Installing & Using the TCS TXM-20Be Crystal Drive on your Bolex H16, H8 Spring-Wind Camera

NOTE: This motor will only fit H16 and H8 cameras that have the added 1:1 drive shaft, beginning with s/n about 210,601 of 1965 and up, including the models Rex-4, Rex-5, SB, SBM, M4, M5, and S4.

If you are not sure, look at your I-T control; if it is a **round chrome knurled knob** then your camera has the 1:1 shaft. If however it is a **lever** in a recess, your H16 camera does not have the 1:1 shaft and you must instead use the TCS TXM-26B crystal motor.

1. Installation

1A. ***VERY IMPORTANT:*** First prepare the camera for motor attachment:

1. Turn the camera's **MOT** lever down to **O** to disengage the clockwork spring motor.

2. Remove the spring winding handle by folding it up as if to wind the spring, but turn it *clockwise* instead of counter-clockwise. It has a left-hand thread and will unscrew. If it is excessively tight use penetrating oil on the coupling point.

3. Set the speed dial to **64** or higher, fully clockwise. This is required to prevent the camera's mechanical governor, which is still connected, from fighting the crystal motor and causing overload and overheating.

4. Lock the release slide in the left **M** (lock-run) position to permit the mechanism to operate and not stall the crystal motor.

5. On Rex models with a variable shutter, remove the Rexofader if present, and lock the variable shutter in the **top** (fully open) **0** position. We recommend always locking it in the **top** (fully open) **0** position for the most pleasing picture quality. Whatever the setting, be sure it is locked in place to prevent random changes of the exposure while running, and especially when you start and stop.

Warning: *Failure to follow these above steps will result in motor or camera damage that is not covered by your warranty, and/or will result in inferior quality film. Be sure the settings are not accidentally bumped out of the above positions during use.*

1B. Attach the motor to the camera by following these steps:

1. Lay the camera down on a cushion or other soft surface, with the lid side down.

2. If the camera side still has the 3.5mm headless screws filling the motor mounting holes, two of these must be removed with a small screwdriver. (The ones in the upper left and lower right.)

3. Line up the motor drive shaft with the camera's 1:1 shaft. It is the one below and to the right of the other, 8:1 shaft. Turn the motor shaft with your fingertips until the drive slots line up with the corresponding wide and narrow drive lugs in the 1:1 shaft. Place the spring-loaded motor drive shaft on the camera's shaft.

4. Tighten the two motor mounting screws finger tight. It is not necessary to use tools. Run the camera at 12.5 FPS for a moment to seat the shaft, if it did not pop fully into place.

2. Operation

Power is supplied through the 4-pin XLR connector. 12 or 12.6 volts DC is required. Pin 1 is negative (—) and pin 4 is positive (+). Reversed DC polarity will cause the camera to run at high speed backwards and could damage any connected accessories. If you are not sure your battery and all cables are correctly wired, do not use them until proper polarity is verified with a voltmeter. Do not apply more than 14.4 V as this may cause damage.

Running **speed** is selected by the rotary switch. The speeds are 12.5, 15.625, 25, 31.25 and 50 FPS (frames per second.) All of these speeds except 15.625 and 31.25 are HMI safe for 50 Hz powering of the lights. This means that if you are filming under HMI or fluorescent lights, or discharge type street lights, you will get flickerless results when you film at 12.5, 25 and 50 FPS. The other two speeds are odd ones but are included at no extra cost.

None of the speeds are HMI safe for 60 Hz power; for these you connect the TMC Milliframe Controller. If you are filming under daylight or high-amperage incandescent light, any speed can be used at will. No harm should be done by changing speeds while running. Remember that a speed change calls for a corresponding lens

aperture change.

Running is controlled with the Run-Stop rocker switch. In case the camera has a film jam, be ready to stop the camera immediately to prevent tripping the breaker or causing camera or motor damage.

A **sync alarm** light is provided. It will light up whenever the chosen speed (internal or external) is not being maintained. Slight weak flickering at low speeds may be normal, depending on film friction, camera condition, etc.

The **circuit breaker** inside should never trip in normal operation. It protects from gross faults, such as a film jam. If it trips, indicated by running weakly or not at all with 12 volt power connected, turn to Stop and unplug any accessories. Normal operation should resume in about 5 or 10 minutes.

If you are using a Rex-5, M-5, or SBM with a 400' (122 m) film **magazine**, plug the magazine takeup motor into one of the sockets on the top of the TXM-20Be.

•Note that if using the **MM** takeup, you need to insert it as follows:

- •For filming at 12.5 through 25 FPS, plug it into the **left** socket.
- •For filming at 31.25 through 50 FPS, plug it into the **right** socket.

•If you are using the **WM** takeup motor, always plug it into the **right** hand socket, and set the approximate speed on the dial of the WM motor.

Note that the torque motor might not be able to turn fast enough, at the beginning of the roll, to safely run at speeds at or above 50 FPS using a standard 2" (5 cm) core. The solution is to use a 3" (7.5 cm) diameter core (available from your film lab) for takeup, or else do not film at high speeds for about the first 50 or 100 feet (15 or 30 m) of the roll.

Your Bolex is not a self-blimped (quiet) studio camera. For sound filming, you must either use a blimp or barney indoors, or else film outdoors at a distance, or through a closed window. Alternatively, plan on dialog replacement via "looping."

For double-system **sound**, you should use a film sound recorder such as a Nagra, or else a stereo cassette recorder that has been modified to record a crystal pilot signal on one track, such as from a TCS model TX-10. (The normal speed in Europe is 25 FPS with a 50 Hz pilot.) At the beginning of each sound take, you need to use a clapstick that can be seen by the running camera and heard by the running recorder's microphone, as a start mark. The crystal pilot is then used for resolving (transferring in sync) to 16mm perforated magnetic film that has the same number of holes per second as does the picture film. It may also be possible to use newer media such as DAT (digital audio tape), MiniDisc, Hi-Fi video tape, etc. Subsequent editing and mixing steps are beyond the scope of these instructions and we refer you to the books and courses on the subject.

3. Using External Speed Control

The TXM-20Be has a 9-pin DE-9 connector for external speed control. This permits running at some 40,000 speeds between about 10 and 50 FPS. This will accept the TCS **TMC** Milliframe Controller as well as the **TVCe** Videoframe Controller. The **TMC2** Milliframe Controller can also be used, however the TXM-20Be does not have a frame pulse output and will not advance the footage counter in that model.

Set the speed dial of the TXM-20Be to the **25, MC** position when using external speed control.

The TMC or TVCe draws very little current, and would take a week, 24 hours a day, to discharge the average battery, so to simplify operation no separate standby switch is provided.

External control permits "odd" speeds to be used, such as for filming when a video or computer monitor is in the scene, reducing shutter bar. It also permits the use of unusual HMI speeds, or traditional speeds, that are not provided on the camera's speed dial.

3A. Special considerations for filming from video or computers

Your eye is not fast enough to see it, but the image on a video monitor or TV is actually composed of a spot of light that scans across the face of the picture tube from left to right, and from top to bottom, to paint the rectangular "raster" area that your eye sees as a picture because of the eye's slow response time.

To conserve video bandwidth and increase the number of available TV channels, video employs "interlaced scan" which means that it writes the odd-numbered lines and then goes back and fills in the spaces with

all the even-numbered lines. Each set of odd or even lines is known as a "field" of which there are 50 per second; a full set of lines is a "frame" and there are half as many, namely 25 per second. This works well when viewing the TV at a distance, but close-up your eye can see that the illuminated lines are alternating back and forth and this appears as "line crawl" so it looks like the lines are moving up or down. European video in PAL or SECAM has 50 fields, 25 frames, 625 lines per frame, 15,625 lines per second.

A regular cine camera has a shutter that is open half of the time or less, 25 times per second, and only part of each video frame is illuminated during that time. So, just pointing an ordinary camera at a TV set will yield alternating light and dark bands in a different place in each film frame, an irritating effect known as "shutter bar."

How Other Cameras Do It

High-end professional cameras are able to include a regular video monitor in the shot by virtue of filming at 25 or 12.5 FPS (frames per second) with a 180° shutter opening, giving an exposure time equal to one field or one video frame respectively. The slight remaining shutter bar can be seen in the mirror reflex finder and moved, with the speed controller's "phase" button, to the bottom of the monitor's picture, where it will remain for the duration of the shot. People with unlimited budgets making feature films use instead special rented 24 FPS video equipment so they can film from it at 24 FPS.

How Your Bolex Can Do It

Your Bolex does not have a 180° shutter opening, so you can not film at 25 or 12.5 FPS because the resulting shutter bar will be very wide, though stationary, and you will not be able to see where it is through the viewfinder because the camera does not have a mirror shutter. Also, the Bolex shutter is very close to the film plane which will give greater difficulty with shutter bar owing to the small penumbra of the shutter edge. The shutter is also driven through multiple gear meshes, particularly a variable shutter, so there may be increased random variation in shutter timing from one frame to the next.

The best you can do is film at an FPS rate, suited to your shutter opening, so that your exposure time is exactly 1/25 or 1/50 of a second per frame. This will give an optical splice that is in a different place in each frame, but it may not be too visible if conditions are right. You will be using "odd" filming rates so double-system sound filming is probably not feasible.

In the following formula, you can calculate the FPS rate if you know your camera's exact shutter opening, and the video field rate which is 50 in Europe:

$$\text{Filming Rate (FPS)} = \frac{\text{Video Field Rate} \times \text{Shutter Opening}}{360}$$

Thus, in Europe, if your shutter is exactly 131° you would film at 18.194 FPS. If your shutter is exactly 143° you would film at 19.861 FPS. If your shutter is exactly 170° you would film at 23.611 FPS. These speeds are theoretical calculations and should be verified by test. If the monitor is large in the film frame you might prefer to get all of the scanning lines, requiring filming at one half of these speeds.

For filming from a computer monitor you would need to find out the frame rate, generally 56 to 75 on non-interlaced monitors and 30 to 37.5 on interlaced ones, to enter into the above formula. You may be able to establish a frame rate by removing the lens and pressure plate, and running the camera without film while looking through the running shutter. Vary the speed to get a stationary shutter bar. This computer frame rate is then entered into the above formula to calculate the filming rate.

4. For Technicians

The 25, MC position is normally used when connecting the Milliframe or other Controller.

The Milliframe Socket is numbered. Pin 6 is +12V, pin 3 is 100 PPF (pulses per frame) external reference of 5V CMOS logic, pins 5 and 9 are ground, shell is ground, other pins are not connected in this model. The external signal must be a 50% duty cycle symmetrical square wave with full 0 to +5 volt HC (High Speed CMOS) amplitude, and about 100Ω source resistance.

The Torque Motor sockets are for either an original Bolex 5.95mm x 2.1mm locking inverted power plug, or a standard 5.5mm x 2.1mm locking inverted power plug, preferably a Mouser 1710-2120. Center is positive, outside is negative.

If it is necessary to adjust the crystal frequency, use a counter of known accuracy and attach it to the TP test point and case ground. Adjust trimmer capacitor for 6.400000 MHz ± 20 Hz.