Installing and Using the TCS TXM-21Aa 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-21Aa. Remove the 8 screws on the bottom of the TXM-21Aa and lift off the bottom cover. Unpack the two camera attaching screws and spacer washer(s) and have them ready to install.

Place the camera and motor on a pillow or cushion with the camera and motor fronts facing up. Gently engage the 35-tooth gear on the camera bottom with the matching internal-tooth gear sleeve in the motor. This sleeve is very flexible owing to a universal joint, and may need to be helped into position. Turn the inching knob slightly while gently jiggling the camera to enable it to slip fully into place. Pass the two screws through the motor top plate up into the camera, and tighten them gently. **Note:** If a 3/8"-16 x 1/2" screw is furnished for the rear of the camera, it **must** be used with either one 1/8" or two 1/16" washer(s) under the screw head, to prevent the screw from protruding too far into the camera and causing malfunction or damage to it.

Do not fully tighten the two screws until you are sure the motor is flush against the camera, and the inching knob turns without binding.

2. Powering. The TXM-21Aa requires one or normally two sources of **12.6 volts DC**. A single 12-volt battery plugged into the left-hand receptacle is used for low speeds up to 12 FPS. A second 12-volt battery is added for normal speeds of 24 FPS and higher. The 4-pin male XLR receptacle of each uses standard wiring, that is with pin 1 negative (—) and pin 4 positive (+). **Do not apply reversed polarity** to the first or second battery connection as this can cause damage to the motor and to connected accessories even with the run-stop switch turned off. Reverse polarity or overvoltage damage is not covered by your warranty.

If using **line-operated power supplies**, be aware that often the earth ground is connected to the negative output pin, if the power cord has a 3-wire grounding type plug. This can be determined by using an ohmmeter or continuity tester. In this case, the power supply going to the right-hand socket must have the ground connection lifted or cut, or else this will present a short circuit to the left-hand socket's power supply.

When using a single 12 volt battery, the pins of the right-hand connector have 12 volts on them when the Run switch is on. **Do not short** these pins to the connector shell or this will instantly blow the fuse and could cause other damage. Keep the slip-in plastic cap in place on this connector to prevent problems, when it is not in use.

If you want to use a single **24 volt battery** that is tapped at 12 volts, connect it as follows: Connect the negative end to pin 1 of the left connector. Connect the 12 volt tap to pin 4 of the left connector. Wire the full 24 volts through an additional fuse holder and 5 amp fuse, to pin 4 of the right-hand connector, but plug it in only if running above 12 FPS. Be sure to label the plugs "Left" and "Right" to prevent confusion. Plugging them into the wrong receptacles will place a short circuit across the full 24 volts.

It is best to **not apply more voltage than needed**, as it will cause excess heating of the power transistor.

A **Fischer 11-pin** socket may be found on the front as an optional extra. This supplies 12 volts DC for an accessory such as a zoom motor. It is not equipped for speed control; speed control is instead done through the socket on the rear. The Fischer socket is protected by the main 5 Amp fuse.

3. Maximum speed. The highest speed included is 30 FPS (frames per second.) If your camera mechanism is worn and has play in the cam, however, you may not get a steady picture at 30 FPS. This is no fault of the motor. Run tests to determine your personally acceptable speed range.

4. Basic Operation. The camera is started and stopped with the **rocker switch** at the front of the left side.

The **cooling fan** only runs with the motor.

The **power transistor** will get hot in normal use so try to avoid contact with it.

A **Milliframe Controller**, if connected, will draw a small standby power and other accessories can draw their normal current.

The motor **brush holders** are exposed, so do not strike and thereby damage them. Avoid subjecting the TXM-21Aa to dirt, fumes or moisture.

The **speed** is selected with the rotary switch at the rear. The available speeds are 12, 24, 25 and 30 FPS. If you change speed, remember to also change the lens aperture accordingly.

60 Hz HMI speeds are 12, 24 and 30 FPS.
50 Hz HMI speed is 25 FPS.

When illumination is daylight or high-amperage tungsten lights, you can film at any speeds you like. Also, there is no harm in changing speed while running.

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.

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 24 FPS. An occasional slight flicker means the circuit is working hard to maintain sync, but has not actually lost sync.

5. External Speed Control. Connecting a TCS **Milliframe Controller** will automatically make it the reference for controlling the speed. Connection is by the RJ-12/RJ-45 socket on the Left side of the motor. The speed switch on the motor is totally inactive with an external reference, and it can be left in any position.

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 12 (or perhaps less) to 30 (or slightly more) FPS.

The TCS Milliframe Controller should receive power for at least a few seconds before the motor is started, in order to stabilize its output. No standby switch is provided, because of the small current drain of the Milliframe Controller, about 25-50 mA (.025-.050 Amp.)

The Run-Stop switch on the TMC or TMC^2 Milliframe Controller might be usable for remote control of the camera, but this is not recommended. For this application, leave the motor rocker switch turned on; when the Milliframe Controller is in the Stop position, the camera should be stopped and the Sync Alarm will light. (When stopped by remote control, the current drain is still 175 to 200 mA (.175-.200 Amp.)) Some TXM-21Aa's might draw an additional current or even creep forward slowly when remotely stopped in this way, which can cause overheating of the power transistor. Use this stopping mode for only a short time.

The TXM-21Aa has a digitally synthesized frame pulse output so it will actuate the footage counter in the TMC^2. If an excessive speed is called for, which lights the Sync Alarm, the footage count will be greater than the film length actually used.

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 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!" Note that if your camera's rotating mirror has a black stripe on it, there will be an addtional false shutter bar seen in the finder that will not actually appear on the film. Run tests to determine which is which.

Note that the Arri Model 2A camera has a narrower shutter opening than the other models and will, therefore, give a wide and dark shutter bar on the film where you see a wide and light shutter bar in the finder.

6. 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 one or more of: a directional microphone and sound-absorbing walls; to use a blimp or barney; 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 for

theatrical filming, and **25** FPS in Europe and much of the world for television filming. The **30** FPS rate is also used for film commercials that are to be transferred to U.S. 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. However, be very careful about selecting this speed for theatrical length material, as many video standards conversion schemes assume that film is always shot at 24 FPS, so 30 FPS film may give odd artifacts. Theater projectors generally run only at 24 FPS.

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,) MiniDisc, 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 in the short term. Since general purpose audio 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 (not just the same model) 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.

If the magnetic film recorder is omitted and the film and audio are transferred directly to video or to a **computer file** for editing, be aware that NTSC film scanners actually run at 23.976 FPS and this difference must be taken into account to keep picture and audio in sync. The lowest cost solution, if your audio will be on DAT, CD, MiniDisc or Hi-Fi video tape, may be to actually film at 23.976 FPS, which eliminates special sampling rate and time code frequencies while recording, as no "speed pulldown" of the audio is then required. However, 23.976 is not a fully HMI safe filming speed, though it should be acceptable with a square wave or high frequency HMI ballast, or of course with daylight or with high-wattage tungsten lights. 23.976 FPS can be achieved by connecting the TCS Milliframe Controller, or the lower cost Videoframe Controller.

7. Maintenance. The TXM-21Aa has permanently lubricated (in theory) porous bronze bearings. Re-oiling may however be appropriate after long and heavy use.

The **gear sleeve** that engages the camera's drive gear can have its teeth brushed with a small amount of grease. This will reduce the chance of causing wear to the camera's gear. This requires removal of the camera.

Remove the motor bottom plate to reach the following:

The **universal joint** should have a little grease packed into it; if it looks dry add some with a small stick.

The **timing pulleys and timing belt** could benefit from applying a light amount of a friction-reducing Teflon®-containing spray lubricant, sprayed on to a cotton ball, and the moistened cotton then rubbed on the teeth. Turn the pulleys by hand so you can reach all of the teeth.

The **sintered bronze & thrust bearings** should have about one drop of turbine or SAE 30 oil added to the shim washer(s) underneath the camera drive shaft timing pulley, and to the bearing on each end of the motor. Running the motor slowly should draw it into place as needed. **Note:** Do not run the motor with the bottom plate removed as this will not allow proper cooling, and creates the risk of getting your fingers or hair caught in the pulleys, with consequent personal injury.

Use a rag to mop up any excess oil and grease inside the TXM-21Aa case. Replace the bottom plate and screws.

8. In Case of Difficulty.

Fuse. The TXM-21Aa has a 5 Amp GMA (5 x 20 mm) 32 Volt or higher standard fuse. It should blow in case of a film jam or other gross fault. The operator should, however, be alert and ready to turn off the power instantly in case of a film jam. The fuse may not act rapidly enough in every conceivable situation to prevent all possible damage to the motor and camera. It does not separately protect the second power input. Applying reversed polarity or overvoltage will cause damage to the motor electronics or connected accessories, even with the rocker switch turned off, and possibly without blowing the fuse.

9. (for technicians)

Milliframe Controller connections. An RJ-12 6-conductor cable is used to connect to the Milliframe Controller. Pin 1 is +12 volts, pin 2 is open for internal crystal or ground for external reference, pin 3 is 5 volt 100 pulse per frame input, pin 4 is ground, pin 5 is 5 volt frame pulse output, and pin 6 is ground.
Other accessories might use all 8 positions in the socket using an RJ-45 8-conductor cable. In this case, pin 1 is +5 volts low current, 2 is +12 volts, 3 is open for crystal or grounded for external, 4 is 100 PPF input, 5 is ground, 6 is frame pulse, 7 is ground, 8 is direct 0~5 volt input to speed control follower circuit for factory calibration and special uses. Ideally do not use an 8 conductor cable unless pin 8 actually needs to be connected, or the running speed can become erratic.

Fischer connections: Pin 11 is positive and pin 9 is negative. The other pins are not connected.

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TXM-21Aa Instructions.pub rev 2001/02/08