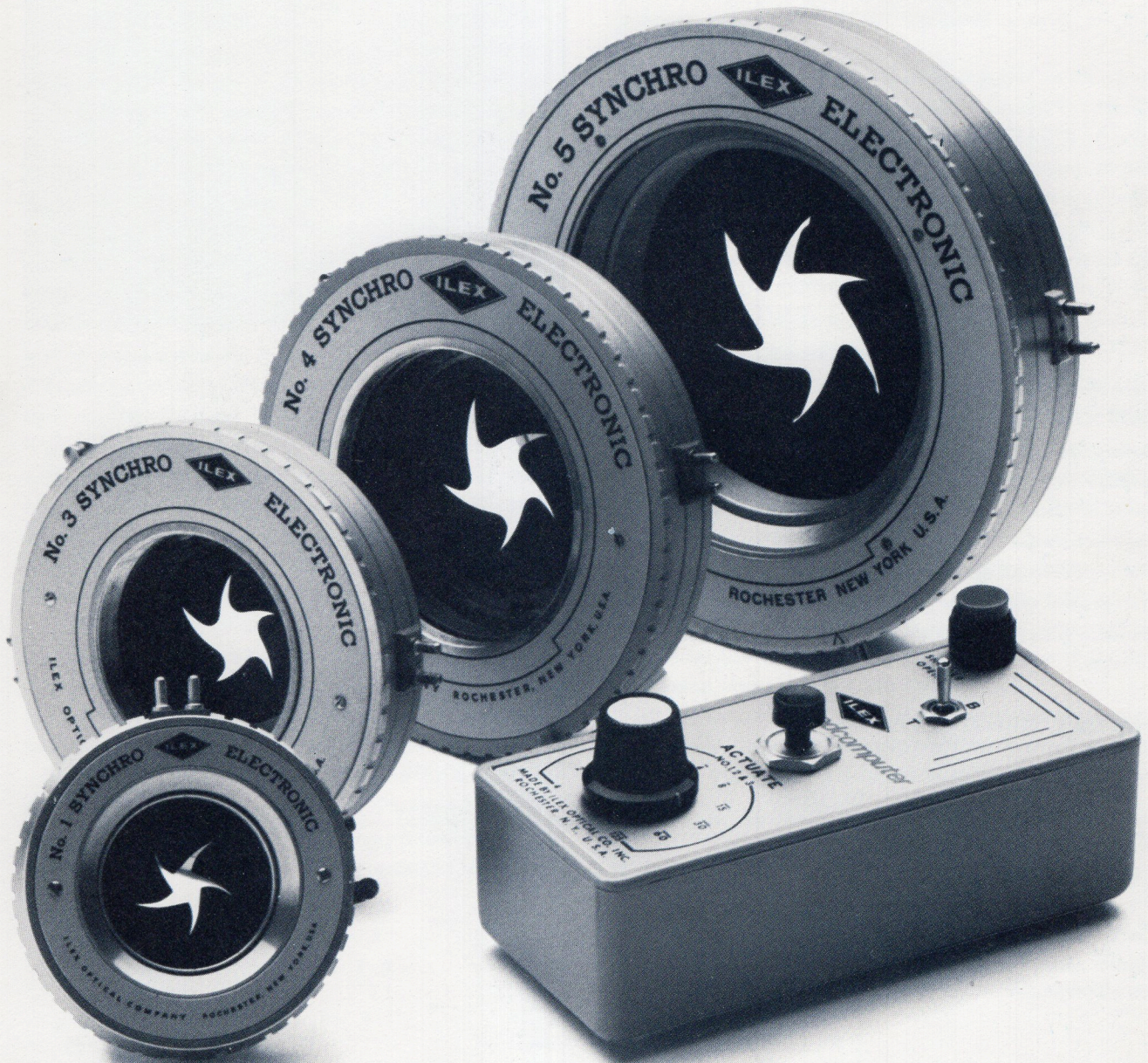




# Shutters





## SHUTTERS

Shutters are used to turn on and off electromagnetic radiation. They accomplish this by mechanically removing and imposing a completely opaque barrier across the optical path. Two basic forms of shutter are normally used. "Between-the-lens" shutters open and close a symmetric aperture (usually consisting of five thin metal blades) for a predetermined length of time. These shutters are usually placed between the forward and rear sets of optical elements in a photographic objective, at a location where rays are neither strongly convergent nor strongly divergent and equal time history of transmission for all elements of the field is preserved. The second common form of shutter is a "focal-plane-shutter" which transports a variable width slit across the focal plane at a fixed (or variable) speed. The width and speed of the motion determines the amount of light transmitted.

"Between-the-lens" shutters were originally designed for specific camera applications, but their general usefulness in the optical laboratory is so great that a clear understanding of their operation is essential.

### ILEX "BETWEEN-THE-LENS" SHUTTERS

Two types of "between-the-lens" shutters are manufactured by Ilex; electronic shutters and mechanical shutters. Both operate by swinging the thin metallic shutter blades from the center outward. When fully open, they form a circular aperture for a preset period of time. Both types also incorporate a 10-or-12-bladed iris diaphragm which may be independently operated to vary the diameter of the clear aperture as seen through the shutter.

Electronic shutters are activated by an electromagnetic solenoid. When the solenoid is energized, a lever arrangement simultaneously draws all the shutter blades open. De-energizing the solenoid allows the blades to be redrawn closed by a spring. Duration of the open time is specified by an electronic control unit known as a Speedcomputer®. The Speedcomputer® is housed separately and may be located at some distance from the shutter itself. Facilities for remote electrical operation of the Speedcomputer® (and shutter) are provided.

Mechanical shutters are activated by a spring driven gear

wheel assembly. The spring is wound by a cocking lever on the shutter housing. Upon release, the spring drives a high-to-low ratio gear train which engages a pinion-ratchet drive. This arrangement produces a constant energy dissipation system which opens and then closes the leaves of the shutter. The timing for the duration of opening is provided by an escapement-type timing mechanism similar to that found in a watch. Remote operation of mechanical shutters is possible with a push cable release system. Remote distance is restricted by the mechanical nature of the cable.

While the actuation method varies between the electronic and the mechanical shutter versions, both rely upon a mechanical opening and closing mechanism. Both types therefore are subject to mechanical wear and eventual failure. Electronic shutters are inherently more accurate, stable, and longer-lived than mechanical shutters because they contain so few mechanical parts and linkages.

Both types of shutters have been designed to assure as long a trouble-free and accurate life as possible. Under normal operating conditions, a life of 200,000 operations should be expected from mechanical shutters and 1,000,000 operations from electronic shutters.

There are two causes for time aberrations which occur in between-the-lens shutters. When the opening time is long, i.e., one second, there is little concern about the time required for opening and closing, but when the opening times are in milliseconds, both the reaction time and the changing size of the opening in transition determine the actual open time. Opening and closing times vary with the shutter size, as well as with ambient operating conditions, cleanliness of the mechanism and wear history. A small aperture is uncovered and covered much more quickly than is a large aperture. Consequently, with a fast shutter speed, the exposure will be shorter for small apertures than for large apertures.

Opening and closing times of both mechanical and electronic shutters are of the order of 3 milliseconds (subject, of course, to the provisions above). With electronic shutters, the time between command and opening is both constant and repeatable. Furthermore, variations in opening and closing times are markedly less for electronic shutters than for mechanical shutters.





## ILEX MECHANICAL SHUTTERS

Ilex Mechanical Shutters are self-cocking automatic shutters. They are operated simply by pressing the finger release lever, i.e., cocking and tripping are accomplished in one operation. Operation of mechanical shutters can be accomplished using the finger release lever, or by using a cable release attached to the cable guide. The cable guides are made to accept the standard ASA type cable release thread, No. 5-44.

Each size has available an independently operated "press-focus release" lever which permits the shutter blades to be opened without operating the shutter mechanism or the necessity of changing the shutter speed setting to "T" for focusing.

Mechanical shutters have built-in 10-blade iris diaphragms. Diaphragm opening is controlled by a lever on the shutter housing. An f-number scale is provided to indicate the opening. On special order, an f-number scale to match the focal length of the optics being used can be engraved on the face of the shutter. A separately moveable mechanical stop may be set on the f-number scale to repeat a frequently used diaphragm opening position.

Each shutter has built-in "X" synchronization with a bi-post connector designed to fire flash equipment of any kind. The "X" synchronization contacts are silver plated. The contacts can be utilized to signal exactly that point in time at which the shutter blades have become fully opened.

The Ilex mechanical shutters are equipped with "B" (bulb) and "T" (time) speed settings. The "B" setting is the setting at which the shutter leaves will open and remain open until the activating finger release lever is released. The "T" setting is the setting at which the shutter leaves will open and remain open until the activating finger release lever is depressed a second time.

### Ilex Mechanical Shutters

		PRODUCT NUMBER	
		04 IMS 001	04 IMS 003

### SPECIFICATIONS

Number of shutter blades	5	5
Number of iris leaves	10	10
Cable release socket (ASA standard)	No. 5-44	No. 5-44
Flash synchronization	X	X
Shutter speeds (seconds)	T, B, 1, 1/2, 1/5, 1/10, 1/25, 1/50, 1/100	T, B, 1, 1/2, 1/5, 1/10, 1/25, 1/50, 1/100
Weight, grams	85	225

### DIMENSIONS

Outside diameter	63.0mm	87.3mm
Seat to seat dimension	21.0mm	26.0mm
Lens threads front and rear	31.2mm (50 TPI)	45.0mm (50 TPI)
Shutter mounting thread (flange)	33.7mm (40 TPI)	48.6mm (40 TPI)
Shutter mounting thread length	6.5mm	6.1mm
Front seat to blade plane	10.6mm	14.0mm
Rear seat to iris plane	8.5mm	8.9mm
Max. aperture opening	25.4mm	34.9mm
Min. aperture opening	1.6mm	2.5mm





## ILEX ELECTRONIC SHUTTERS

Ilex Electronic Shutters are electronically operated. The simplicity, reliability and accuracy of these shutters make them well suited to situations demanding precise operation and long trouble-free life. These shutters may be operated with the Speedcomputer® timing electronics described below or with customer supplied DC open and hold signals.

The Ilex electronic shutter is the only completely electronic shutter of its kind. While most electronic shutters are electronically controlled only during long exposures, and revert to mechanical control at the high speed, the Ilex Electronic Shutter is electronically controlled for all exposure times, resulting in greater accuracy, consistency, and fewer control mechanism parts to become defective.

Electronic Shutters are available in four maximum aperture sizes: 25.4mm, 34.9mm, 42.7mm and 63.5mm. All but the largest are 5-bladed shutters; the largest has 7 blades. All are equipped with built-in iris diaphragms. Diaphragms may be adjusted from full aperture to approximately 10% of full aperture diameter. Diaphragm opening is controlled by a lever on the shutter housing. On special order an f-number scale can be engraved on the shutter faceplate to indicate the opening. A separately moveable mechanical stop may be set on the f-number scale to repeat a frequently used diaphragm opening.

A microswitch in the shutter provides electronic flash synchronization. Alternatively, this normally open switch can be used as an event trigger.

Electronic shutters may be used with or without the Speedcomputer®<sup>4</sup> timing and actuation system. The Speedcomputer® provides accurate pre-calibrated timing signals to operate the shutter at speeds from 4 seconds to 1/125 second

(1/60 second maximum speed in the two larger aperture shutters). "Bulb" and "Time" operation controls are also provided.

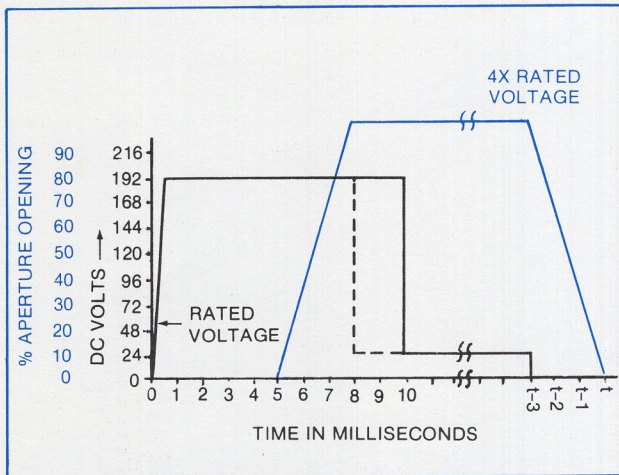
Unlike other electrical shutters whose power source is built into their housing, the Ilex electronic shutter may be operated by other circuitry. To open the shutter a DC signal 4 times the rated solenoid voltage should be applied to the bi-post connector for 3 to 5 milliseconds. To keep the shutter open, a holding DC voltage of one-half the solenoid rating must then be maintained after opening. Removal of this signal will quickly close the shutter.

Standard solenoids are rated at 48 Vdc. (Optional solenoid ratings of 3, 6, 12 and 24 Vdc are available on special order.) Thus the nominal opening signal should be 192 Vdc for 3 to 5 milliseconds with a standard solenoid, and the holding signal should be 24 Vdc.

As a standard feature, each size of the Ilex electronic shutter has an independently operated "press focus" lever which permits the shutter blades to be opened without operating the shutter mechanism. In addition, the mounting dimensions of all Ilex electronic shutters are the same as those of the corresponding number size of Ilex mechanical shutters. This permits the added flexibility of using lenses mounted for Ilex mechanical shutters in Ilex electronic shutters.

All Ilex shutters, mechanical and electronic, conform to all applicable ASA and DIN standards. Housings are made of aluminum and lacquer finished for long durable life. Shutter blades are made of steel; iris blades are made of phosphor bronze. Both are finished matte black. All electrical shutter contacts are silver plated.





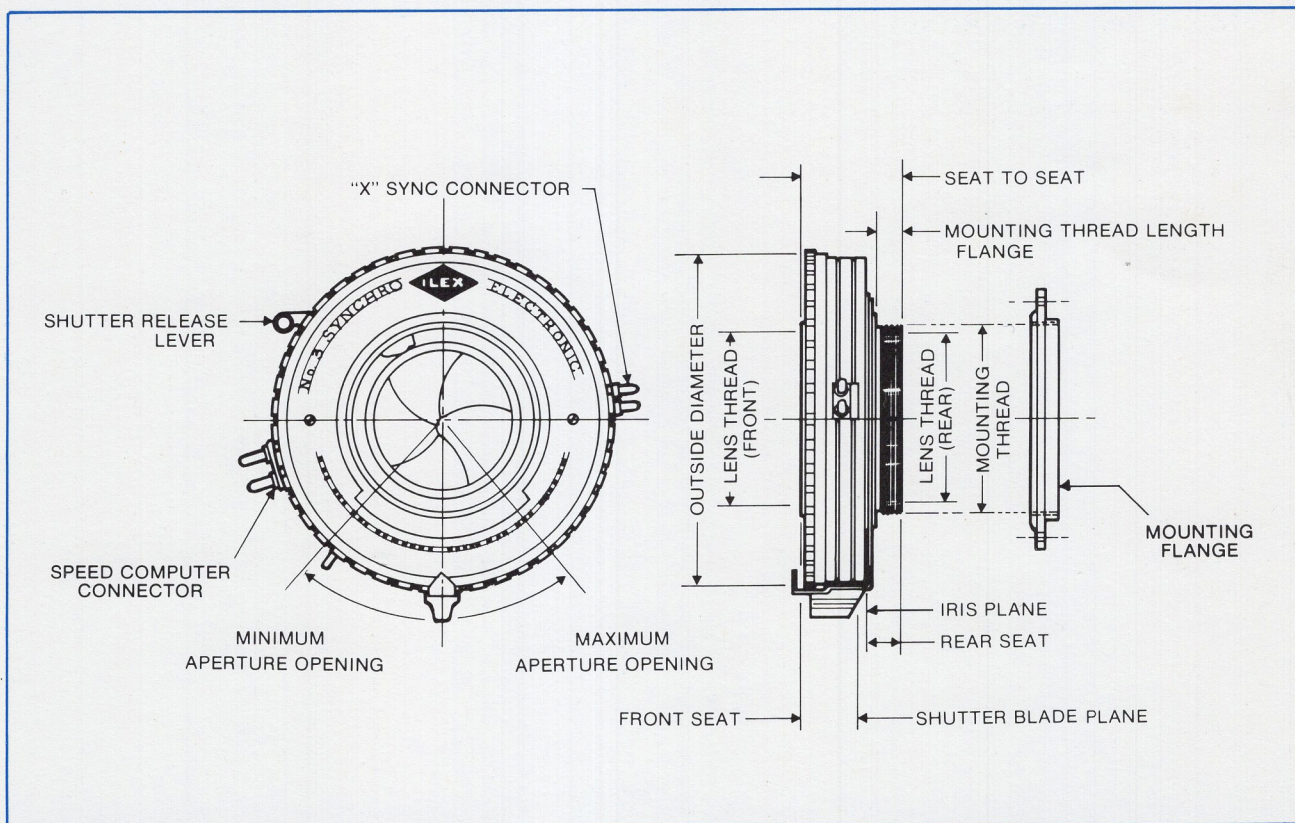
THIS DIAGRAM ILLUSTRATES typical opening and closing times for Ilex Electronic Shutters. The 3-millisecond reaction time is a function of both aperture and shutter age, but is nevertheless typical. The lower diagram illustrates the relation between the initial DC pulse and the shutter reaction. The 5-millisecond delay is both repeatable and constant. The voltages are typical for the standard 48Vdc solenoid. Non-standard voltage solenoids operate at the same 8:1 ratio of DC voltages.

Shutters modified and/or designed for specific applications are supplied routinely by Ilex. A substantial number of special OEM shutters are currently being manufactured for specific customers. Typical applications include medical x-ray devices, thermographs, oscilloscope photography, census information processing, laser research and products, military instrumentation, microfilm printers, surveillance cameras, commercial photography, and various research applications.

### ILEX ELECTRONIC SHUTTERS

	PRODUCT NUMBER			
	04 IES 001	04 IES 003	04 IES 004	04 IES 005
Weight, grams (shutter only)	85	198	255	454
Number of shutter blades	5	5	5	7
Number of iris leaves	10	10	10	12
Flash synchronization	"X"	"X"	"X"	"X"
Shutter speed setting of Speedcomputer®	B, T, 4, 2 1, 1/2, 1/4, 1/8, 1/15, 1/30, 1/60, 1/125	B, T, 4, 2 1, 1/2, 1/4, 1/8, 1/15, 1/30, 1/60, 1/125	B, T, 4, 2, 1, 1/2, 1/4, 1/8, 1/15, 1/30, 1/60	B, 5, 4, 2, 1, 1/2, 1/4, 1/8, 1/15, 1/30, 1/60
Power consumption (watts)	2.8	4.0	4.0	6.0
Solenoid voltage:	48 Vdc standard (3, 6, 12, and 24 Vdc available as options)			
Maximum current draw:	3-4 milliamperes			

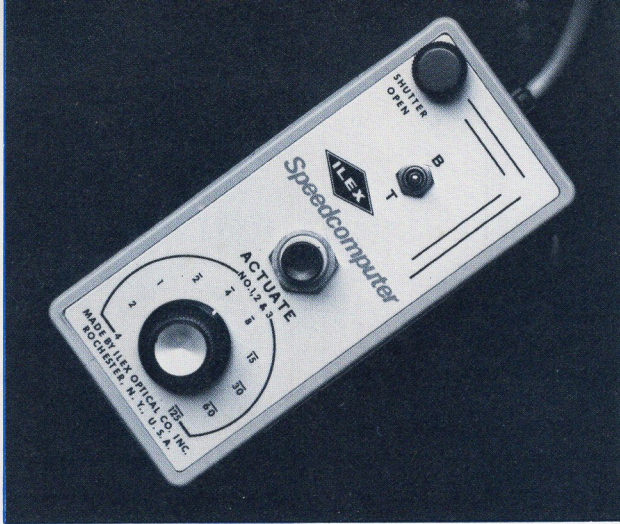




## ILEX ELECTRONIC SHUTTERS

DIMENSIONS	PRODUCT NUMBER			
	04 IES 001	04 IES 003	04 IES 004	04 IES 005
Outside diameter	63.0mm	87.3mm	103.4mm	129.0mm
Seat to seat dimension	21.0mm	26.0mm	27.0mm	27.5mm
Lens threads front and rear	31.2mm (50 TPI)	45.0mm (50 TPI)	59.6mm (40 TPI)	76.2mm (30 TPI)
Shutter mounting thread (flange)	33.7mm (40 TPI)	48.6mm (40TPI)	63.5mm (30 TPI)	82.1mm (30TPI)
Shutter mounting thread length	6.8mm	6.2mm	5.1mm	6.0mm
Front seat to blade plane	10.6mm	15.1mm	15.7mm	14.7mm
Rear seat to iris plane	8.5mm	8.5mm	9.1mm	9.5mm
Maximum aperture opening	25.4mm	34.9mm	42.7mm	63.5mm
Minimum aperture opening	1.6mm	2.2mm	3.4mm	5.1mm





## ELECTRONIC SHUTTER CONTROLLER

### ELECTRONIC SHUTTER CONTROLLER

The Ilex Speedcomputer® is an electronic control unit for use with Ilex Electronic Shutters. The Speedcomputer® provides precise drive voltage to open the Electronic Shutters for a predetermined length of time. The shutter may be triggered by the front panel push button.

The Speedcomputer® provides the following calibrated shutter speeds: 4, 2, 1, 1/2, 1/8, 1/15, 1/30, 1/60 and 1/125 seconds. (Maximum of 1/60 second on the two larger Ilex Shutters.) A three-way front panel switch provides a "Bulb" setting, which will hold the shutter open until it is released, and a "Time" setting, which will hold the shutter open until the switch is turned off.

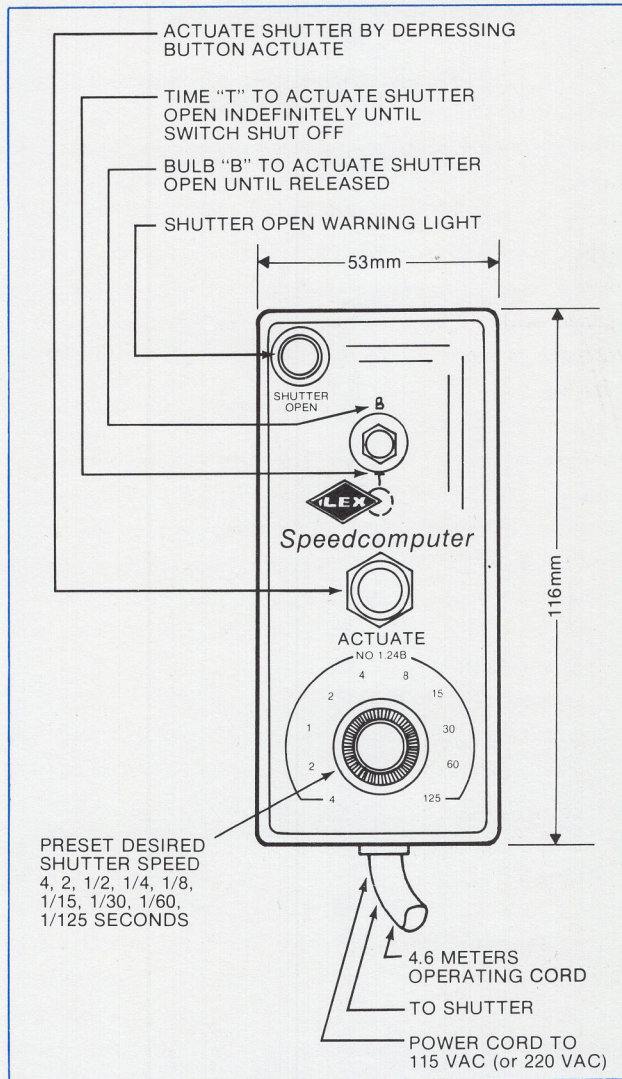
A front panel light indicates when the shutter is open. The Speedcomputer® may be easily hand held or mounted in a convenient location. A 2.4 meter cable connects the Speedcomputer® to the Ilex Electronic Shutter. A further 2.4 meter cable is supplied for connection of the Speedcomputer® to a 115 Vac (or 220 Vac) power source.

#### Electronic Shutter Controller (for 115V operation)

	PRODUCT NUMBER	
	04 ISC 001	04 ISC 004
For use with the following	04 IES 001	04 IES 004
Electronic Shutters:	04 IES 003	04 IES 005
Size (mm):	116 x 53 x 35	
Weight (grams):	454	
Voltage:	115Vac, 60 Hz	

#### Electronic Shutter Controller (for 220V operation)

	PRODUCT NUMBER	
	04 ISC 003	04 ISC 005
For use with the following	04 IES 001	04 IES 004
Electronic Shutters:	04 IES 003	04 IES 005
Size (mm):	116 x 53 x 35	
Weight (grams):	510	
Voltage:	220Vac, 50 Hz	



### SPEEDCOMPUTER

The Speedcomputer is a control device used to actuate the shutter. With its solid state circuitry it controls all shutter speeds with great accuracy. Its 116 x 53 x 35 mm dimensions and its 4.6 meter operating cord allow the user a lightweight, hand-held control device with maximum flexibility.



