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1. Introduction

1.1 About ThingM

Thank you for buying a ThingM Stop-Motion Camera Control.

ThingM (pronounced exactly like it looks) is a "single-axis motion control system in a box" which is specifically adapted for stop-motion camera drives. ThingM operates a stepper motor to rotate a camera's 1:1 drive shaft at variable single-frame speeds, exposure times, and lapse time intervals. ThingM's motion-controlled acceleration and deceleration results in smooth handling of film shot single-frame style, without the hard starts and stops produced by conventional AC motors or constant-speed DC motors.

ThingM was originally designed and built by Dave Milici, while studying filmmaking and engineering at the University of Illinois in the early 1980s. After relocating to the San Francisco Bay Area, DaveM built motion control systems for various animators and visual effects cameramen. Eventually, ThingM evolved with versatile exposure features which were otherwise custom programmed for computer-based motion control systems. By the 1990s, ThingM was chosen as the standard stop-motion camera control on such commercial animation productions as Skellington Productions' "*The Nightmare Before Christmas*" and Danger Productions' "*Bump in the Night*".

1.2 Contact Info

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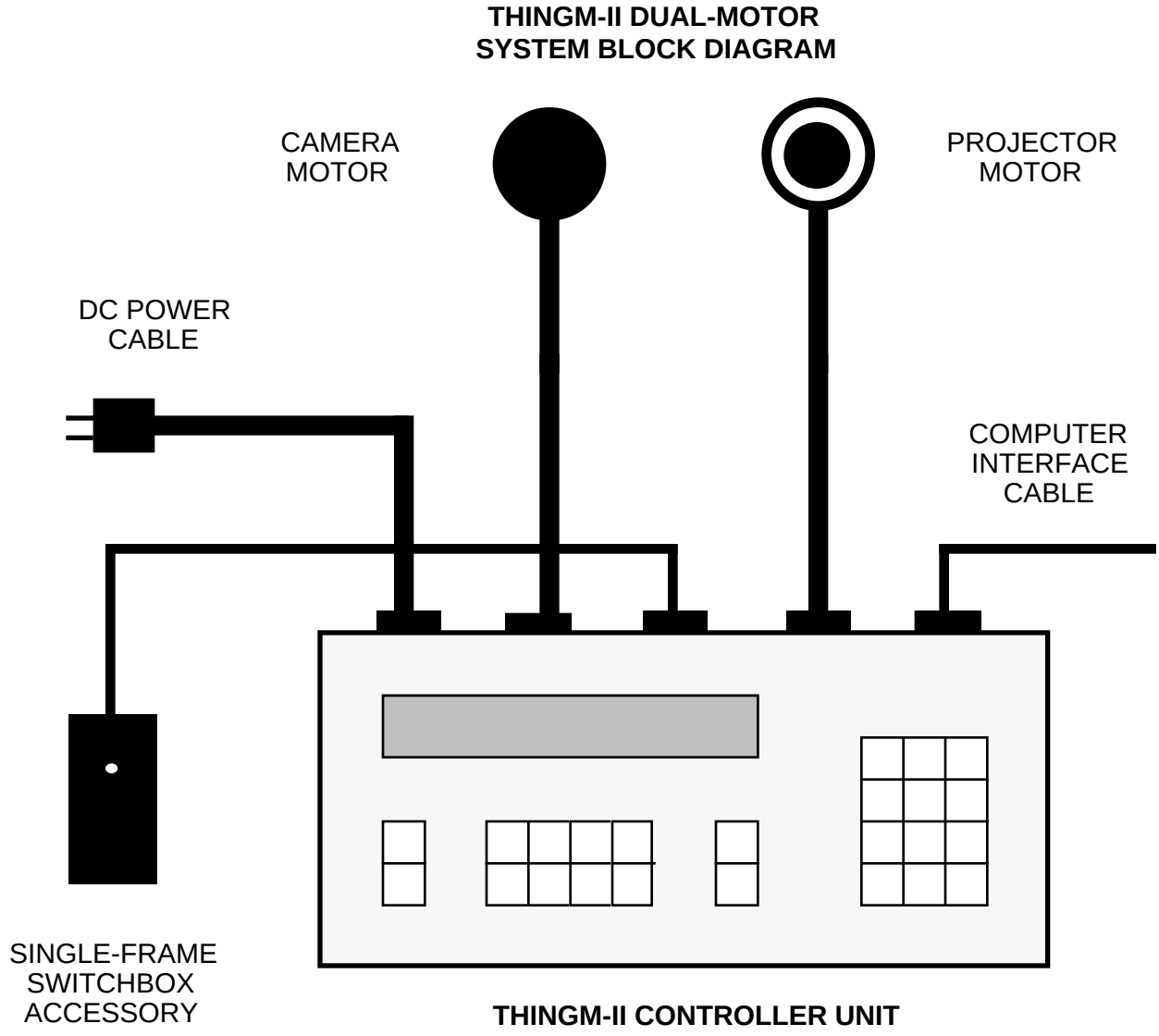
2. Features

2.1 Hardware Configuration:



ThingM-II Controller Unit:

- Integrated Controller and Driver in single Aluminum case;
- Controller with 24-key keypad input and 40-character extended LCD display output;
- Half-stepping Motor Driver providing for 1.0 to 2.5 Amps per phase at full power, reduced to 20% power at standstill;
- Power cable connector for external DC power supply;
- Motor cable connectors, with external switch sensing line(s);
- Trigger input / output connector, for external single-frame switch

input, and/or optional remote device trigger output;
- Serial communications connector for RS-232 compatible computer interfaces;

ThingM-II Accessories:
- External DC Power supply;
- Motor cable for camera motor assembly;
- Single-frame switch box and cable for input trigger port;
- Serial communications adaptor cable for RS-232 standard 25-pin D connector (modem style).

35mm Camera Motor Assembly:
- Size 34 stepping motor (3-3/8 inch diameter), in either 2.9 Amp low-current rating (recommended), or 4.9 Amp high-current rating (alternate for compatibility with existing motors and drivers);
- Motor mount for 1:1 drive shaft coupling on 35mm Mitchell or Bell&Howell camera capable of single-frame operation;
- Position sensing switch for Shutter-Home position.

16mm Camera Motor Assembly:
- Size 23 stepping motor (2-1/4 inch diameter), in either 1.0 Amp low-current rating (recommended), or 3.9 Amp high-current rating (alternate for compatibility with existing motors and drivers);
- Motor mount for 1:1 drive shaft coupling on 16mm Mitchell or Bolex camera capable of single-frame operation;
- Position sensing switch for Shutter-Home position.

2.2 Software Features:

Standard ThingM Features:
- Frame Count and Direction to +/-32000 frames;
- Exposure Times from 0.12 to 100 seconds;
- Lapse Times from 0.01 to 100 seconds;
- Film Speeds from approximately 1 to 4 frames per second;
- Adjustable motor speed and ramping characteristics;
- Input Trigger for single-frame operation;
- Output Trigger for individual exposure status;

Additional ThingM-II Features:
- Low-power holding torque for motor at standstill;
- Remote control operation via serial communications interface;

2.3 Optical Printer Installation

The dual-motor (or triple-motor) ThingM installation for the JK optical printer replaces the original AC motors with DC stepper motors. The main

advantage of using the stepper motors is that motor operation may now be motion-controlled with acceleration / deceleration ramping for each frame. This allows the printer operator to make the most of the JK mechanical movement with soft-starts and soft-stops on each frame.

Since this 2-motor installation is an adaptation of the original ThingM camera control, only one motor may run at a time. That is, either the Camera motor or the Projector motor will run a frame, but not both at the same time. This will prevent the occurrence of an occasional extra blurred exposure, which is notorious on the JK printer. Even though both motors do not run simultaneously, they may each have their own speed and ramping characteristics. This allows great flexibility for customizing Camera Exposures for raw stock and/or Projector Speed for printed footage.

All printer operations are performed from the keypad of the ThingM controller. This includes Camera operation, Projector operation, and Sequenced Camera:Projector operation. Each type of operation is specified with data items like Frame Counts and Direction. The "**CAM**" or "**PRJ**" prefix key determines which Camera or Projector item is selected. The rest of the keys do the actual data entry, like "**FRM**" for Frame Count and "**DIR**" for Direction. A "**SEQ**" key determines if Camera:Projector sequencing is active or not. A Switch-Box accessory fires off Camera or Projector Single Frames, independently of the current program set-up.

Additional operating features for Exposure Times and Printer Speeds are available as Internal Menu selections. That is, they are not directly available as Program Menu selections, and do not appear as keypad legends. This will help prevent inexperienced operators from accidentally changing exposure data from the default settings. When an Exposure Time is selected, it will pause the camera shutter open during any Camera exposure. When Speed is selected, it will change the speed of any Projector frame operation. The Ramp selection further allows the customizing of the Projector's acceleration / deceleration interval for extreme cases of problematic projection film.

The 3-motor installation is for aerial-image optical printing. The prefix selection keys are expanded to include **CAM**, **PRJ**, and **AER**. In this configuration each of the main and aerial projectors may be run separately or in sync with each other, as selected by an additional **SYN** function key. When running in sync, each projector runs by the same number of frames at the same speed. The direction of travel may be selected independently for each projector, even during sync operation. The 3-button switch-box accessory can single-frame any of the 3 motor axes, regardless of the SEQ or SYN operating modes.

3. Operation

3.1 Quick Start

The following "quick-start" instructions are intended for more technically experienced users, or anyone who is just plain anxious to see ThingM do something immediately. More complete instructions are described further on (in excruciating detail...).

Hint: Try ThingM on a test bench, before attempting to mount the camera motor. You might want to see how the camera motor operates without being attached to anything.

(1) Connect motor and power cables.
All the cable connectors are physically distinct, so you can't mix them up.

(2) Turn power on.
ThingM should show signs of life in its LCD display, first with a **"*THINGM*"** greeting, then with an **"OK+"** prompt.

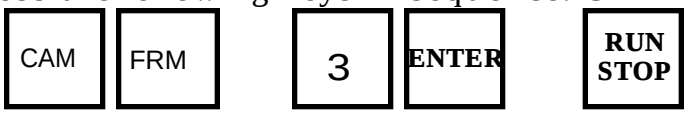
(3) Press the **RUN** key.

ThingM should run the camera motor 1 complete revolution, equivalent to a single exposure.

These first 3 steps should confirm ThingM's basic single-frame operation. If you have a problem getting these simple results, stop and check your work for the obvious. Refer to the ***Troubleshooting*** section for more information.

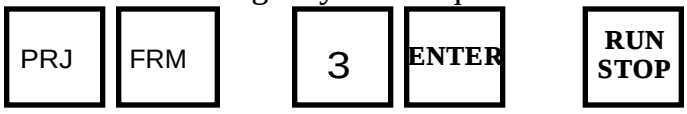
Otherwise you're ready to try programming a few simple commands.

(4) Press the following keys in sequence: **CAM FRM 3 ENTER**.



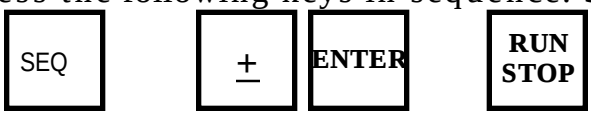
Pressing the **RUN** key will shoot 3 consecutive camera exposures.

(5) Press the following keys in sequence: **PRJ FRM 3 ENTER**.



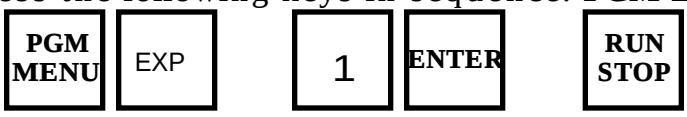
Pressing the **RUN** key will advance the projector by 3 frames. Note that the projector motor always runs one revolution at at time.

(6) Press the following keys in sequence: **SEQ + ENTER**.



Pressing the **RUN** key will shoot a sequence of 3 camera exposures alternately with 3 projector frames. This is the default 1:1 sequencing mode used most commonly for "straight" optical printing.

(7) Press the following keys in sequence: **PGM EXP 1 ENTER**.



Pressing the **RUN** key will shoot 3 time-exposures 1 second long, in the previously programmed 1:1 sequence. Note that the camera motor pauses at an intermediary rotational position for each exposure time, before completing its 360-degree revolution.

By this point you should have been able to program and run these simple commands. If you don't quite get it, read on for further detailed explanations. You might also want to refer to the ***Function Keys*** section to identify your ThingM keypad's layout.

3.2 Operation Overview

Reset Sequence:

When ThingM is first powered on, it automatically resets itself and all of its internal memory. You should see the LCD display the **"*THINGM*"** initialization message momentarily, then change to the **"OK+"** prompt. If you don't see this sign-on message sequence, press the **RESET** pushbutton on the back panel.

You might have occasion to reset ThingM manually (with the **RESET** pushbutton) if you discover you have programmed some nonsensical value, like a very long Exposure Time or very fast Film Speed.

Note that resetting ThingM manually a 2nd time (or more) will re-synchronize the controller electronics only, but will not affect the data values which are stored in memory for that particular shooting session. For example, if you have already programmed Exposure Time and Lapse Time information, then pressing the **RESET** button will allow these values to remain in memory instead of re-initializing them to the power-on default values. Only by turning the power off, then back on again, will the default values be programmed into memory from scratch.

Keypad Operations:

The ThingM keypad allows basically 2 modes of operation: Programming and Running. Programming may take a few keystrokes to complete (typically beginning with the **PGM/MENU** key), while Running is as simple as pressing the **RUN/STOP** key. In fact if all you want to do is shoot a single frame at a time, ThingM is already programmed to run 1 preset Frame Count at power-on time.

For Programming mode, the **PGM/MENU** key is used in 1 of 2 different ways. One method is to access each data selection individually, where the **PGM/MENU** key is used like a prefix to some other key. The other method is to access all data selections sequentially, where the **PGM/MENU** key is repeatedly pressed to "scroll" through a whole menu of selections.

With the first method, each data selection is associated with one of the number keys, such as **FRM, EXP, LPS,** etc being located under the 1, 2, or 3 keys. (Refer to the ***Function Keys*** section for the particular keypad layout, or better yet, just look at the keypad legends on your own ThingM.) Once you have become familiar with the orientation of the menu selection keys, you will find that you can access them directly in a single key stroke without using the **PGM/MENU** key first. (This is like "hot-keying" in desktop computer applications.) The only difference between whether a number key is used as a menu selection or as a data value is when the cursor on the display is flashing.

Prefix Keys:

In ThingM-II multiple motor installations, like the dual motor JK Optical Printer, or triple motor Aerial Image Optical Printer, some keys are designated as "prefix" keys for programming selections. These prefix keys, **CAM**, **PRJ**, and **AER**, are used to select data selections such as **FRM**, **DIR**, and **CTR**. That is, explicitly keying **CAM FRM** will program a preset Frame Count which counts camera frames during a running sequence, while keying **PRJ FRM** will program a separate preset Frame Count which counts projector frames instead. Separate independent data selections for Direction and Counter Totals are selected the same way: ie, **CAM DIR** versus **PRJ DIR**, and **CAM CTR** versus **PRJ CTR**, etc.

Data Displays:

Any time a data key is pressed, a flashing cursor will appear to prompt for the clearing, updating, or entering of data. You have the option for pressing the **CLEAR** key, or entering a new value with a sequence of number keys, or leaving the data entry alone. Once the data value on display is acceptable, press the **ENTER** key to accept it. (If you are familiar with IBM PCs or Apple Macintosh computers, this is like pressing the RETURN key or clicking the OK button in an application program.)

If for some reason you do not want the data entry, and you cannot remember what the original entry in memory was, you can hit the **PGM/MENU** key instead. This will allow you to start the data entry process all over. (This is like pressing the ESCAPE key or clicking the CANCEL button in a PC or Mac computer application.)

In either case, the cursor should stop flashing on the display, and return to the OK prompt with the current Counter Total. This is true whether the data was actually updated or not. If you are not sure, then just check the menu selection again.

Running Sequences:

Once all applicable data has been programmed into ThingM, the sequence may be run by pressing the **RUN/STOP** key. If only 1 Preset Frame Count is programmed, the camera motor will run only 1 revolution. If more than 1 Preset Frame Count is programmed, the motor will run continuously as long as there are no time exposures or time lapse intervals. If a Lapse Time is programmed, the motor will pause after each full revolution. If an Exposure Time is programmed, the motor will also pause in the middle of each revolution at the the shutter-open position.

If you wish to pause the running sequence, press the **RUN/STOP** key again. The current exposure should complete its revolution cycle, and a **HLD** prompt should appear to flash on the display, indicating a run-time Hold state. Pressing the **RUN/STOP** key once more will allow the running sequence to complete its Preset Frame Count. Otherwise any other key, such as **CLEAR** or **PGM/MENU**, will stop the whole sequence altogether.

Motor Operation:

In any of the above cases, the camera motor will always run some multiple of a full revolution. Each motor revolution is motion controlled with acceleration and deceleration ramping. Only after the final deceleration ramp does the ThingM controller logic sense for the camera Home switch. Normally the motor locates the Home switch position exactly at the end of the revolution. Otherwise the motor continues to run at its lowest speed until it reaches Home, if a Home sensing switch is installed. (This would happen in cases where the motor had stalled or slipped if there was not enough torque available at the desired Speed and Ramp. This may also happen with the first exposure after the motor assembly was mounted on the camera.)

3.3 Operation Details

Set-Up Configuration:

WARNING: Make sure the Power is OFF before plugging or un-plugging

cables, especially the motor cable.

The optional DC power cable connects between the external DC power supply and the 4-pin male Amp connector labeled **POWER** on ThingM's back panel, if provided.

The camera motor cable connects between the motor and the 8-pin female Amp connector labeled **MOTOR1** on ThingM's back panel.

The projector motor cable connects between the motor and the 8-pin female Amp connector labeled **MOTOR2** on ThingM's back panel.

The optional single-frame switch box accessory connects to the 4-pin female Amp connector labeled **TRIGGER** on ThingM's back panel.

Power-On Sequence:

Turning on the Power will reset all of the ThingM unit's controller and driver electronics. The controller LCD display will momentarily say "***THINGM***" and then prompt "**OK+ 0**". The driver will initially reset without energizing the motor, so you may turn it freely before firing the first exposure.

At this point you may begin programming selections like Frame Counts, **FRM**, and Exposure Times, **EXP**, from the keypad. Or you may just start shooting by pressing the single-frame button.

Standby Motor Torque:

Whenever ThingM runs the motor, the driver is operating at full power for maximum torque. When the motor comes to a standstill after a complete revolution, the driver will remain operating at full power for a short time interval. If the motor is not intended to run again, the driver will automatically reduce its power to a standby level for the rest of the time. (Refer to **TRQ** data selection.)

At the reduced standby power and torque level, it may be possible to deliberately turn the motor shaft by hand, though not without resistance. There is a feature for turning off the motor power altogether, which will allow the motor shaft to turn freely when loading and unloading film for the camera. Refer to **PWR** data selection.

Input Trigger Operation:

A remote switch may be plugged into the **TRIGGER** connector for single frame operation. One single exposure will only occur after the switch is released. This type of operation guarantees single-framing, and prevents accidental double-framing.

Output Trigger Operation:

ThingM's output trigger is normally active throughout the duration of any exposure. This is typically used to cue an external device prior to shooting an exposure, such as a video assist unit or frame grabber. When a trigger time is programmed, a delay will occur before each single frame exposure, or before the first continuous frame sequence, in order to fire the output trigger. This pre-exposure trigger delay is intended for installations

using lamps which need to warm up and stabilize for a few seconds prior to shooting. Refer to **TRG** for details.

Program Menu Selections:

The ThingM keypad is organized with the common program selections available with either 1 or 2 keystrokes.
The most commonly used program selections may be directly "hot-keyed" by a single keystroke:

Frame Count;
Direction;
Counter Total;
Sequencer;
Alternate Sequence;

The 2-keystroke sequences use the **PGM/MENU** key as a prefix:

Step-Frame Sequence;
Skip-Frame Sequence;
End Frame Goto;
Exposure Time;
Lapse Time;

The less commonly used internal data selections must always be accessed by a 3-keystroke sequence, beginning with the **PGM/MENU** key, followed by the **INT** key (decimal point key), then a particular number key.

Motor Speed;
Speed Ramp;
Motor Torque Time-out;
plus lots of others specific to stepper motor operation.

Refer to the various ***Function Keys*** section for complete details.

Running Film Frames:

Shooting single frame exposures may be accomplished directly from the manual switch plugged into the **TRIGGER** port. Intentionally shooting more than one exposure at a time must be done by programming a preset Frame Count, **FRM**. The Frame Count selection is more often used for running continuous frames of film, such as advancing or rewinding. The direction of travel may optionally be toggled via the **DIR** direction key.

As an alternative to running film by relative Frame Counts, an End Frame feature is also available, **END**. The End Frame feature will only alter the Frame Count and Direction for the duration of that programmed sequence. After running to the End Frame, the original Frame Count and Direction are restored. Repeated use of the End Frame function may be used for cue sheet programming. Refer to **FRM**, **DIR**, and **END**.

Exposure Times:

ThingM automatically adjusts the motor speed operation to shoot a particularly selected Exposure Time. For short Exposure Times, the motor will rotate in continuous motion by a proportional speed. For long Exposure Times, the motor will pause in the middle of the rotation at the Shutter-

Open position for time exposures. The camera motor will run at a separately selected speed for these long time exposures, called the “whip-open” speed, **WSP**.

For a motion picture camera shutter opening of 180 degrees, the exposure time is half of the motor revolution time. So the following equivalent exposure times would select these corresponding film speeds.

0.12 sec (1/8) exposure time <--> 4 frames per sec speed;
0.25 sec (1/4) exposure time <--> 2 frames per sec speed;
0.50 sec (1/2) exposure time <--> 1 frame per sec speed;

Actual motion picture cameras have shutter openings which are less than 180 degrees, so this table may only be used for approximate values. ThingM will compute the speed for the selected exposure time at a specific Variable Shutter Angle, which is programmed as internal setting **SHR**.

In order to make ThingM run the camera motor reliably without stalling, practical minimum and maximum speed values are set, usually in the range of 1 to 4 revolutions per second. The Minimum Speed is directly programmed as internal setting **MSP**. The maximum speed is determined by internal setting for Minimum Exposure Time, **MEX**. (The **MEX** setting is a convenient way to specify a non-zero Exposure Time when the user clears the **EXP** value to 0. That is, if **MEX** = 0.12 seconds, then any time **EXP** data entry of “0” becomes a minimum value of “0.12” seconds instead.)

In very special cases it may be desirable to overide the computed motor speed with an alternate speed. Explicitly selecting Film Speed after Exposure Time would accomplish this. Refer to **EXP**, **SPD**, **MEX**, and **MSP** for details.

Camera:Projector Sequences:

When the Sequencer function is turned on, ThingM-II runs camera and projector frames in some kind of alternating sequence. The 3 types of sequencing available are Alternate, **ALT**, Step-Frame, **STP**, and Skip-Frame, **SKP**.

Alternate Sequences are the most common type used for 1:1 shooting or integer multiples thereof, such as 2:1, 3:1, 4:1, etc, for extending camera re-photography of projection footage, or 1:2, 1:3, 1:4, etc, for condensing camera re-photography.

Step-Frame sequences are for fractional conversion factors where an extra camera frame is added every so many 1:1 alternate cycles. Step-frame conversions are for cases where lengthening film time has to be greater than 1:1 but less than 2:1, such as when printing Super8 film shot at 18 fps onto 16mm film for 24 fps.

Skip-Frame sequences are for the other type fractional conversion factors where a projector frame gets skipped every so many 1:1 cycles. This conversion is for shortening film time less than 1:1 but not quite 1:2, like 24

fps film needing to be presented at 18 fps.

Note: The ThingM-II selects Camera:Projector sequences in a manner similar to older optical printer sequencers made by JK. Camera counts are always specified first, followed by Projector counts, regardless of whether Alternate, Step-Frame, or Skip-Frame sequencing has been selected.

Here are some examples. For doubling the frame rate of footage in Alternate mode, program **ALT** for 2 TO 1. For halving the frame rate in Alternate mode, program **ALT** for 1 TO 2. For stretching footage shot at 18 fps to 24 fps, use Step-Frame mode to add a 2nd camera frame every 3 cycles: program **STP** for 2 TO 3. For condensing footage shot at 24 fps to 18 fps, use Skip-Frame mode to skip a 2nd projector frame every 3 cycles: program **SKP** for 3 TO 2. (Remember the projector value is entered last, which is consistant with sequencers made by JK.)

For complete frame rate conversion info, refer to tables published in the Optical Printing chapter of ***The American Cinematographer's Handbook***, or other optical printing manual.

4. Examples

Example #1: Clear 120 frames in the camera.

CAM + FRM + 120 + ENTER.
RUN.

Example #2: Clear the camera cumulative total counter to 0.

CAM + CTR + CLEAR + ENTER.

Example #3: Advance the film in the projector by 20 frames.

PRJ + FRM + 20 + ENTER.
RUN.

Example #4: Set the projector cumulative total counter to frame number 1234.

PRJ + CTR + 1234 + ENTER.

Example #5: Select a 1:1 sequence to run for 240 projector frames.

ALT + 1 + ENTER + 1 + ENTER.
SEQ = ON + ENTER.
PRJ + FRM + 240 + ENTER.
RUN.

Example #6: Continue the above 1:1 sequence by running the projector in reverse for 240 frames.

PRJ + DIR = REV + ENTER.
RUN.

Example #7: Continue the above 1:1 sequence until the camera reaches frame number 500.

CAM + END + 500 + ENTER.
RUN.

Example #8: Rewind the camera film to frame number 0.

SEQ = OFF + ENTER.
CAM + END + 0 + ENTER.
RUN.

Example #9: Adjusting the alternate sequence to 2:1, which prints every

projector frame twice.

SEQ = ON + ENTER.
ALT + 2 + ENTER + 1 + ENTER.
PRJ + DIR = FOR + ENTER.
RUN.

Example #10: Changing the sequence completely to print only every 3rd projector frame twice, for a total of 400 camera frames.

SEQ = ON + ENTER.
STP + 2 + ENTER + 3 + ENTER.
CAM + FRM + 400 + ENTER.
RUN.

Example #11: Changing the sequence back to 1:1 alternate mode, for 240 aerial projector frames.

SEQ = ON + ENTER.
ALT + 1 + ENTER + 1 + ENTER.
AER + FRM + 240 + ENTER.
RUN.

Example #12: Running both projectors in sync for 960 aerial projector frames.

SYN = ON + ENTER.
AER + FRM + 960 + ENTER.
RUN.

Example #13: Running both projectors in sync, with main projector forward and aerial projector in reverse.

SYN = ON + ENTER.
PRJ + DIR = FOR + ENTER.
AER + DIR = REV + ENTER.
RUN.

5. Troubleshooting

No Power?
Check the power supply and cable connections to **POWER** connector.

Weak power?
If you have a Volt-meter, check for 10-14 Volts DC input to **POWER** connector, and 5 Volts DC output from the **TRIGGER** connector.

Unintelligible display at power-on?
Press the **RESET** pushbutton on the back panel.

Motor does not run?
Check motor and cable connections to **MOTOR** connector.

Motor runs more than 1 revolution on first exposure?
If motor assembly includes a Shutter-Home sensing switch, the motor may not have been initially located at the Home position.

Motor runs continuously with only 1 exposure programmed?
Shutter-Home sensing switch may not be switching from "Normally-Open" position properly.

Motor stops after only part of a revolution for first exposure?
Check if a very long Exposure Time has been programmed, by pressing the **EXP** key. Note that if this is the case, you should press the **RESET** button to re-program it instead of the **RUN/STOP** key. Otherwise ThingM will wait for the rest of the long Exposure Time before returning to the OK prompt.
If not, check if the Steps per Revolution setting, **STP**, has been changed.

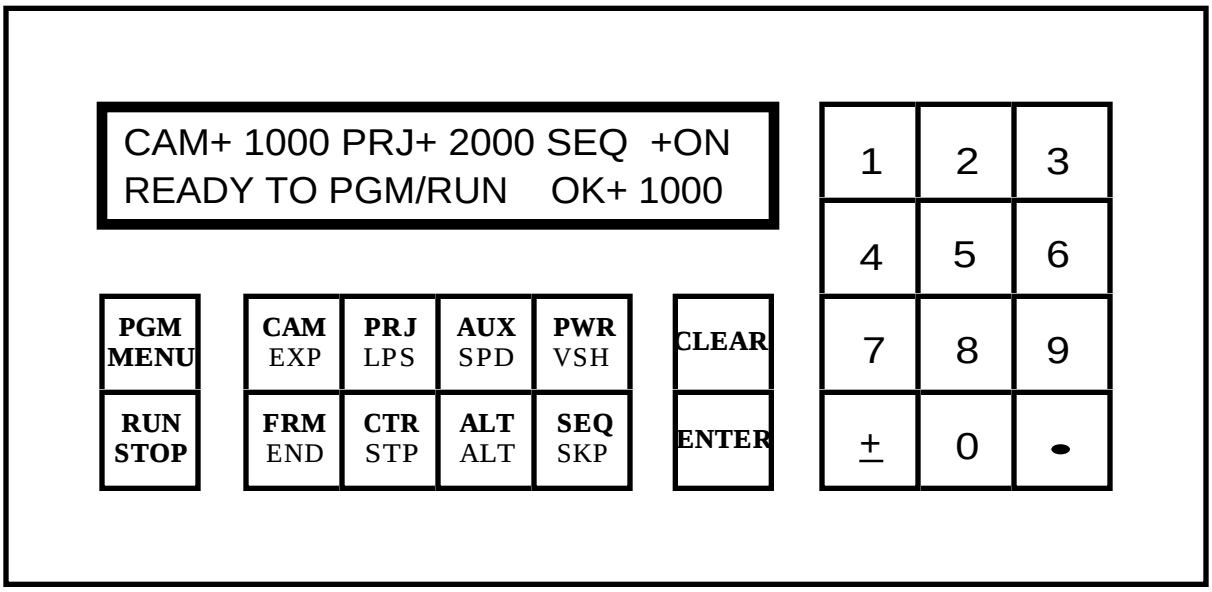
Motor only runs 1 frame when a Lapse Time is programmed?
Check that you also programmed a Frame Count, **FRM**.

Motor slips or stalls when running?
Check for mechanical friction, possibly from improperly threaded film!
If you are running fast Exposure Times, try lowering the Film Speed, **SPD**, or lengthening the Ramp Count, **RMP**.

6. Function Keys

ThingM-II Version 4.x

(Note: Your ThingM may have a different software revision EPROM inside. Check your keypad layout for matching ThingM functions to number keys.)



Keypad Identification:

PGM MENU **PGM/MENU** For programming data selections. **PGM/MENU** key pressed repeatedly will sequence through all available data selections, such as Frame Count, Direction, Counter Total, Exposure Time, Lapse Time, and Trigger Time. **PGM/MENU** pressed as prefix to **1** through **9** keys will access these data selections individually, as an alternative to sequencing through the entire menu.

RUN STOP **RUN/STOP** For running and stopping programmed exposures. RUN/STOP key works like a toggle switch: If the camera motor is at a standstill, then the next exposure will run. If the motor is already running then it will stop the motor after the next completed exposure, and hold shooting the rest of the sequence. That is, **RUN/STOP** pressed the 1st time will begin running program, **RUN/STOP** pressed a 2nd time will hold the running program, and **RUN/STOP** pressed a 3rd time will continue the paused program.

ENTER For entering all data values at program prompts, as denoted by a flashing cursor on the display.

CLEAR For clearing data to zero values at program prompts. (You still need to use the **ENTER** key in order to accept the zeroed value.)

0...9 keys For entering numeric values for data like conventional keypad, whenever display cursor is flashing. Also used for individually selecting program functions (no cursor flashing), when used as function keys **PGM/MENU 1** through **PGM/MENU 9**.

• key Decimal point for data values, such as Exposure Time, Lapse Time, and Film Speed. Also used to access internal data selections, when used as **INT** function keys **PGM/MENU •**.

+/- key Plus sign for positive numbers, or Minus sign for negative numbers, such as Frame Counts and Counter Totals. Also used for toggling direction of motor rotation, forward or reverse, when used as **DIR** function keys **PGM/MENU +/-**.

Program Menu Data Entries:

CAM: Camera Selection = Camera control selected for subsequent data entries. Used as a prefix key to program entries like **FRM** Frame Count, **DIR** Direction or **CTR** Total Counter. May also be used as a prefix to **RUN** for running a camera sequence.

SEQ: Sequencer = Activates camera:projector sequencing. Initialized = 0 for no sequencing. Note: sequences always start with a camera exposure, and either end with a projector frame when **PRJ** counting is effective, or end with a camera exposure when **CAM** counting is

effective.

PRJ **or** PGM MENU 3 **PRJ:** Projector Selection = Main Projector control selected for subsequent data entries. Used as a prefix key to program entries like **FRM** Frame Count, **DIR** Direction, or **CTR** Total Counter. May also be used as a prefix to **RUN** for running a projector sequence.

DIR **or** PGM MENU + **DIR:** Direction = direction of film travel, selected to either +FOR or -REV according to toggle of Minus (-) key. That is, each press of the Minus key will flip the direction back and forth between Forward or Reverse. This selection must be quit by using the ENTER key, as in the rest of the data selection procedures. Once the direction is selected, the OK prompt will denote the direction with a + or - character following it: as OK+ or OK-.

Note: Once the direction is set, the sign of the Preset Frame Count is updated in memory. Particularly, if you select the Reverse direction, the Preset Frame Count will be be turned into a negative number, and will display a Minus sign the next time you look at it. If you are used to using frame counters which never bothered with negative numbers, it is advisable that you always select your Preset Frame Count first, and then set the film Direction after that.

Initialized = +FOR for Forward film travel.

FRM **or** PGM MENU 4 **FRM:** Preset Frame Count = the number of camera exposures per run-time sequence. Typically set for many continuous frames or time-lapse operation. A negative Frame Count, denoted by a number with a Minus sign, will set the direction in Reverse. Otherwise positive Frame Counts default to the Forward direction. Initialized = 1 Frame for single frame operation.

CTR **or** PGM MENU 5 **CTR:** Counter Total = cumulative count of exposed frames. May be preset to any value. Typically may be used for assigning a counter frame number according to a cue sheet. Usually used just for clearing the Counter to 0. Counts up when camera running forward, and down when running reverse. Initialized = 0 frames.

[PGM MENU] [END] **or** [PGM MENU] [6] **END:** End Frame = destination frame to go to. Provided as an *alternate method* to using the preset Frame Count. Computes the difference between the current Counter Total and the specified End Frame destination, and updates the Frame Count and Direction data entries to Note: Entering an End Frame equal to the Counter Total frame will compute a Frame Count = 0, which will *not* Run at all.

[PGM MENU] [STP] **or** [PGM MENU] [7] **STP:** Step Camera Sequence = camera:projector sequence for adding (or stepping) extra camera exposures to a 1:1 sequence. The extra camera frames are specified over so many projector cycles. This is entered as 2 consecutive data values, first for Camera Step Frames and second for Projector Cycles. Initialized = 1:1 sequencing, (which is not any different from alternate mode sequencing).

[ALT] **or** [PGM MENU] [8] **ALT:** Alternate Sequence = camera:projector sequence for alternating camera exposures with projector frames. This is entered as 2 consecutive data values, first for Camera Frames and second for Projector Frames. Initialized = 1:1 sequencing.

[PGM MENU] [SKP] **or** [PGM MENU] [9] **SKP:** Skip Projector Sequence = camera:projector sequence for skipping over projector frames in a 1:1 sequence. The dropped proctor frames are specified over so many camera cycles. This is entered as 2 consecutive data values, first for Camera Cycles and second for Projector Skip Frames. (The camera value is specified first in order to be consistant with the other types of sequencing.) Initialized = 1:1 sequencing, (which is not any different from alternate mode sequencing).

[PWR] **or** [PGM MENU] [0] **PWR:** Motor Power Enable = condition of motor power level applied to motor at standstill, On or Off. Usually motor power is On with some residual standby holding torque inbetween exposures. Toggling this key will turn all Power Off to the motor, thus allowing the motor to turn freely. This Off condition would be typically used for loading and unloading film in the camera. Initialized = On.

Internal Menu Data Entries:

These are internal data settings for re-configuring some of ThingM's features. Normally you will not use these set of key sequences at all. (Note that the organization of the internal data selection keys has been configured to correspond more closely with the pre-labelled data selection keys.)

[PGM MENU] [•] [0] **VER:** Version number of ThingM Software, for identification purposes only. This version is VER 4.10, as seen by pressing these 3 keys sequentially: **MENU • 0**.

[PGM MENU] [EXP] **or** [PGM MENU] [•] [1] **EXP:** Exposure Time = actual exposure time for camera motor to either run a continuous revolution or stop at the shutter-open position. May be specified with 0, or 1, or 2 decimal places in seconds. Exposure times automatically affect film speeds, SPD. Short exposure times will compute fast film speeds down to a minimum exposure time, MEX. Long exposure times will compute slow film speeds down to a minimum film speed, MSP. Only longer exposure times will use the time-exposure mode for stopping at the shutter-open position at the whip-open film speed, WSP.

(The MEX minimum exposure time, MSP minimum film speed, and SHR variable shutter angle may be changed as Internal data selections.) Initialized = 0.12 seconds for default exposure.

[PGM MENU] [LPS] **or** [PGM MENU] [•] [2] **LPS:** Lapse Time = time for camera motor to stop inbetween exposures. May be specified with 0, 1, or 2 decimal places in seconds. Small lapse times less than the rotational time of the motor are ignored. Exposure times are likewise compensated for in running of lapse times. Initialized = 0.00 seconds for no lapse timing.

[PGM MENU] [•] [3] **VSH:** Variable Shutter Angle = angle opening of variable shutter defined in terms of degrees. This value is important for determining the correct relationship between exposure times and film speeds. If you ever close down your variable shutter, you must change this value to re-compute the correct relationship between exposure times and film speeds. Initialized as follows for these cameras:

170 degrees for 35mm Bell+Howell 2709;

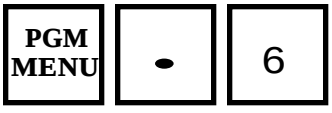
170 degrees for 35mm Mitchell standard;
235 degrees for 16mm Mitchell;
100 degrees effective (= 135 degrees * 75%) for 16mm Bolex reflex, including compensation for beam-splitter light loss;
Accessed by **MENU • 3**.

SPR: Steps per Revolution = number of stepper motor pulses defined for 360-degree motor rotation. Initialized = 400 pulses per revolution for conventional DC stepper motors using half-stepping drivers. Accessed by **MENU • 4**.

For dual-motor ThingM-II, there are two successive prompts for Camera Steps per Revolution, **CPR**, and Projector Steps per Revolution, **PPR**, for individual motor selections. Additionally, there is a final prompt for the Projector Adjustment Steps, **ADJ**, explained below.

ADJ: Adjustment Steps = additional adjustment steps for projector to locate its Home position. Normally the projector drive will rotate a single revolution, as defined by the number of steps per revolution (PPR). If the projector axis does not sense its Home position switch, as may be the case with problematic film, then the projector will advance an additional number of Adjustment steps. If the projector axis still cannot locate its Home position, then ThingM will put the run-time sequence in a special Hold mode and flash the message **"PIN"** on the display. In this situation the user *must manually re-adjust the projector drive axis* with the inching knob attached to back of the projector motor. It is recommended that the user check the film in the projector gate before proceeding. Initialized = 0 steps, for no adjustment.

OPN: Open-Shutter Rotation = fraction of motor rotation defined between Shutter-Closed and Shutter-Open positions, ie, how far the camera motor needs to rotate to pause at the Shutter-Open position for time exposures. (This is not to be confused with variable shutter angle.)
Initialized as follows for these cameras:
0.50 rev (180 degrees) for 35mm Bell+Howell 2709;
0.50 rev (180 degrees) for 35mm Mitchell standard;
0.35 rev (125 degrees) for 16mm Mitchell;
0.31 rev (110 degrees) for 16mm Bolex reflex;
Accessed by **MENU • 5**.



MSP: Minimum Film Speed = minimum motor

speed for all speed computations. Also denotes film speed for changing over from continuous-rotation exposures to intermittant-rotation time exposures. Initialized = 0.93 revolutions per second = frames per second on 1:1 drive shaft. Accessed by **MENU • 6**.

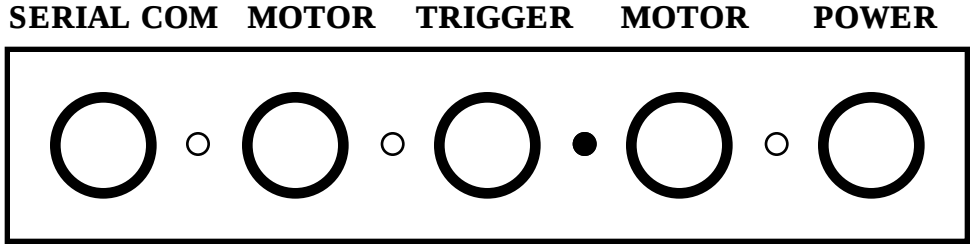
SPD: Film Speed (Motor Speed) = rotational motor speed of camera drive in frames per second. Equivalent to revolutions per second on 1:1 camera drive shaft. See the typical relationships above in the Exposure Time section. Initialized = 3.92 frames per second, for default 0.12-second Exposure Time at 170-degree Variable Shutter Angle. May be any practical speed value for DC stepper motor driving 1:1 shaft, from approximately 1.00 to 4.00 frames per second. Accessed by **MENU • 7**.

RMP: Acceleration / Deceleration Ramp = fraction of motor revolution to ramp from starting speed to maximum speed. Initialized = 0.25 rotation for about quarter-revolution ramped speed motor operation. Minimum ramp = 0 for constant speed operation. Maximum usable ramp = 1.00 full revolution, to accommodate both acceleration and deceleration for stop motion modes. Maximum allowable ramp = 2.50 revolutions, which works for continuous motion modes only. Accessed by **MENU •8**.

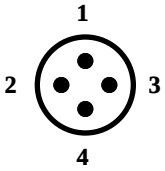
TRQ: Torque Time-out = time duration of motor holding torque at standstill. This time interval controls the length of time that motor is energized to full holding torque after complete camera exposures. After this length of time, the motor reduces to its standby torque instead. This torque time-out insures no additional mechanical motion between exposures. May be specified with 0, or 1, or 2 decimal places in seconds, as in exposure time or lapse time. Initialized = 0.01 seconds additional energization time before torque reduction at standstill. Accessed by **MENU • 9**.

7. Technical Info

THINGM-II BACK PANEL LAYOUT

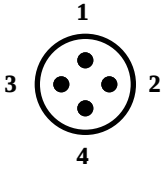


POWER



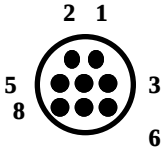
1 --- (no connection)
2 --- +12 Volt DC Input
3 --- (no connection)
4 --- Power Ground

TRIGGER



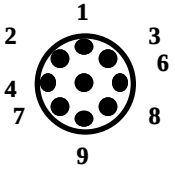
1 --- +5 Volt DC Output
2 --- Input Trigger 2
3 --- Input Trigger 1
4 --- Logic Ground

MOTOR



1 --- Motor Phase A In/Out
2 --- Motor Phase C In/Out
3 --- Motor Phase AB common
4 --- Switch Ground
5 --- Motor Phase CD common
6 --- Motor Phase B In/Out
7 --- Home Switch Input
8 --- Motor Phase D In/Out

SERIAL COM



1 --- RS-232 Signal Ground
2 --- TXD In
3 --- RXD Out
4 --- RTS In
5 --- (no connection)
6 --- CTS Out
7 --- DSR Out
8 --- DTR In
9 --- (no connection)

7.2 Trigger Port Connection Diagram

Note: The following schematic diagram is intended as a reference for experienced electronic technicians. This is only an example of using ThingM's TRIGGER port to connect with two typical external devices. If you have any questions about interfacing input/output trigger devices to ThingM, please contact Ironic Research Labs for assistance.

THINGM TRIGGER INPUT / OUTPUT SCHEMATIC