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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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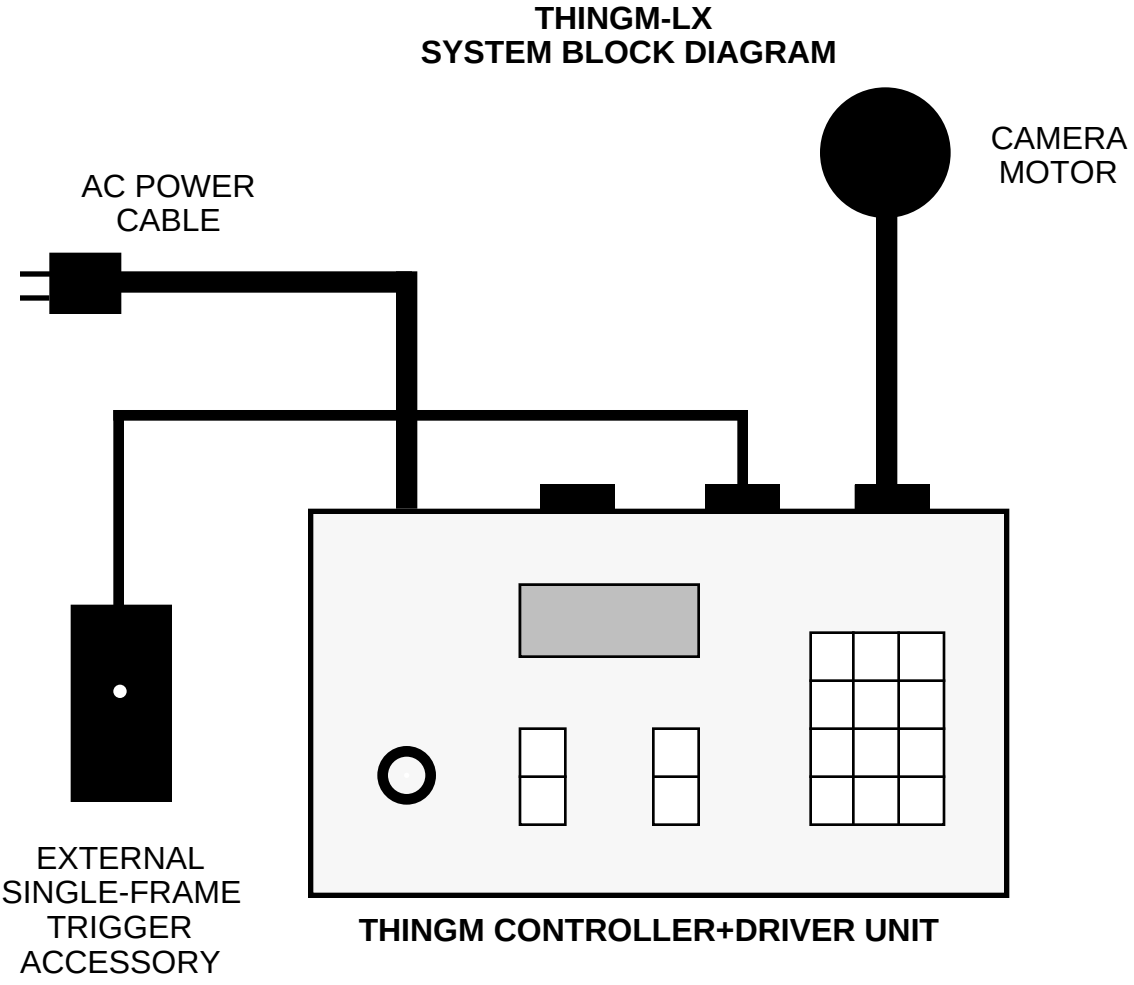
2. Features

2.1 Hardware Configuration:



ThingM-LX Controller Unit:

- Integrated Controller and Driver in single Aluminum case;
- Controller with 16-key keypad input and 8-character 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;
- Internal AC-DC power supply for motor power and regulated 5-Volt logic power;
- Motor cable connector, with external switch sensing line(s);
- Trigger input / output connector, for external single-frame switch input, and/or optional remote device trigger output;
- Integrated single-frame push-button switch on front panel.

ThingM-LX Accessories:

- Motor cable for camera motor assembly;
- Single-frame switch and cable for input trigger port;
- AC Relay junction box and cable for output trigger port;
- Dual AC Relay junction box and cable for frontlight/backlight exposures;
- Optional DC Power connector, cable, and switch for external 12-Volt battery pack supply.

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;
- No position sensing switch required;
- Wiring for rack-over detection switch.

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;
- Exposure Times linked to Film Speeds;
- Input Trigger for single-frame operation;
- Output Trigger for individual exposure status;
- Output Trigger Time Delay prior to shooting exposures.

Additional ThingM-LX Features:

- Open-loop motor operation without shutter position sensing switch;
- Low-power holding torque for motor at standstill;
- Rack-over switch detection;
- Exposure Wedge sequences;
- Remote control of Time Exposures via Input Trigger line;
- Frontlight/Backlight multiple exposure sequences, with external relay device control via Output Trigger line.

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.

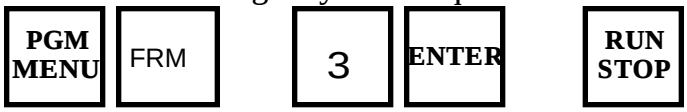
(3) Press the **RUN** key.

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.

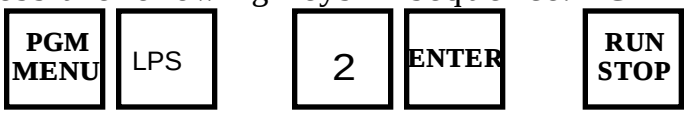
Otherwise you're ready to try programming a few simple commands.

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



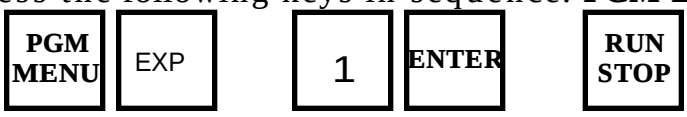
Pressing the **RUN** key will shoot 3 consecutive exposures.

(5) Press the following keys in sequence: **PGM LPS 2 ENTER**.



Pressing the **RUN** key will shoot 3 exposures in lapse intervals 2 seconds apart.

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



Pressing the **RUN** key will shoot 3 time-exposures 1 second long, at the previous lapse intervals 2 seconds apart. 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 3 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.

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 AC 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 or battery pack and the 4-pin male Amp connector labeled **POWER** on ThingM's back panel, if provided. (Custom option.)

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

The optional rack-over switch connects to an extension wiring pair at the motor end of the motor cable. (Custom wiring option.)

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

The optional relay trigger cable connects to this same **TRIGGER** connector. (This means that the remote switch accessory and relay trigger accessory may not be used at the same time, unless with an adaptor.)

Power-On Sequence:

Turning on the AC 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.

Open-Loop Motor Operation:

Per customer request, there is no shutter position sensing switch on the motor mount assembly. Therefore it is the responsibility of the camera operator to manually align the motor shaft to the shutter-closed position.

All motor operations are programmed by ThingM to run in multiples of complete 360-degree revolutions. Therefore it is also recommended that the camera operator insure that a reference mark on the motor shaft remain in alignment ("in phase") between exposures. If not, the motor may be slipping steps, and a different speed ramp characteristic may have to tried before proceeding to shoot. (Refer to **SPD** and **RMP** data selections.)

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.

Rack-Over Switch Detection:

If the camera is racked over, ThingM will automatically detect this condition and flash a warning message "**RKO**" on its display. It will not be possible to perform any ThingM operations from the keypad or the single-frame trigger until the camera is racked back into the shooting position.

Note: The rack-over switch must be connected to the wiring extension on the motor cable in order for this feature to work. This is because the rack-over detection switch is configured as "normally-open".

Input Trigger Operation:

A remote switch may be plugged into the **TRIGGER** connector for single frame operation. (This input trigger line is internally tied together with the red pushbutton switch on the face of the ThingM controller unit.) 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.

Hardware Note: The output trigger is active on a single line. A cable can be fabricated to drive an opto-isolated solid-state relay for conventional AC lamp operation via ThingM's output trigger signal. A more elaborate cable assembly can drive a pair of solid-state relays for frontlight/backlight operation from the same output trigger signal. Refer to ***Technical Info*** section for example schematic diagrams.

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 on the number keypad:

Frame Count;
Direction;

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

Absolute Frame Goto;
Counter Total;
Exposure Time;
Lapse Time;
Trigger Time;
Motor Power;
Wedge Sequence;
Frontlight/Backlight Sequence;

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.

Film 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 Absolute

Frame feature is also available, **ABS**. This is useful for rewinding film to a particular frame number for repeat pass shots. The Absolute Frame feature will only alter the Frame Count and Direction for the duration of that programmed sequence. After running to the Absolute Frame, the original Frame Count and Direction are restored. Refer to **FRM**, **DIR**, and **ABS**.

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.

Wedge Exposure Sequences:

A special Wedge Sequence feature is included for shooting wedges of exposures with standard Exposure Time values. All wedges start from 0.12 second Minimum Exposure value, **MEX**, and change by exactly half-f/stop exposure values from there. (0.12, 0.17, 0.25, 0.35, 0.50, 0.70, 1.00, etc.) Therefore the only value to program is the final Wedge Exposure Time, **WDG**, in the sequence.

Once the Wedge Sequence is programmed, it will run automatically by the next press of the **RUN** key. After the Wedge Sequence is through running, ThingM will restore the previously programmed Frame Count and

Exposure Time for continued shooting. (Note: Re-programming the Frame Count or Exposure Time after selecting a Wedge Sequence will cancel the Wedge Sequence. Using the single-frame Input Trigger instead of the RUN key will also cancel any pending Wedge Sequence.) Refer to the **WDG** data selection.

Frontlight/Backlight Exposure Sequences:

A special Frontlight/Backlight exposure sequence is available for shooting multiple exposures sequentially under separate frontlight and backlight conditions.

Under this special feature, frames are shot two exposures in a row, first with frontlight lighting conditions active, and second with backlight lighting active. The frontlight and backlight lamps are plugged into a special AC relay assembly, controlled by ThingM's Output Trigger signal. (Refer to ***Technical Info*** section for connection details.)

After selecting the Frontlight/Backlight feature On, ThingM provides additional prompts for entering separate frontlight and backlight data values. Two sets of Exposure Times, **EXP**, and Trigger Times, **TRG**, are programmed to accomodate different lighting rigs for frontlight and backlight conditions. The Frame Counts, **FRM**, and Counter Totals, **CTR**, will subsequently count "frames" as multiples of two exposures, to be consistant with cue sheets prepared for normal single-frame operation. (This 1:2 frame counting is also compatible with separating the frontlight and backlight exposure elements on an optical printer.) Refer to **FBX** function for details.

4. Examples

Example #1: Run a single frame exposure.

RUN.

Example #2: Advance 120 frames in the camera.

PGM + FRM + 1 2 0 + ENTER.
RUN.

Example #3: Clear the camera cumulative total counter to 0.

PGM + CTR + CLEAR + ENTER.

Example #4: Change the exposure time to 0.25 seconds, and then shoot 48 exposures.

PGM + EXP + 0 . 2 5 + ENTER.
PGM + FRM + 4 8 + ENTER.
RUN.

Example #5: Rewind the camera film to frame number 0.

PGM + EXP + CLEAR + ENTER.
PGM + ABS + 0 + ENTER.
RUN.

Example #6: Shoot a wedge up to an exposure time of 4.00 seconds.

PGM + WDG + 4 . 0 0 + ENTER.
RUN.

Example #7: Change the exposure time to 1.00 seconds, and then shoot until frame # 240.

PGM + EXP + 1 . 0 0 + ENTER.
PGM + ABS + 2 4 0 + ENTER.
RUN.

Example #8: Shoot lapse time intervals at 5 second intervals for 1000 frames.

PGM + LPS + 5 . 0 0 + ENTER.
PGM + FRM + 1 0 0 0 + 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.

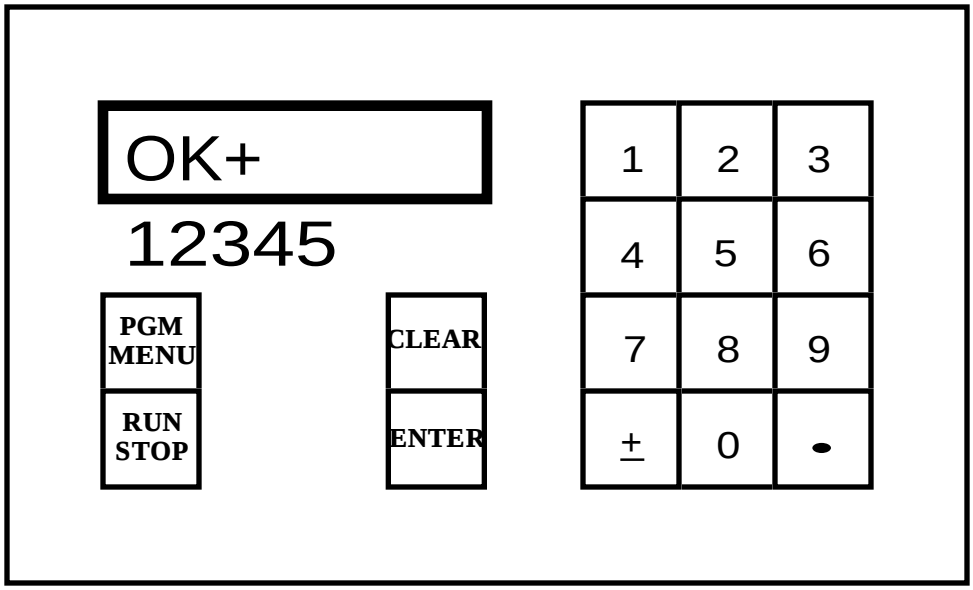
Motor only runs 1 frame when a Lapse Time is programmed?
Check that you also programmed a Frame Count, **FRM**.

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-LX Version 2.4x
(Based on Skellington Productions' specified function keypad layout.)

(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:

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.

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.

PGM MENU **2**

ABS: Absolute Frame = absolute destination frame to go to. Provided as an *alternate method* to using the preset Frame Count, effective only once each time an Absolute Frame is selected. Typically useful for advancing or rewinding film without affecting the preset Frame Count and Direction. Computes the difference between the current Counter Total and the specified Absolute Frame destination, and updates the Frame Count and Direction data entries to Run for the next time only. Sets the Direction temporarily to Reverse if lower than the current Counter Total, or leaves the Direction Forward if higher. After running, the previously programmed Frame Count and Direction are restored. Always defaults to the current Counter frame whenever selected (per customer request). Note: Entering an Absolute Frame equal to the Counter Total frame will compute a Frame Count = 0, which will *not* Run at all.

PGM MENU **3**

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 **4**

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.

Special remote controlled exposure mode is selected by entering a negative value for the Exposure Time, such as "-1.00". When this exposure mode is entered, a time exposure is run for as long as the Input Trigger line is active, like holding down the single-frame button. (This is like the "Bulb" exposure mode on still cameras.) This may also be used for precise exposure control from a remote external device connected to the Input Trigger line, like a motion control computer or digital timer unit.

PGM MENU 5

WDG: Variable Exposure Time Wedge = sequence of exposure times, shot in range from minimum exposure value, MEX, to the selected final exposure value, WDG. The available wedge exposure values are pre-set at half-f/stop increments in the range of 0.12, 0.17, 0.25, 0.35, 0.50, 0.70, 1.00, 1.41, 2.00, 2.82, 4.00, 5.64, 8.00, 11.28, 16.00, 22.56, 32.00, 45.12, and 64.00 seconds. May be specified with 0, or 1, or 2 decimal places in seconds, as in default exposure time. Initialized = 0.00 seconds for NO wedge sequence.

Once the wedge sequence is selected by the PGM key, it will run automatically by the next press of the RUN key. The WDG prompt will appear, and list each exposure time value as the wedge frames are being shot. Once the wedge sequence has run out, it will restore the previously selected Exposure Time and Preset Frame Count as defaults.

PGM MENU 6

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 7

FBX: Frontlight/Backlight Exposures = selection of frontlight/backlight option, either On or Off. When this feature is turned on, a special multiple exposure sequence becomes effective for automatic frontlight and backlight sequencing. Frames are shot two exposures in a row, first with frontlight lighting conditions active, and second with backlight lighting active.

Separate exposure values are entered for frontlight and backlight conditions, as identified by EX1 and EX2 prompts for Exposure Time.

Likewise, separate trigger delays prior to each exposure are entered, as indentified by the TR1 and TR2 prompts for Trigger Time. When runnning, the frontlight and backlight exposures are identified by the RX1 and RX2 prompts for the same Frame Count value. (This means the actual number of frames shot will be actually twice the number of "frames" counted.) Initialized = Off.

Hardware Note: The single output trigger line controls both frontlight and backlight devices. A custom cable can been fabricated for the use of this trigger to control a bank of 2 relays, one for controlling AC outlets for frontlight lamps, and the other for backlight lamps. The frontlight devices become active when the trigger line goes active, as in the default ThingM trigger configuration. The backlight devices are active in the opposite state, when the trigger line goes inactive.

PGM MENU 8

TRX: Output Trigger Action = direct overide of output trigger line, either On or Off. Normally the output trigger line is active only during exposures, and Off anytime else. This feature allows the camera operator to toggle the trigger line On and Off for testing purposes, or for previewing a scene under shooting light conditions. The next exposure will revert the output trigger line to its normally programmed On-Off pulse, as specified with TRG Trigger Time. Initialized = Off.

PGM MENU 9

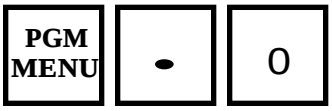
TRG: Trigger Time = time delay between output trigger and camera exposure. When set to a value greater than 0, the trigger line will fire first, so there will be a delay before the next exposure. In single-frame mode, there is always a delay before the exposure. In continuous mode, there is only one delay before the first exposure. In time lapse mode, there is a time delay between exposures which is accounted by the lapse time intervals. May be specified with 0, or 1, or 2 decimal places in seconds, as in exposure time or lapse time. Initialized = 0.01 seconds minimum additional time.

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-labeled data selection keys.)



VER: Version number of ThingM Software, for identification purposes only. This version is VER 2.40, as seen by pressing these 3 keys sequentially: **MENU • 0**.

STP: 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 • 1**.

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:

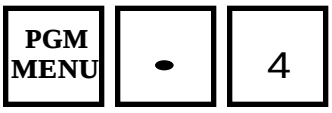
0.50 rev (180 degrees) for 35mm Bell+Howell 2709;
0.50 rev (180 degrees) for 35mm Mitchell standard;
0.35 rev (125 degrees) for 16mm Mitchell;
0.31 rev (110 degrees) for 16mm Bolex reflex;

Accessed by **MENU • 2**.

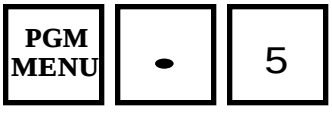
SHR: Variable Shutter Angle = angle opening of variable shutter defined in terms of degrees. This value is important for determining the correct relationship between exposure times and film speeds. If you ever close down your variable shutter, you must change this value to re-compute the correct relationship 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;

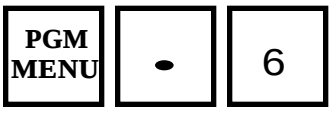
Accessed by **MENU • 3**.



MEX: Minimum Exposure Time = minimum limit to short exposure times. This value is somewhat arbitrarily defined, but is necessary to keep very short exposure times from generating very fast film speeds. This is especially helpful in Variable Exposure Time sequences to keep all exposures shooting at practical single-frame speeds. Initialized = 0.12 seconds. Accessed by **MENU • 4**.



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 • 5**.



WSP: Whip-open Film Speed = maximum motor speed for use in intermittant-rotation time exposures, also known as "whip-open" exposures. The actual time interval for pausing at the Shutter-Open position is automatically compensated from the selected Exposure Time and this motor speed. Initialized = 2.00 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

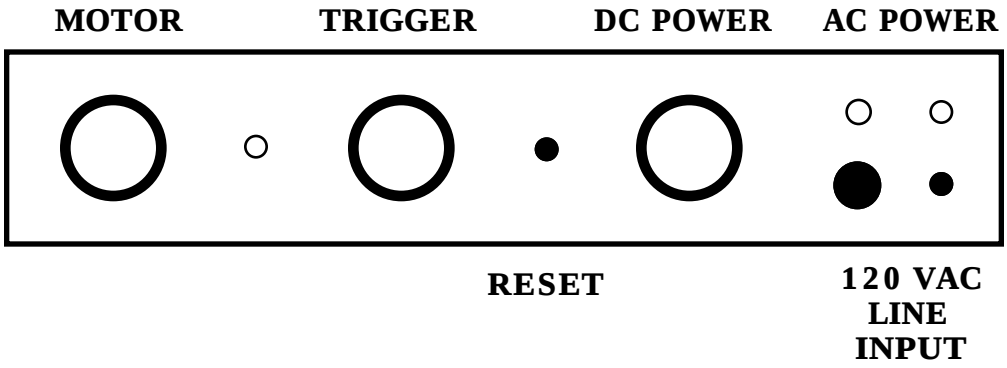
MENU •8.

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 = 0.10 seconds additional energization time before torque reduction at standstill. Accessed by **MENU • 9**.

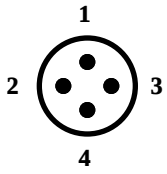
7. Technical Info

7.1 Back Panel Pin-out Diagram

THINGM-LX BACK PANEL LAYOUT

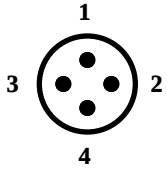


DC POWER



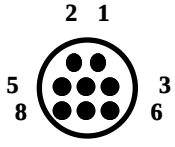
1 --- (no connection)
2 --- +12 Volt DC Input
3 --- (no connection)
4 --- Power Ground

TRIGGER



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

MOTOR

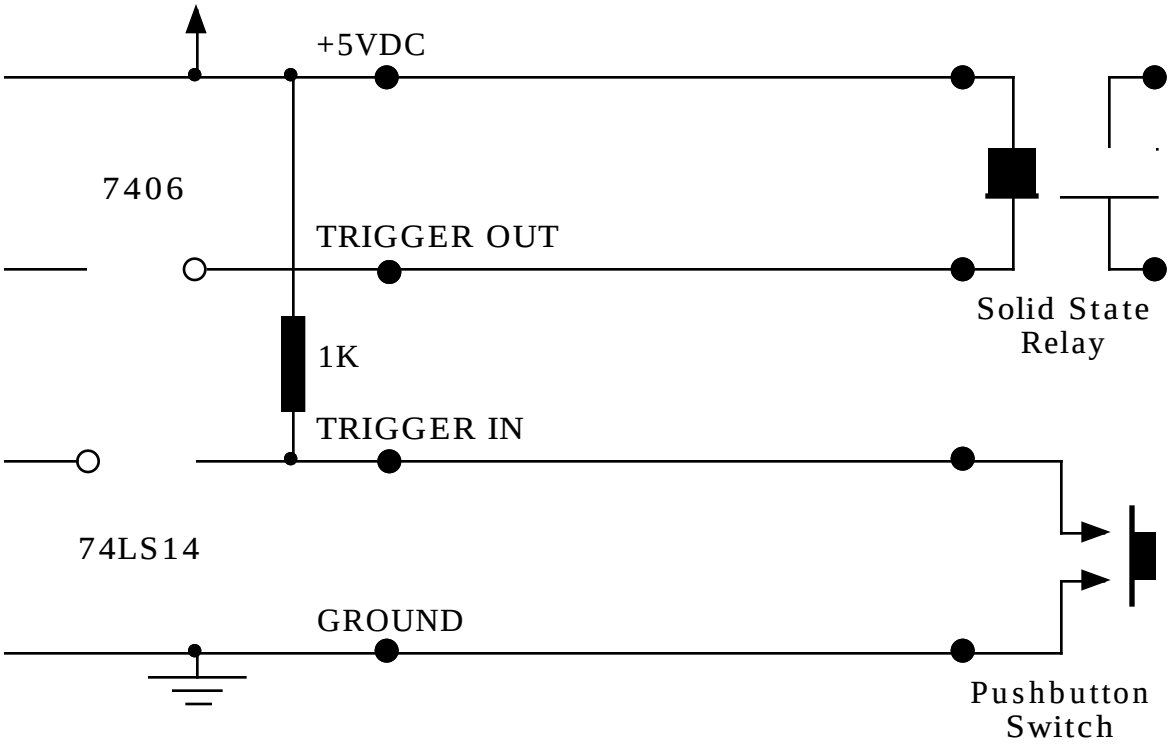


1 --- Motor Phase A In/Out
2 --- Motor Phase C In/Out
3 --- (no connection)
4 --- Switch Ground
5 --- (no connection)
6 --- Motor Phase B In/Out
7 --- Rack-Over Switch Input
8 --- Motor Phase D In/Out

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



7.3 Trigger Frontlight/Backlight Connection Diagram

Note: The following schematic diagram is intended for experienced electronic technicians.

This example uses ThingM's Output Trigger signal to interface with a pair of opto-isolated solid-state relays for Frontlight/Backlight operation. One relay is driven normally with Output Trigger signal active low relative to +5VDC, and the other relay is driven with same Output Trigger signal plus external pull-up resistor active high relative to ground.

THINGM TRIGGER OUTPUT SCHEMATIC FOR FRONTLIGHT/BACKLIGHT RELAYS