: ZEISS CP.3, Leica Thalia, Cooke S7/i, Leica M0.8, Angénieux Type EZ and Ultra 12x zooms, Sigma Cine Lenses, IB/E Optics Raptors, and many more.
9. ALEXA LF is backwards compatible with all Super35 lenses and can record Super35 images with its LF sensor.
10. Large Format sensors offer more flexibility for the designer: sensitivity, dynamic range, resolution, etc.
11. Probably the only thing that kept Large Format format from universal acceptance in motion picture production has been the cost of the big negative. Until now.

*But don’t take my word for it. Here’s what many colleagues have been saying about Large Format.*

## Franz Kraus, ARRI Executive Board Member

“Before I talk about the ALEXA LF, I want to briefly mention the ALEXA 65. The ALEXA 65 was meant to give the creatives in our industry access to the beauty and aesthetics of the long established 65mm film format—but in a state-of-the-art compact digital camera with an efficient, far less cumbersome and less costly workflow. The immediate adoption of the camera in various high-end films proved the success of this undertaking.

“As there have been rather few 65mm film cameras in service, we intended the ALEXA 65 to be a niche product; the camera is rented, rather than sold. Knowing that a camera system is only as lucrative as the related lens offerings, we also knew about the given limitations in the start phase. Today we have 70 operating cameras worldwide with a constantly growing number of prime lenses and also specialty lenses. The ALEXA 65 has become the pinnacle of high-end shooting.

## All our digital cameras can be seamlessly integrated within one given project

“We learned on several occasions, due to lens choice, availability or aspect ratio, that only a center-part of the sensor was exposed, still delivering stunning images. That is when we started thinking about the ALEXA LF, aiming for a format long established in still photography, but serving the film industry as VistaVision only in niche applications in the past.

“The ALEXA LF brings most of the beauty of the ALEXA 65 to many more applications. The workflow is a pure ALEXA workflow and therefore less complicated and data-hungry than the one of the ALEXA 65. As the image sensors of the ALEXA, ALEXA LF and ALEXA 65 share the same high dynamic range and ARRI

# Why Large Format?



color science, all of our digital cameras can be seamlessly integrated within one given project.

“Now it is up to you to look into this new format and find its preferences for your projects. I am very curious to learn how LF will develop with respect to the established Cine 35 format.”

## Dr. Joerg Pohlman, ARRI Executive Board Member

“The Alexa 65 showed us that a large sensor can make quite a difference in image quality. We also saw that lenses play an integral role in creating an overall beautiful image. Our goal was to make this image quality and the resulting creative possibilities available to a much wider part of the profession.

## Stunningly beautiful images

“I believe the Alexa LF together with the Signature Primes is achieving that goal with stunningly beautiful images, and I must admit that the images I have seen so far went well beyond my very high expectations. I cannot wait to see the first movies made with this new system.”

## Dr. Winfried Scherle, Senior Consultant at ZEISS and former head of the Camera Lens Division

“The industry has evolved quickly from analog to digital. It was revolutionary. This is just the beginning of a long journey. Future trends will include more and more Large Format sensors, because innovation happens there and they will be more attractive. We have seen that for a long time, and invested in this format. I noticed the trend step by step. It was a gut feeling. Sometimes a gut feeling is the right approach for innovations and finding disruptive pathways that change the world.”

## Otto Nemenz, President of Otto Nemenz International

“Most cinematographers never saw a larger sensor or larger format that they did not want to fill up. I will probably not buy another lens that is not Large Format.”

## Martin Cayzer, CEO of ARRI Rental Group

“During the last 2 years we have received a lot of feedback from our clients regarding their 65mm format images, with the more common responses being that it is more immersive, perceived to be a more natural perspective to human vision and has 3D-like qualities. Of course, there are well-documented technical reasons for this—including the shallow depth of field, the additional resolution and the effect of longer focal length lenses to achieve a similar field of view as 35mm.

“But, in all the ALEXA 65 tests we have sat through with filmmakers there have been very few comments regarding the technical aspects of the image. The reactions are mostly powerful emotional ones about the beauty of the images and how they relate to story-telling. It's clearly a format that, as you would expect, can create a dramatic presence on a large screen of stunning vistas and landscapes. Surprisingly, and just as important, is the impressive and beautiful treatment of faces and interiors in Large Format. For many, those are compelling combinations for telling their stories on a large canvas.”

## Large Format lets us fill the frame creatively and play in different ways

## Gerhard Baier, Managing Director of C.W. Sonderoptic, sister company of Leica

“We are big supporters of Large Format because of its potential for immersive, cinematic storytelling. It is the way our eyes see the world. It provides a more natural point of view to tell our stories. The bigger picture of Large Format lets us fill the frame creatively and play with foreground and background perspective in different ways than we were doing in Super35. Magnification and perspective are different because we can use longer lenses to achieve the same field of view, which is especially evident at wider angles. That creates space for orientation and navigation within

# Why Large Format?

the scene for creative and emotional impact. What we are familiar with in still photography is now moving into the motion picture world. It was always there, but had the limitation of cost. This opens a new era of motion picture storytelling.

“Knowing ARRI cameras and the beautiful images they provide, I am very enthusiastic about the new ARRI Large Format camera. It is a visionary tool to capture cinematographers’ creative points of view. We’re excited by the new LPL mount with its shorter Flange Focal Depth and wider diameter. I like its ability to work with existing PL lenses, honoring what we have and ready for the future. That is very helpful for lens designs in the coming years. We look forward to equipping our Leica Thalia large format lenses with this new mount.

“We also look forward to ARRI’s new LDS-2 metadata system and are happy that the protocol will be shared. It’s good that LDS and /i talk to each other. I would like to equip our Thalia lenses, and whatever else we may have in the future, with LDS-2. We are delighted to be part of anything that helps DPs and DITs on set and that streamlines the post production world. Data is becoming ever more important for cinematographers as they work on shows with a lot of compositing and additional work in post.

“It is increasingly essential for the DP to become even more involved in post. The DP is responsible for light and shadow and image capture. After the image enters into the camera, goes to the DIT on set and on to dailies and the post house, the need for good metadata continues to increase. In this process, the responsibility remains in the hands of the DP. Metadata is a big part of this new world of bigger pictures and larger formats.”

## Dan Sasaki, Panavision VP of Optical Engineering

“Full Frame offers magnification benefits about 1.5 times greater than traditional 35mm capture. For example, if we use a 27 mm lens in Super 35, we would choose a 40 mm lens in Full Frame in order to get a similar field of view. As a result, the image produced by the Full Frame combination would provide a much more natural perspective and magnification than the Super 35mm counterpart. This is because the imaging characteristics produced by the greater magnification and perspective characteristics of the larger imager more closely relate to how we see naturally.

“The larger format gives us a more natural perspective, meaning fewer distortions and a more natural depth of field. Objects appear to look sharper even though we may not be using a sharper lens. As an example, we are not really worried about how many leaves are on a tree; we’re more interested in whether it’s an oak tree and that our actor is under it. The higher magnification associated with large format photography, be it 65mm or Full Frame, emphasizes the imaging cues that convey reality more accurately than with traditional Super 35mm cinematography.

“A convenient feature of Full Frame is that it shares many of the characteristics of the 65mm format yet the lenses don’t get really large and there’s an existing infrastructure for it. Because of this, Full Frame has a future that will serve both the television and feature segments. On the other hand, the formats offered by imagers greater than Full Frame create magnification and natural perspective cues that are unique in the art of cinematography.

“There are millions of Full Frame still photo lenses that people are

familiar with. You can get high speed lenses in a manageable size. We’re finding out the hard way with 65mm large format sensors that the lenses can get a bit cumbersome and costly, especially ones with large apertures. With the Full Frame format you can easily meet the 4K to 8K requirements without making the pixels insanely small. An added benefit to the Full Frame format can be revealed when we add all of the combinations possible with anamorphic compression. It gets really interesting.”

## Jeff Allen, Managing Director of Panavision Europe

“It’s generally our view at Panavision, as a rental company with operations around the world and thinking about cameras for the future, that standard 35mm as we currently know it in the movie industry, with a 24 x 18 mm image area, will be used like the current 16mm format. And, Full Frame, with its 36 x 24 mm image area, will become the standard for what used to be 35mm cinematography. In fact, we had this conversation with ARRI engineers when they came around to us last year. Of course, above that, you’ll have larger format cameras like the ALEXA 65. But I think that Full Frame 24x36 mm will become the de facto format for feature filmmakers, and Super 35 format will predominantly remain the domain of TV.”

## Daniela Kesselem CW Sonderoptic Product Manager

“Large Format offers interesting visual cues. And everybody is familiar with it from a hundred years of still photography. In 1913, a Leica engineer named Oskar Barnack realized that 35mm motion picture film, which ran vertically with images that were each 24 x 18 mm, could achieve greater resolution by turning the film on its side. In that way, each frame had a larger image area: 36 x 24 mm. The Leica format was born, also known as Full Format. It became a worldwide standard for still photography. You might also say, playfully, that the cine business is rejoining the Leica Format after a hundred years’ vacation in S35.”

## Masaya Maeda, President and COO of Canon

“It is a challenge how far we can go with dynamic range and sensitivity using current APS-C or Super 35 size sensors. A larger sensor size is actually more advantageous because of the larger pixel pitch.”

## Severine Serrano, Managing Director of Angenieux Sales

“Angenieux has introduced zoom lenses for Large Format cameras. Innovation is the key to the future. In the coming years, we aspire to continue making fine lenses that move great stories onto screens, and in the process, to always have relevant products that help write the continuing history of cinema.”

## Michel Suissa, Manager of The Studio at B&H

“Shooting with Large Format cameras will soon become almost as common as when people were shooting in S35. It all began with DSLRs from the consumer world that had Full Frame sensors.”

## Masa Yasumoto, VP of Sanwa Group

“In 2015, I wondered which direction cameras would go. There was only one direction—to a Larger Format that was approximately the size of Full Frame still cameras, 36 x 24 mm in size.”

## Klaus Eckerl, Managing Director of IB/E Optics

“The future is big!”

# Large Format Art



For centuries, very large format paintings adorned castles and graced galleries. What was the appeal of large format art, especially in the Netherlands? The Dutch Golden Age in the 17th Century was made possible by its navy, trade, discovery, and science. At that time, the Dutch Republic was the most prosperous nation on earth. The output of art was prodigious. If you were somebody, you had paintings. And, if you were head of a militia, guild or night watch, you hired Rembrandt. If he was busy, you booked another prominent artist to paint an even bigger canvas than your rival merchants and burghers. Van der Helst's *Officers* stretches out 24 feet in glorious 3.17:1 aspect ratio. Rembrandt's *Militia* is an almost pre-anamorphic desqueezed 1.195:1 ratio, towering 12 feet tall. Often, the dimensions of these paintings were determined by the structures and locations they would occupy.

There is something special about seeing a great, large format work of art. It is monumental from afar. Get closer to examine the details, brush strokes and nuances. The viewing becomes a participatory experience. Moving around from side to side enhances the three dimensionality of the scene without resorting to the distractions of polarized paraphernalia.

Which brings us to back to Large Format Cinematography and ALEXA LF. Even more than the grand allure of great scale, there is also the promise of a new freedom of expression, free from the historic bonds of traditional aspect ratios. The big picture of an ALEXA LF allows the cinematographer to let the subject and story determine the boundaries. The technology of ALEXA LF and the possibility of an infinite choice of framelines will enable this new aspect ratio independence.

## Aspect Ratio Independence

In 1792, a wealthy merchant named Jan Gildemeester converted two large rooms in his house on Amsterdam's Herengracht into an art gallery. Then he had Adriaan de Lelie's paint a "catalog" of his paintings, a wall-to-wall display of golden frames. Each one is a different size and ratio. There's a lesson in this.

Gildemeester stands in the center of the room, a Rembrandt above his head. His collection of more than 300 paintings included works by Jacob van Ruisdael, Pieter de Hoogh, Gerard ter Borch, Peter Paul Rubens and Rembrandt.

Adriaan de Lelie  
*The Art Gallery of Jan Gildemeester Jansz*  
1794-1795. oil on panel, h 63.7cm x w 85.7cm  
Rijksmuseum, Amsterdam

Bartholomeus van der Helst. *Officers and Other Members of the Militia of District VIII in Amsterdam...* c. 1640 - 1643. Oil on canvas. h 235 cm x w 750 cm. (93 x 295 in.) Rijksmuseum Amsterdam.



Rembrandt van Rijn. *Militia Company...* (*The Night Watch*). 1642. Oil on canvas. h 379.5 cm x w 453.5 cm. Rijksmuseum Amsterdam.





Stephan Schenk, Managing Director of ARRI Cine Technik and, together with Walter Trauninger, General Manager of Business Unit Camera Systems

**JON FAUER:** Please give us some background about developing the new ALEXA LF camera system.

**STEPHAN SCHENK:** There was an obvious gap. Cinematographers can use 65mm format ALEXA 65 camera systems as well as S35 camera systems like ALEXA SXT W, ALEXA Mini and AMIRA. While the ALEXA 65 is great for selected 65mm projects and film sequences, it's not an appealing option for a broader range of productions.

So, we needed to look into something that answered the clearly existing demand for larger format images but with smaller data footprint and slimmer workflow.

**From your point of view, who are the customers for the new ALEXA LF camera? And who will continue to buy ALEXA SXT W, Mini and so on?**

That's an interesting question. We have our preconceived ideas based on feedback we get from the market, as always. But what winds up happening is sometimes different.

**Let me guess. You're expecting ALEXA LF to be for enthusiasts of Large Format cinematography, and a year from now we will be talking about how it caught on at every level of production.**

Clearly, ALEXA LF is meant to be a camera for high-end applications. We have seen the high level of interest in larger format cameras on big budget feature films. And it's fair to say that the ALEXA 65 paved the way there.

But certainly, commercials will also endorse the wish for a larger format look. Feature films and commercials often travel together. And also, some high-end TV series might wish to differentiate their look. Nevertheless, we don't at all think that S35 will disappear.

**What about anamorphic?**

We see people using anamorphic not only on features but also on commercials and TV series. When I started, people were not even thinking about shooting anamorphic for TV. Now you see it quite often. It's fair to say that cinematographers are always pushing the boundaries, the limits, always looking for new looks and new

ways to tell their stories. And the anamorphic look will remain an important tool in their toolset.

**How would you describe the look of the ALEXA LF Large Format camera system from where you sit?**

It is a new look, a different angle of view, a new perspective, with shallower depth of field. It definitely looks different. But we are launching not only a camera but also a new mount and an entire series of new Large Format lenses, the ARRI Signature Primes. Together with the ALEXA LF, the look is just stunning.

The lenses have a beautiful combination of gorgeous, velvety skin tones, nice bokeh, smooth out of focus areas, and straight lines stay straight. The name "Signature" is appropriate. Our designers put their signature on these lenses. But it is also up to cinematographers to lend their signatures to create the looks that move images from script to screen.

**Suppose you're a cinematographer in pre-production on a high-end feature and I'm the director. We're both talking about large format. How do we make the decision whether to go ALEXA 65 or ALEXA LF?**

Well, there are only 70 ALEXA 65 cameras out there. If I have the chance to get access to one of them, I would shoot a test comparing it to the ALEXA LF. And I would also test the Signature Primes and other Full Frame lenses. No project is the same and different stories need different tools. Also, productions have different budgets. And, if budget and availability allows, it might also be ALEXA 65 and ALEXA LF.

**So, mixing and matching cameras is possible?**

Absolutely. The reason you can match between ARRI cameras is that they share the same color science and the sensors are based on the same architecture. Cinematographers can be confident that their ALEXA, ALEXA Mini, ALEXA 65, and AMIRA cameras will match with the ALEXA LF. Mixing the different cameras depending on the scene is happening more and more.

## It's a matter of production value

**I have some business questions. Imagine you're a parsimonious producer. You're trying to spare every expense. How does the DP talk you into using this new Large Format camera system on the next feature?**

It's a matter of production value. Many producers have realized, over the years, the benefits of using our camera systems. Yes, the ALEXA LF may be a bit more expensive in the beginning. Rental rates will be a little bit higher. But it pays for itself with reliability on set and production value in the end. If a camera system breaks down, the amount of time you spend on set to fix it is enormous.

The same thing in post: how long does it take you to get the skin tones right? You can correct a color. But skin tones are not so easy to fix. DPs should be able to convince producers just by showing and comparing the images that demonstrate more production value. However, that doesn't mean now, all of a sudden, everything needs to be larger format. As I said, every story is different and needs different tools.

**OK. Another economics question. Suppose you're the DP and I'm the hardened Hollywood producer on a TV series. You really want to use the new ALEXA LF because of the look. And**



I, the producer, say something like, “In two words, impossible. I can get a regular ALEXA much cheaper at the rental house.” How do you talk me into going for the LF?

I would say, “Do you want to do something different this time? Do we work the same way we have been doing things together in the past? Or do we want to create a different look for the series? Do we want to have a more cinematic, more high-end look? Or do we want to stay with what we have—which doesn’t mean it’s bad. But do we want to be different? Do we want to set ourselves a little bit apart from the look of others and create a higher production value?”

**You’ve convinced me! What is the roadmap for rolling out the ALEXA LF system?**

The launch events are in February. Shipping of the ALEXA LF cameras will start by the end of Q1. The ARRI Signature Prime lenses will start shipping in June. We’ll have an initial set of 4. By the end of 2018, the plan is to have 12 lenses. In 2019 the set will be completed with the 12 and 15mm wide angle lenses, the 95 and 280 mm tele lens.

**What about service?**

That’s an important part of our offering and I’m proud of our service organization. We have a global network of ARRI Certified Service Centers. They work on a 24/5 connected network. As you know, things inevitably seem to happen after-hours and in the middle of the night. But there are no after-hours at ARRI because we can follow the path of the sun around the world. So, if Germany or the UK is going to sleep, the Americans wake up and take over. Then the Asians are on call. And so on around the world.

**ALEXA LF introduces a new mount and a next generation lens data system, LDS-2. What are ARRI’s plans to make it available to other companies?**

To achieve the beautiful look of the Signature Prime lenses in combination with a compact and lightweight design we also needed a new mount, the LPL Mount. It is based on the concept of the PL mount, but larger and even improved in its ease of use. We will share the lens mount specifications with other manufacturers.

It would be presumptuous to think that cinematographers will use ARRI cameras only with ARRI Signature Prime lenses. That

will never be the case. There are so many choices. So, we have to make our mount available to others. There is a formal license. But it’s a minor cost intended to maintain consistent specs and quality. The same applies to LDS-2, our lens data system, which we further improved and will continue to develop.

**Luckily, a lot of lens manufacturers can stay with their existing PL mount, because ALEXA LF has a PL-to-LPL adapter.**

Exactly. We do care about the investment of our customers and all the PL lenses out there can be used with the PL-to-LPL adapter on ALEXA LF.

But equally, there will be an LPL mount for the ALEXA Classic, ALEXA Mini and AMIRA so that the Signature Prime lenses can be used on these cameras in combination with ALEXA LF. It’s a complete system.

**If I’m a rental house, does the ALEXA LF system make everything I have obsolete?**

Not at all, it is just the opposite. You have flexibility with this new camera to do what you have been doing. It increases your possibilities in particular because it’s the same sensor, only larger. It is backwards compatible with almost all previous lenses. It has the same pixels as the S35 ALEXA, the Mini, the AMIRA and even the 65. ALEXA 65 and ALEXA Mini are currently used together on many projects, so we see ALEXA LF also as a complimentary tool when shooting in 65mm or S35.

**And I assume most ALEXA accessories will fit?**

Yes, it really is a complete camera system and existing accessories will fit from the start.

1. The entire PCA range can be used. So, a rental house doesn’t need to buy a whole lot of accessories—because they already have them from the ALEXA ranges.
2. The entire ECS Electronic Control System, the Wireless Control Units and so on will work from day one with the camera.
3. ALEXA LF will also fit nicely on our Camera Stabilizer Systems like the Trinity Rig.

The entire ARRI camera ecosystem works hand in hand with the ALEXA LF and the Signature Prime lenses. Therefore, it is a new camera system that stays within the infrastructure of our product groups but also is compatible to other manufacturers’ products.



ALEXA LF on location in Thailand, mounted on a Trinity Rig, working with ARRI Wireless Control Unit. Story later in this issue.



Marc Shipman-Mueller (above, center, with ALEXA LF) is a Product Manager for Camera Systems at ARRI, with Susanne Mayer (Marketing) and Frederic Merten (Product Management).

**JON FAUER:** Marc, what is your process of defining a new camera and what is the difference between a product manager and a project manager?

**MARC SHIPMAN-MUELLER:** All through the year, we have meetings with management to determine our strategy, our road map. As Product Manager, I talk to cinematographers, rental houses, camera assistants, DITs, VFX Supervisors and other crew members. What are they doing? What can we do to make their jobs easier? How does it affect post production? Additionally, I keep an eye open for market and technology trends and keep in close contact with our Research and Development team regarding what is technologically possible.

With all that information in the back of my head, I then have to look into my crystal ball and define a new product that I think, 2 years from now and for the next 5 years after that, will be a useful tool and therefore a success. That's actually pretty scary, if you think about it. Luckily, we have built up our product management team, and we all work closely together and openly discuss our ideas and that really helps. Then I present the specifications to management, we make further changes, and when we have the rough outline of what we want I hand it over to Research and Development and say, "We should build this."

All along, we ask various other departments at ARRI for feedback, like the Digital Workflow Solution group and the Service team, to include what they have learned. Then we have lots of meetings with everyone in R&D, led by the Project Manager, during which we work out the fine details of the specifications. The Project Manager then supervises the logistics of actually developing the camera.

**You've been Product Manager on many cameras, including ALEXA, ARRICAM, 235. What do you do while it's being developed?**

I'm still here. There are always additional questions. What did I mean? Why do we do this? Often, there are various compromises.

Should it be 7 millimeters higher or 14 millimeters longer? What's more important? I remember on the Arriflex 235 project, Michael Haubmann gave us a choice, "We can buy this chip to allow that function. But it's bigger. Or we buy another chip that's 2mm smaller, but then we don't have this function. What's more important?" Because of the research I have done earlier on how camera crews work, we can then make informed decisions. There are thousands of these choices—big and small—along the way. And each one of these little decisions shapes the camera to go a little more in the right direction, to be the right tool for the job.

When the time comes for the release, we look at what we have accomplished and what is the best way to communicate the camera's features to the market. Our Digital Workflow Solutions team starts working on arranging for test shoots and show reel material. I work closely with the marketing department on the presentations, the website, the press releases. That's very exciting and the rewarding culmination of a lot of work.

**Introducing a new camera system seems very much like the opening night of a movie for all of you.**

Yes. I will have butterflies in my stomach up to opening day in London on February 2. The first week after the announcement is also tense. Although I've introduced many new cameras, the nervousness always lingers for the next week. What do our customers think? Is our camera satisfactory? I know everything is fine if someone calls and says, "I've got this shoot and I need the new camera yesterday." The orders we get at the beginning are like the first weekend box-office.

**I think your phone will be ringing non-stop. When were the first inklings of this camera? What was the first spark?**

You know, there's this guy Jon Fauer who has written a lot about the looming of Large Format in a magazine called *Film and Digital Times* [laughs].

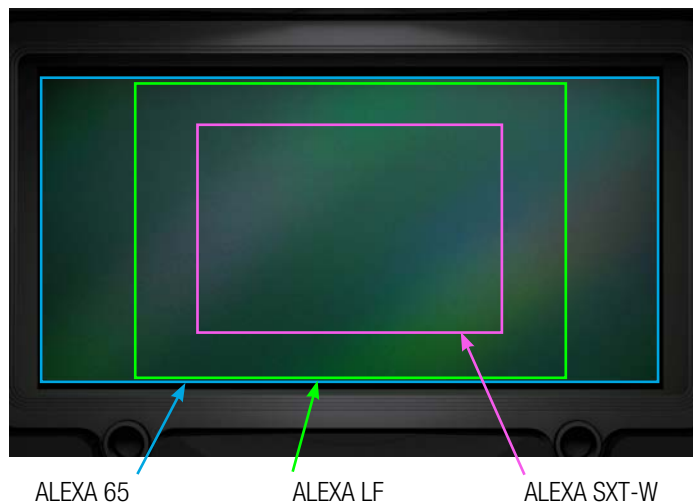
We also had an inkling that Large Format would be compelling. It was actually when work began on the ALEXA 65 sensor that the idea came up. Instead of making a sensor three times as large as Super35 for the ALEXA 65, what if we made it twice as large? Turns out, that is just a little bit bigger than Full Frame. From that concept came the next question: What kind of camera could we build around this sensor?

We looked at all the options and decided that it would be important to come to market really quickly, so the new camera and the new lenses could come out together, as a complete system. And that is one of the reasons the ALEXA LF is based on the existing ALEXA SXT W. The ALEXA SXT W is a processing power house, definitely able to support a large format sensor and the higher data rates involved.

**When you developed SXT W, did you know about the LF?**

We knew we could go in that direction because the SXT W is a derivative of the ALEXA 65. They share the same electronics. The electronics for the ALEXA 65 were designed in a way that they would also fit in a regular ALEXA.

What makes the 65 a little bigger is the extra cooling you need for the front end, for the sensor. But the innards, all the electronic boards, have the ALEXA shape. And the ALEXA LF is only a little larger than the SXT W. So, the SXT W has the same, very power-



ful, electronics as the ALEXA 65. This allows us to do 3D LUTs, HDR monitoring, four fully independent monitoring outputs and all those other processor-intensive tasks.

**In terms of a timeline, when did you either get the green light, or give the green light, to do this camera?**

We started in 2016. It was one of the fastest developments we've ever done. It was approved and immediately went into full development.

**All kidding aside about FDTimes, what is it that appeals to you about the large format aesthetic?**

Working for a German engineering company, my natural instinct is to analyze the Large Format aesthetic, break it down into parameters and quantify it technically. I've tried that, but in the end, I don't think it's a useful exercise because it is the images that count. Our customers and cinematographers are in the business of making moving pictures. Pictures either move us or they don't. That is what is important.

I looked at the ALEXA LF images and I can see they are better. They're more pleasing. And other people like them better as well, including the cinematographers we've shown them to. I do have some observations. They're not yet complete. But here they are.

First, to get the same angle of view as in the Super35 format, you have to use longer focal length lenses (more telephoto). Given the same T-stop, that results in a shallower depth of field, providing greater visual separation between foreground and background. Which gives you a more cinematic look.

Second, using longer focal lengths results in a different and more natural perspective. It specifically makes faces look more pleasing, which is very important. It's no accident that portraits are often shot at 85 to 135mm.

**Except Roger Deakins...**

But for most mortals, you will be using these longer focal lengths that feel more natural to the way we see. And third, you have the benefit of less noise with a larger sensor. The noise per pixel is exactly the same. But because you have more pixels on the same display, the noise actually appears smaller than the noise would be from a Super35 camera.

Dr. Tamara Seybold and Harald Brendel in your Image Science Department showed me examples today and the explanation was what you just said: because of the larger sensor, the blow-up is less given the same display screen size.

So, I think you get a better picture with greater separation between foreground and background, a more natural perspective and less noise. Of course, all these things play together along with many other parameters, including the critical choice of what lenses you use. But, really, I don't think we have to be all German about this. It simply looks better and everyone can see it.

**Is it exactly the same sensor as the other ALEXAs?**

The individual photo sites are exactly the same size, 8.25 microns. ALEXA LF uses the same sensor technology and the same color science as we have in the ALEXA, ALEXA 65, ALEXA Mini and AMIRA. Nevertheless, there has been an evolution. The original sensors were in the ALEXA. The next revision went into the AMIRA and the Minis. They were essentially the same but had a higher clock rate. That's why the Mini and the AMIRA can do 200 fps. That AMIRA/Mini revision was also the basis for the 65 sensor. And then the engineers said they could improve the 65 sensor even further. So, they made a new revision and that is what we have in the ALEXA LF.

**When you say a new revision, is that hardware or software?**

It's both. It is a different way of routing the signal through the sensor. It is a slightly different timing. We're improving each time. And, as anybody who manufactures a large sensor knows, it's also a question of yield. With the latest revision for the LF, these changes help us to get a better yield.

**Simulating a week of running shots with the camera mounted on a car that is continuously driving over cobblestones in the Arctic and the Amazon.**

**Is the ALEXA LF as tough in the field as regular ALEXAs?**

Our quality control department tests the living daylights out of our cameras. They run environmental tests at temperatures below minus 20 degrees Celsius to make sure the camera works at minus 20. Then it gets heated to plus 45. Next, they put each camera on a shaking machine. With electronics, anything that fails usually fails in the first week.

We're trying to simulate a week of running shots with the camera mounted on a car that is continuously driving over cobblestone in the Arctic and the Amazon. We do this with prototypes during development, and then manufacturing does the same thing with every camera that gets delivered.

**Last question—you're a DP in love with the new ARRI Signature Prime lenses. How do you describe them in combination with the new camera?**

ALEXA LF and ARRI Signature Prime lenses provide a painterly, organic, gentle, smooth and cinematic image. It's a new, complete camera system with a very different and very exciting look.



Klemens Kehrer, Head of R&D in Vienna and Project Manager for the ALEXA LF in Munich.

**JON FAUER: You worked on many other ARRI cameras before becoming Project Manager of the ALEXA LF?**

**KLEMENS KEHRER:** I was Project Manager on the Arriflex 235 and 416. And before that I participated on every camera project since the 765—when we still did the design drawings on paper.

**I also asked Marc Shipman-Mueller this question. What is the difference between a Product Manager and a Project Manager?**

Marc is the Product Manager. He decides what to build. As the Project Manager, I get it built. We should also mention the head of manufacturing and R&D. He gets the funding, makes sure that we get the resources, is responsible for assembly and gets it out the door. That's Walter Trauninger, who is also a Managing Director of the ARRI Business Unit Camera Systems.

**Take us through your work in developing the ALEXA LF.**

When I started, it was already cleared, and it had to get to market as quickly as possible. You could almost say that the first and most important thing we decided was what not to do. Anything that might slow things down was ruled out. The next step was to decide what was necessary, what was possible. That meant building on the platform of the ALEXA SXT W. We verified the things we wanted to change. Every new ALEXA has needed more power than the last one. Also, image processing increases with the size of the sensor. We had to improve the thermal management. The ALEXA, as you know, has a cooling system with heat pipes that go out to the back, where you have the radiator. We now have an additional cooling for the SXR Capture Drive because the data rate is so high. We used simulation software to optimize the thermal management system, which is one of the major issues of every camera.

Next, we checked that the sensor could do what it should. Then, the whole team worked on CAD drawings to develop PCB boards for the new sensor and the new sensor control board. We built prototypes as fast as we could. Next came prototype manufacturing, assembly and testing everything thoroughly to make sure the camera system was reliable. The deadline to build a camera in a little over a year was rather ambitious.

**Although you used parts from the ALEXA SXT W, there appear to be some major refinements.**

Exactly. We had to make the body longer and wider by about 12mm because of the heat the camera produces, to make room for the heat pipe for the capture drive and for the larger fan to get

enough air through the chimney in the rear. The main processing boards have been equipped with bigger FPGAs (Field Programmable Gate Arrays (the main processing units) because we now have twice the amount of data to process. The geometry of the sensor in relation to the lens mount can be adjusted from the outside of the camera, from the front, without having to open it up. That is quite an improvement for manufacturing.

**Take us through the design process of the lens mount.**

We had a very long discussions about several concepts. One was a radical change, but its reliability could not be predicted. The other, ultimately accepted, was a more traditional, but fool-proof, PL-style breech lock. We built both prototypes in parallel and then checked with a number of key customers what they thought about both versions. The designs were done at ARRI Austria in our R&D facility, supervised by Josef Handler, head of mechanical design and development.

**Was the 44mm flange focal depth determined by the camera or the lens design?**

It came from both sides. The new mount had to fit onto existing ALEXAs (except Studio). So, you couldn't go too far into the camera body. And it still had to accept all existing PL mount lenses with the PL-to-LPL adapter. Making the adapter was also a challenge because the distance from 44 to 52 mm is not much. We had to include LDS-2 contacts and LDS-1 backward compatibility. Normally an adapter would have the electronics built in. And you go through the same contacts. But as there was so little space, we were not able to fit any electronics into the adapter. Therefore, we had to have secondary contacts in the mount so the signal goes back into the camera where the electronics are.

**When you showed me the designs, why were there many variations of the front view?**

We worked hard to build light baffles. The reason was, when we put some third party lenses on the camera, we saw a lot of stray light bouncing around inside. This caused reflections, loss of contrast and milky shadows. We have a very clever guy here who did a lot of simulations and he came up with excellent ways to reduce stray light. It was a little challenging to get a sensor twice the size into a body that has exactly the same front dimensions as on the previous ALEXAs.

Speaking of the front end, there's another thing that readers of FDTimes might like. It's not the big buying decision, but it is an example of how we really listen to users. This is the first ALEXA where you can replace the RS connectors without having to remove the front housing and the delicate sensor assembly. As we all know, connectors eventually can break and a simple way to exchange them is a helpful thing.

**The R&D facilities are in Munich and Vienna, the cameras are built in Munich. You must spend a lot of time commuting?**

I travel back and forth all the time. It's not a problem. I keep a toothbrush in my backpack, always ready to go [laugh]. I even have my choice of offices here in Munich. I look at the list of who is out or on vacation, and that is the desk I occupy for the day. It's always interesting and I get to meet a lot of people in different departments. Actually, I don't sit at the desk for very long. When I'm here in Munich, I'm busy running around all day.



Dr. Achim Oehler is Project Manager Digital Cine Cameras at ARRI. He has been a force behind ARRI's evolution into the digital age and every ALEXA camera, from ARRISCAN to ALEXA 65 and now ALEXA LF.

**JON FAUER: The ALEXA LF has the latest revision of the ARRI ALEV sensor technology. What is different?**

ACHIM OEHLER: From the previous revision, the A3X, which is the ALEXA 65 sensor, we learned that it's not at all easy to design a large sensor. A large sensor inherently has long lines with certain properties – like slower signal propagation – that you have to respect. So, you have to implement certain circuits to speed it up. We improved this for some stages of the sensor. And we fixed many little details to further minimize cross talk, smear, fixed pattern and all those other evils of an image sensor. And it turned out that the resulting ALEXA LF sensor is quite nice.

**Which means less noise for this revision of the ALEV sensors?**

Noise is dominated by the pixel and the readout path in the end. For both, the noise-relevant structures are unchanged. So, the noise is more or less the same. But it's important not to add additional noise like fixed pattern noise or other types of non-random noise, and not to be artifact-limited.

**What is fixed pattern noise? Like a screen door effect?**

Something like that. You see fixed pattern noise when you move the camera and fine structures appear in fixed positions. It could be eliminated by calibration, but you don't have infinite amounts of bits per pixel for calibrating the sensor. You have to distribute your calibration resources, so that the image looks good in all cases. But there's always a residual. And that's normally called fixed pattern.

Another problem can be line noise. It's a horizontal noise pattern that can be generated on chip or by electromagnetic interference.

If these noise sources are eliminated, there is only the pixel and the readout path dominating the noise. So, when you're designing a sensor, you try to minimize the above mentioned noise sources and to achieve the best noise performance for the pixel and the readout path.

**How were you able to manage RAW data recording and post-processing internally in this camera?**

The ALEXA LF can do uncompressed ARRIRAW recording up to 90 fps for Open Gate and up to 150 fps in 2.39:1 widescreen sensor mode. Full color reconstruction with ProRes recording is possible up to 60 fps Open Gate and up to 90 fps widescreen. This makes a big difference for a large format camera. Because the internal bandwidth is so much higher than in the Alexa SXT, we had to control it thermally, and this is why there's a bigger fan now. The bigger fan allowed us to add a separate heat sink under the side cover where the Codex Capture Drive is located. This is quite valuable because you can keep the camera in equilibrium at all speeds, even when you're recording at 90 fps Open Gate continuously.

**How were you able to complete ALEXA LF so rapidly?**

It was really quick. We were able to build on our existing technology, especially on the Alexa 65 technology. So, that's the story of the latest episode in the story of our ALEV sensor design, which was first conceived for the original ALEXA as a sophisticated, cinematic high dynamic range sensor, and continues to the latest ALEXA LF.

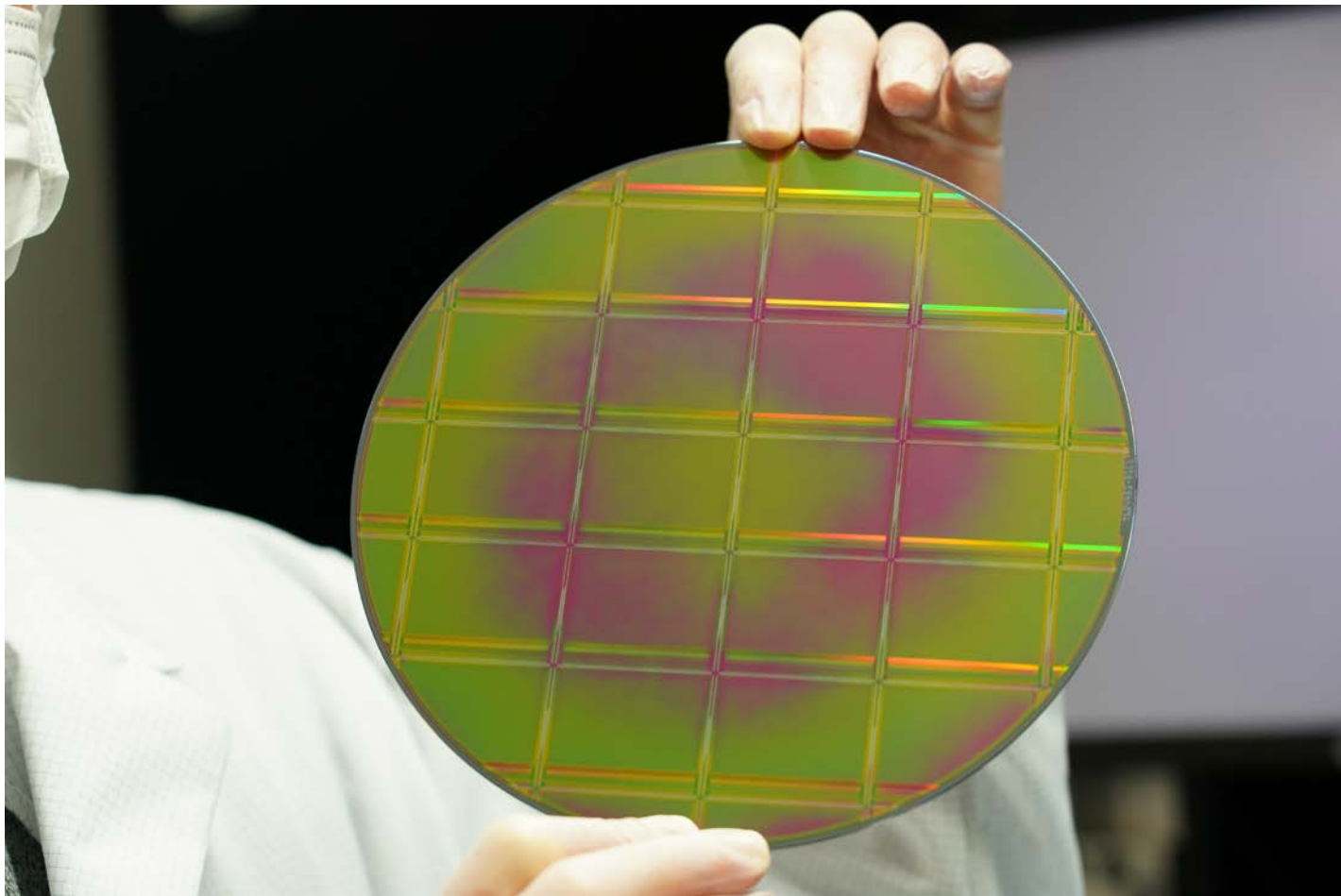


Above: The ARRI ALEXA LF sensor team.

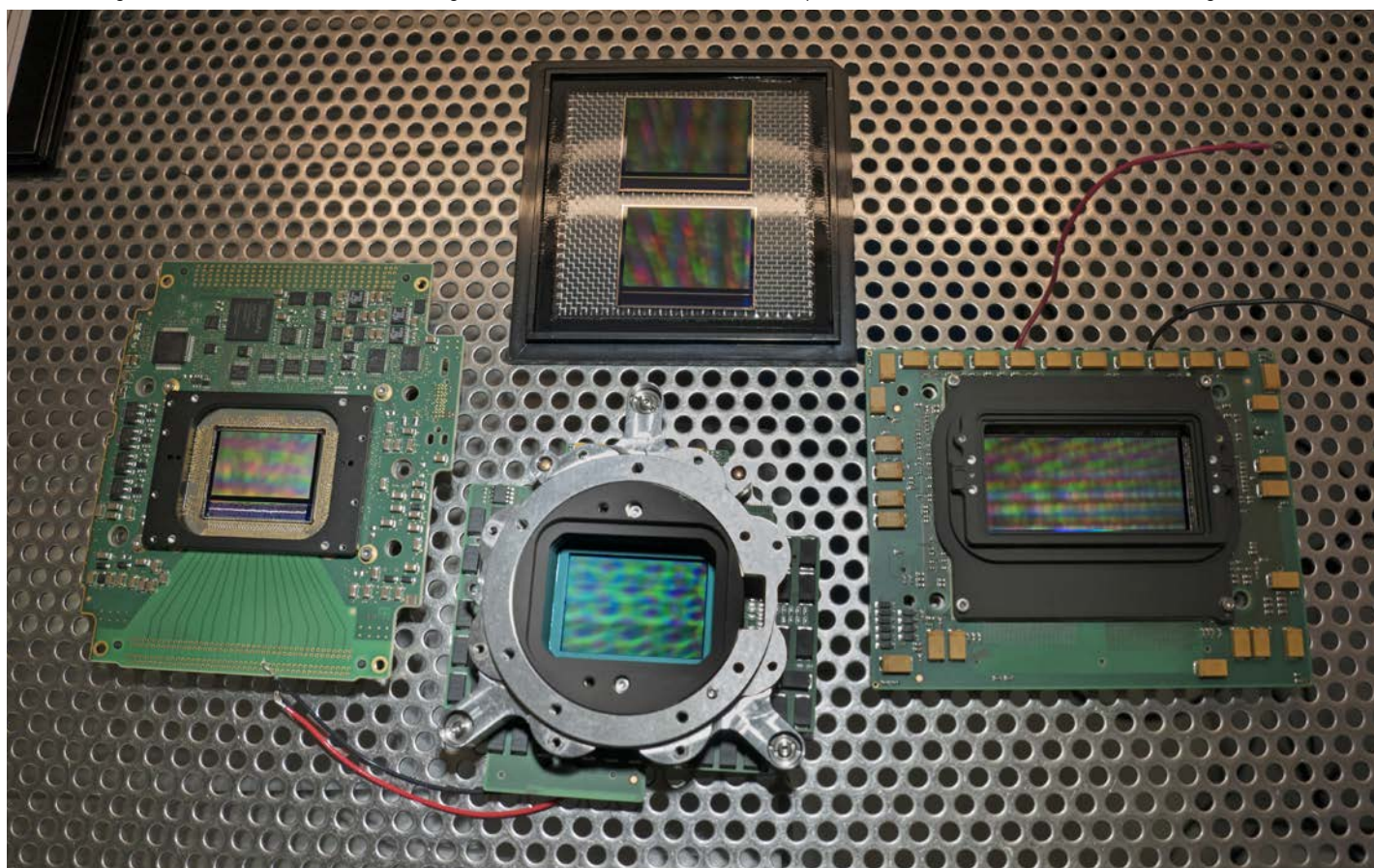
Right: Achim Oehler and the magically levitating ALEXA LF.



# ALEXA LF Sensor



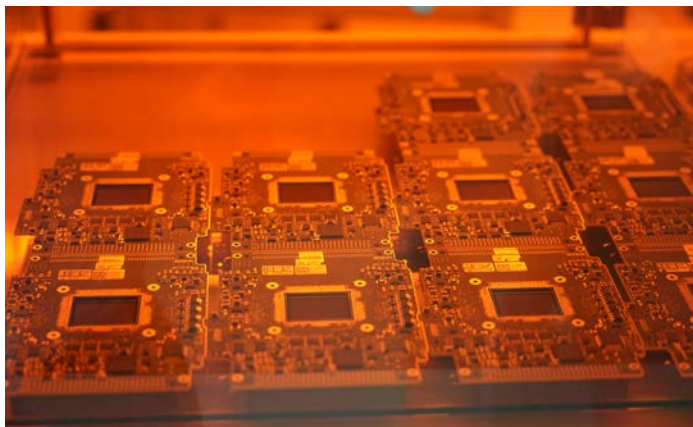
Above: it begins with a wafer. Below, various stages of sensor assemblies and size comparisons. Left: ALEXA. Center: ALEXA LF. Right: ALEXA 65



# ALEXA LF Sensor



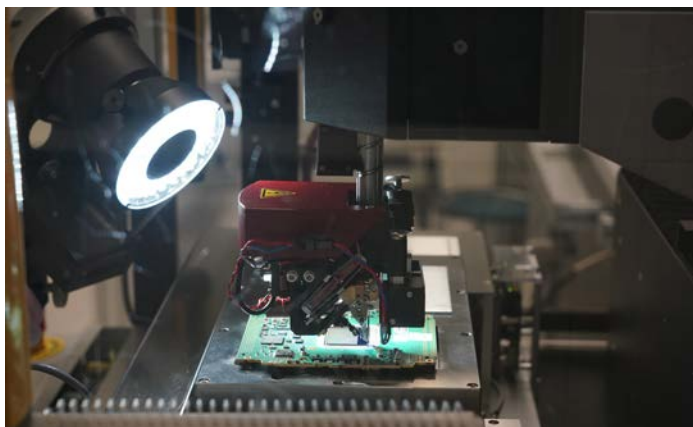
Camera sensor assembly clean room at ARRI



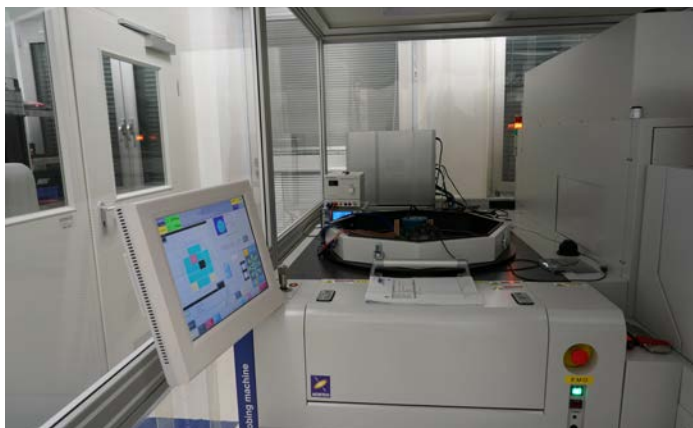
Sensor assemblies



Inspection



Wire bonding



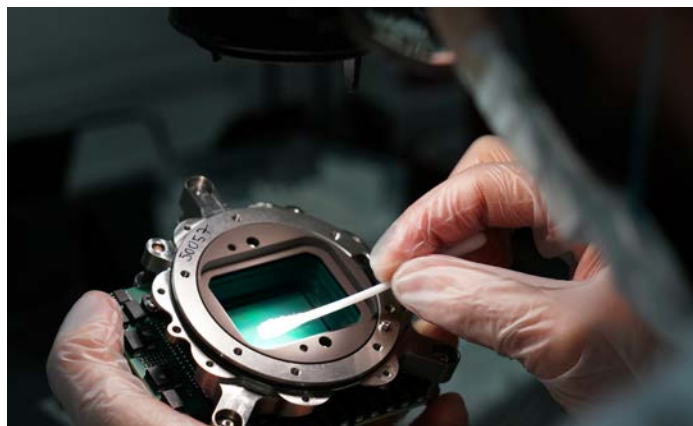
Wafer testing



Wafer testing

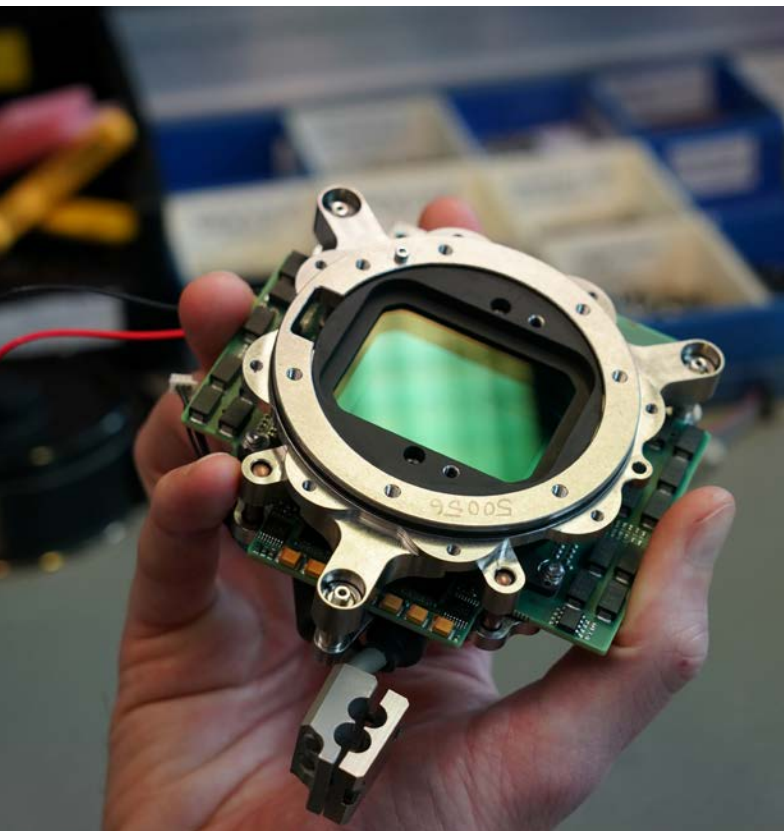


Cleaning cover glass

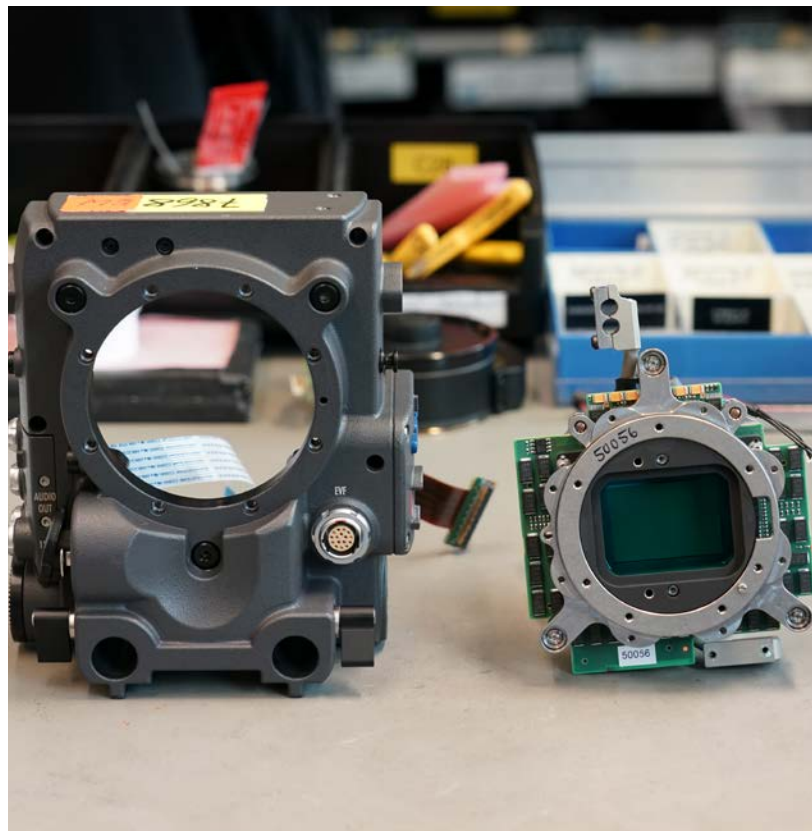


# Building an ALEXA LF

Let's build an ALEXA LF. This is a simplified view of a very complex process, sort of an ALEXA Assembly for Bluffers Guide. Do not attempt.



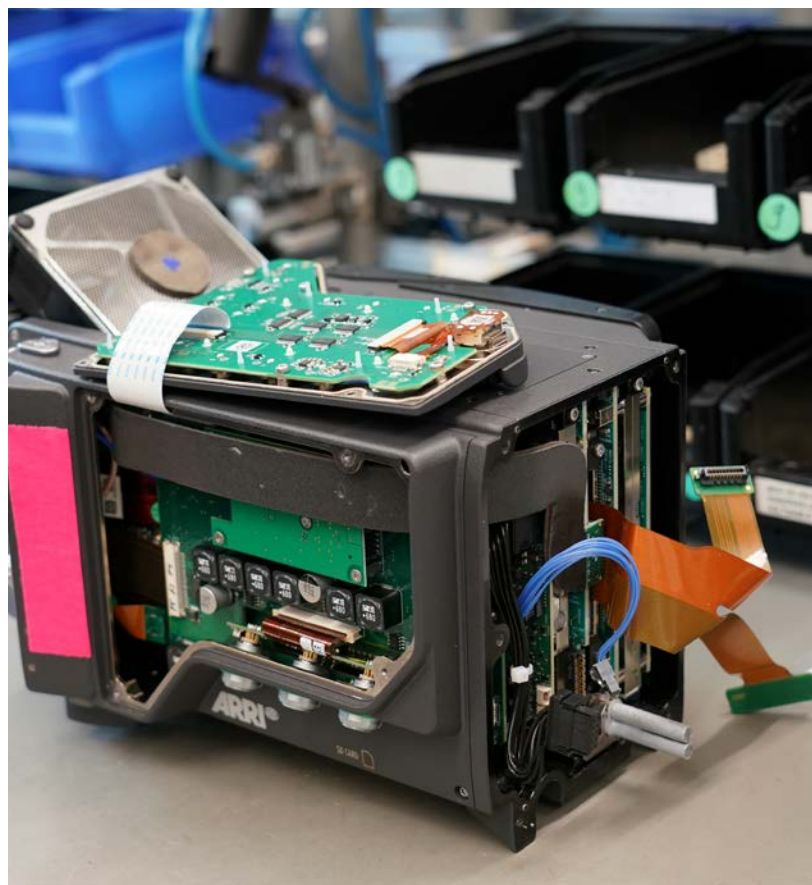
Take one ALEV 3 2X sensor assembly module.



Prepare ALEXA LF front housing.



Sensor assemblies installed. Attach LPL mount to camera body on left.



Printed Circuit Boards and fan go inside the rear camera body housing.

# Building an ALEXA LF



The cooling fan goes in.



Fan cover is attached.



Wireless video module goes on the back.

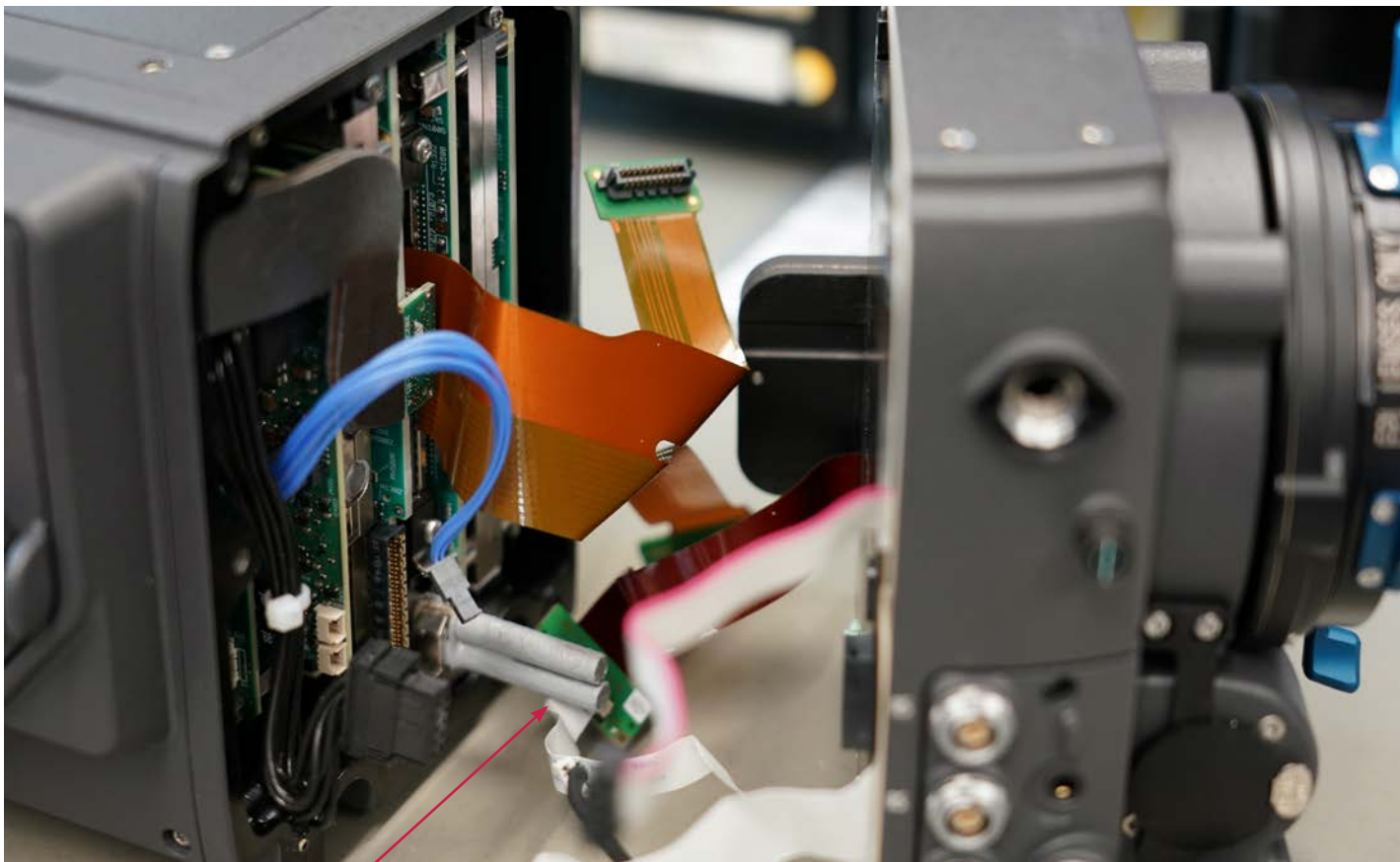


Prepare rear assembly.



Yasmin Bulut and Oliver Luft prepare to join front and rear sections.

# Building an ALEXA LF



Tubes called Heat Pipes keep the sensor cool by drawing heat away. Connect cables.



Testing, testing. Simulate a week of continuously driving over cobblestones in the Arctic and the Amazon.



Andreas Weeber tests all models of ALEXA. Nice to see they read FDTimes, above right.

# Programming and Testing and Color Science



David Zucker with eclectic collection of cameras.

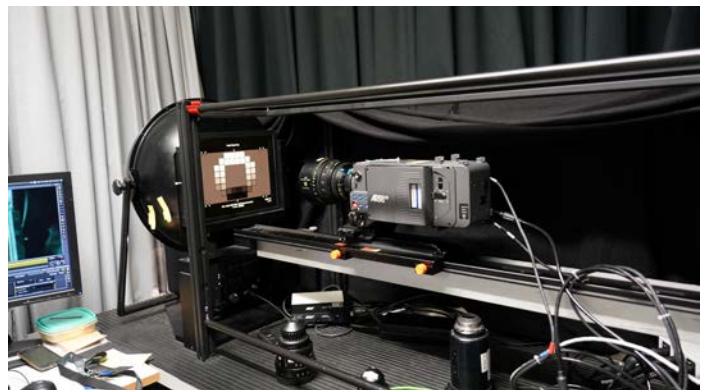
Below, L-R: ALEXA 65, ALEXA LF, ALEXA.



Dr. Tamara Seybold and Harald Brendel.



Michael Grädler.





# ARRI Signature Primes



## ARRI Signature Prime Specs

| Lens                     | Focal Length | T-Stop  | MOD from sensor plane | Front diameter | Length from flange | Weight           |
|--------------------------|--------------|---------|-----------------------|----------------|--------------------|------------------|
| ARRI Signature Prime 12  | 12 mm        | T1.8-22 | 0.35 m / 14"          | tbd            | tbd                | tbd              |
| ARRI Signature Prime 15  | 15 mm        | T1.8-22 | 0.35 m / 14"          | tbd            | tbd                | tbd              |
| ARRI Signature Prime 18  | 18 mm        | T1.8-22 | 0.35 m / 14"          | 114 mm         | 178 mm / 7.01"     | 2.0 kg / 4.4 lb  |
| ARRI Signature Prime 21  | 21 mm        | T1.8-22 | 0.35 m / 14"          | 114 mm         | 178 mm / 7.01"     | 2.1 kg / 4.6 lb  |
| ARRI Signature Prime 25  | 25 mm        | T1.8-22 | 0.35 m / 14"          | 114 mm         | 178 mm / 7.01"     | 1.9 kg / 4.2 lb  |
| ARRI Signature Prime 29  | 29 mm        | T1.8-22 | 0.35 m / 14"          | 114 mm         | 178 mm / 7.01"     | 1.9 kg / 4.2 lb  |
| ARRI Signature Prime 35  | 35 mm        | T1.8-22 | 0.35 m / 14"          | 114 mm         | 178 mm / 7.01"     | 1.7 kg / 3.7 lb  |
| ARRI Signature Prime 40  | 40 mm        | T1.8-22 | 0.35 m / 14"          | 114 mm         | 178 mm / 7.01"     | 1.9 kg / 4.2 lb  |
| ARRI Signature Prime 47  | 47 mm        | T1.8-22 | 0.45 m / 18"          | 114 mm         | 178 mm / 7.01"     | 1.8 kg / 4.0 lb  |
| ARRI Signature Prime 58  | 58 mm        | T1.8-22 | 0.45 m / 18"          | 114 mm         | 178 mm / 7.01"     | 2.1 kg / 4.6 lb  |
| ARRI Signature Prime 75  | 75 mm        | T1.8-22 | 0.65 m / 26"          | 114 mm         | 178 mm / 7.01"     | 1.9 kg / 4.2 lb  |
| ARRI Signature Prime 95  | 95 mm        | T1.8-22 | 0.85 m / 3' 1"        | 114 mm         | 178 mm / 7.01"     | 2.4 kg / 5.3 lb  |
| ARRI Signature Prime 125 | 125 mm       | T1.8-22 | 1 m / 3' 4"           | 114 mm         | 178 mm / 7.01"     | 2.3 kg / 5.1 lb  |
| ARRI Signature Prime 150 | 150 mm       | T1.8-22 | 1.5 m / 6'            | 114 mm         | 208 mm / 8.19"     | 3.5 kg / 7.7 lb  |
| ARRI Signature Prime 200 | 200 mm       | T2.5-22 | 1.8 m / 6'            | 114 mm         | 216 mm / 8.58"     | 3.6 kg / 7.9 lb  |
| ARRI Signature Prime 280 | 280 mm       | T2.8-22 | 2.5 m / 8' 2"         | 134 mm         | tbd                | 5.5 kg / 12.1 lb |

*Some weights shown here may not be final*



Thorsten Meywald, ARRI Product Manager for Optical Systems

## **JON FAUER: How did the ARRI Signature Prime LF Large Format lens project begin?**

**THORSTEN MEYWALD:** It was clear that if we were to make a Large Format camera, then we also needed to make Large Format lenses. Our discussions of style confirmed that we were not just aiming for the highest resolution, lowest distortion and very good correction of all optical artifacts. It should be a unique style. But what kind?

When you look back at landmark optical designs of the past 100 years, those lenses were state of the art at their particular time. However, in the transition from analog film to digital, external influences of mechanical film transport, contact printing and the entire photo-chemical process were replaced by a steady sensor. It didn't move. Even with the best film gate and registration pins, the image in film cameras was softened by the physical movement of the film and the random pattern of grain. To overcome these external softening effects, many lens designs became sharper, which we might now describe as being "technical."

## **For a Large Format camera, we also needed to make Large Format lenses**

Our new lenses are not purely technical. Of course, they have the resolving power for existing sensors and also sensors in the future. They are distortion-free because it was not our goal to fall behind what we have achieved many years ago. So what else were we searching for? The style of an image is not only defined by the areas that are in focus. The image areas in front of and behind the focal plane are also essential.

This was the one of the most challenging things—to create pleasing bokeh in both directions, in the foreground and in the background. These bokeh should also be as smooth as possible, free of any artifacts, not disturbing. Maybe you have seen bokeh on older lenses with a kind of swirl pattern. Or onion rings, which are another kind of pattern that result from tooling marks.

### **Bokeh refers to more than the out of focus highlights?**

Bokeh describes the entire style of the out of focus image, the smoothness, the contrast, the absence or presence of artifacts. The out of focus highlights are just one part of the bokeh and they are defined by the shape of the aperture.

**Your new LF lenses with LPL mount seem lighter and smaller than if they had been PL mount.**

Most Signature Primes are thinner than Master Primes. From 18 to 125 mm, the Signature Prime barrels are all the same size. If we had designed these lenses with a PL mount and wanted to achieve the same performance for Large Format, then we would have a much more complicated design. The reason is that the PL mount is simply too small in diameter. It's also further away from the sensor and that makes the lens design more complicated. When you have these lenses in your hand you notice how light they are.

**When I picked one up, it felt like a mock-up without glass elements. How do you make them so light?**

The lightest is the 35 mm at 1.7 kg. The heaviest is the 125mm at 2.3 kg. We used a lot of high index glass and made the lens elements much thinner. The main reduction in weight comes from the lens barrel itself. It's no longer aluminum; it's magnesium. This material is used in the aircraft industry and also for Formula 1 and other motor sports. It is much lighter compared to aluminum.

### **How did you achieve the look of these lenses?**

There's a good balance regarding MTF for human faces, but also for landscapes, fabrics and other more technical textures (MTF can be defined as the relationship between resolution and contrast). We are working at high MTF frequencies because these lenses are made not only for 4K or 6K sensors, but also looking to the future which might go even beyond 8K. These lenses will be at rental houses and on productions for at least 20 to 30 years. If you don't drop them, they might last almost forever. After a while, they too will be called vintage lenses 30 years from now.

We were really sure to have the resolving power but also very careful not to add too much harsh contrast at the higher frequency resolving power. Otherwise you get a fine detail micro contrast which is too sharp, too contrasty, and that doesn't look nice. What this means is that you see quite a high resolution in the scenery but when it comes to human faces, to skin tones, it's a bit smoother. It's not out of focus or un-sharp, it's just smoother. In fact, when it comes to pure resolution, the new Signature Primes have a very high resolution. But the balance is better for the digital age. The skin tones are natural and pleasant. The contrast is more pleasing.

### **How will Signature Primes look in projection at rental houses?**

Spectacular. From the center to the outer corners, the quality is very uniform. We have controlled vignetting, shading and the illumination level from the center to the corners for every focal length.

### **In real-life, how will Signature Primes look to cinematographers?**

In practical terms when shooting, the optical design has created a kind of gentle roundness and dimensionality. They are matched across the entire series, from wide to tele. There is no breathing—no shift in image size as you focus from extreme close-up to infinity. For me, telecentricity was very important and it was hard to do for the optical designers. We have done something that we call "strong telecentricity" and some of the lenses have chief ray angles which are very small.

**In designing your new LPL mount, was the shallower flange focal depth influenced by rear element diameter and the desire to be telecentric?**

## Thorsten Meywald, cont'd

Sensor size determines lens barrel diameter and the exit pupil size. The “sweet spot” is generally to have the flange focal distance around the same as the sensor diagonal. The ALEXA LF sensor has a 44.71mm diagonal. The flange focal distance is 44 mm.

**In Super35, if it weren't for the mirror shutter, the ideal flange focal distance would have been somewhere around 30mm to still be telecentric?**

Yes. Although at 52 mm, it can also be telecentric—just further away because of the mirror shutter. The extra distance makes the optical design more complicated.

There's another technical reason for the telecentric design. The sensor has micro lenses in front of each photosite. If the micro lenses are hit by light coming at an angle, you may have a shading effect and also color fringing. It's a chromatic aberration that is extremely difficult to correct. And even if camera sensors in the future don't have micro lenses, we're still on the safe side.

In the early design phase, we put aside thoughts about PL, XPL or any existing kind of mount and asked instead what would be the ideal mount or the ideal dimension for this camera and lens system. After a while, the optical and mechanical lens designers came back and that's how we ended up with 44 mm flange focal depth and a 62 mm diameter.

There was an added mechanical reason for the 44 mm depth. That was the minimum distance to retrofit the new LPL mount onto all existing ALEXA, ALEXA Mini and AMIRA cameras (except the ALEXA Studio with its spinning mirror shutter). We have a legacy of tens of thousands PL cameras and lenses out in the market and need to make sure that nothing becomes obsolete. We are inviting other lens and camera manufacturers to participate in our new LPL mount technology to form a common standard in our industry.

**There seems to be consensus among Full Frame designers about flange focal depth for Full Frame sensors. The Canon EF mount is also 44 mm, Nikon F is 46.5 mm and Panavision DXL SP70 mount is 40 mm.**

Clearly, 44 mm is a “happy distance.” Although the PL mount has been a standard for many years, at some point we needed to rethink everything and ask if we really must stick to the old system and compromise in the future? For us, it really was time to acknowledge that the PL mount was made for the much smaller format of Super35. Yes, you can get the light through to a full frame sensor with a PL mount, but not in an ideal way, especially when it comes to high speed or high performance lenses.

**Any other unique features of the design?**

We are using some exotic glass elements to carefully control color fringing. You can talk a lot about style and vintage look and if you want to accept distortion or not. But I think we all agree that nobody wants to accept color fringes. In the old days of film, color fringes were not that obvious because the film grain and random movement was more forgiving. But with digital sensors and pixel sizes getting smaller, it's not that forgiving any longer. You clearly see color fringing. You can correct it in post to some degree by replacing the magenta, cyan or other color with something less obvious. But that's an arduous task. A better choice is to correct the color fringes from the outset.

**Since every DP wants his or her own “signature look,” tell us about some of the ways they can achieve this.**

You can replace the front and the rear elements. Normally, the lenses come with very good anti-reflective coatings. We will offer elements with a more old-style look, with a lot of ghosting and reflectivity like in earlier eras when the coatings were not as good. It's the similar flexibility we have with Master Anamorphics. Either the front or the rear or the combination can be swapped. It is a simple task for the rental houses to do. In addition you can use special rear filters. We have developed a very unique magnetic rear holder which accepts a net filter but also other effect filters.

**What's the roadmap?**

February is the market introduction of the camera and the lenses. First customer shipments begin in May with 35, 47, 75 and 125 mm. It's a good range to start. Then, for every following month in 2018, there will be delivering at least one or two focal lengths. By end of 2018 we will have 13 different lenses in the market. Three lenses will come in 2019: 12, 15, and 280 mm. I don't think we ever introduced so many lenses in such a short time.

**In summary?**

I can repeat what cinematographers who tested them have been saying about our lenses. The look is organic, natural, very smooth. A classical style with modern interpretation. A modern lens with references to the past, but not a vintage lens. A modern take of a historic look. But it is modern and anticipates the look of the future. It's something different. It's classical but new. It's a new style. And that's the reason we call them Signature Prime. The logo is handwritten in a silver color. The silver color gives you a suggestion of the past, from the film days, when silver was used in the film. Signature means ARRI as a company, with our 100 years of experience, put our signature on these lenses. This is our style. It also means that each cinematographer using these lenses has placed his or her own signature or signature look upon the images. These professionals, working every day with the lenses, will bring out styles and looks that we haven't seen yet, that we haven't imagined. In a way we didn't even dream possible. That makes it truly fascinating for us. Very often, I'm thinking in terms of a signature dish that comes from a restaurant. The chef says, “This is something I want to cook for you. It is not a la carte; this is something special.”

**I know you love good food and wine. The look of Signature Primes reminds you of which wines?**

I would go for a Bordeaux that you can store a very long time. It develops its taste when you open it. When you pour it in a decanter, the immediate impression is interesting. After five minutes, it's different. After half an hour, its signature nose comes through. We did not design these lenses to present obvious effects. Of course, you can make a lens with a lot of artifacts. You put it on the camera, and, oh yes, flaring—or streaks or lots of distortion. However, if you tell stories, and we're always telling stories in our films, the story is the message of the entire production and the entire team. And the lens itself is a tool, and in the hands of professionals, a brush. You start like a painting with a white canvas and you have your brush, your colors and your ideas. Signature Primes enable the style and the style is a collection of possibilities that can grow in the hands of creative people.

# ARRI Signature Primes



Initial Set: 35, 47, 75, 125 mm

## Dust and Moisture Protection

ARRI Signature Primes are dust and water resistant. However, they are not waterproof. Cleaning and maintenance is relatively simple. As introduced with the Master Anamorphics, the front and rear lens element can be easily replaced.

## “Flare Sets”

Specially coated front and rear and front lens elements and “flare sets” will be available.

## Service

ARRI is setting up advanced service stations worldwide, with clean rooms at levels rarely seen in cine lens facilities and custom-designed measurement equipment. The equipment is similar to ones used in manufacturing: projector, collimator, MTF machine, LDS calibration units and torque testers for the gear rings. ARRI lens technicians will be able to completely disassemble a lens and reassemble it back to the original factory specifications. These factory service centers will be in Munich, but also in Burbank, Hong Kong and Beijing.

## Large Format Signature Primes on S35 Cameras

“We know that our new Signature Primes will be used not only for Full Frame or Large Format, but also for Super35,” Thorsten Meywald said. “I’m convinced that many rental houses will buy

these lenses as their universal primes. They are good for Large Format, good for smaller formats, the form factor is good and they are even lighter than many other primes.”

To address both formats, the Signature Primes have optional format masks. When you shoot with a Full Frame lens on a smaller sensor, stray light might bounce around inside the camera mount cavity causing stray light, hazing or ghosting. Light baffles and light traps inside the Signature Primes help minimize internal barrel flare. Furthermore, there is a magnetic holder on the rear end of the lens and format masks attach there. Every Signature Prime lens will be shipped with dedicated format masks for LF Open Gate and Super35 Open Gate. Also, a net holder is installed at the rear of the lens. In near future, expect even more options for format masks and effect filters.

## Telecentric design

Telecentric means the light rays remain parallel from the rear of the lens to the sensor. Otherwise, the rays converge like a cone. Telecentric lenses typically have large rear elements. A strong degree of telecentricity often does a good job at controlling breathing. It also can nicely influence the look of the lens.

## Bokeh

Signature Prime bokeh are smooth and round. The lenses have 11 aperture blades and each one is additionally rounded.



# The Signature



Andreas Moeller, above, is the industrial designer who created the signature for the Signature and the exterior look of the lenses. He's holding a prototype lens, when it was still generically called FF as in Full Frame Prime until someone wisely pointed out that the tentatively named ALEXA FF actually had a larger than Full Frame imager. The next step, "quick, bring Andreas back," followed. He worked on the styling of ARRI UWZ, ALEXA Mini, Amira, L-Series and SkyPanel lights and now this latest set of ARRI lenses.

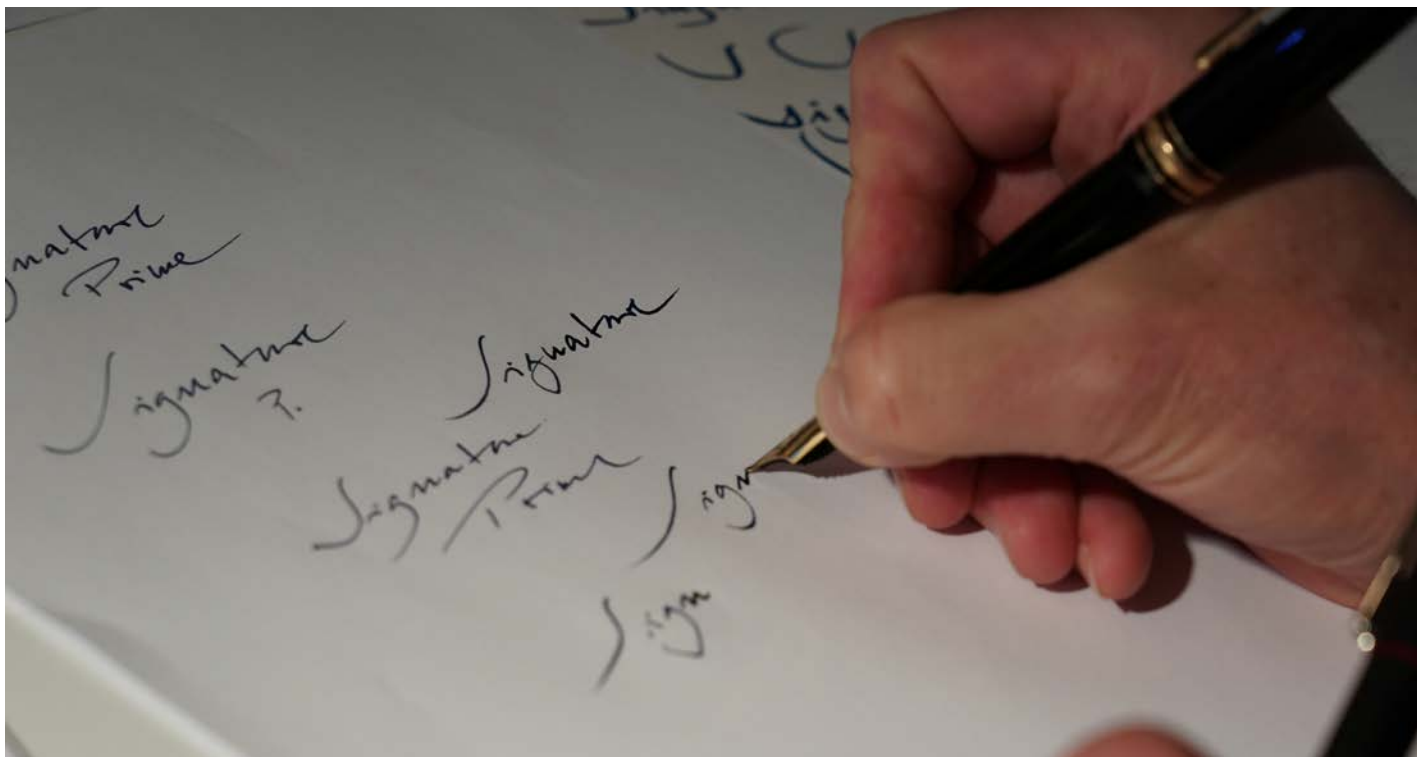
The industrial design of the Signature Primes involves the sensuous, tactile feel of the barrel surfaces. You can hold it comfortably in one hand, which makes lens changes a breeze. The weight is impossibly light—the result of magnesium mechanical housings and advanced optical design. All the barrels in the set have the same shapes, with the same gently curving and consistent radiuses where the lens width meanders deliberately to do its job.

"It's a calm, iconic design," Andreas said. "It looks to the future. Index marks are tapered to eliminate parallax. Design was very important for all of us."



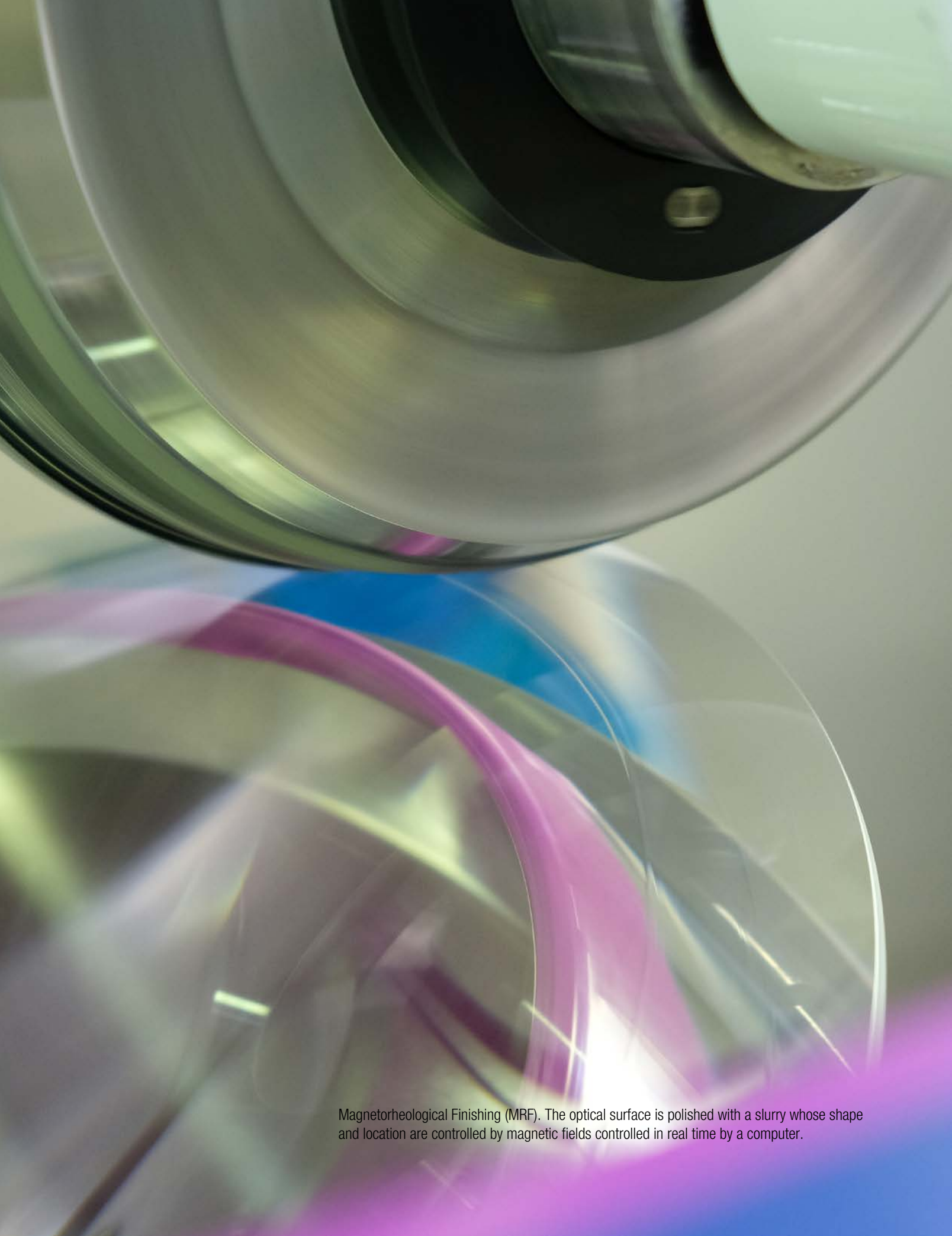
The signature of the Signature was first done by hand, using a drawer full of pens and writing instruments and a ream of fine paper. Next, the hero calligraphy was scanned, digitized and ready to be painted on the new series of lenses.

ARRI Signature Primes are now ready for cinematographers to add their own signatures and unique looks for the films that these lenses will shoot.



# Signature Prime Lens Manufacturing





Magnetorheological Finishing (MRF). The optical surface is polished with a slurry whose shape and location are controlled by magnetic fields controlled in real time by a computer.

## Building Signature Primes

“Building a lens is not so easy,” said Thorsten Meywald. “Along with glass elements and a metal housing, inside every lens are a couple of hundred parts that you cannot see from the outside. It’s sort of like a boat in a bottle, putting all these parts inside the barrel.”

It all starts with the glass. Sometimes you begin with a solid block of glass, but that kind of grinding and shaping is usually for prototypes. More often, pre-formed glass blanks are purchased. They have been pre-shaped to roughly the size and shape of the desired lens element. Then you grind and polish. And yet, all this grinding, polishing and edging is labor-intensive and time consuming. Some of the complex elements in ARRI Signature Primes are made by Precision Glass Molding (PGM) in a single, relatively quick and very accurate process.

Custom-designed precision glass molding machines create complex aspheric elements to micron tolerances. A glass blank is heated to very high temperatures until its consistency is like hot jello. This takes a few minutes and extra care is taken to avoid bubbles. Molds press the glass into its final shape. The glass is then cooled for about half an hour. This is significantly faster than traditional methods.

During our tour of Signature Lens manufacturing, Thorsten explained, “First you need to make a mold as precisely as possible. You need to have the experience to make it and you need the precise technology to measure it. You require the right glass

material and not every kind of glass is suitable. Heating and cooling must be done carefully to prevent air bubbles or cracks. You can get it to an accuracy of less than five microns. And if that is not enough, you can put it on the Magnetorheological Finishing (MRF) machine.

“Traditional polishing can sometimes take several days for one surface. And you need two surfaces. Some aspheres, and especially negative aspheres, are so extreme that traditional polishing would never work. And Precision Glass Molding gives the lens designer more freedom to use very exotic surfaces or shapes for the aspheric elements.

“After inspection and centering, every lens element gets its own special anti-reflection coating. The optical designer together with the coating designer have determined the chemistry of coatings on every surface.

“There are optical designers, mechanical designers, coating designers and now electronic designers because we also have LDS-2 encoders inside.

“The Signature Primes are very lightweight because many elements are thin and the barrels are magnesium. The focus, iris and zoom gear rings are aluminum. You can’t anodize magnesium so we paint it and the paint consists of different layers. There’s a texture to the paint for better grip. And you can hold it with one hand. There are two screw holes at the bottom and on the top for accessories.”

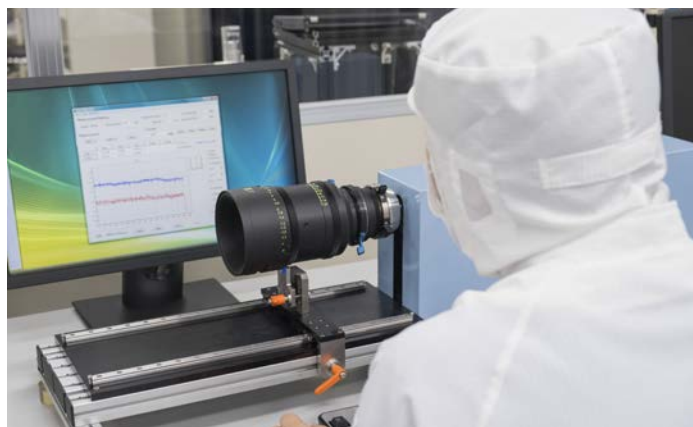


Assembling a lens “like a boat in a bottle” in a very clean room.

## Building Signature Primes



Lens coating.



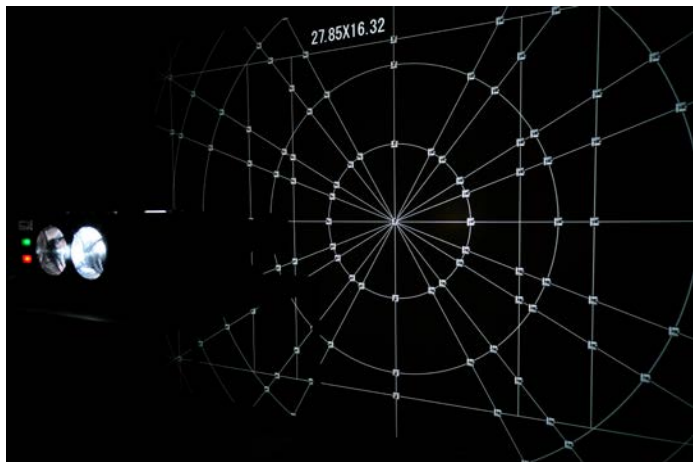
Measuring torque (lens barrel tension) for smooth operation.



MTF testing.

T-Stop tester ensures consistent and correct aperture values.

# LDS-2 Lens Data System



Signature Primes have ARRI's new Lens Data System LDS-2 built in. They have accurate and absolute value encoders, so you no longer have to calibrate end stops with your wireless control every time you change a lens. The camera automatically identifies the position of the encoder and understands the positions of all lens barrels. LDS-2 is backwards compatible with LDS-1 and understands /i Technology. LDS-2 works on the CANbus (Controller Area Network) protocol which was originally developed by Bosch and has been standard on most cars sold in the EU since 2001.



LDS-1 was a proprietary ARRI protocol and was a mystery to most third parties. The new LDS-2 system should be much easier for other companies to work with. Lots of different cameras and lenses coexists on set, and future harmony of metadata and mounts would be nice.

The new LPL mount integrates /i and automatically identifies whether the metadata is LDS-1, LDS-2 or /i. Additionally, motion sensors in the camera provide positioning metadata.



Calibrating LDS-2 lens metadata on prototypes.



ARRI LDS-2 Calibration and testing station.



Prototypes of initial set of Signature Primes, above and right.



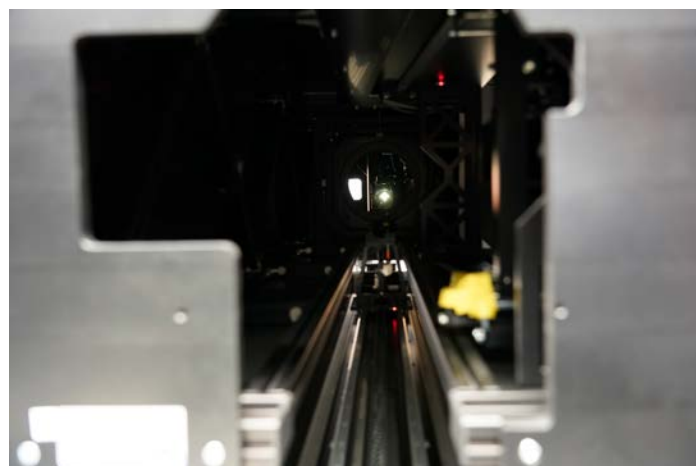
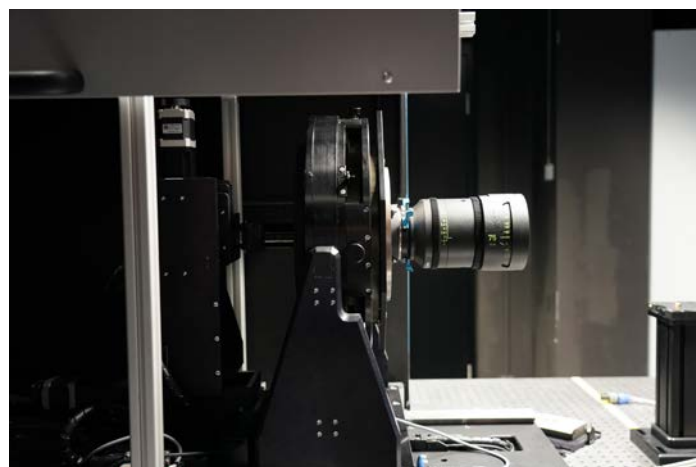
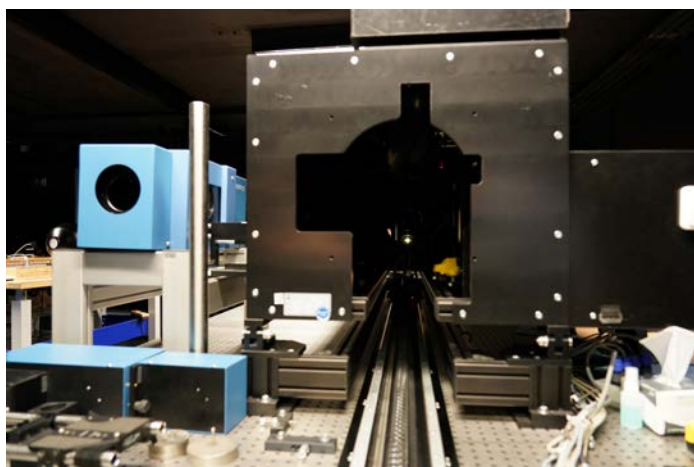


Everything that ARRI builds is tested and tested and QC'd again. Here we are in the underground lair of Dr. Matthias Pesch, Dr. Susanne Fiebig and Thorsten Meywald (above) with their enormous Trioptics ImageMaster Universal MTF optical testing device. It is extremely sophisticated, and measures almost any optical parameter you'd like to know.

In addition to testing MTF (Modulation Transfer Function) to

determine the lens performance, it also measures Effective Focal Length, Flange Focal Distance, Distortion, Field Curvature, Chromatic Aberrations, Astigmatism, Relative Transmission, Vignetting, Field of View, Ray Angle, and Depth of Field.

Opposite, top: an ornate shadow box to test texture and resolution. Opposite middle and bottom: ALEXA LF with Signature Prime is tested for flare, narcissism and car headlight simulation.



# Image Testing



# New LPL Mount

This is the new LPL mount. It attaches to the ALEXA LF camera with 7 screws. The LPL mount has 3 blue ears. The flange focal depth is 44 mm. The inside diameter is 62 mm.

Everything else works pretty much like a PL mount. Rotate the breech clockwise to lock ("Clock to Lock"). Rotate counter-clockwise to unlock.

LDS-2 metadata contacts are at the familiar 12 o'clock position for lens metadata. LDS-2 is backwards compatible with LDS-1 and /i Technology.

By the way, ARRI plans to license the LPL mount and the LDS-2 to third party lens and camera manufacturers at a nominal fee.

## Why did ARRI need a new mount for Large Format?

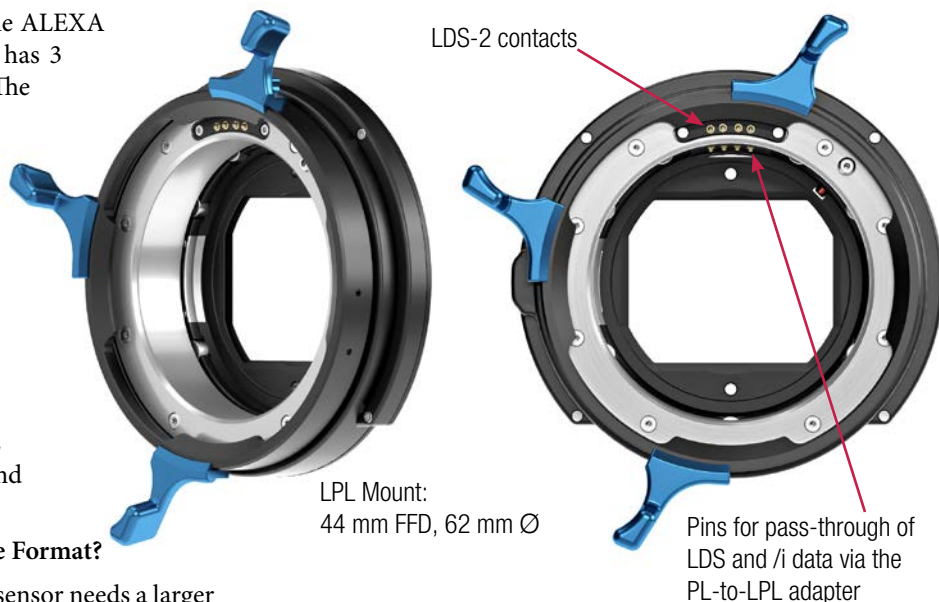
Marc Shipman-Mueller explained, "A larger sensor needs a larger lens mount for optimal lens design. The traditional PL mount compromises full frame lens design—because the PL mount diameter of 54 mm was based on a Super35 image area. The LPL mount has various advantages. It allows lens designers to build full frame lenses that are smaller and lighter with a faster T stop. It also allows a telecentric lens design."

## Why does the new LPL mount have a shorter flange depth (44mm) and wider diameter (62mm) than PL?

Thorsten Meywald replied, "You can make your camera a little bit shorter if you have a reduced flange focal depth (also called flange focal distance or back focus). In the past, this distance was necessary to make room for the spinning mirror shutter. That was the

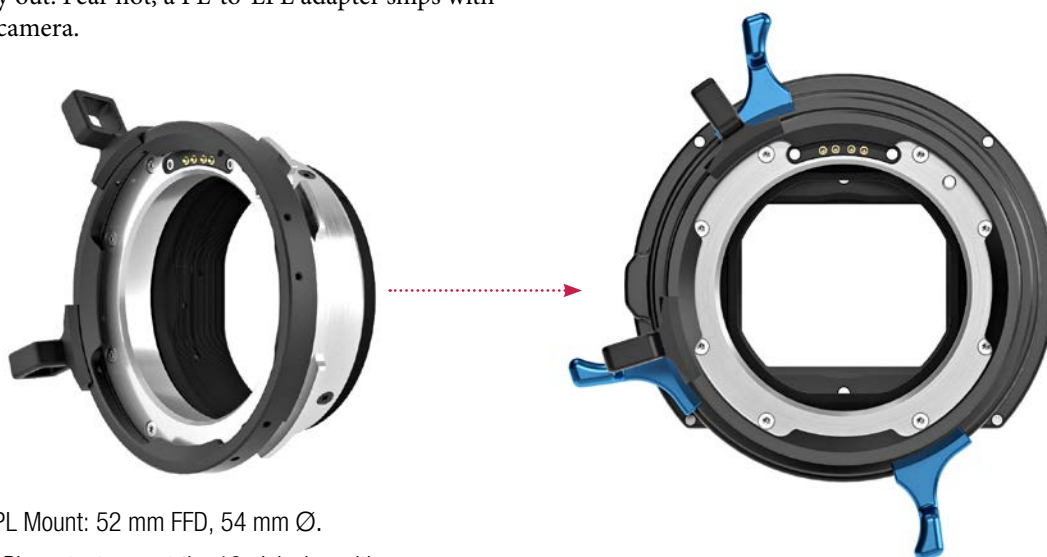
reason for the 52mm flange depth of the PL mount. We don't need that room any longer on our digital cameras. The optical viewfinder is a thing of the past. Also, a shorter back focus distance on the camera enables the use of adapters for a lot of other lenses in the market: M, EF, F, and so on.

This is really a big benefit for cinematographers. Never before have so many lens choices been available: modern lenses, vintage lenses, converted lenses—not only cine, but also from still photography but even from the industrial world. There are so many choices for creativity."



## PL-to-LPL Adapter

"But what about my vast inventory of PL lenses?" I hear a rental house manager cry out. Fear not, a PL-to-LPL adapter ships with every ALEXA LF camera.



PL-to-LPL Adapter. PL Mount: 52 mm FFD, 54 mm Ø.

- LDS-1 and LDS-2 PL contacts are at the 12 o'clock position.
- What happens if you're using an /i lens? Aren't the contacts supposed to be at the 3 o'clock position? Yes. In that case, just rotate the PL-to-LPL adapter 90 degrees clockwise and lock in place.

With the PL-to-LPL adapter in place, it's easy to see which mount is which. The PL mount has 2 traditional black ears. The LPL mount has 3 blue ears.

# LPL and PL Lenses on ALEXA LF

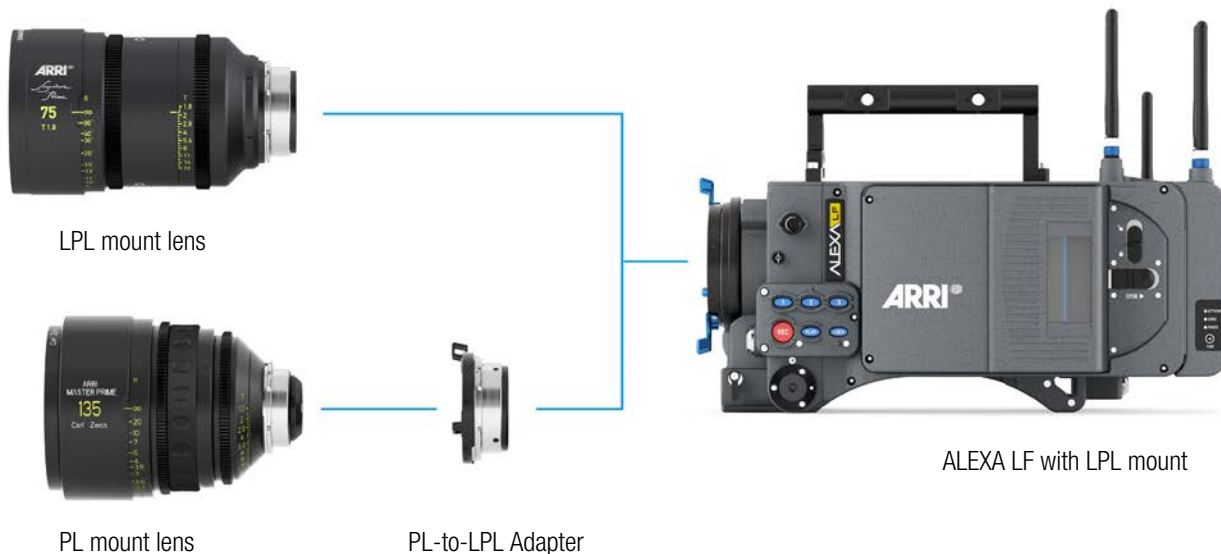
LPL and PL will work together in harmony.

ALEXA LF accepts: LPL lenses and PL lenses with the adapter.

If you're mixing LPL and PL on the same show, you might want to buy extra adapters for each PL lens. History repeats itself. That's what most people did when ARRI switched from bayonet mount to PL mount in 1983.

DPs liked the PL mount so much better and there was a brisk business in bayonet to PL adapters. I suspect the same thing will happen again and the LPL mount will become beloved and ubiquitous. It really is very good.

At this point you may wonder, if the world is going LPL, what happens to all my PL mount cameras?



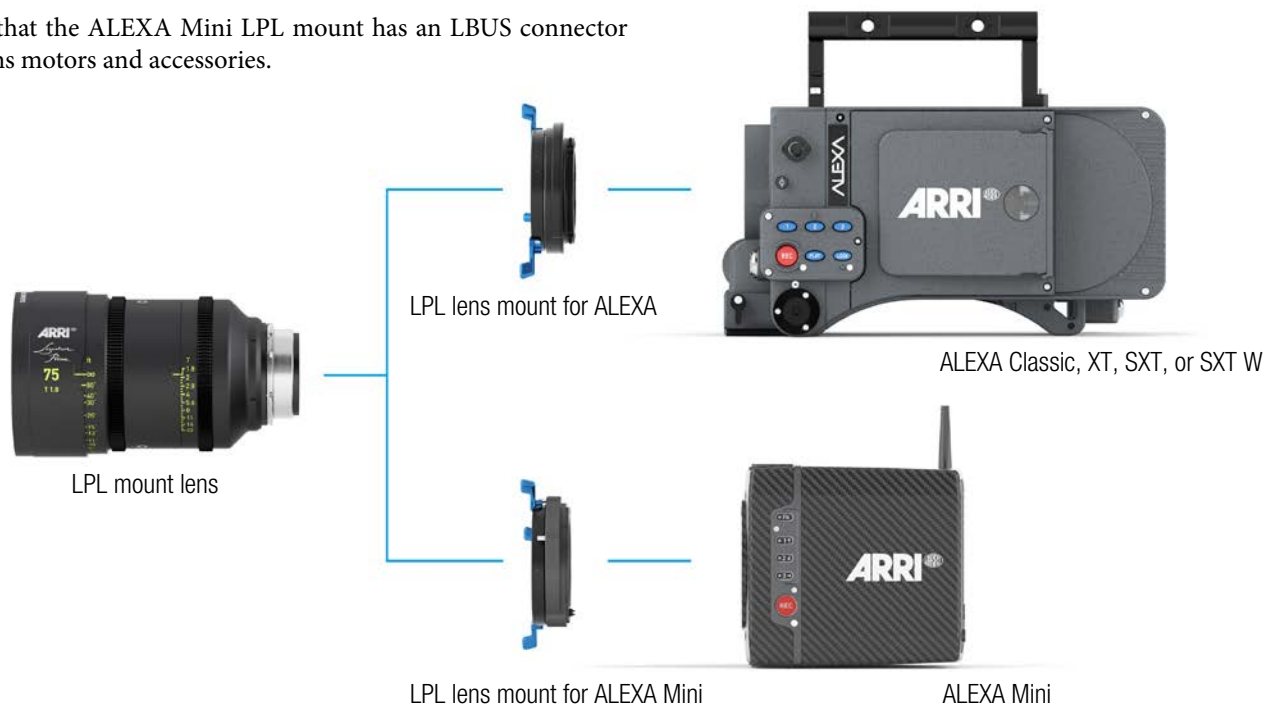
## LPL Lenses on ALEXA Classic, XT, SXT, and SXT W, Mini and AMIRA

Conveniently, the same LPL mount that fits on the ALEXA LF also fits on the ALEXA Classic, XT, SXT, and SXT W. (It will not work on the ALEXA Studio because of its mirror shutter).

However, the LBUS connector is not active when this mount is attached to an AMIRA.

There's also an LPL mount for ALEXA Mini. It fits on the AMIRA as well.

Note that the ALEXA Mini LPL mount has an LBUS connector for lens motors and accessories.



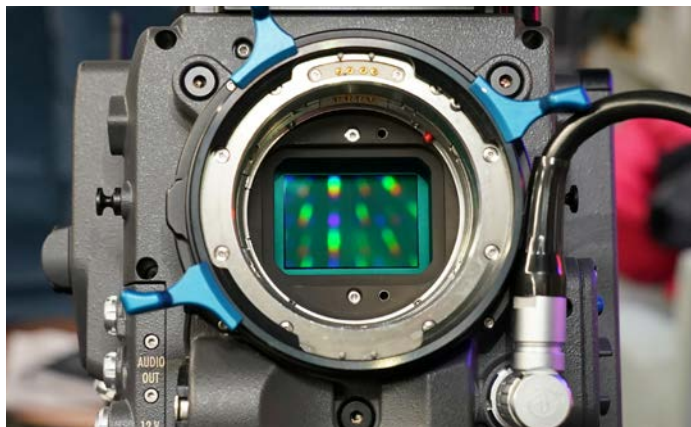
## PL-to-LPL Adapter



PL-to-LPL adapter accepts any PL mount lens on ALEXA LF. The PL mount has 2 traditional black ears. The LPL mount has 3 blue ears.



# Sensor Modes



Remember the 5 C's of Cinematography from film school? ("Composition, Camera Angle, Continuity, Close-Up and Cut.") Haskell Wexler ASC famously recalled only 3 C's, and they were not part of the curriculum: "Cars, Chicks and Cameras."

This "C" chapter is about "Composition." In the digital age, composition is influenced by several things. Among them are aspect ratio, framelines, and cropping. We'll get to those in a minute. Most important is sensor mode.

Sensor Mode is how much of the entire sensor you want the camera to read out. Think of it as the hard matte previously installed in film camera gates. For those of us who were wondering why it took so long for Full Frame (Large Format) cameras to come out, Sensor Mode was a major thing. The larger the sensor, the more area the electronic circuits have to digest. And that is why there has been a compromise of maximum frame rate and resolution and image height. Put another way, the taller the image height, the slower (lower) your maximum frames per second rate will be.

And that is why ALEXA LF has 3 Sensor Modes. They are accessed from the camera menu and there's no need to reboot or do a factory reset when switching sensor modes.

The first Sensor Mode is **LF Open Gate**.

This provides the maximum sensor area, 36.7 by 25.54 mm, and the maximum resolution, 4448 x 3096 photo sites. You need full frame lenses. There is no surround view. Maximum frame rate is 90 fps recording ARRIRAW and 40 fps in ProRes 4444 XQ.

Higher frame rates are possible in ARRIRAW since ProRes requires extra processing steps of de-bayering and compression.

The second sensor mode is **LF 16:9**.

This is the smallest sensor area that meets 4K UHD deliverable standards. Full frame lenses cover the active image area. However, some Super 35 lenses, especially longer focal lengths, will also fill the image circle. More on that later.

Surround view is available to see errant C-Stands and drooping microphones. It is indicated by the dotted yellow line at left.

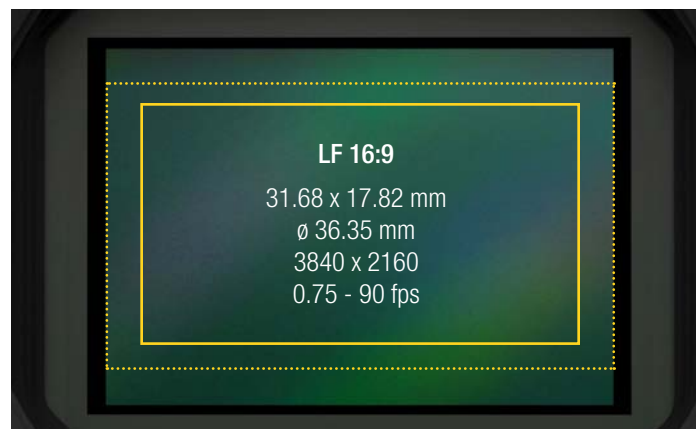
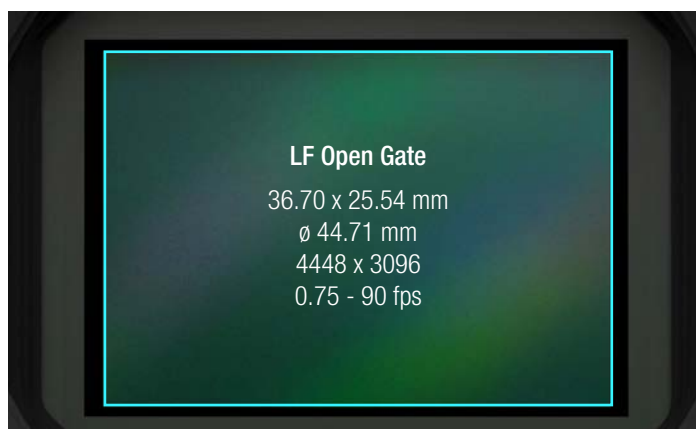
The maximum frame rate is 90 fps in ARRIRAW and 60 fps in ProRes 4444 XQ.

The third sensor mode is **LF 2.39:1**.

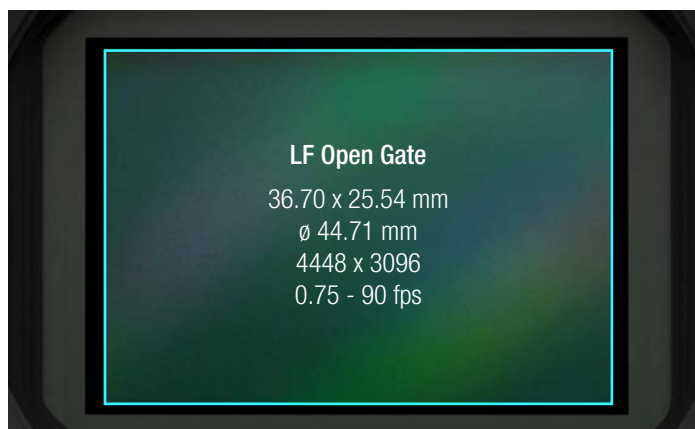
This is for spherical widescreen (non-anamorphic 2.39:1) using spherical Large Format and Full Frame lenses.

There is no surround view. The image height is a "mere" 15.31. This enables a maximum frame rate of 150 fps in ARRIRAW and 60 fps in ProRes 4444 XQ.

I imagine that some cinematographers may ask for surround view safe area top and bottom and would be willing to sacrifice high frame rates for some scenes or perhaps the entire show. Presumably this could be a future SUP software update.



# Frame Rates and Resolution



## LF Open Gate

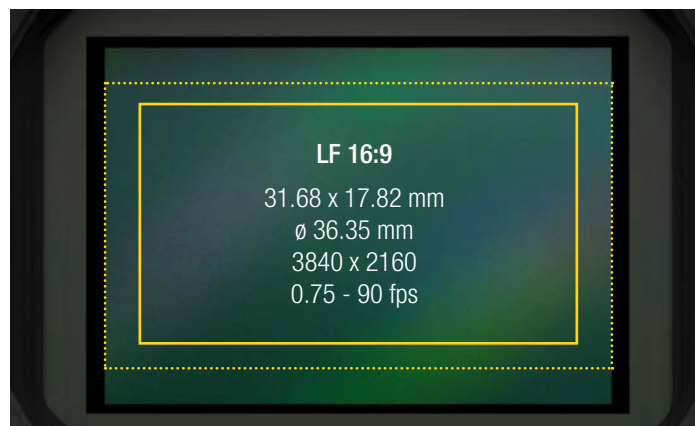
### Maximum fps with SXR Capture Drive

|                |        |
|----------------|--------|
| ARRIRAW        | 90 fps |
| ProRes 422     | 60 fps |
| ProRes 422 HQ  | 60 fps |
| ProRes 4444    | 60 fps |
| ProRes 4444 XQ | 40 fps |

### Maximum fps with SxS PRO+ cards

|         |   |
|---------|---|
| ARRIRAW | — |
| ProRes  | — |

Record ARRIRAW and ProRes at Native Resolution of LF Open Gate Sensor Mode: 4.5K



## LF 16:9

### Maximum fps with SXR Capture Drive

|                |        |
|----------------|--------|
| ARRIRAW        | 90 fps |
| ProRes 422     | 60 fps |
| ProRes 422 HQ  | 60 fps |
| ProRes 4444    | 60 fps |
| ProRes 4444 XQ | 60 fps |

### Maximum fps with SxS PRO+ cards

|                |        |
|----------------|--------|
| ARRIRAW        | —      |
| ProRes 422     | 60 fps |
| ProRes 422 HQ  | 60 fps |
| ProRes 4444    | 40 fps |
| ProRes 4444 XQ | 30 fps |

Record ARRIRAW and ProRes at Native Resolution of LF 16:9 Sensor Mode: 4K UHD. *Also possible to down-sample and record the image to ProRes 16:9 2K or ProRes 16:9 HD.*



## LF 2.39:1

### Maximum fps with SXR Capture Drive

|                |         |
|----------------|---------|
| ARRIRAW        | 150 fps |
| ProRes 422     | 100 fps |
| ProRes 422 HQ  | 100 fps |
| ProRes 4444    | 100 fps |
| ProRes 4444 XQ | 60 fps  |

### Maximum fps with SxS PRO+ cards

|                |        |
|----------------|--------|
| ARRIRAW        | —      |
| ProRes 422     | 90 fps |
| ProRes 422 HQ  | 60 fps |
| ProRes 4444    | 40 fps |
| ProRes 4444 XQ | 30 fps |

Record ARRIRAW and ProRes at Native Resolution of LF 2.39:1 Sensor Mode: 4.5K

## LF 16:9 4K UHD Sensor Mode, Image Circle and Illumination Circle



ALEXA LF 16:9 sensor mode 3840 x 2160 (4K UHD)  
36.35 mm image circle, 31.68 x 17.82 mm image area



ALEXA LF Open Gate 4480 x 3096: 44.71 mm image circle  
36.70 x 25.54 mm image area

I grilled Marc Shipman-Mueller with the same question asked of Stephan Schenk. “Pretend I’m a tough producer obsessing about the cost of 12 extra C-stands, and you’re the DP who wants to shoot with an ALEXA LF. How do you convince me to part with a few dollars more?”

Marc replied, “It should be easy to convince most producers of feature films. Just look at the success of the ALEXA 65. But what about a TV series? With the ALEXA LF, you get ALEXA image quality in 4K HDR. That makes the DP and the producer happy. Most TV series now are being shot in ProRes with SxS PRO cards, and the ALEXA LF can also do that. Same workflow. What about the lenses? Well, we have a sensor mode in the ALEXA LF called “LF 16:9.” That is 3840 x 2160, so still UHD 4K. And it turns out, Master Primes longer than 35mm will cover this LF 16:9 sensor mode. You can use MPs for most shots and rent just one or two Large Format lens for the wide-angle shots. By the way, an MP 35mm with the LF 16:9 sensor mode has the same angle of view as an MP 26mm for Super35 2.8K.”

The image circle of ALEXA LF in 16:9 4K sensor mode is 36.35 mm. Most S35 lenses have image circles originally specified at 29 to 31 mm. See the ARRI Lens Illumination Guide. The longer focal lengths of some additional S35 lenses will cover ALEXA LF 36.35 mm: for example Ultra Primes longer than 20mm. Some zooms as well.

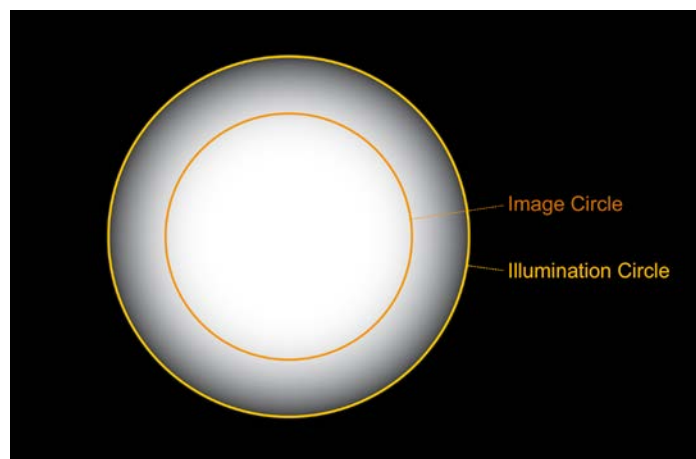
We will have a new vocabulary. There are two circles. There’s the image circle. It’s the area of coverage that optical engineers and manufacturers affirm specified performance of the lens to the edges of frame. And then there’s the illumination circle—where there’s an image, but the optical engineers don’t “guarantee” the quality. We might call it “character.”

Marc continued, “Both circles of most ARRI lenses are very large. This has to do with film—remember that? We wanted to make sure that if a customer shot Super35, but had forgotten to switch the lens mount from N35 to S35, they would still get an image. That is a very obscure piece of historical film-technology trivia by now, but because of that, our lenses have a bigger image circle and a bigger illumination circle than most other Super35 lenses.

And that makes them great for this LF 16:9 sensor mode. Just to be clear, MPs don’t cover the full LF sensor in Open Gate. But, from 35 mm on, they do cover this LF 16:9 sensor mode, which is 4K, and therefore ready for TV shows with a 4K mandate.

**To review: The longer focal lengths of Ultra Primes, Master Primes and some other S35 lenses can cover the larger ALEXA LF 16:9 UHD 4K sensor mode image circle of 36.35 mm.**

Once upon a time, Image Circle was supposed to be a precise measurement. However, one manufacturer’s circle might not be same as the next. And besides, what DP ever accepted specifications as gospel? What if you liked slight shading or softening at the edges? Are image circles the vestiges of an analog age, when film gates were metal and unyielding unless you attacked them with a Dremel Multi Tool?



Perhaps our new vocabulary will rename Image Circles as the diagonal of the camera’s image coverage. And Illumination Circles will define the more artistic areas that a lens might fill.

Despite the panoply of PL lenses out there, ALEXA LF is inviting the use of Large Format lenses that amply cover its full 44.71 image circle. This frontier is so new and exciting, I don’t even yet know what the Illumination Circles of Signature Primes are. Uh-oh—could some of them cover Medium Format Still images?

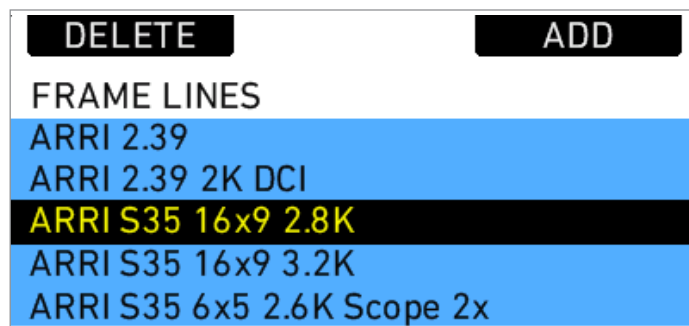
# Framelines

There are 2½ ways to get framelines in your ALEXA LF EVF viewfinder and on the MON OUTs.

1. Stick with the default framelines that can be summoned up from the camera menu, just as before with previous ALEXAs. You can access those from the viewfinder by pressing the EVF button and then using the jogwheel to get to SELECT FRAMELINES, or by going to the camera display on the camera right side and drilling down to: MENU > MONITORING > FRAME LINES. Once selected, these framelines are the same on all outputs.

2. Use the online ARRI Frameline Composer and “build” your own ([arri.com/camera/alexa/tools/arri\\_frameline\\_composer](http://arri.com/camera/alexa/tools/arri_frameline_composer)).

Save the XML file onto a FAT formatted SD card (maximum capacity of 4GB) in the folder ARRI/ALEXA/Framelines. Then, load the SD card into the ALEXA LF SD card slot and press MENU > MONITORING > FRAMELINES > FRAMELINE 1 (or 2) > ADD. This will add your custom framelines to the menu.



Menu showing some of the of available in-camera framelines.

2½. If you need to quickly mark something on screen (maybe the position of a product during a tabletop commercial), ALEXA LF offers USER RECTANGLES. They are simple rectangles that can be custom sized, positioned and turned on/off. Look in the FRAME LINE menu on the EVF and on the camera right display.

## ARRI Frameline Composer

**SENSOR**

Camera: ALEXA LF  
 Sensor Mode: LF Open Gate  
 Lens Squeeze: 2.0x

**▼ FORMAT A**

Aspect Ratio: 2.39:1  
 Style: Full Box regular  
 Shading: none  
 Line Width: 4 Pixel  
 Scaling: 100 %  
 Position H: 50 %  
 Position V: 50 %  
 Format Name: AspectRatio:2.39:1\_Scaling:100

**▼ FORMAT B**

Aspect Ratio: 1.78:1  
 Style: Left/Right regular  
 Shading: none  
 Line Width: 2 Pixel  
 Scaling: 100 %  
 Position H: 50 %  
 Position V: 50 %  
 Format Name: AspectRatio:1.78:1\_Scaling:100

**▶ FORMAT C**

**CENTER MARKER**

Center Marker: Small Cross  
 Align To: Format A  
 Line Width: 4 Pixel

**FRAMELINES**

File Name: FDT Open Gate 2.39 and 1.78  
 Download Frameline File: Download XML  
 Download Preview as Image: Download PNG  
 Save your settings with: Create URL  
 Create a Frameleader: Create Frameleader

**PREVIEW**

**ADVANCED PIXEL CALCULATION**

Format: ARRIRAW  
 Resolution: 4.5K

|  | Format A |        | Format B |        | Format C |        |
|--|----------|--------|----------|--------|----------|--------|
|  | Width    | Height | Width    | Height | Width    | Height |
| <b>Sensor</b>  | 4448     | 3096   | 4448     | 3096   | 4448     | 3096   |
| <b>SensorArea</b><br><span style="border: 1px solid #ccc; padding: 2px;">mm</span> | 36.70    | 25.54  | 36.70    | 25.54  | 36.70    | 25.54  |
| <b>Recording</b>   | 4448     | 3096   | 4448     | 3096   | 4448     | 3096   |
| <b>Frameline</b>   | 3696     | 3096   | 2752     | 3096   | 0        | 0      |
| <b>Offset Left</b>   | 376      |        | 848      |        | 0        |        |
| <b>Offset Top</b>  | 0        |        | 0        |        | 0        |        |

version info: AFLC-4.1 build 1024

# Framing Chart and Cropping in Post

ALEXA LF essentially has 3 “format masks:” LF Open Gate, LF 16:9 and LF 2.39:1.

Within those sensor modes, you can compose and create any frameline or aspect ratio your creative heart desires, but the camera will not window or crop beyond those 3 Sensor Modes.

That’s not a bad thing. It just requires cropping in post. DaVinci Resolve and other finishing tools are good at this and do it all the time.

Don’t forget, “The projectionist has final cut.” If you don’t want to leave the final framing up to the projectionist or a random person who happened to be in the post house finishing suite, be sure to shoot a framing chart. The online ARRI Frameline Composer

does a great job helping you to print a chart that corresponds exactly to the way you see it.


You definitely should shoot the chart at the beginning of the job. It doesn’t hurt to repeat at the beginning of each day, especially for the nice folks who do your dailies.

The example on the previous page and below shows framing and cropping for a format that’s increasingly popular for commercials and some TV series. Shoot anamorphic 2x for a 16:9 release on TV. The left and right sides are pillared and cropped.

Note that we defined the frame as LF Open Gate, 2x lens squeeze, 2.39 aspect ratio, full height.

Quiz: Which lenses do that? (A: Scorpio FFA 2x Anamorphics.)

ARRI Frameline Composer Framing Chart



Title

Director

DoP

Text1

Text2

Siemens stars

Sensor Area Pitch

ARRI Logo

ARRI Rental Logo

Arrow Format A

Show Format A:

Show Format B:

Show Format C:

Center Marker

Background image

Download Frameleader

2.39:1 and 1.78:1

Epic Productions

Itsy Bitzer

Sensor area pitch:  
1.44inch x 1.01inch  
36.70mm x 25.54mm  
4448pixel x 3096pixel

Format A 2.39:1

Sample Text 1

Sample Text 2

☒ center ON/OFF

☒ corners ON/OFF

☒ ON/OFF

☒ ON/OFF

☐ ON/OFF

☒ ON/OFF

☒ ON/OFF

☒ ON/OFF

none

Choose File no file selected

svg

Download Image

Font

Font

Font

Font

Font

Size

Size

Size

Size

Size

30

30

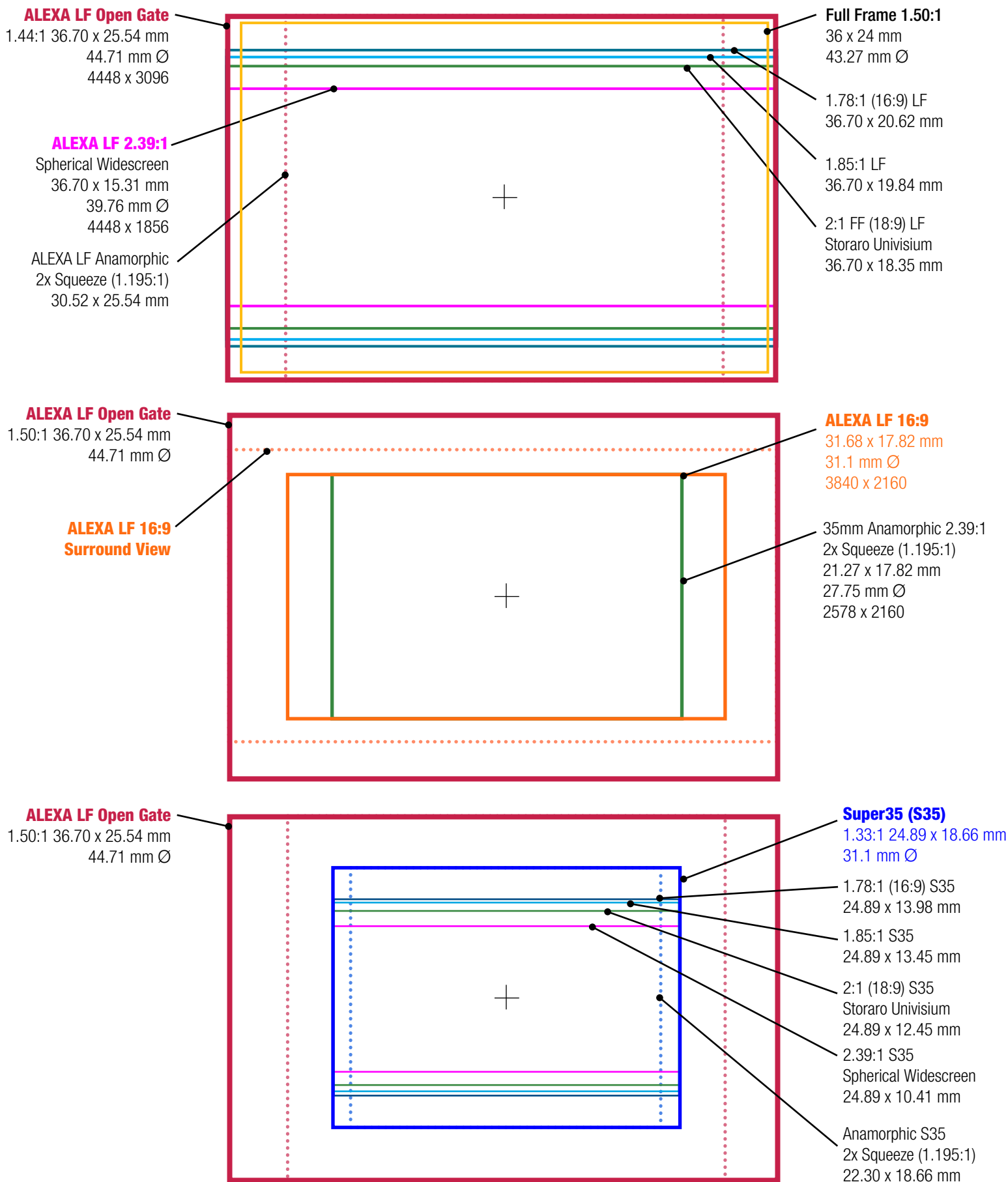
30

30

10

# Framelines

The Large Format Sensor makes a multitude of compositions, aspect ratios and framelines possible



# Large Format Math

## S35 32 mm lens

ARRI/ZEISS Master Prime 50/T1.3 depth-of-field table in feet

| Distance<br>feet | T1.3       |           | T2        |           | T2.8      |           |
|------------------|------------|-----------|-----------|-----------|-----------|-----------|
|                  | from       | to        | from      | to        | from      | to        |
| INF              | 290'       | INF       | 217'      | INF       | 133'      | INF       |
| 60'              | 50'        | 76'       | 47'       | 97'       | 41'       | 118'      |
| 30'              | 27' 3"     | 33' 7"    | 26' 5"    | 37'       | 25'       | 40'       |
| 20'              | 18' 9"     | 21' 6"    | 18' 5"    | 22' 10"   | 17' 6"    | 23' 10"   |
| 15'              | 14' 4"     | 15' 10"   | 14' 1"    | 16' 6"    | 13' 7"    | 17'       |
| 12'              | 11' 6 3/4" | 12' 6"    | 11' 5"    | 12' 11"   | 11' 1"    | 13' 3"    |
| 10'              | 9' 8 1/4"  | 10' 4"    | 9' 7"     | 10' 8"    | 9' 4"     | 10' 10"   |
| 9'               | 8' 9"      | 9' 3 1/4" | 8' 8"     | 9' 6"     | 8' 6"     | 9' 8"     |
| 8'               | 7' 9 3/4"  | 8' 2 1/2" | 7' 9"     | 8' 4 1/2" | 7' 7"     | 8' 6"     |
| 7'               | 6' 10 1/4" | 7' 2"     | 6' 9 3/4" | 7' 3 1/2" | 6' 8 1/4" | 7' 4 1/2" |

## LF 50 mm lens

ARRI/ZEISS Master Prime 32/T1.3 depth-of-field table in feet

| Distance<br>feet | T1.3      |         | T2     |        | T2.8   |        |
|------------------|-----------|---------|--------|--------|--------|--------|
|                  | from      | to      | from   | to     | from   | to     |
| INF              | 110'      | INF     | 90'    | INF    | 61'    | INF    |
| 60'              | 39'       | 130'    | 36'    | INF    | 30'    | INF    |
| 30'              | 24'       | 41'     | 23'    | 57'    | 20'    | 87'    |
| 20'              | 17' 1"    | 24' 3"  | 16' 6" | 29'    | 15' 3" | 35'    |
| 15'              | 13' 4"    | 17' 3"  | 13'    | 19' 6" | 12' 2" | 22'    |
| 12'              | 10' 11"   | 13' 4"  | 10' 8" | 14' 8" | 10' 2" | 16'    |
| 10'              | 9' 3"     | 10' 11" | 9' 1"  | 11' 9" | 8' 8"  | 12' 7" |
| 9'               | 8' 5"     | 9' 9"   | 8' 3"  | 10' 5" | 7' 11" | 11'    |
| 8'               | 7' 6"     | 8' 7"   | 7' 5"  | 9' 1"  | 7' 2"  | 9' 7"  |
| 7'               | 6' 7 1/2" | 7' 5"   | 6' 7"  | 7' 10" | 6' 4"  | 8' 2"  |

An LF 50 mm lens has about the same field of view as an S35 32 mm lens. As the ARRI/ZEISS Master Prime Depth of Field Charts above show, at 8 feet, the Large Format 50 mm at T2.8 has the equivalent DOF as an S35 lens 32 mm at T1.3.

The trick is to use the same set of charts. It doesn't matter that one lens is LF and the other is S35. Don't fall into the trap of using online charts where you enter format size, which is irrelevant. What's important is that the circles of confusion (CoC) are the same for both. This is counterintuitive to the film days where you consulted different charts for 16mm and 35mm, because the CoCs were different.

**So, the difference in depth of field between LF and S35, comparing lenses with the same angle of view, is the equivalent of about 2 stops.**

As Uwe Eckerl (IB/E Optics) reaffirms, "It is important to mention Circle of Confusion (CoC.) In the digital world, CoC relates somewhat to pixel size. This is especially true comparing ALEXA cameras, which all have the same pixel size, whether S35, LF or 65. Also, it is important to emphasize using the same angle of view, the same object size with different working distances."

**To choose a Large Format lens with the same angle of view as your familiar Super35, multiply the S35 lens by 1.5. Or divide the LF lens by 1.5 to find the comparable S35 focal length.**

Some people use a factor of 1.4. It depends on whether you're comparing with 'Scope, Academy or various other sensor FF (36 x 24 mm), at 36.70 x 25.54 mm.

## Large Format (Full Frame) Q & A

### Whom do ARRI ALEXA LF cinematographers join?

They "rediscover" the format that millions of Leica, Canon, Sony, Nikon and other still camera users have been shooting in for almost a century.

ALEXA LF is a whisker wider than FF. FF is 36 x 24 mm. ARRI LF is 36.70 x 25.54 mm.

In addition to the new ARRI Signature Primes, there are many additional choices of Full Frame and Large Format cine lenses that are already here: from Leica, Cooke, ZEISS, Sigma, Angénieux, IB/E Optics, Panavision, ARRI, Schneider, Canon, Sony and others.

These and many more FF still photography lenses can be used directly, or with mount adapters, on ALEXA LF. The nice thing about its shorter, 44 mm flange focal depth is the ability of the camera to accept lenses that come in many different mounts.

*Jumping into this big world of Large Format cinematography, it is helpful for to look again at the simple, but not always intuitive, math in figuring out focal length equivalents and depth of field differences between the Super35 we've known and the Large Format we're rediscovering.*

**Q: You have a Super35 format 12mm lens. What is the Large Frame equivalent to get the same angle of view?**

A: 18mm. Multiply the S35 focal length by 1.5. For the same angle of view, a 12mm in S35 is similar to an 18mm in Large Format.

**Q: What happens when you put an S35 lens on ALEXA LF?**

A: It works fine. You can still shoot with S35 PL mount lenses on ALEXA LF with the PL-to-LPL mount adapter. You can compose for S35 and crop in post.

**Q: What happens with a Large Format lens like a Signature Prime on a Super35 camera like ALEXA SXT?**

A: The LF lens looks the same as the S35 lens. An 18mm LF lens on the S35 camera looks just like an 18mm S35 lens on the S35 camera.

**Q: I have an ALEXA S35 with a Signature Prime 40mm LF lens at T2. How would that compare with the same ALEXA S35 camera using a Master Prime 40mm S35 lens at T2? Will they look the same in both Depth of Field and Field of View?**

A: Yes.

**Q: Is the depth of field the same for a 12mm Master Prime S35 lens and an 18mm Signature Prime lens at the same aperture?**

A: No. The depth of field is not the same. At the same aperture, you get the equivalent of 2 stops less (shallower) depth of field with the LF lens compared to Super35. The Signature Prime LF 18mm lens at T2.8 has the equivalent depth of field of the Super35 Master Prime 12mm lens at T1.4.

Careful: as mentioned earlier, when calculating, use the same circle of confusion (e.g. 0.03mm / 0.001 inch), or the same set of lens charts. Do not be tempted to consult separate LF and S35 charts—because they usually calculate by using different CoC values.

And what of a Signature Prime lens wide open at T1.8? Remember the 2-stop difference. Wide open, these lenses afford the shallowness of a Super35 lens hovering around an equivalent of T0.9.

DPs love these new creative possibilities. Camera Assistants, facing matters of life and depth, can be confident in their talents and the help of wonderful new focus assist tools that make life with Large Format a rewarding adventure.



Cinematographer Matias Boucard and Trinity Stabilizer operator Junior Luciano on location in Bangkok, Thailand with ALEXA LF and ARRI Signature Primes



**JON FAUER:** How did you first learn about the new ALEXA LF camera and Signature Primes?

**MATIAS BOUCARD:** At IBC in September, Natasza Chroscicki and Natacha Vlatkovic from ARRI France asked if I would like to visit the factory in Munich. As an owner of ARRI cameras, I was interested in seeing how an ALEXA was made.

I visited ARRI in November. Then, suddenly Marc Shipman-Mueller and Susi Mayer appeared and asked if I would like to see something secret and new. A few minutes later, I was looking into the eyepiece of the prototype ALEXA large format camera. I know from experience that the first 5 minutes that I have with a camera and a lens are precious and essential to really feel if I like the look or not. Because ARRI used one of my commercials (Nike "Da Da Ring") for their HDR demo reel, they asked me if I would like to be one of the first to do a test with the new camera system. 10 days later, I was in Bangkok shooting a commercial and that proved to be a good location for the test.

I had recently worked with ALEXA 65, and also RED VV, so maybe that's why ARRI thought of me to do the Large Format demo. It was an honor and a pleasure.

**What was the concept and where were the locations?**

We shot in Bangkok's Chinatown, in an old hotel above a cinema theater, in an old polo club outside Bangkok, and in a Buddhist temple. I was looking for locations with texture and lots of personality. I knew that with a small crew and local casting I need strong and cinematic locations. The concept was really simple, not

trying to build a proper story, but give to the audience enough visual material with the casting and the locations to let them build their own story. I didn't want the story to overshadow the performance of the ALEXA LF camera and the lens. It's a test; it's not a short movie. At some point, it's like a trailer. You feel backstory between the characters or you just see the moment.

**Tell us about the crew and logistics.**

I was shooting in Thailand before the test with La PAC, a French production company. I asked them if they could help me with support. We asked the executive Thai production company TA PROD and the producer Serge Timbres to help us to organize the shoot.

I asked for a really small crew to be able to catch real-life moments, because everything happened so quickly and we had such a short schedule for prep and shoot. My plan was to organize a traditional film crew but be able to switch into a documentary mode when we needed.

We had a fantastic crew. Everybody was so involved and excited about the project. We did it like a passion project, and the more we shot with the camera and lenses, the more everybody was motivated by the footage. It was really exciting to discover the performance of the camera at the same time as we were shooting. Normally I come on the shoot with a solid knowledge about the lens and the camera that I use. Here, except for the ALEXA look, everything was different.

We had 2 camera assistants: a focus puller and a 2nd assistant.

# Matias Boucard

Christoph Beckmerhagen flew in from ARRI Munich to help us with the camera and the data. We had 2 grips and 2 electricians to work with our Trinity rig operator and to run a generator for the batteries. We didn't have any make up or hair stylists. I was focused on presenting the LF as naturally as possible, with a small crew, to show how the camera system is easy to use.

For me that method was the best way to present the camera. It was only the camera, and not me, doing the look. So, people can see the performance of the camera and not my taste or my look.

We had the chance to put the ALEXA LF on a Trinity Rig 5-axis camera stabilizer. Junior Luciano did an amazing job on the project. He flew in from Shanghai right after a shoot to work with us.

I did the first day in Chinatown in the hotel and on the street with a slider and handheld using an Easyrig. On the second day, we shot in the Polo Club, Buddhist Temple and Thai Kickboxing location with the Trinity. I love movement and Junior is a really good operator and a good production partner. It was good to work with him, for example, on the Pool sequence where the Trinity rig gave us so much flexibility. He was able to move around the pool table as he wanted, without any restriction.

I like to shoot low angles sometimes. The fact that you don't have to do any technical changes to go from high to low mode helped us a lot. With the young girl, I was able to put the camera wherever we wanted, following her improvised movements without any restriction.

## Lighting?

I used a foamcore to bounce natural light, and I used a SkyPanel at times. Mostly, it was natural, available light—just working with the natural contrast of the location. My goal was to work as simple and quickly as possible. I did the demo with non-professional actors so we had to be flexible.

## ARRI Signature Prime Lenses.

We worked with 3 prototype Signature Prime lenses: 35, 47 and 75 mm—wide open at T1.8. We used ND filters to maintain maximum aperture even in bright sunlight. The primes are very lightweight and are all the same size. That is convenient on set when you only shoot with primes and you want to be fast. (You don't have to reposition mattebox, follow focus or lens motors.) In the beginning, I was worried about not having a focal length wider than 35mm, because what I like about Full Frame is working with wide angle, shallow depth of field combined with low distortion.

Ultimately, I was really delighted by the 35mm Signature Prime. I used it a lot for wide shots and close-ups, without any restrictions. I played with all 3 lenses, without thinking, just testing and using each one. I was continuously surprised: everything that I saw was organic. We would put each lens on the camera and something exciting would happen in front of us. It was exciting to discover the beginning of a new look with this camera and lens system and to be the first to test. It was truly an honor to learn how it reacted to highlights, shadows, color and contrast.

I was surprised how the camera and lenses offered something new in the continuity of the ALEXA experience. It was such a pleasure to see new lenses with character, not trying to copy a vintage look. You can feel that the lens department at ARRI listened to the industry and avoided building a "perfect tool" like the Master

Primes.

I happen to love Master Primes, but with the Signature Primes, I feel that ARRI tried to redefine their legacy in a new series of lenses that make a statement about new creative potentials. They venture into the unknown where it's difficult to decide exactly when an optical artifact is good or not, when you have to correct it or not, but it's exactly where you have to trust yourself and what you see and just ask yourself if you like it and if it's telling you something. Otherwise you just correct all the artifacts and you create perfection. I'm not sure that art demands perfection.

## Your impressions about the look of the Signature Primes.

For me, the look of ALEXA LF and Signature Primes is organic. You can feel that these lens have been created after 10 years of ARRI's experience working in digital, trying to combine some of the knowledge that we learned with the comeback of vintage lenses, and moving beyond. They have a real identity when you combine them with the camera. It's exciting because they have been made at the same time as the camera. They are created to work with the ALEXA LF and help contribute to this new look. You need them for the high resolution of the LF; you need a lens that is more organic. In my mind, it's like closing your eyes and touching a piece of wood. You feel that it's organic, soft and warm. It's natural.

## What are your overall comments about the ALEXA LF camera and the Signature Primes?

For me, the best thing about the higher resolution of the camera is its color, contrast and palette. This camera is part of the ALEXA family—it just happens to be higher resolution because the sensor is bigger. This higher resolution is not compromised by a look that is too metallic. It's really something new in the continuity of ARRI cameras between ALEXA Super35 and ALEXA 65.

You have the same experience as you do when shooting with ALEXA XT and at the same time the higher resolution, combined with the quality of the ALEXA sensor, brings you to another level. The skin tones are impressive. After years of shooting ALEXA Super35, it's really pleasant for me to see a new look without having to re-learn a new technology.

On our test shoot, after the first 5 minutes, I was shooting as if I had an ALEXA XT in my hand, without doing anything special. Just the large format look and the picture was different; the tool that you have in your hand is still the same. Another good thing is that now you have 150 fps in ARRIRAW. That is an excellent speed for many slow-motion sequences.

As I said earlier, the combination of resolution and the look of the lens creates something really special. For example, when I was shooting in the boxing training camp, everything was lit by fluorescents. I was very happy to see a bit of flare around the lights, not having hard edges, but also the flare was contained and not washing out the rest of the image. The resolution of the camera helped me to keep details everywhere and keep a nice color contrast.

Now you can shoot with an ALEXA in true 4K for shows like Netflix, with an easy workflow. What I especially like is that ALEXA LF is not just more pixels in the same sensor, it's more pixels in a larger sensor, with the quality we are familiar with, and without making any compromises.







# The ALEXA LF System



ARRI Signature Prime Lenses



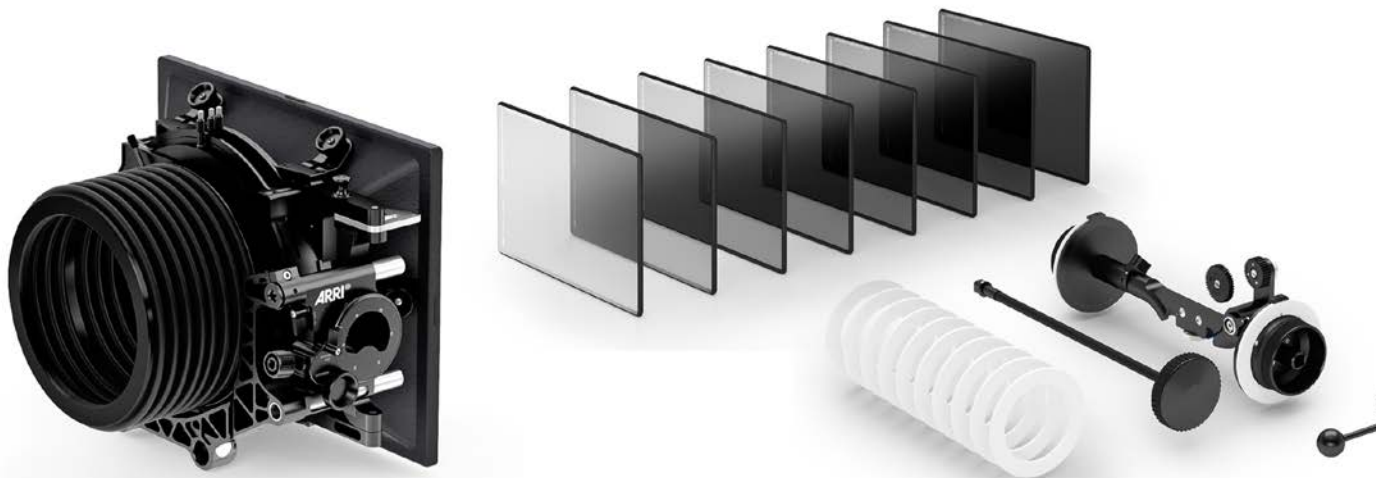
ARRI Cine Lenses



CLM-3, CLM-5, cforce mini  
and cforce plus lens motors



WCU-4 Wireless Control Unit



ARRI PCA Professional Camera Accessories

# The ALEXA LF System



ARRI ALEXA LF with Signature Prime, Viewfinder, Viewfinder Bracket



ALEXA Accessories



ARRI Camera Stabilizer Systems



Transvideo Starlite ARRI-WVS with wireless video receiver



ARRI DMS-1 Duo set for two-camera setups: 2 Transvideo Stargate monitors and 2 WVR-1 Receivers.



ARRI Workflow

# ARRI ALEXA LF



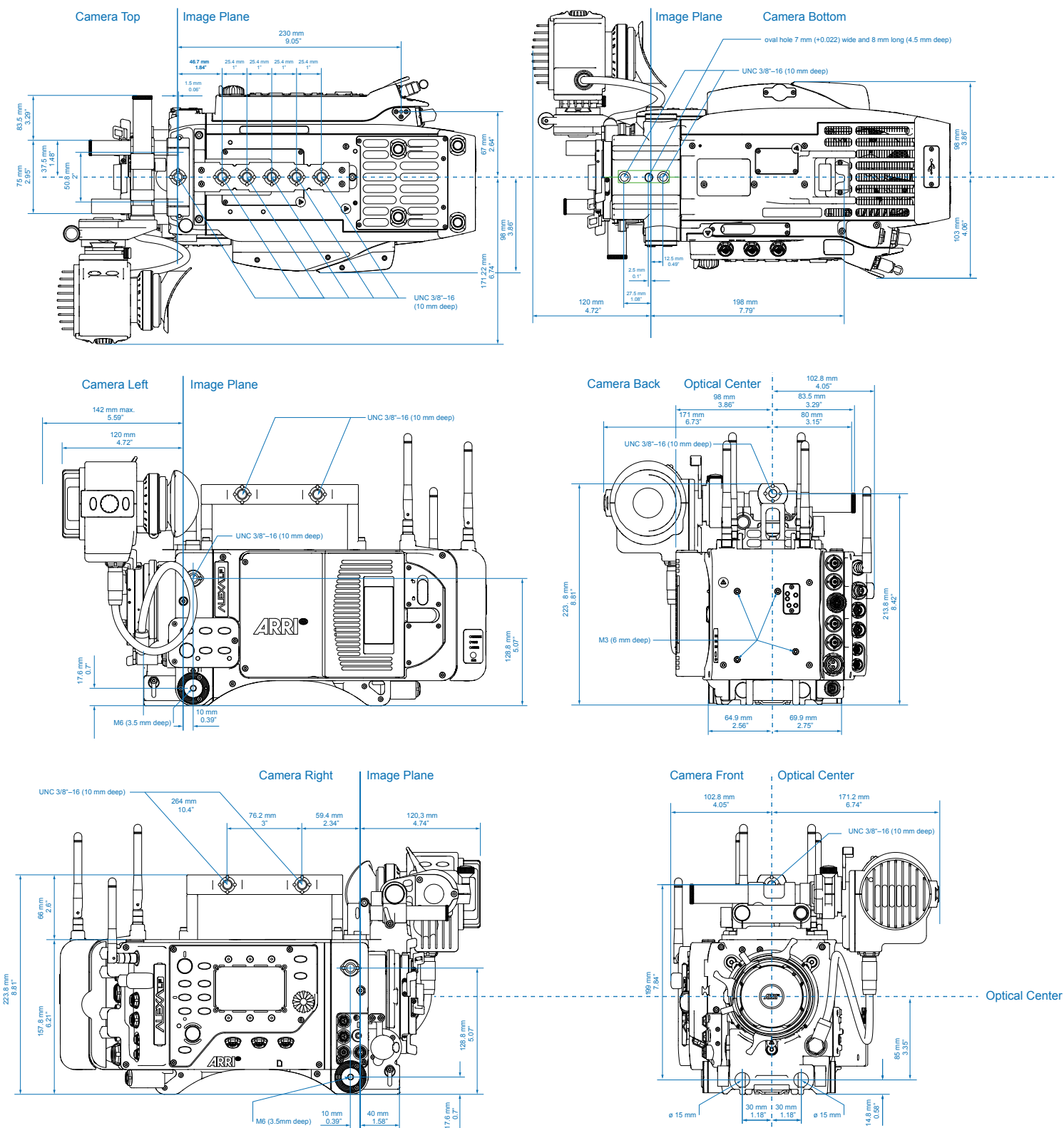
# Dimensions

## ALEXA LF



CAMERA DIMENSIONS – Version 2018-01

Technical Data are subject to change without notice.



### ALEXA LF

|   | Length          | Width          | Height         | Weight           |
|---|-----------------|----------------|----------------|------------------|
| Body + LPL mount  | 351 mm - 14.33" | 201 mm - 7.91" | 158 mm - 6.22" | 7.8 kg - 17.2 lb |
| Body + LPL mount<br>Electronic Viewfinder EVF-1, EVF-1 cable KC-150-S,<br>Viewfinder Mounting Bracket (VMB-3) | 414 mm - 16.3"  | 251 mm - 9.88" | 224 mm - 8.82" | 9.4 kg - 20.7 lb |



Above, from left to right *standing*: Stephan Schenk, Walter Trauninger, Henning Rädlein, Matthias Pesch; *sitting*: Harald Brendel, Dr. Achim Oehler, Susanne Mayer, Thorsten Meywald, Klemens Kehr, Marc Shipman-Mueller, Frederic Merten, Dr. Tamara Seybold, Christoph Beckmerhagen.



Achim Oehler and Marc Shipman Mueller



Thorsten Meywald

# ALEXA LF Specifications

|                     |  |
|---------------------|--|
| Camera Type         | Large Format (LF) film-style digital camera<br>with LF Open Gate, LF 16:9 and LF 2.39:1 switchable active sensor area<br>EVF electronic viewfinder<br>Built-in radios for the ARRI Wireless Remote System, ARRI Wireless Video System and WiFi,<br>Built-in LF FSND filter holder,<br>Lens Data System LDS-1, LDS-2, /i<br>Integrated shoulder arch and receptacles for 15 mm lightweight rods<br>Capable of High Dynamic Range and Wide Color Gamut recording and monitoring. |
| Sensor              | Large Format (36.70 x 25.54 mm) ALEV III CMOS sensor with Bayer pattern color filter array   |
| Sensor Modes        | Sensor Mode LF Open Gate (36.70 x 25.54 mm, Ø 44.71 mm)<br>4448 x 3096 used for LF Open Gate ARRIRAW 4.5K<br>4448 x 3096 used for LF Open Gate ProRes 4.5K   |
|                     | Sensor Mode LF 16:9 (31.68 x 17.82 mm, Ø 36.35 mm)<br>3840 x 2160 used for LF 16:9 ARRIRAW UHD<br>3840 x 2160 used for LF 16:9 ProRes UHD<br>3840 x 2160 down sampled to 2048 x 1152 for LF 16:9 ProRes 2K<br>3840 x 2160 down sampled to 1920 x 1080 for LF 16:9 ProRes HD  |
|                     | Sensor Mode LF 2.39:1 (36.70 x 15.31 mm, Ø 39.76 mm)<br>4448 x 1856 used for LF 2.39:1 ARRIRAW 4.5K<br>4448 x 1856 used for LF 2.39:1 ProRes 4.5K  |
| Operating Modes     | LF Open Gate, LF 16:9 or LF 2.39:1 sensor modes. Switching takes approx. 20 seconds.<br>All sensor modes available in ARRIRAW and ProRes.  |
| Frame Rates         | ARRIRAW<br>LF Open Gate 0.75 - 90 fps<br>LF 16:9 0.75 - 90 fps<br>LF 2.39:1 0.75 - 150 fps   |
|                     | ProRes<br>LF Open Gate 0.75 – up to 60 fps<br>LF 16:9 0.75 – 60 fps<br>LF 2.39:1 0.75 – up to 100 fps  |
|                     | All speeds adjustable to 1/1000 fps increments.<br>Some limitations based on recording media or recording format.  |
| Shutter             | Electronic rolling shutter, 5.0° - 358.0° up to 60 fps; 5.0° to 356° above 60 fps.<br>Shutter angle adjustable to 1/10 degree increments.  |
| Cover Glass Filters | Permanent cover glass filters in front of the sensor: Optical low pass (OLPF), UV, IR.   |
| Filters             | Includes a built-in Internal Filter Module (LF IFM) filter holder that accepts one of eight (ND 0.3 to ND 2.4) Large Format Full Spectrum Neutral Density (LF FSND) filters that are swapped manually.<br>They are not held in with magnetics like SXT, but spring loaded.   |
| Exposure Latitude   | 14+ stops for all sensitivity settings from EI 160 to EI 3200, as measured with the ARRI Dynamic Range Test Chart (DRTC).  |
| Exposure Index      | EI 800   |
| White Balance       | Presets for 3200 (tungsten), 4300 (fluorescent), 5600 (daylight) and 7000 (daylight cool). Automatic calculation or manual white balance for 2000 to 11000 Kelvin, adjustable in 100 K steps.  |
| Color Correction    | While white balance changes the red/blue hue of the image, color correction changes green/magenta. Adjustable range from -12 to +12 CC.<br>(1 CC corresponds to 035 Kodak CC values or 1/8 Rosco values.)  |
| Sound Level         | ≤ 20 db(A) while recording LF Open Gate ProRes 4.5 K 4444 @ 30 fps and ≤ +30° Celsius (≤ +86° Fahrenheit) measured 1 m / 3 feet in front of the lens.  |

# ALEXA LF Specifications

|                           |   |
|---------------------------|---|
| Power In                  | <p>3 possible inputs: BAT connector<br/>Optional Battery Adapter Back (V-Mount or Gold Mount),<br/>Optional Battery Adapter Top</p> <p>All inputs accept 11.5 - 34 V DC.</p> <p>Approx. 137 W power draw for camera and EVF-1 in typical use recording ProRes at 24 fps to an SXR Capture Drive at room temperature, without accessories. Initial power draw during power up is higher.</p>   |
| Power Out for Accessories | <p>12 V connector: limited to 12 V, up to 2.2 A.</p> <p>RS, EXT and ETHERNET: input below 24 V is regulated up to 24 V; above 24 V: input voltage = output voltage.</p> <p>RS and EXT connectors combined are limited to 2.2 A.</p> <p>ETHERNET is limited to 1.2 A.</p> <p>Maximum power draw is also limited by the power source.</p>   |
| Weight                    | <p>ALEXA LF body with LPL mount: 7.8 kg / 17.2 lb</p> <p>ALEXA LF body with LPL mount, electronic viewfinder, viewfinder cable, viewfinder mounting bracket and handle: 9.4 kg / 20.7 lb</p>  |
| Dimensions                | ALEXA LF body with LPL mount: Length: 364 mm / 14.33", width: 201 mm / 7.91", height: 158 mm / 6.22"  |
| Hostile Environments      | -20° C to +45° C (-4° F to +113° F) @ 70% humidity max, non-condensing. Splash and dust-proof with sealed electronics. System cooling through radiator / single fan.  |
| Lens Mount                | LPL mount. 62 mm Ø stainless steel. Supports LDS-1, LDS-2 and /i. 44.00 mm nominal flange focal depth without LF FSND filters. Compatibility with PL Lenses using supplied ARRI PL-to-LPL Adapter.  |
| Other Lens Mount Options  | The easily-exchangeable lens mount (7 screws) allows other non-LPL mount lenses to be used.   |
| Viewfinder (EVF-1)        | Low latency ( $\leq 1$ frame delay) electronic color viewfinder with 1280 x 784 F-LCOS micro display (image: 1280 x 720, status bars: 1280 x 32 above and 1280 x 32 below image) and ARRI LED illumination, temperature controlled. Image can be flipped to use viewfinder on camera left or right side. Viewfinder Mounting Bracket allows movement of viewfinder forward/backwards, left/right, up/down, 360 degree rotation and placement on camera left or right. EVF-1 controls: viewfinder and basic camera settings, ZOOM button, EXP button (false color exposure check) and jog wheel. |
| Assistive Displays        | For EVF-1 and MON OUT: preset and custom frame lines, user rectangles, surround view, 180° image rotation, camera status, false color exposure check, peaking focus check, compare stored image with live image, RETURN IN video and anamorphic de-squeeze (1.25x, 1.3x, 1.5x, 2.0x). For MON OUT, additionally: Reel & clip number.  |
| Controls                  | <p>Camera right: Main user interface with a 3" transfective 400 x 240 pixel LCD color screen, illuminated buttons, button lock and jog wheel.</p> <p>Camera left (Operator side): Illuminated buttons and button lock.</p> <p>Camera acts as a web server, displaying the ALEXA Web Remote on web browsers of computers connected to ETHERNET connector or via WiFi.</p> <p>Optional accessory Remote Control Unit RCU-4 for cabled remote control via camera ETHERNET connector. Optional accessory Wireless Compact Unit WCU-4 for wireless remote control.</p>                               |
| Recording Codecs          | Uncompressed and unencrypted ARRIRAW (.ari) or compressed and unencrypted QuickTime/ProRes recording. All formats include embedded audio, timecode and metadata.  |
| Supported Media           | <p>For ProRes recording:<br/>SxS PRO+ 256 GB (SBP-256D, SBP-256E), requires SxS Adapter 2</p> <p>For ARRIRAW and ProRes recording:<br/>SXR Capture Drives 1 TB (CDX-37019), requires SXR Adapter<br/>SXR Capture Drives 2 TB (CDX-37021), requires SXR Adapter</p>  |
| Playback                  | <p>Playback of ARRIRAW or ProRes recorded material visible on EVF-1 and MON OUT.</p> <p>Playback audio available over headphone jack and embedded in the MON OUT signal.</p>  |

# ALEXA LF Specifications

|  |   |  |  |
|--|---|--|--|
| SD Card  | To import and store ARRI Look Files, camera set up files, frame line files and user pixel masks, and custom lens tables for the Lens Data Archive (LDA).<br>Stores frame grabs in ARRIRAW (.ari, 12-bit), TIFF (.tif, 16-bit), DPX (.dpx, 10-bit) or JPEG (.jpg, 8-bit) format. Stores log files.<br>Also used for installing Software Update Packets (SUPs).   |  |  |
| Monitor Outputs  | MON OUT 1a, MON OUT 1b and MON OUT 2 supply uncompressed 6G UHD-SDI (3840 x 2160, 16:9) or 1.5G HD-SDI video (1920 x 1080, 16:9) all at 4:2:2 YCbCr; “legal” range video at 23.976, 24, 25, 29.97, or 30 fps.<br>MON OUT 1b is a clone of MON OUT 1a.<br>MON OUT 3 supplies uncompressed 1.5 G HD-SDI video (1920 x 1080, 16:9), 4:2:2 YCbCr; “legal range” HD video at 23.976, 24, 25, 29.97, or 30 fps.<br>All MON OUT supply embedded audio, time code, metadata and recording flag.<br>The integrated wireless video transmitter transmits a clone of MON OUT 3.<br>The wireless signal can be received by the optional Wireless Video Receiver WVR-1.  |  |  |
| Image Processing   | 16-bit linear internal image processing in full ALEXA Wide Gamut/Log C color space.<br>Target output color spaces: Log C, Rec 709 or Rec 2020.<br>An ARRI Look File (ALF-2) containing the name of the target color space, CDL values and a 3D LUT can be applied to ProRes or MON OUT images and will be saved in metadata.<br>ARRI Look Files for HDR monitoring with PQ or HLG tonal curves are available.<br>Optional horizontal image mirroring.   |  |  |
| Audio  | 1x XLR 5-pin AUDIO IN for 2 channel, line level, balanced audio.<br>24-bit / 48 kHz A/D conversion.<br>Uncompressed PCM audio recording to ARRIRAW, ProRes and embedded in all HD-SDI outputs. Only available with same project/sensor speed at 23.976, 24, 25, 29.97 and 30 fps.<br>Max of 2.5 dBm output from AUDIO OUT headphone connector.  |  |  |
| Connectors   | 1x media slot (SxS PRO+ or SXR Capture Drives)<br>3x BNC monitor out 6G UHD-SDI<br><br>1x BNC monitor out 1.5G HD-SDI<br>1x XLR 5-pin analog audio in<br>1x BNC return video in 1.5G HD-SDI<br>1x LEMO 16-pin external accessory<br>1x Fischer 2-pin 24 V power in<br>4x Fischer 3-pin 24 V remote start / stop & accessory power out<br>1x LEMO 2-pin 12 V accessory power out<br>1x LEMO 5-pin timecode in/out<br>1x TRS 3.5 mm headphone mini stereo jack<br>1x custom LEMO 16-pin electronic viewfinder<br>1x custom LEMO 10-pin Ethernet with 24 V power<br>2x Fischer 5-pin Lens Control System<br>1x Fischer 12-pin for CLM-2, CLM-3, CLM-4 or later<br>1x Fischer 12-pin for CLM-2, CLM-3, CLM-4 or later<br>1x Fischer 12-pin for CLM-2, CLM-3, CLM-4 or later | lens motor<br>lens motor<br>lens motor | MON OUT 1a<br>MON OUT 1b<br>MON OUT 2<br>MON OUT 3<br>AUDIO IN<br>RET IN<br>EXT<br>BAT<br>RS<br>12 V<br>TC<br>AUDIO OUT<br>EVF<br>ETHERNET<br>LCS<br>IRIS<br>FOCUS<br>ZOOM |
| SUPs   | Camera software updates via free-of-charge Software Update Packets  |  |  |
| Software Tools (apps)  | ARRIRAW Converter (ARC), ARRI Color Tool (ACT), ARRI Meta Extract.  |  |  |
| Software Tools (online)  | ALEXA Camera Simulator, ARRI Lens Illumination Guide, ARRI Frame Line Composer (AFC),LUT Generator, ARRI Formats and Data Rate Calculator   |  |  |
| Note: Technical data based on ALEXA LF Software Update Packet SUP 2.0.<br>SUP 2.0? Yes, the first software for the ALEXA LF is called SUP 2.0.<br>All data subject to change without notice. |   |  |  |

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This special report has been prepared for ARRI

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