

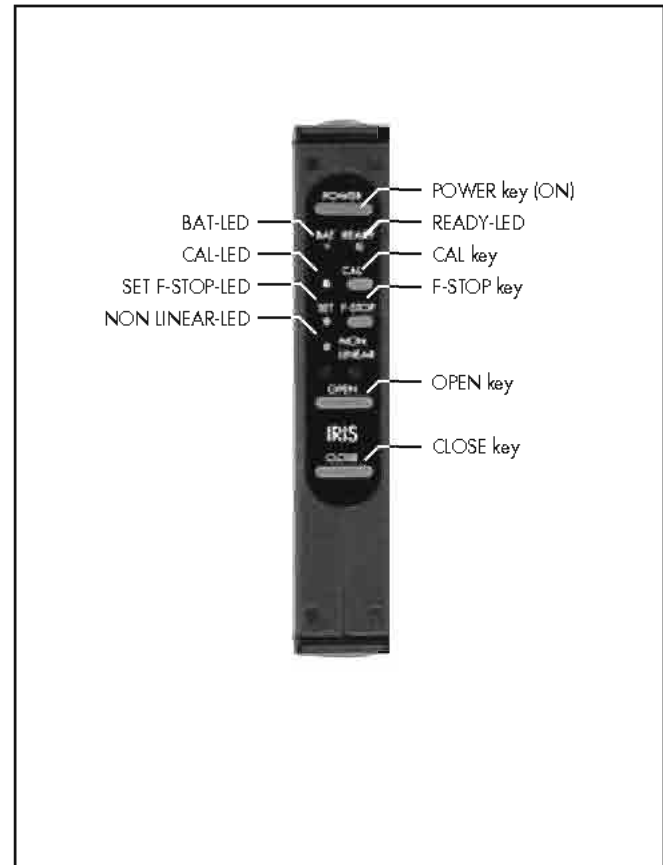
## 5.2.6 ICU-1 (Iris Control Unit)

The ICU constantly monitors the frame rate of the camera. If a frame rate change occurs, the ICU will calculate a new value for the iris to compensate for the exposure change, and instruct the lens motor to change the iris ring accordingly.

Iris changes are calculated and set in such short time intervals that all changes are smooth - even if the camera's frame rate is changing very slowly.

### Speed Ramp Overview

A speed ramp is a change of the camera's frame rate (fps), performed while the camera is running. Speed ramps can be used for a myriad of effects, from the dramatic speeding up or slowing down of the action to the subtle enhancing of a scene's timing. A speed ramp essentially allows the cameraman to compress or stretch time transparently and dynamically.



The frame rate of the new generation of ARRIFLEX cameras can be changed with the following accessories: RU-1 (Remote Unit), RCU-1 (Remote Control Unit), CCU-1 (Camera Control Unit) and LCC (Laptop Camera Controller).

Since each frame's exposure time is dependent on the camera's frame rate, the mirror shutter setting and the aperture setting on the lens, a change in the camera's frame rate results in a change of the exposure.

ARRI currently provides two methods to compensate for this change in exposure:

- The ARRIFLEX 535 and 435ES are equipped with an electronic shutter that can change its open shutter angle on the fly to compensate for the change in exposure during a speed ramp. The CCU, LCC or RCU are needed to create such speed/shutter ramps. There is no visible change in the depth of field in the picture with this kind of exposure compensation.

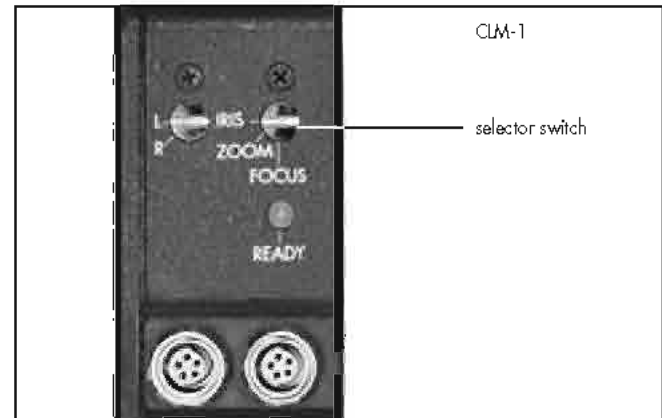
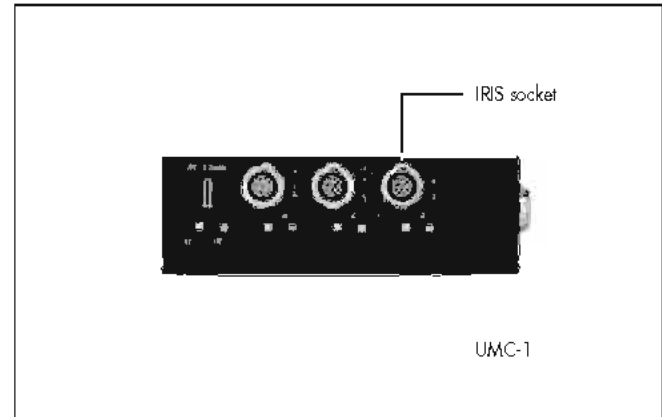
- The ICU-1 (Iris Control Unit) can change the lens iris on the fly to compensate for the change in exposure during a speed ramp even on cameras that are not equipped with an electronically adjustable mirror shutter. With the ICU, speed ramps can be performed on the following ARRIFLEX cameras: 535, 535B, 435, 435ES, 35 III, 16SR I, 16SR II, 16SR II HS, 16SR 3, 16SR 3 HS, 765.

### 5.6.2.1 Setup

- Make sure that the lens motor is tightly attached to the support rods, and that the support rods are tightly locked into the sliding base plate.
- Switch the selector switch on CLM-1 lens motor ⇨ **photo** to IRIS or connect CLM-2 motor to the IRIS socket ⇨ **photo** of the UMC-1.

Note: The lens motors can be adapted to attach either to the 19 mm or to the 15 mm support rods. Make sure you have the correct attachment for the lens motor.

Note: Some older lenses do not have the proper gear ring on the iris ring. Make sure that all lenses to be used have the proper gear on the iris ring (see chapter 6.7 Iris Gear Rings).



### ICU-1 Connecting Cables

The ICU-1 identifies different camera models through different cables.

The ICU-1 and the lens motor are generally powered from the camera, but can also be connected to a separate 12 or 24 Volt battery (with cable LC-S1). The ICU-1 will automatically detect if the incoming voltage is 12 or 24 Volts.

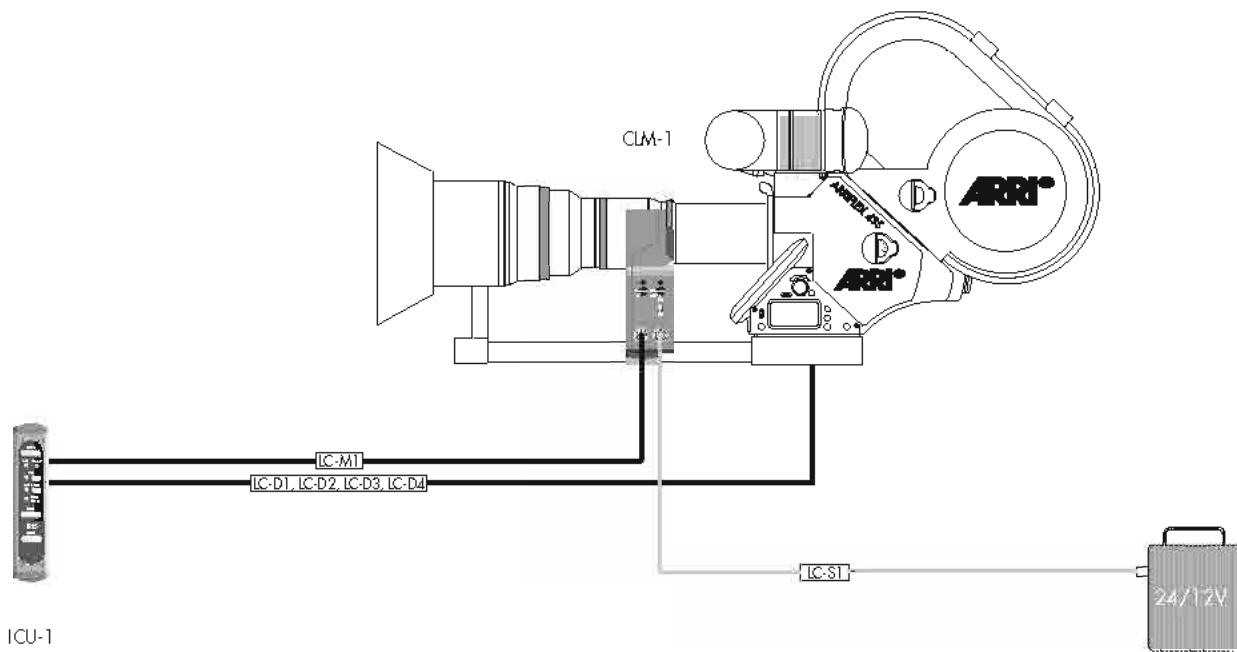
**Note:** If the camera runs on 12 V, it is recommended to use a separate 24 Volt battery for the ICU-1. The lens motor will be able to respond at a faster rate when connected to a 24V power source.

**Note:** When powering the ICU-1 and the Motors from the camera, make sure that the maximum load of the used connector on the camera is not exceeded

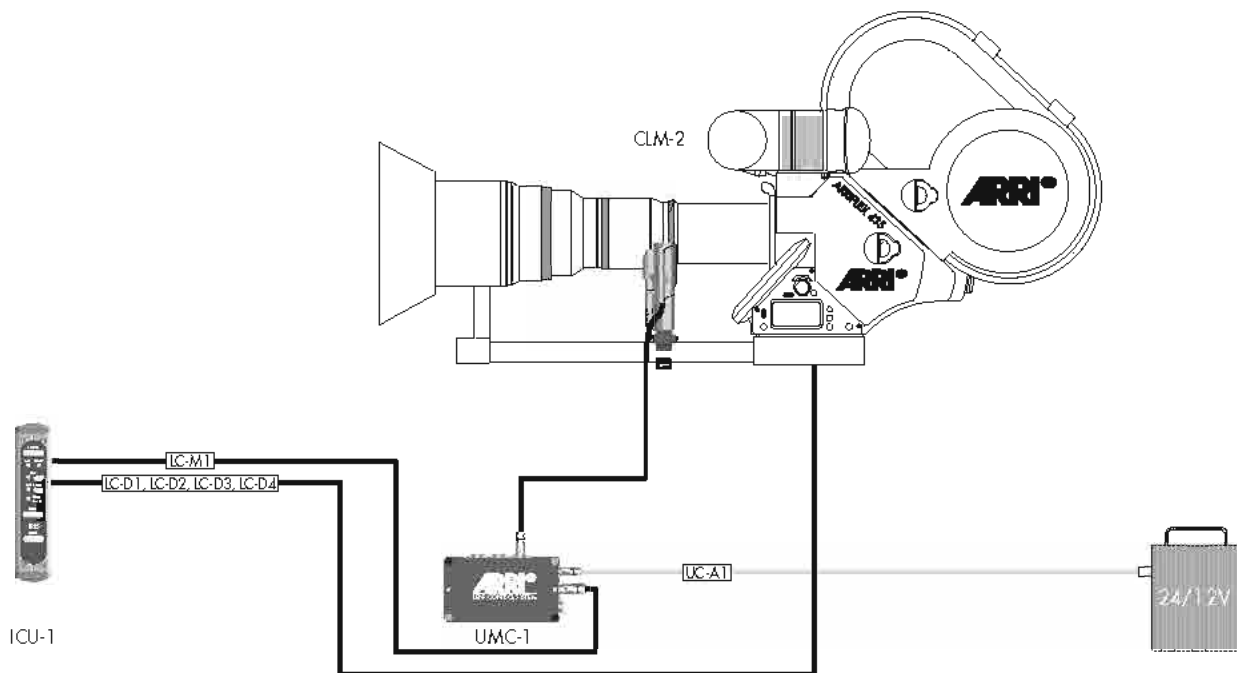
- Make cable connections according to the diagram. To power the ICU-1 from a separate battery, connect cable LC-S1 to the battery and to the unused connector on the lens motor.

Camera	Camera Cable
ARRIFLEX 535	Connect LC-D1 to RU receptacle
535B	Connect LC-D1 to ACC receptacle
16SR 3	Connect LC-D1 to ACC receptacle
16SR 3 HS	Connect LC-D1 to ACC receptacle
435ES	Connect LC-D1 to RU receptacle Part number: K2.47029.0
ARRIFLEX 35 III	Connect LC-D2 to 11 pin accessory receptacle
435	Part number: K2.47030.0
435ES	
ARRIFLEX 16SR	Connect LC-D4 to 11 pin accessory receptacle
16SR II	Part number: K2.47048.0
16SR II HS	
ARRIFLEX 765	Connect LC-D3 to SCU receptacle Part number: K2.47031.0

# ICU-1 cable diagram with CLM-1



## ICU-1 cable diagram with CLM-2

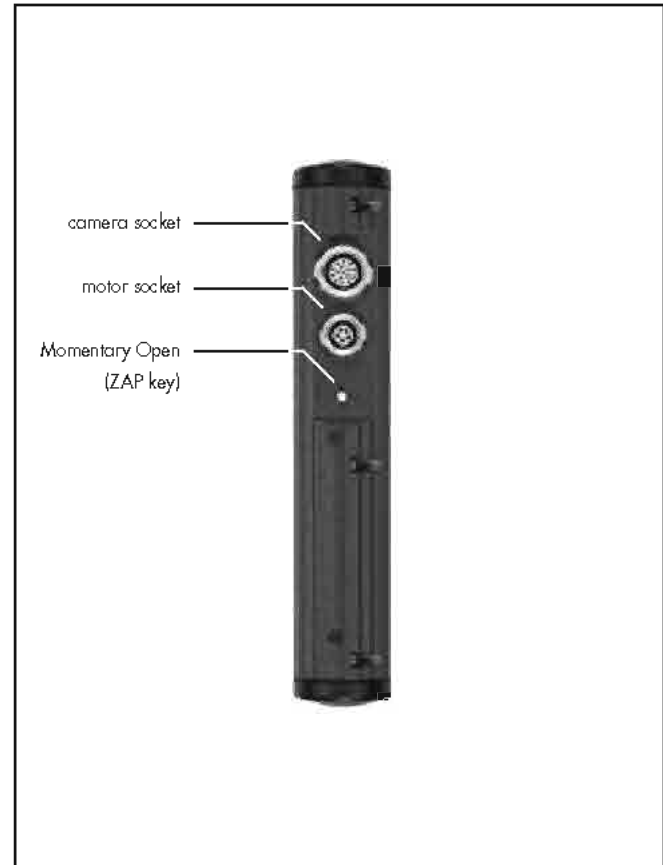


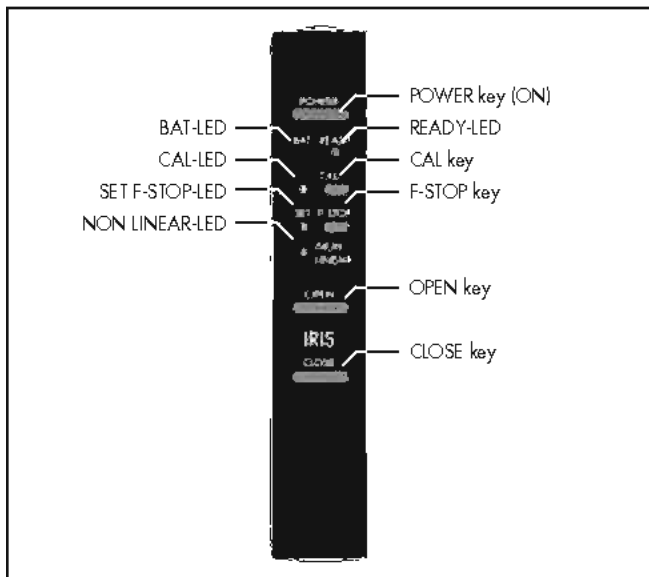
Note: The ARRIFLEX 435ES can be used with cable LC-D1 (9 pin) or with cable LC-D2 (11 pin) since it has both a 9 pin and a 11 pin accessory connector.

Note: Cables for camera models not listed here can be supplied on request.

Note: When using a UMC-1 together with the URM-1 both other lens rings (zoom and focus) can be remotely controlled via the same UMC-1.

Note: The connection of a CLM-1 as a motor for the iris ring on the ICU-1 via a UMC-1 is not possible (and of no use as the direct connection to the motor is also possible).





### 5.6.2.2 Turning ICU-1 Power On

- Push the POWER key → photo to switch on the ICU-1.
- The READY LEDs on the ICU-1 and on the lens motor will illuminate briefly and then indicate the system status. See table below.

#### Setting ICU-1 Reaction Speed

The ICU-1 can be set to a fast or slow reaction speed. This setting determines how fast the ICU-1 reacts to a change in the camera's frame rate.

For most cameras, the fast reaction speed should be used. If you detect a jittering in the lens motor while the camera is running at a constant speed, or a jerky motor movement

ICU READY LED	Camera	ICU	Lens motor
Slow green flashing	Standby	Ready	Ready
Fast green flashing	Ramping up to speed	Set to beginning F-Stop	Ready
Steady green light	Running at speed	Will follow any frame rate changes	Will follow any frame rate changes
Red	See "Trouble Shooting" chapter		
Red/green flashing	See "Trouble Shooting" chapter		

during a speed change, you can change the reaction speed to SLOW, which will reduce these effects.

Note: The minimum ramp duration time for the slow setting is twice as long as for the fast setting. If you need a short ramp duration, use the fast setting.

To set the ICU-1 reaction speed:

- Turn the ICU-1 power off.
- Turn the ICU-1 power back on while holding down the
  - OPEN button to set the ICU-1 to the fast reaction speed,
  - or the
  - CLOSE button to set the ICU-1 to the slow reaction speed.
- The green SET F-STOP and NON LINEAR LEDs will blink alternately for about 2 seconds in rapid succession if a fast reaction speed is set, and in slow succession if a slow reaction speed is set.

The last reaction speed set in the ICU-1 will remain in memory even if the ICU-1 is turned off.

Note: Lens motors with a serial number smaller than 1190 will always use the fast reaction speed, disregarding of the reaction speed setting on the ICU-1.

Note: Some older ICU-1 models do not have the capability to change the reaction speed. They will always use the fast reaction speed. The ICU-1 can change reaction speeds from software version V0210 on. Older units can be upgraded by your local ARRI service center.

Note: When using the SLOW setting, the minimum ramp times must be doubled – please see the following chapter on calculating the ramp time.

Beginning Frame Rate	Time	Ending Frame Rate
[fps]	[Seconds]	[fps]
3	16	150
	12	128
4	8	112
	6	96
5	4	80
	3	64
6	2	56
7	1.50	48
8	1.00	40
10	0.75	32
12	0.50	28
14	0.25	24
16		20
20	0	16
24		14
28	0.25	12
32	0.50	10
40	0.75	8
48	1.00	7
56	1.50	6
64	2	5
80	3	4
96	4	
112	6	
128	8	
150	12	3
	16	

## Calculating the Ramp Time



*Do not change the camera frame rate abruptly!*

The rate of the permissible camera fps change depends on the beginning frame rate and the acceleration characteristics of the lens motor. The ramp time set should not be below the calculated minimum!

All values given here are for the fast reaction time setting. The minimum change time should be doubled if the reaction time is set to SLOW.

The minimum change time can be calculated using the following formula:

$$t = \frac{(V_2 - V_1)}{4 V_1}$$

t Minimum ramp time (in seconds)

V<sub>1</sub> Beginning frame rate for a positive ramp or ending frame rate for a negative ramp (in fps)

V<sub>2</sub> Ending frame rate for a positive ramp or beginning frame rate for a negative ramp (in fps)

Note: A "positive" ramp is a frame rate change to a higher fps value. Example: 10 to 50 fps.  
A "negative" ramp is a change to a smaller fps value. Example: 50 to 10 fps.

The approximate minimum ramp time can also be derived from the nomogram. To calculate the minimum ramp time, connect the two camera frame rates with a straight line and read the time at the intersection of that line and the time scale.

For example, if ramping from 12 to 48 fps, the ramp should not be shorter than 0.75 seconds.

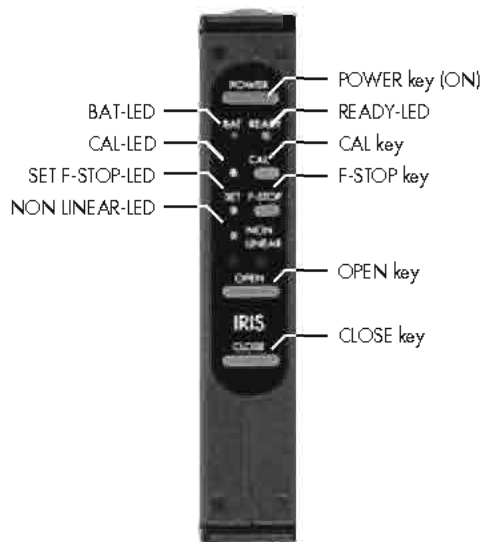
To shorten the ramp duration when a large fps range is covered, the ramp can be broken up into separate smaller ramps. These can be run consecutively.

For example, if ramping from 4 to 96 fps, 6 seconds would be the minimum time. But if ramping:

- from 4 to 16 fps, the minimum ramp time is 0.75 seconds, and if then ramping
- from 16 to 96 fps, the minimum ramp time is 1.25 seconds.

Combined, the new minimum time is only 2 seconds. Consecutive frame rate ramps can be created with an external camera controller like the LCC.

Changing camera frame rate manually with VSU:  
Multiply derived minimum ramp time by 3 to be sure that possible uneven speed change of the ramp is not critical.



## ICU-1 Calibrating

During calibration the ICU-1 learns and memorizes the end-stops of the iris ring to avoid the mechanical stress of driving the ring all the way to the end. Any previously stored end-stops will be erased during calibration.

You should calibrate the ICU-1:

- when setting up
- after a lens change
- after having moved the iris ring while the ICU-1 was switched off
- after the lens motor and the iris ring gear have been separated
- if the CAL-LED flashes.

- Push the CAL key ⇨ **photo** on the ICU-1.  
While the ICU-1 is calibrating, the yellow CAL-LED will be illuminated.



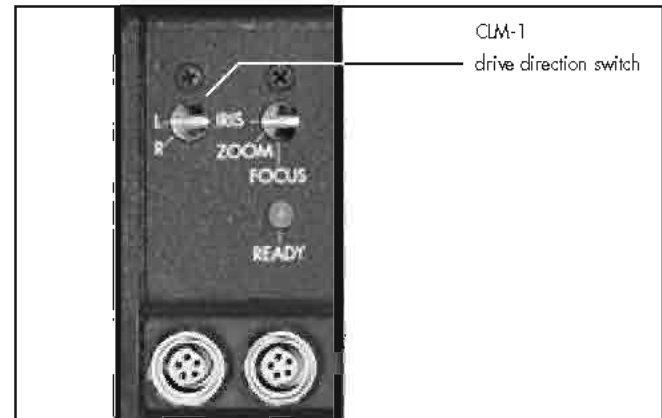
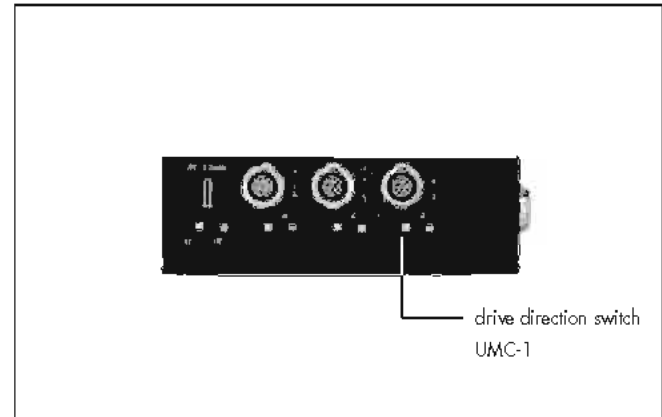
*If the CAL LED flashes: End stops have not been defined yet or the lens ring has been turned while the ICU-1 was switched off and then been driven to an end-stop. Repeat calibration process!*

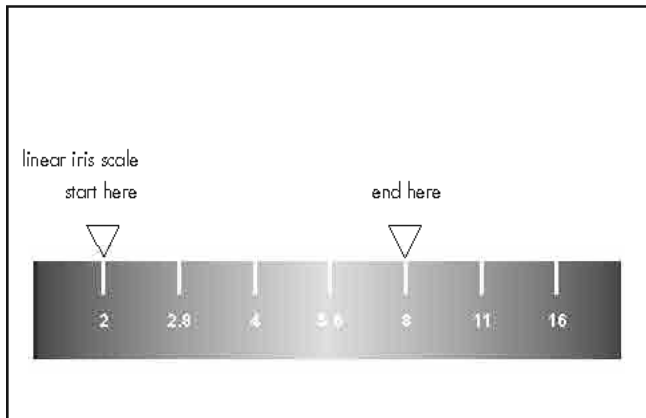
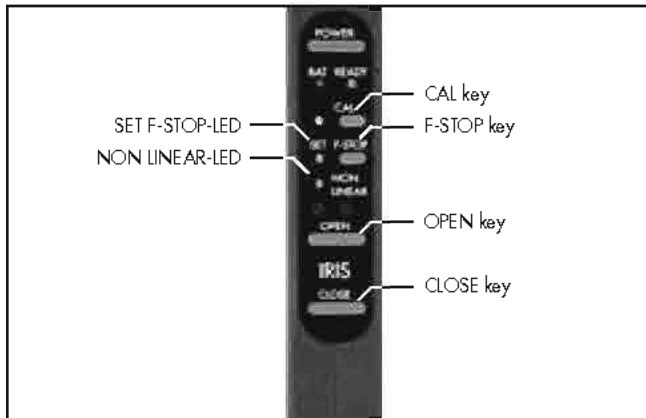
Note: Pay specific attention to the gears when calibrating. Sometimes the gears can slip because they do not mesh closely enough, or the lens motor is not clamped down tight enough on the support rods, or the support rods are not clamped tightly enough on the bridge plate. If this happens, re-tighten everything. In extreme cases it helps to push the lens motor towards the lens while calibrating. This is only an issue during calibration, as the ICU-1 uses a lot of torque during calibration.

### Setting the ICU-1 Lens Motor Drive Direction

The ICU-1 can perform the proper iris correction only if the lens motor drive direction corresponds to the OPEN and CLOSE keys.

- Check the current lens motor drive direction by pushing the OPEN and CLOSE key on the ICU. The iris should open when the OPEN key is pushed, and close when the CLOSE key is pushed. If that is not the case, switch the drive direction switch (labelled L/R) on the CLM-1 lens motor ⇄ **photo**, or on the UMC-1 ⇄ **photo** for CLM-2 lens motors.





### Assigning F-Stops with the ICU-1

The ICU-1 has to be taught where on the iris ring the F-Stops are. There are two different methods for two different types of iris scales:

- A **linear** iris scale is an iris scale where each F-Stop is exactly the same distance from the next one. Zeiss Standard Primes, Super Speed Primes and Variable Primes have a linear iris scale, for example. Assigning F-Stops for a linear iris scale is a one step procedure.
- A **non-linear** iris scale is an iris scale where the distances between the F-Stops differ. The Angenieux 25-250HR has a non-linear iris scale, for example. Each F-Stop will have to be assigned individually for a non-linear iris scale.

### Assigning F-Stops

#### for a lens with *linear* iris ring markings:

- Use the OPEN and CLOSE keys ⇨ **photo** to precisely position the iris ring either at the largest or at the smallest **full** F-Stop.
- Push the F-STOP key ⇨ **photo** and keep it pushed down. Use the OPEN and CLOSE keys to move the iris ring four F-Stops further. If you are at a T 2.8, for instance, you should go to a T 11 (see graphic). The SET F-STOP LED will flash while you move the lens ring.
- Release the F-STOP key. The SET F-STOP LED ⇨ **photo** will illuminate to indicate that a linear iris scale has been memorized.

### Assigning F-Stops

#### for a lens with *non-linear* iris ring markings:

- Use the OPEN and CLOSE keys ⇨ **photo** to precisely position the iris ring either at the largest or at the smallest **full** F-Stop.
- Push the F-STOP key ⇨ **photo** and keep it pushed down.
- Use the OPEN and CLOSE keys to set the iris ring to each F-Stop. At each F-Stop push the CAL key ⇨ **photo** briefly.

Do not go to the end positions unless they represent a full F-Stop change from the last F-Stop marking. The NON LINEAR LED ⇨ **photo** flashes while you read the F-Stops. You can assign a minimum of two and a maximum of twelve F-Stops.

- Release the F-STOP key. The NON-LINEAR LED ⇨ **photo** illuminates and thus indicates that the settings are valid. If the NON-LINEAR LED stops blinking or does not illuminate, the settings have not been memorized properly. Then you must repeat the procedure.

Note: When assigning F-Stops on both linear and non linear scales, use only full F-Stops! The widest open F-Stop on many lenses, for example, is **not** a full F-Stop. The most common full F-Stops are:  
1, 1.4, 2, 2.8, 4, 5.6, 8, 11, 16, 22, 32, 45.

### **Verify Operation**

- Run the camera without a magazine attached.
- Use your speed controller to change the speed from 24 to 48 fps. Watch the lens iris ring: it should open up one stop.

### **Resetting after a Lens Change**

- Swing the lens motor back onto the iris ring and tighten it. Make sure that the lens motor gear meshes with the iris ring gears without any play.
- Make sure that the lens motor is tightly attached to the support rods, and that the support rods are tightly locked into the sliding base plate.
- Switch the ICU-1 on.
- Calibrate the ICU-1.
- Assign F-Stops.

### **If the Iris Ring Moves While Power is Off**

If the iris ring is moved while the ICU-1 is switched off, the end positions memorized in the ICU-1 and the actual end positions of the iris ring will no longer be the same!

- Switch the ICU-1 on and re-calibrate.  
It is not necessary to assign new F-Stops.

### 5.6.2.3 Operating the ICU-1

Before starting the camera, the beginning frame rate and the corresponding F-Stop have to be set. Once the camera is running, the ICU-1 will remember the beginning frame rate and F-Stop. It will then correct the iris for any change in the camera's frame rate. Once the camera is stopped the ICU-1 will set the iris back to the beginning F-Stop.

The ICU-1 will interpolate all F-Stop values that fall in between two full F-Stops. For linear iris rings, the ICU-1 will use those interpolated values in the space between the last F-Stop and the end position of the iris ring. For non linear iris rings, the ICU-1 will extrapolate based on the values from the last full F-Stop and use the results in the space between the last F-Stop and the end position of the iris ring.

The ICU will remember its calibration and the assigned F-Stops even when it is switched off.

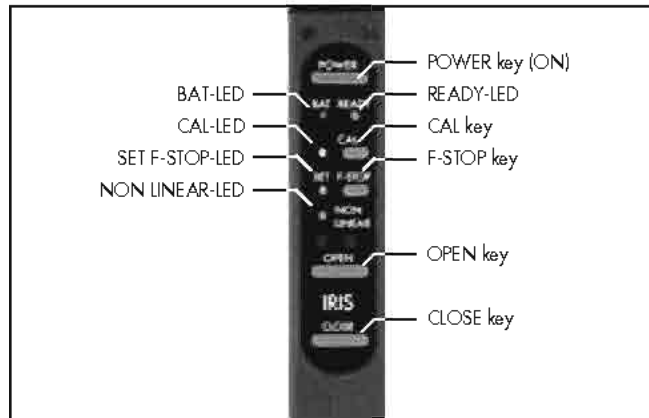
- Set the ICU-1 up as described in the previous chapter.
- Set the beginning frame rate on the camera.
- Set the beginning F-Stop with the ICU-1.
- Start the take.  
The ICU-1 will be ready one second after the camera has reached speed. If the frame rate of the camera changes during the take, the ICU-1 will automatically compensate for the change in exposure by changing the iris accordingly.

Note: The ICU-1 will lock all operating buttons while the camera is running to prevent unintentional operation of those buttons.

### Operating the ICU-1 with the ARRIFLEX 535 or 435ES

The ARRIFLEX 535 and 435ES cameras can be programmed with the RCU-1, the LCC or the CCU to perform simultaneous frame rate and mirror shutter changes to compensate for differences in exposure during speed ramps.

To use the ICU-1 during a frame rate change on these cameras, the mirror shutter must be programmed to remain constant, i.e. kept at the same angle through the whole frame rate change!



### Setting a F-Stop

To open or close the iris:

- Push the OPEN or CLOSE key ⇨ **photo**.  
The lens motor will move the iris ring as long as one of these buttons is pushed. If a button is pushed for a long duration, the lens motor will increase the rate of change. If the button is released, the speed of change will be set back to the slower value.

### Momentary Opening of the Iris (ZAP)

- To open the iris temporarily, push the zap key ⇨ **photo** located on the ICU-1 back side, underneath the connectors.  
The iris will remain open as long as the zap button is pushed. When the zap button is released, the ICU-1 will return to exactly the same position it was in before the zap button was pushed.

Note: This feature is disabled while the camera is running!

### ICU-1 and Variable Primes

When using the ICU with the Variable Primes, make sure that the iris ring does not move in the area between T-22 and CLOSE. An improper exposure would result.

### ICU-1 Battery LED

- Replace the battery when the battery LED (labelled BAT) illuminates or flashes.



*Do not start any new scenes!*

- Immediately replace the battery when the battery LED flashes. Otherwise, you run the danger of deep discharging the battery.

The battery LED reacts to the following voltage limits:

Main Voltage	BAT Indicator	Actual Voltage
24V	illuminated	< 20 V
	flashing	< 18 V
12V	illuminated	< 10 V
	flashing	< 9 V

### ICU-1 Main Fuse

The main fuse is a self resetting thermal fuse. If it blows due to an error, remove the cause of that error and let the fuse reset itself. Under normal conditions it will reset in five to ten seconds. High outside temperature or a severe error will prolong the resetting time.

**Note:** If you suspect a blown fuse while using the ICU-1 with the ARRIFLEX 535A, 535B, or early models of the 16SR 3, make sure to also check the camera's accessory fuse!  
Later models of the 16SR 3 and the 435 and 435ES are equipped with self resetting thermal fuses. The same method for resetting applies.

### Button Lock During Run

The ICU-1 will lock all buttons while the camera is running. If a locked button is pushed, the ICU-1 will show a red LED as long as that button is pushed.

