Installing and Using the TCS TXM-18 Crystal Motor for Arri 2A, 2B, 2C

1. Installation. First detach the existing motor by removing the attaching screws and the idler gear, all of which will not be used with the TXM-18.

Place the camera upside down on a table. Gently engage the 35-tooth gear on the camera bottom with the matching interior gear in the upside down motor. Turn the inching knob slightly while jiggling the motor to enable it to slip fully into place. Pass the two long screws through the motor down into the camera, and tighten the two screws. Do not fully tighten the screws until you are sure the motor is flush against the camera and the inching knob turns without binding.

2. Powering. The TXM-18 requires **12 volts DC** for normal filming at speeds up through 40 FPS (frames per second.) The 4-pin male XLR receptacle uses standard 12 volt wiring, that is with pin 1 negative (—) and pin 4 positive (+). If using a single battery, note that the pins of the "Extra" battery receptacle are live when the motor is running. Install the plastic insulating cover to prevent short circuits.

For speeds at or above 40 FPS a second 12 volt battery is connected to the "Extra" receptacle. It also uses standard wiring, 1 — and 4 +.

3. Maximum speeds. If your Arri 35mm camera is the standard speed type, only use speeds up to 50 FPS. If you have a High Speed movement, speeds to 75 FPS can be used for a short time.

4. Basic Operation. The camera is started and stopped with the **"RUN - STOP"** rocker switch. No current is drawn in STOP, except that a Milliframe Controller, if connected, will draw a small standby power from the Normal battery.

a. The speed range of the TXM-18 is selected with the four-position rotary switch.

The **"50 HMI"** position is for European speeds of 10, 11-1/9, 12-1/2, 14-2/7, 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 **"59.94"** position gives speeds approximately the same as in the 60 HMI position, reduced by dividing them by 1.001 to equal the film to video transfer rates on a Rank or Bosch to NTSC (U.S. system) video. The most likely to be used are 14.985 FPS (achieved by selecting 59.94 and 15,) 23.976 FPS (via 59.94 and 24,) and 29.970 FPS (via 59.94 and 30.) 29.970 FPS can also be used to film from an NTSC video monitor as described later.

The **"60 HMI"** position is for the American speeds of 12, 13-1/3, 15, 17-1/7, 20, 24, 30, 40 and (with a High Speed movement) 60 FPS. These speeds are all safe for use under HMI or fluorescent lights powered on 60 Hz current. You can also use 10 FPS from the "50 HMI" range.

The **"75"** position is primarily for filming at 75 FPS, although all nine positions work, giving speeds that are 25% higher than on the "60 HMI" range or 50% higher than on the "50 HMI" range. Most of these duplicate speeds that already are found on the dial, although four new speeds are obtained (18-3/4, 21-3/7, 37-1/2 and 75 FPS.) The full speed chart, later in these instructions, shows all possible speeds.

b. The actual **speed** is selected with the nine position rotary switch. Each position has four possible speeds depending on the setting of the four position switch, above. Only the two most common speeds for each position, for 50 Hz and for 60 Hz HMI lighting, are included on the dial. The center position of the rotary switch, for example, is marked with both *20* and **24** FPS speeds. The *20* in *italics* is the 50 Hz European speed (remember *Italy* is in *Europe*.) The **24** in **bold** is the 60 Hz American speed. If you keep the four position switch in the correct HMI 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 camera's **inching knob** on the side. 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, and to flicker slightly when running below 12 FPS.

e. The **"Phase"** button lowers the running speed by 0.45% while depressed. It is used for moving the roll bar to the bottom of the monitor frame, when filming with a video monitor in the shot. It works at all speeds, either built-in or coming from the external speed control. It is most likely to be useful filming at 14.985 or 29.970 FPS from an NTSC monitor, at 12.5 or 25 FPS from a PAL or SECAM monitor, or at 24 FPS from a special 24 frame video system.

If your camera has a black stripe painted on the reflex viewing mirror, you will see two roll bars in the finder. Depending on the width of the stripe, one bar will be the real roll bar that will show on film, and the other will be a phantom that will show only in the finder. Film tests should determine which is which.

5. External Speed Control. Connecting a TCS **"Milliframe Controller"** will automatically make it the reference for controlling the speed. Connection is by the 9-pin DE-9 socket on the rear of the motor. The 9-position speed switch on the motor is still partly active with an external reference, to enable reaching the selected speed rapidly. To take advantage of this feature, **also** set the 9-position switch to the 60 Hz speed that most closely approximates the external speed. 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 1 to 50 FPS (75 FPS with a high speed movement camera.)

The TCS Milliframe Controller should receive power for a few seconds before the motor is started in order to stabilize its output. To accomplish this, connect the normal 12 volt power cable at least a few seconds before starting. No standby switch is provided because of the small current drain of the Milliframe Controller, about 30 mA (0.030 Amp.)

For filming from a video or computer monitor, the speed of the external controller is set so as to get a stationary shutter bar. When you start filming the scene, push the controller's or motor's "Phase" button until the shutter bar is where you want it, such as at the bottom of the monitor's picture. Then the director can call "Action!"

6. Filming In Reverse. The right front of the motor case has a second rocker switch for forward or reverse filming. Push the top for running forward, and push the bottom to run in reverse. A red stripe

6. Filming In Reverse. The right front of the motor case has a second rocker switch for forward or reverse filming. Push the top for running forward, and push the bottom to run in reverse. A red stripe will appear to warn of being in the Reverse position.

***WARNING: Never** change this position while running. It is likely to **permanently damage** the motor and camera, as well as burn out other components. This damage is not covered by warranty.*

7. Application Notes for sound filming:

a. Your Arri 2A-B-C 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 etc. 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. HDTV 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 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 35mm 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 equipment is not adjusted as accurately as equipment intended for double system sound, 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 **23.976 and 29.970 speeds** are primarily intended for generating footage that will just be transferred to U.S. NTSC video, and not be used for making film prints. These 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 on the **same piece** of 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 35mm 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 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.

8. In Case of Difficulty.

Fuse. The TXM-18 has two non-replaceable, automatically resetting PTC (positive temperature coefficient) thermistor "fuses." If more than two or three times the normal current is drawn by the motor and accessory speed control, the PTC device(s) 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 the switch to STOP, unplug the Milliframe Controller if used, and let the unit cool for 30 seconds to 10 minutes, depending on the severity and duration of the overload. Normal operation should then resume. The operator should be alert and ready to turn off the power instantly in case of a film jam. As would be the case with with fuses, the PTC's may not act rapidly enough to prevent damage, especially if using two 12 volt batteries.

Rough Running Without a Camera. The TXM-18 is designed to be run only with the camera attached. Without a camera, the motor will overshoot and take a while to reach crystal speed, and the flexible camera drive coupling will rattle, causing the out of sync light to flicker. This is normal.

Milliframe Controller connections. Usually a standard DE-9 to DE-9 male to male cable is used to connect the TMC-55Aa to the TXM-18. These are often available at well-stocked computer stores. Only four wires, plus shield, are used but the other five do no harm. If you must repair an existing cable, like numbered pins are joined together, using only pins 5, 6, 8 and 9 (and shell.) Pins 5 and 9 are ground, pin 6 is 12 volts, and pin 8 is signal of 3200 pulses per frame, 5 volt square wave, the same functions but not pin numbers as on a Fischer plug. There is no frame pulse signal.

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Complete Speed Chart for TCS TXM-18

Space does not permit marking all possible speeds on the TXM-18 chassis.

Switch Position	50 Hz HMI Speeds	59.94 Hz Speeds	60 Hz HMI Speeds	75 FPS Special
1	10	11.988	12	15
2	11 1/9	13.320	13 1/3	16 2/3
3	12 1/2	14.985	15	18 3/4
4	14 2/7	17.126	17 1/7	21 3/7
5	16 2/3	19.980	20	25
6	20	23.976	24	30
7	25	29.970	30	37 1/2
8	33 1/3	39.960	40	50
9	50	59.940	60	75

Notes:

1. Speeds above 40 FPS require two 12 volt batteries.
2. Do not run standard 2A-B-C cameras above 50 FPS.
3. Filming from video monitors, use 25 or 12.5 FPS for PAL/SECAM, 29.970 or 14.985 FPS for NTSC, and 24 FPS for special 24 frame video. The lower speed of each pair should be used if the monitor is large in the film frame, to photograph both fields of interlaced scan, i.e., get all the scan lines. Push the “Phase” button to move the roll bar to the bottom of the frame.
4. All bets are off for filming from computer monitors. Connect the TMC-55Aa Milliframe Controller and play with the speed buttons until you get a stationary shutter bar. When you begin filming, push the “Phase” button on either the TMC-55Aa or the TXM-18 until the roll bar is at the bottom of the monitor frame. If you have more than one computer in the shot you may try filming around 5 FPS in an attempt to soften the roll bars on all of them.
5. Filming for video transfer with double-system audio on DAT or Hi-Fi video may require that you film at 23.976 or 29.970 FPS to hold sync in takes over 20 seconds long. See manual.

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