Installing and Using the TCS TXM-17 Crystal Motor for Arri 16-S, 16-M

1. Installation. First remove the existing motor by loosening the clamp, then pulling out the motor. **Clean** the front gold electrical contact and the front coupling ball on the TXM-17, the camera's electrical motor contact spring, and the inside of the camera's mating rubber coupling, with a cotton swab stick moistened with rubbing alcohol. Do not touch these components with your fingers. Install the TXM-17 by lining up the index pin with the slot in the camera, then push the motor fully in until the trim ring is flush against the body. Tighten the clamp.

2. Powering. The TXM-17 requires **12 volts DC**. Operation on 8 volts is not guaranteed. If you want to try to film at 60 FPS (frames per second) a 14 volt battery can be used intermittently, but we don't recommend routinely using this higher voltage. Make sure the correct DC polarity is applied; normally positive polarity is applied to the **Left** pin on the Arri-S original 2-pin socket, to pin 2 on the Arri-M 3-pin socket, and pin 4 of cameras converted to have the standard XLR 4-pin socket. The ultimate test is that when the run switch is on, positive voltage is found on the lower spring contact that connects to the front pin on the motor. If polarity is reversed, the motor may not be harmed but it will turn backwards at high speed, 50-60 FPS.

3. Magazines. There should be no problem using the **16-M** 400' magazines as they are driven mechanically by the camera body. The **16-S** 400' magazine torque motors, however, are mostly designed for 8 volt operation. They must be converted for use on 12 volts to prevent overheating and burnout, and also to reduce electrical interference with the drive motor.

4. Basic Operation. The camera is started and stopped as before with the camera's usual switch.

a. The **speed range** of the TXM-17 is selected with the two-position slide switch. This switch is recessed to prevent damage or accidental actuation, and its setting can be changed with a toothpick or small screwdriver. The **upper** position is for European speeds of 10, 12-1/2, 16-2/3, 20, 25, 33-1/3 and 50 FPS. These speeds are all safe for use under HMI or fluorescent lights powered on 50 Hz current. The **lower** position is for the American speeds of 12, 15, 20, 24, 30, 40 and (on 14 volts) 60 FPS. These speeds are all safe for use under HMI or fluorescent lights powered on 60 Hz current.

b. The actual **speed** is selected with the rotary switch. It is recessed to prevent damage or accidental actuation, and it is changed with a small screwdriver. Note that the molded-in pointer in the switch needs to be towards the desired speed. Each position has two possible speeds depending on the setting of the slide switch, above. The center position of the rotary switch, for example, is marked with both *20* and **24** FPS speeds. The outer *20* in *italics* is the 50 Hz European speed. The inner **24** in **bold** is the 60 Hz American speed. If you keep the slide switch in the correct position, and the out of sync alarm light stays dark while filming, any speed you select will be safe for HMI or fluorescent lights powered by your power line (mains) frequency. (For use under 60 Hz lights, you can also select 10 FPS on the 50 Hz European range.)

c. If the camera stops running with the viewfinder dark, use the **Manual Advance** knob on the back of the motor. Turn it clockwise to restore the viewing position.

d. The **"Sync Alarm"** light will come on any time the motor is not running at the selected speed. It is normal for it to come on briefly at the beginning of a shot.

5. External Speed Control. Connecting a TCS Milliframe Controller or Videoframe Controller will automatically make it the reference for controlling the speed. Connection is by the 4-pin Mini-Din socket on the rear of the motor. The speed switches on the motor have no effect when the external control is connected. The "Sync Alarm" light on the motor will show whether the externally selected speed is being maintained. External speeds should be kept within the range of 5 to 50 FPS (60 FPS on 14.4 volts.) Since the external speed control will mostly be used for filming from video or computer monitors, or filming at 29.970 FPS for NTSC video transfer, the motor is designed so that external speeds in the 30 to 40 FPS range will lock into sync the most rapidly. (Note: There is .6 volts difference between the camera body and the case of the external controller. To prevent a possible momentary speed disturbance while filming, do not let the two cases touch.) There will be some difference in behavior according to the type of control:

a. The TCS **Videoframe** Controller outputs the correct frequency as soon as power is applied, so its 23.976 and 29.970 speeds will instantly become correct.

b. The TCS **Milliframe** Controller ideally should receive power for a few seconds before the motor is started in order to stabilize its output. However, since the pre-electronic Arri S and M cameras have no provision for standby power before starting, this is not possible. Therefore, when starting, the camera will run at erratic speeds for a few seconds before settling down.

For filming from a video or computer monitor, the speed of the external controller is set so as to get a stationary shutter bar. (Note that some cameras may have a black stripe on the rotating reflex mirror that will give an extra, false shutter bar in the finder but not on the film. Usually the narrower of the two is the true shutter bar. This should be established by test.) When you start filming the scene, push the controller's "Phase" button until the shutter bar is where you want it, such as at the bottom of the monitor's picture. Then call "Action!"

Caution: Do not connect anything to the Mini-Din socket unless you know the applied power is the correct polarity, otherwise the accessory and the motor can both be damaged. Do not connect any accessory that draws much more current than would the TCS Milliframe or Videoframe controllers (i.e., about 30 mA) or damage to the motor may occur.

6. Application Notes for sound filming:

a. Your Arri S or M is not a self-blimped quiet camera, so for successful sync sound filming you may need: a directional microphone and sound-absorbing walls; to use a blimp or barney indoors; to film outdoors at a distance; or to film through a window. Of course, to shoot a music video where the performers are miming to playback and no audio is being recorded, camera noise is not a problem.

b. Choice of filming speeds:

Traditional sound speeds are **24** FPS used in North America, and **25** FPS in Europe and much of the world. The **30** FPS rate is popular for film that is to be transferred to U.S. NTSC video, as it eliminates "judder," an irritating 12 Hz irregularity in the strobing of moving objects arising from the so-called "2-3 pulldown" for digitally converting 24 FPS film to 30 FPS video. The audio recorder such as a Nagra or cassette must be equipped with a crystal sync generator to record a pilot signal (a timing or speed

"judder," an irritating 12 Hz irregularity in the strobing of moving objects arising from the so-called "2-3 pulldown" for digitally converting 24 FPS film to 30 FPS video. The audio recorder such as a Nagra or cassette must be equipped with a crystal sync generator to record a pilot signal (a timing or speed reference) on the recorder's pilot or spare audio track. (Suitable crystal sync generators are also manufactured by TCS.) This tape is then resolved (i.e., transferred in sync) to 16mm perforated magnetic film, at the same speed as the picture, for editing.

It is also possible to have the sound on DAT (digital audio tape,) CD (compact disk,) or on Hi-Fi video tape such as 8mm, Hi-8, VHS, etc. Since these formats automatically record a control track that is locked to the same crystal on playback, acceptable sync can usually be maintained by simply re-recording to magnetic film without any special equipment. The magnetic film recorder is run at the same speed as the filming rate (24, 25 or 30) preferably locked to a crystal rather than the power line (mains) frequency, which can vary somewhat. Since general purpose sound equipment is not adjusted as accurately as equipment intended for sync sound use, the best sync will be obtained by playing the digital or Hi-Fi tape back on the same piece of equipment as was used in the field. The picture and sound rolls can then be edited to make film prints, or interlocked together for transfer to video.

The **Videoframe Controller** is primarily intended for generating footage that will just be transferred to U.S. NTSC video, and not be used for making film prints. The 23.976 and 29.970 FPS speeds are the exact speeds that a Rank or Bosch film scanner actually runs at when set to "24" and "29.97" respectively. Therefore, when filming at these speeds you are working in exact real time as far as the film scanner is concerned. Your audio can then be on DAT (digital audio tape,) CD (compact disk,) or on Hi-Fi video tape such as 8mm, Hi-8, VHS Hi-Fi, etc. This self-resolving audio can then be just played back without special equipment and re-recorded on the audio tracks of a professional video tape format. The start mark or clapstick can be lined up on two video tape machines, run together for editing. This eliminates the intermediate transfer to 16mm magnetic film, possibly saving cost and the loss of audio fidelity. This also permits keeping multiple channels of audio, which would usually be lost on magnetic film. It is also possible to film for eventual film release, by several possibly confusing options: **1**. Film at 23.976 FPS with audio on a Nagra or cassette recorder, using a 59.94 Hz crystal pilot frequency instead of 60. The tape can then be resolved to 16mm magnetic film with normal techniques and sync will be maintained. **2**. Film at 23.976 FPS with audio on a Nagra or cassette recorder, using a 60 Hz pilot frequency. In resolving, a 60.06 Hz reference frequency is used instead of 60. The disadvantage here is that 60.06 is not recognized as any sort of standard and crystals for this are rare. **3**. Film at 23.976 FPS. Record your audio on CD, Hi-Fi or DAT, and when re-recording run the magnetic film recorder at 23.976 FPS by feeding in a 59.94 Hz reference instead of 60. Not all magnetic film recorders are capable of this, however. **4**. In this case, dub from the digital audio to a Nagra tape while recording a 59.94 crystal pilot, then resolve that to 60 Hz to the mag film normally. (TCS makes crystal sync generators of 50 and 60, or 59.94, Hz and can make them up in a box for use on AC, or on batteries.)

In all cases, the differences above are mainly in how sound sync is maintained. For filming under conventional **HMI** lights, fluorescent lights, or discharge-type street lights the question of HMI compatibility arises. 24 and 30 FPS are HMI safe for lights operated on 60 Hz power. 25 FPS is safe for lights operated on 50 Hz power. 23.976 and 29.970 FPS are not HMI safe and a slow pulsation of exposure might be noticed. The remedy here is to use "flickerless" HMI lights, or else high-amperage tungsten light. Of course, when filming under **daylight** or high-amperage **tungsten**, any speed can be used at will anywhere in the world.

7. In Case of Difficulty.

Fuse. The TXM-17 has a non-replaceable, automatically resetting PTC (positive temperature coefficient) thermistor "fuse." If more than about three times the normal current is drawn by the motor and accessory speed control, the PTC device will switch to a high temperature high resistance state that will prevent the motor from running or the sync alarm light from coming on. In this case, turn off the power switch, and let the unit cool for 5 or 10 minutes. Normal operation should then resume.

Running Backwards. If the motor turns at high speed the wrong way, your DC polarity is reversed and must be corrected. The fact that your original variable speed motor runs the right way means nothing as it is a wound-field type that will turn the same way with either polarity.

Sync Drift. If you suspect that proper sync is not being maintained, a TV receiver can be used as sort of a poor man's strobe. If you have a U.S. set, run the camera at 29.970 FPS with a Videoframe Controller or Milliframe Controller and you should get a stationary shutter bar. (If you don't have the ability to run that speed, select 30 FPS instead; the shutter bar should move from bottom to top of the picture in about 16 seconds.) For European PAL or MESECAM receivers, run the motor at 25 FPS and you should see a stationary shutter bar.

If the bar is moving improperly, that is definitely crawling down with 29.970 or 25 FPS or moving at the wrong rate at 30 FPS, this indicates that the camera is running slow. The most frequent cause of this is a slipping coupling between the motor and the camera. The coupling ball is machined to the same diameter as the original motors' couplings. Since most rubber cups have become loose with age and use, the diameter of the ball is increased at the factory by applying a piece of heat-shrink tubing. In case you are still getting slippage, first try cleaning the rubber and the motor ball with rubbing alcohol, avoiding fingerprints on either. If this does not work, try making the fit tighter by applying a second piece of 3/8" (10mm) heat-shrink tubing to the ball, and heating it to a shrink fit.

Conversely, if the ball diameter is too large to fit into the camera's rubber coupling, the heat-shrink tubing can be removed by slicing it with a knife.

A very slow movement of the shutter bar in either direction may be due to normal frequency tolerances in either the video source or the motor. The crystal frequency in the motor is best checked by connecting a frequency counter with recent calibration to CD4060 pin 9 and ground, and while running adjusting the nearby trimmer capacitor for 3686.400 kHz ±12 Hz or ±3 PPM (parts per million.)

Mini-Din Connections. In case the speed controller cable is damaged and needs repair, tell your technician that pins 1 and 2 are shields and grounds, pin 3 is +12 volts 30 mA power output, and pin 4 is 5 volts p-p 3200 pulses per frame 50% duty cycle square wave input signal, rising to +12 volts at low current when nothing is connected, to enable the internal crystal speeds.

Important Note for TCS TXM-17 Crystal Motor

The instruction manual possibly skims over the fact that the rotary speed switch is correctly set when the molded-in **arrow or pointer** is towards the desired speed. Do **not** set the screwdriver **slot** towards the speed as you will be off by two speed positions.