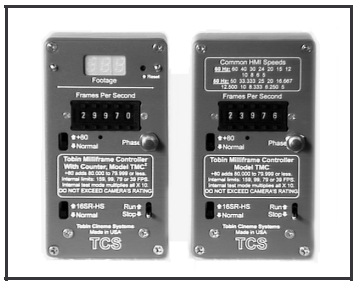
Using the TMC and TMC^2
Tobin Milliframe Controller



1. Introduction. The TMC or TMC^2 permits speed control of a compatible movie camera in .001 FPS (frame per second,) or *milliframe,* steps. This is done to enable filming at various rates under HMI discharge lamps, fluorescent lights, or metal-arc street lights without having a flicker or pulsation in the film. Or, it enables filming with a video or computer monitor in the shot, controlling the shutter bar. It can just be used to provide traditional speeds that are not present on the camera's speed dial.

The TMC^2 gives the added facility of a digital footage counter.

2. Connection. The unit plugs into cameras that are equipped for external control, via your choice of cables.

The ***Fischer cable*** has an 11-pin Fischer plug to fit the Arri 35-BL, 16-SR High Speed and 16-SR cameras, the Arri 16-BL with TCS TXM-9/F crystal control unit, and other camera conversions that are compatible.
The ***Aaton cable*** has a 9-pin WPI (formerly Amphenol) "Tiny Tim" plug with a right-angle shell to fit most Aaton cameras with the on-board battery, and in most cases it will also work with the motors requiring the WPI cable, listed next.
The ***WPI cable*** has a 9-pin WPI (formerly Amphenol) "Tiny Tim" plug and is for the Arri 16-S and 16-M equipped with the TCS TXM10-S crystal drive, the Bolex H-16 equipped with the TCS TXM10-B crystal drive, the Arri 16-BL with TCS TXM-15 or TXM-19 crystal control unit, the Eclair NPR with a TCS TXM-14 crystal motor, and other compatible cameras.
The ***DE-9 cable*** fits the Arri 35mm 2A, 2B and 2C equipped with the TCS TXM-18 crystal motor, the TXM-D and TXM-20 motors for the Krasnogorsk K-3 camera, and the TSC Speed Checker.
The ***Mini-DIN 4*** cable fits the Arri 16-S and 16-M fitted with the TCS TXM-17 crystal motor.
The ***RJ-12*** cable fits the Arri 2A-B-C with TXM-21, TXM-21A, TXM-21Aa, Eclair CM3 with TXM-21C, Arri 16-BL with TXM-25, and Bolex H-16 with TXM-26.
The ***3.5mm*** cable fits the TXM-22 and requires a 0.6X speed calculation be made and entered in the TMC.

3. General Operation. Turn the camera to "Standby" (if provided) to furnish power to the unit. Dial in the desired speed with the pushwheel switches. Each digit is separately controlled, incremented with the bottom button and decremented with the top button. The decimal point will flash red until the selected speed is stable, at which time it becomes a steady green to advise you that it is safe to start the camera running; this should be rapid at speeds around 30 FPS and only take a second or two longer at other normal speeds. Very high settings will take longer to stabilize.

The useful Controller low-end limit is about .100 FPS, but in practice the lowest speed is limited by your camera, typically to 5 or 10 FPS depending on its design. The speed is too low if the camera runs unevenly.

With cameras so equipped, the Run-Stop switch on the Controller can be used for remote control. This is possible with the Arri 16-SR and 35-BL and Aaton cameras, and perhaps others. The switch and wiring are only intended to give a controlling signal to an electronic camera, and cannot be used to directly switch amperes of motor current.

The decimal point being green lets you know that the camera is correctly being told what speed to run; it is still necessary to check the camera's out of sync warning to ensure the speed is being achieved.

In the following, and in the speed tables, trailing and leading zeros are omitted. If a speed of 5 FPS is stated, for example, this would be entered as 05.000 in the pushwheel switches. (Trailing zeros are those to the right of the decimal point. Leading zeros are those to the left of the first non-zero number.)

Speeds up to 99.999 FPS are obtained with the pushwheel switches alone.

High Speed Filming is obtained by setting a speed of 79.999 or less in the pushwheel switches, and by using a toothpick or equivalent turning on the "+80" switch to add 80.000 FPS to the indicated reading. This enables speeds of up to 159.999 FPS to be obtained in .001 FPS steps. Do not exceed the camera's maximum speed rating or it may well be damaged. Setting high speeds can be inhibited as discussed in section 9. Setting super-high speeds up to 1599.99 FPS is described in section 10.

Arri 16-SR High Speed cameras require only half as many pulses per frame and are made to run at the correct indicated speed by changing the front panel switch, using a toothpick or equivalent, from "Normal" to "16SR-HS." This change will only affect cameras using the Fischer cables, so the switch can be left in this position if your other cameras don't use the Fischer connector.

4. Filming Under HMI Lights. For shooting under discontinuous (flashing) illumination there are only certain speeds that will give flicker-free footage. Such sources include HMI lights, fluorescents, and discharge type street

lights. On 60 Hz and 50 Hz current, these lights flash 120 or 100 times per second respectively. To get even exposure from one frame to the next there must be a whole number of flashes per frame.

Safe speeds can be calculated by dividing the flashing rate by 1, 2, 3, 4, 5 and so on and for your convenience the range of HMI-safe speeds from 4 to 120 FPS is given on tables on the rear of the Controller. Abbreviated tables of the most common speeds are also found on the front panel of the TMC.

5. Filming From Video Monitors. For filming with an NTSC (U.S. system) TV set in the shot, the shutter bar can be immobilized by filming at 29.970 or 14.985 FPS. For future U.S. HDTV screens with 60 Hz scan, 30.000 or 15.000 should be safe. For PAL or SECAM monitors, use 25.000 or 12.500 FPS. For special 24 FPS video systems used in high-budget productions, film at 24.000 FPS. In general, the lower speed should be used if the monitor is large in the frame and minimum visibility of the scan lines is desired. Alternatively, if the video signal is fed through a "scan doubler" to eliminate interlace, all of the scan lines will be seen at the higher speed. For best results and greatest predictability the camera shutter should have opening and mirror segments that are both equal to 180°.

If the video originates on a VCR that is running a bit off-speed, the filming rate may have to be altered slightly.

If multiple video sources are feeding multiple monitors, they can be synchronized so the phase bar is in the same place on each by genlocking each source to a master sync generator.

When you start filming, push the "Phase" button to move the shutter bar to the bottom of the frame, and inform the director that he can command "Action!"

6. Filming From Computer Monitors. This is a real no-man's land as each computer sub-model seems to drive its monitor at a different speed, evidently according to the whim of the monitor driver card designer. Run the camera without film while playing with the pushwheel switches to establish the correct filming speed. For the better quality non-interlaced monitors try the range of 28 to 44 FPS. For interlaced monitors try 14 to 22 FPS. The modern trend in newer IBM-compatible computers is towards a 75 Hz vertical refresh rate, implying a filming rate of about 37.5 or 18.75 FPS.

When you start filming, push the "Phase" button to move the shutter bar to the bottom of the frame, and inform the director that he can command "Action!"

In an establishing shot where numerous computer screens are visible, and each is running at a different speed or in a different phase, try setting the lowest possible speed on the controller that still runs the camera smoothly. While not eliminating phase bars, they will be softened to a possibly tolerable degree. Or if you have the required time and temperament, and everything in the shot can be locked down, you could do a multiple exposure with only one monitor turned on at a time, and with the camera running at the correct rate and phase for that particular monitor. Remember to cap the lens and finder each time you run the film in reverse.

7. Filming For Video Transfer With Non-Resolvable Double System Audio. If you are planning to transfer your film to NTSC video, in conjunction with audio on DAT (digital audio tape) or on Hi-Fi video tape whose speed cannot be adjusted, this brings up a sync problem. The Rank or Bosch film scanner does not run at the expected 24 or 30 FPS, but instead at speeds referenced to the 60 ÷ 1.001, or 59.94 Hz, video rate. This makes the normal speeds become 23.976 and 29.970 FPS respectively, causing a 0.1% speed drift. The remedy is to film at the same exact rate at which the film scanner runs, thereby maintaining far better synchronization.

A creative possibility is to find out the available transfer speeds and film at them instead of at normal speeds. For example, if the available Rank can run at 16.03 FPS, you could film and transfer at this rate with double-system audio in perfect sync but with increased motion artifacts, namely more jerkiness than usual.

8. Filming With Certain Cameras. If your camera lacks a mirror shutter, or if its shutter opening is much different from 180°, you may be able to film successfully from video or computer monitors using the following method. It is necessary to know your camera's exact shutter opening, and the vertical rate of the monitor. Use the following formula to calculate the filming rate that will minimize shutter bar by making an optical "splice" in a different place in each film frame, which may not be too visible if you are lucky and are filming at the maximum lens aperture. In this method the "Phase" button is not used as the vestiges of the shutter bar are in a different place in each frame. The video frame rate is 29.970 for NTSC, 25 for PAL/SECAM and possibly 75 for newer computers.

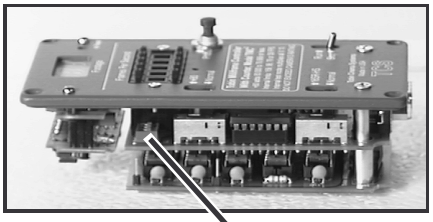
$$\text{Filming Rate} = \frac{\text{Video Frame Rate} \times \text{Camera Shutter Opening}}{360°}$$

Thus, if you are filming from a U.S. TV set and your camera has a 131° shutter opening, you would film at 10.906 FPS to get all the scanning lines. If you would be satisfied with more visible scan lines, you could film at double

that speed, or 21.812 FPS.

9. Setting The Speed Limit Switches. To avoid over-revving and damaging your camera, provision is made in the Controller to limit the 159.999 maximum speed to 99.999, 79.999 or 39.999 FPS. Speeds set in excess of the predetermined limit will be incorrect. For example, with a 39.999 limit, if someone selects 50 the actual speed will become 10 instead, with no indication of the deviation other than hearing the camera running unusually slowly.

To proceed with setting the speed limit, observe the following. Sit down at the work area with the Controller, and ground yourself and the unit to a metal water pipe, or a metal appliance with a 3-wire grounding power cord, to drain off any static charge. Remove the 4 panel screws and lift off the front panel. At the top of the front speed control circuit board you will find 3 tiny switches ganged together. For the TMC^2 this is below the two small boards for the footage counter section.



For no limit (159.999 FPS,) all three switches must be turned ON.

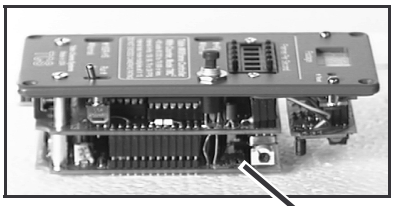
For a 99.999 FPS limit (+80 switch inactive,) turn switch number 3 OFF but leave switches 1 and 2 ON.

For a 79.999 FPS limit, turn switches 2 and 3 OFF but leave switch 1 ON.

For a 39.999 FPS limit, all three switches should be OFF.

Reassemble the unit when done.

10. Ultra High-Speed Filming. An internal jumper change can configure the Controller so that the actual running speed is ten times that indicated. That is, 24.000 becomes 240.00 and 159.999 becomes 1599.99; the speed limits are also ten times greater so 99.999 becomes 999.99, 79.99 becomes 799.99, and 39.999 becomes 399.99. There is no indication of this "ten times" condition on the front panel, to minimize clutter or confusion, since we expect it to seldom, or more likely never, be used for actual filming. The primary use of this jumper change is for testing and calibration of the unit at the factory.



To proceed with setting the speed range, observe the following. Sit down at the work area with the Controller, and ground yourself and the unit to a metal water pipe, or a metal appliance with a 3-wire grounding power cord, to drain off any static charge. Remove the 4 panel screws and lift off the front panel. At the edge of the rear speed control circuit board, near the top, you will find a 3-pin header with a shorting jumper. For normal settings this will be linking two pins in the "Normal" position. To change to the multiplied by ten range, pull the jumper straight out and reinstall it so it is linking two pins in the "Test X10" position. Reassemble the Controller. We suggest affixing a temporary sticker to the front panel warning the user of this change, and also showing where the decimal point is now located. The +80 switch can be re-labeled "+800" as well.

The Footage Counter in the TMC^2

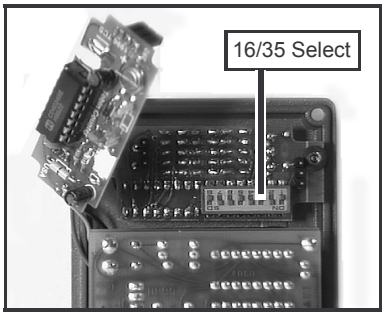
1. General. Three digits are provided, for counting in feet only. To convert to metres, multiply the footage by .3048. The display uses newly invented super high efficiency LED (light emitting diode) digits so the counter module only consumes about 25 mA, so there is no need for dimming the display when idle. A reset button forces the counter to 000 and is pushed with a toothpick or equivalent, while power is connected, when you load a new roll. To count, frame pulses must be coming from the camera, which are divided to get footage.

2. Setting to 35mm or 16mm. To proceed with setting the film size, observe the following. Sit down at the work area with the Controller, and ground yourself and the unit to a metal water pipe, or a metal appliance with a 3-wire grounding power cord, to drain off any static charge. Remove the 4 panel screws and lift off the front panel. There is a tiny 8-gang switch on the rear of the front counter circuit board. For better access to it, pull off the rear counter circuit board. For running **16mm** film, turn ON switches 2, 4, 6 and 7 and turn OFF switches 1, 3, 5 and 8. For running **35mm** film, turn ON switches 1, 3, 5 and 8 and turn OFF switches 2, 4, 6 and 7. Reassemble the unit.

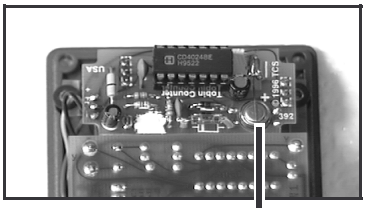
3. Counter Memory. A 1.5 volt No. 392 silver oxide watch battery enables the footage count to be retained in CMOS memory while power is not connected. This battery should last for years. If the footage count is lost when power is removed for a period of hours, it is time to replace it.

To proceed with replacing the battery, observe the following. Sit down at the work area with the

Controller, and ground yourself and the unit to a metal water pipe, or a metal appliance with a 3-wire grounding power cord, to drain off any static charge. Remove the 4 panel screws and lift off the front panel. Locate the battery, on the front of the rear counter circuit board. Tease the wire spring upwards without overly stressing it and poke out the battery using a toothpick or equivalent. Replace the battery with a new one, with the "+" case down in the recess and away from the wire spring, with the wire spring bearing on the raised "—" contact. Reassemble the unit.



Appendix: Pin Connections, etc.



There are no user adjustments inside. Two critical settings are factory calibrated and glued in position. These must not be disturbed except from necessity and by a knowledgeable and properly equipped technician.

Mating plug is a 9-pin female DE-9 connector. Installed receptacle is a DE-9 male, gold contacts.
Pin 1 is the frame pulse from the camera, divided to derive footage. This is not used in model TMC.
Pin 2 is the output for Fischer connectors only, switchable from 3200 to 1600 PPF (pulses per frame.)
Pin 3 is the 100 PPF output.
Pin 4 goes to one side of Run switch, low current circuit.
Pin 5 is negative ground.
Pin 6 is nominal +12 volt power from the camera, usable range 9 to 30 volts DC. Current drain is about 25 mA for the TMC, and about another 25 mA for the counter in the TMC^2.
Pin 7 goes to the other side of Run switch, low current circuit.
Pin 8 is a fixed 3200 PPF output, for other than the Fischer connector.
Pin 9 is negative ground.
Connector shell is negative ground.

Tobin Cinema Systems
http://www.tobincinemasystems.com

HMI & Fluorescent Speeds

60 Hz HMI Speeds: 120 60 40 30 24 20 17.143 15 13.333 12 10.909 10 9.231 8.571 8 7.500 7.059 6.667 6.316 6 5.714 5.455 5.217 5 4.800 4.615 4.444 4.286 4.138 4

(And lower speeds that divide evenly into 120)

Video:
NTSC 29.970
or 14.985
HDTV 30.000
or 15.000
PAL 25.000
or 12.500

Computer:
Try 14 to 22
or 28 to 44

50 Hz HMI Speeds: 100 50 33.333 25 20 16.667 14.286 12.500 11.111 10 9.091 8.333 7.692 7.143 6.667 6.250 5.882 5.556 5.263 5 4.762 4.545 4.348 4.167 4

(And lower speeds that divide evenly into 100)