Magic Lantern v2.3

Stable ports: Canon 5D Mark II, 550D, 60D, 600D, 50D and 500D

Ports in progress: Canon 5D Mark III, Canon 5D (classic), Canon 1100D/T3

User's Guide

www.magiclantern.fm

July 23, 2012

Magic Lantern is an open (GPL) framework for developing enhancements to the amazing Canon 5D Mark II and 550D/T2i digital SLRs. Magic Lantern is being developed by a small team, helped by a very enthusiastic and respectful user community.

Active developers:

Alex – main developer

Arm.Indy – author of crypto tools and most new ports

G3gg0 – reverse engineering guru

Coutts – porting ML to 5D classic

Nanomad – porting ML to 1100D/T3

SztupY – author of ML USB controller and others

Past developers (come back guys!):

Trammell Hudson – original author and former leader of Magic Lantern project

AJ – developed the AJ version of Magic Lantern for 5D Mark II

Code contributions piersg, nandoide, stefano, trho, deti, tapani, phil, RoaldFre, Colin Peart, cpc, msi, robotsound, maclema, adijiwa, kyselejsyrecek, mk11174, Scrax, OnePercent, Raymond Lo, Rob Kramer, Takashi Miyake, Tobias Doerffel, Paul Nolan, Martin M, and the list is growing :)

Card tools by Pel, Zeno, lichtjaar

Website Team Redkite Bart, Nanomad, Michael Zöller, Malcolm Debono, CameraRick, Francis Danforth, Scrax, 1%

Magic Lantern logo by elJoseph

Thanks to all the users who provided feedback, reported bugs, and supported the Magic Lantern project by donations!
Also, thanks to CHDK team and all the supporters of the old 5D2 Magic Lantern!

Magic Lantern is being developed by independent film makers in our spare time and at risk to our beloved cameras. We hope that it saves you time and aggravation on set, and we'd appreciate your support. You can help by donating via PayPal, or through equipment donations. You can also contact me (Alex) via email. Thanks!

Donate

Features

- Audio: disable AGC, audio meters, manual audio controls, selectable input source (internal, internal+external, external stereo, balanced), audio monitoring via A/V cable.

- Exposure helpers: zebras, false color, histogram, waveform, spotmeter, vectorscope.

- Focus tools: focus peaking, zoom while recording, trap focus, rack focus, follow focus, focus stacking.

- Movie helpers: Bitrate control, movie logging (Exif-like metadata), auto-restart after buffer overflow or 4 GB limit, HDR video, advanced FPS control.

- LiveView adjustments: contrast, saturation, display gain for using LiveView in darkness.

- Cropmark images: user-editable overlays to assist framing and composition.

- Fine control for ISO, Shutter, Kelvin white balance and other image settings.

- Bracketing: advanced exposure bracketing, focus stacking.

- Remote release with LCD face sensor and audio trigger, without extra hardware.

- Timelapse: intervalometer (for photos and movies), bulb ramping (manual and automatic), recording at very low FPS (down to 0.2 FPS), silent pictures without shutter actuation.

- Astro- and night photography: bulb timer for very long exposures (up to 8h).

- Info displays: focus and DOF info, CMOS temperature, shutter count, clock.

- For strobists: flash exposure compensation, range up to -10 to +3 EV (depends on the camera).

- Power saving: Turn off display or reduce backlight in LiveView during idle times.

- Handy features: Quick zoom in PLAY mode, key shortcuts for commonly-used features, customizable menus.

- And much more!

Important notes

- **After opening the card door, always wait for LED confirmation (or for 5 seconds) before removing the card!!!** (no such problem on 550D).

- If you have a bootable SD card and have the BOOTDISK flag set in the camera (which the installer does), and you do not have an AUTOEXEC.BIN file on the card the camera **WILL NOT BOOT**! It will hang and not wake up until the battery is removed.

- If you encounter a "locked up" camera, **quickly remove the battery**.

- When in doubt, remove the battery and reboot.

- **And, remember that this software can damage or destroy your camera.**

Contents

Known issues

- First second of recorded audio may be very loud.

- SD monitors are not completely supported (magic zoom and RGB tools will not work).

- **Magic Lantern has no audio controls for Canon 600D/T3i and newer cameras.** Luckily, you can disable AGC from Canon menus.

Common terms

Movie mode

Most cameras have a dedicated movie mode on the mode dial. In this case, it's obvious what movie mode is.

However, the following cameras do not have a dedicated movie mode. For these cameras, Magic Lantern considers the following configurations as "movie mode":

- **Canon 5D Mark II**: in *LiveView*, with *movie recording enabled* AND *LiveView display set to Movie*.

- **Canon 50D**: in *LiveView*, with *movie recording enabled* from ML menu.

When movie mode is active, Magic Lantern will show a Mv symbol on the bottom info bar. In this mode, certain ML tools that normally work for stills (like intervalometer or audio remote shot) will change their behavior and will record movies.

The Q button

Most cameras have a button labeled as [Q]. A few cameras don't, so you will have to use some other button:

- 5D Mark II: use the Picture Style button.

- 50D: use the FUNC button.

- 500D: use the LiveView button.

Liveview screen layout

Magic Lantern uses the available screen space to display operational information in a clear and practical manner. The image shows a screenshot with commonly used ML features enabled.
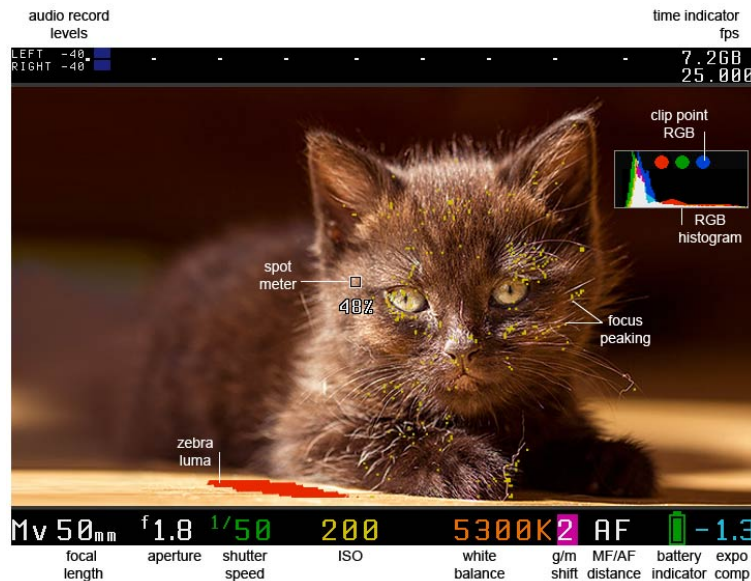
Some items that may need more details:

- Audio meters: this shows the audio record levels, in dB. The bars become yellow at -12 dB and red at -3 dB.

- FPS: the current FPS value is displayed with 3 decimal places (25.000, 24.000, 23.976 etc).

- Shutter speed: in movie mode, values that maintain a certain amount of filmic motion blur (180 degree shutter) are displayed in green. In photo mode, values that may cause blurry pictures are displayed in red.

- ISO: values with low noise (negative digital gain) are displayed in green.

- Clipping dots on histogram: they appear when the image contains overexposed areas.

- Green/magenta white balance shift: not all cameras let you adjust these in movie mode; fine-tune them from White Balance submenu in ML menu.

- Focus distance: this is displayed for most newer Canon lenses. If your lens does not report focus distance, ML will display the AF/MF status instead. Detailed focus and DOF info is displayed in the Focus menu.

Key shortcuts

PLAY mode shortcuts

- `Q` (550D), `UNLOCK` (60D), `DISP` (600D), `LV` (500D), `FUNC` (50D) or `Picture Style` (5D Mark II): show exposure tools (zebra, false color, histogram, waveform, spotmeter) and cropmarks (as configured from Overlay menu).

- `SET + Main Dial (Scrollwheel)` in `PLAY` mode: customizable function (preview HDR images, timelapse playback and others). See SET+MainDial.

- `LV`: create a transparent overlay from current image (when Ghost Image is active). You can use it for panoramas or for repeating shots.

- `LV` on 60D/600D: you can configure it to protect or rate images with a single button press.

- `SET+Erase`: you can configure it to erase images without the confirmation dialog.

Arrow key shortcuts

Arrow keys can be used to quickly adjust the following settings:

- Audio gains and input source;

- ISO (in intermediate steps) and Kelvin WB (press SET for push-button WB);

- Shutter and aperture, in finer steps;

- LCD backlight, saturation and display gain.

You can select what functions you need from Arrow/SET shortcuts submenu, under Prefs.

To enable the shortcut menu, press the following key:

- 550D: the `Av` button (optional: cover the LCD sensor);

- 60D: the `Metering` button (near ISO);

- 600D: the `DISP` button;

- 500D: cover the LCD sensor;

- 50D: the `FUNC` button;

- 5D Mark II: the `Picture Style` button.

Besides the shortcuts, arrow keys can also be used for focusing (see Follow Focus).

See also our Shortcuts article.

Misc shortcuts

- SET pressed at startup: loads vanilla firmware (does not load Magic Lantern).

- INFO/DISP in LiveView: change current display preset, if this feature is enabled.

- Zoom In while recording: it does just that :) (Magic Zoom)

- SET in LiveView: center the focus box.

- Activating *AF mode* dialog when Manual Focus is active will toggle Trap Focus.

Magic Lantern menu

- **Press the "ERASE" button** to bring up the Magic Lantern menu.

- Use arrow keys, joystick or scrollwheels to navigate.

- Use SET and PLAY to toggle values.

- Use Q (or equivalent) to open a submenu with more settings.

- Press INFO or DISP button to get help.

- In LiveView, press Zoom In to preview the image behind ML menu.

- Press MENU to hide items that you don't use (to reduce clutter).

For cameras without Q, use this equivalent button:

- 5D Mark II: press the Picture Style button.

- 50D: press the FUNC button.

- 500D: press the LiveView button.

One-handed menu navigation for 5D Mark II and 50D (optional):

- Open ML menu and submenus with a long press on joystick center key;

- Navigate ML menu with joystick or scrollwheels;

- Close submenus with a short press of joystick center key (use Left and Right to adjust values);

- Close ML menu with a short half-shutter press.

Audio

Manual audio controls.

This menu is not available on Canon 600D / T3i. The 600D/T3i already has manual audio control with Canon firmware, but right now it's not possible to change audio settings from Magic Lantern. You can only use audio meters during recording.

Analog Gain

Gain applied to both inputs in the analog domain, in dB. If you use an external preamp, set this parameter as low as possible; otherwise, set it as high as possible without clipping (audio meters should be green).

L-DigitalGain and R-DigitalGain

Digital gain applied to left and right channel. Recommended setting: 0.

Input source

Audio input source for recording:

- **internal mic**

- **L:int R:ext**

- **external stereo**

- **L:int R:balanced** (internal mic on Left, external mic on Right from both external pins as balanced audio)

- **Auto int/ext**: camera detects if a mic is plugged in. Int is dual mono, ext is stereo.

Canon Balanced Mic to Female XLR Cable Pinouts


```
T   R    S
I   I    L
P   N    E
    G    E
         V
         E
```

FEMALE XLR

Tip = Positive "Hot"
Ring = Negative "Cold"
Sleeve = Ground

1 = Ground
2 = Positive "Hot"
3 = Negative "Cold"
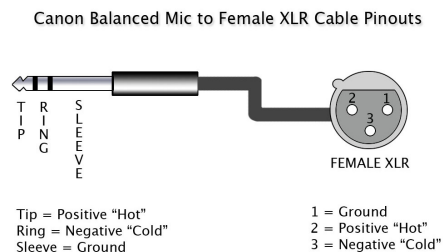
"Balanced audio allows for very long cable runs without interference. Usually balanced mics have three pin XLR connectors and it is very easy to out together an XLR to Canon mic input cable. Balanced allows us to use such pro mics with our little Canons and this is a very welcome surprise for audio guys." (source)

Wind Filter

Digital high-pass filter. See AK4646 datasheet p.34.

Mic Power

This is required for internal mic and certain types of external mics, but it reduces input impedance. See AK4646 datasheet p.31 and the Mic power control thread.

- ON: input impedance is 2 kΩ;

- OFF: input impedance is 30 kΩ.

This setting is always ON when input source is either internal mic or L:int R:ext.

AGC

Enable/disable Automatic Gain Control. AGC is applied only in digital domain (i.e. it overrides digital gains, but you can still adjust analog gain).

Recommended setting: OFF.

Headphone Monitoring

Audio monitoring with headphones, using the A/V cable.

Disable this setting if you are using a SD monitor!

To use audio monitoring, you need a special cable:

- your Canon A/V cable with a RCA - 3.5mm jack adapter;

- a dedicated cable from Sescom;

- or you may solder it yourself (you will have to cut your A/V cable).

Warning: mobile phone cables **will not work**; even if the connector looks similar, it's not identical. You must use the original cable which came with your camera.

Output volume

Digital output gain for audio monitoring. It does not have any effect on the built-in speaker.

For best results, you should a pair of low impedance headphones, for example Audio Technica ATH-M50 (38 ohms). With high-impedance headphones, you may have to use a headphone amplifier like FiiO E5.

Audio Meters

Display input audio level, from -40dB to 0dB; meters become yellow at -12dB and red at -3dB.

Audio meters are only displayed in movie mode.

Expo

Adjusting the exposure parameters. Most of these settings only work in Manual (photo and video), and some of them work in P, Av and Tv too.

WhiteBalance

Advanced white balance control. The preferred method is Kelvin white balance (range: 1500...15000K).

Submenu options:

- Kelvin white balance;

- WBShift G/M: Green-Magenta white balance shift. Useful for fluorescent lighting;

- WBShift B/A: Blue-Amber white balance shift. 1 unit = 5 mireks on Kelvin axis, according to this post;

- Custom RGB multipliers: fine-tune custom white balance;

- Black level: this parameter is applied on RAW data, before applying white balance. Adjust it if you have problems with green or magenta shadows;

- Auto adjust Kelvin + G/M: in LiveView, ML will compute the white balance for the current scene, using the center (200x200 pixels rectangle) as reference gray.

ISO

Advanced ISO control.

Color coding:

- orange = Canon ISO with good noise or dynamic range (100, 160, 200, 320 ... 3200).

- green = ISO with negative digital gain applied via DIGIC (80, 90, 160, 320 - obtained by setting ML digital ISO to a negative value). These can have lower noise and/or better highlight rolloff than their Canon equivalents.

- red = ISO with positive digital gain (avoid these values).

Submenu options:

- **Equivalent ISO**;

- **Analog ISO**;

- **Canon digital ISO** - used for obtaining intermediate ISOs like 160, 320, 640;

- **ML digital ISO** (DIGIC) - in movie mode: enables ISO 50, ISO 80, ISO 51200 and many other intermediate or astronomical ISOs;

- **Highlight Tone Priority** (which increases dynamic range by 1 stop in movie mode);

- **ISO selection** (Canon ISOs or ML ISOs) - only used in movie mode;

Notes and tips for ML digital ISO, in movie mode only:

- Negative values will reduce noise, but may cause color issues in highlights (pink highlights).

- Positive values will increase noise, but in very dark scenes they will also get more shadow detail (at the cost of clipped highlights).

- Consider using negative ISO when you notice noise in shadows or when you want a smooth highlight rolloff.

- Try to use as much negative ISO gain as possible, but without getting pink highlights (-0.3 EV will probably work best; if you use HTP you may go up to -1 EV).

- For increased dynamic range, combine negative digital ISO (which reduces shadow noise) with the excellent Flaat picture styles (which are a very good approximation of log-gamma curves).

Shutter

Fine-tune shutter speed.

- When exposure override is enabled, you can adjust it in 1/8-stop increments (movie mode only).

- In **photo mode**, Magic Lantern displays integer shutter values without rounding them (e.g. 1/50 will be displayed by ML as 1/48). This is not a bug.

- In **movie mode**, shutter values are displayed with one decimal place (for example, in PAL mode, Canon uses 1/33.3 to avoid flicker).

- To use shutter speeds normally not available in Canon firmware (like 1/25 or 1/8000 in movie mode), enable exposure override.

Aperture

Adjust aperture. When exposure override is enabled, you can adjust it in 1/8-stop increments (movie mode only).

PictureStyle

Change picture style or adjust its parameters.

REC PicStyle

You can use a different picture style when recording (toggled automagically). May be useful with flat picture styles.

Exp.Override

This mode bypasses Canon exposure limitations (for ISO, Tv, Av). It enables:

- Manual video exposure controls in cameras without it (500D, 50D, 1100D).

- 1/25s in movie mode (24p/25p) → 1/3 stops better in low light.

- 1/8000s in movie mode, useful for slow motion.

- ISO 12800 is allowed in movie mode on 60D and 600D.

- Full-time DOF preview in photo mode, without blocking certain keys.

Settings:

- **OFF**: Canon default exposure mode.

- **ON**: ML overrides exposure values (change them from Expo menu).

- **Auto**: ML enables it only when needed (that's not auto exposure, but automatic decision of when you need low-level manual controls):

  - For 500D, 50D, 1100D: in movie mode, to enable manual exposure controls.

  - For 60D: in Manual mode with a manual lens, to fix the LiveView underexposure bug.

  - For 550D/60D/600D/5D2: when you select a shutter speed, aperture or ISO value which is not available in standard firmware (e.g. 1/25s or 1/8000s in movie mode).

Side effect: in photo mode, anything slower than 1/30s will be underexposed in LiveView.

LV Display

Selects or displays LiveView display type:

- **Photo display, with exposure simulation**

- **Photo display, without exposure simulation** (for framing and for flash photography)

- **Movie display**.

Overlay

Graphics overlays for LiveView or image review mode: histograms, zebras, focus peaking...

Global Draw

Choose when to enable Magic Lantern overlay graphics: (zebra, cropmarks, histograms, audio meters, ML shooting info...):

- in **LiveView** only;

- in **QuickReview** (photo mode outside LiveView) only;

- **Both modes** (default);

- **Disabled**.

If you use display presets, press Q on this item to switch the presets while you are in ML menu.

Zebras

Enable/disable zebra stripes, which indicate overexposed or underexposed areas.

Color spaces:

- **Luma**: zebras are computed from Y channel only.

- **RGB**: check overexposure for each RGB channel. Clipped channels are displayed in the opposite color (i.e. clipped red shown as cyan, underexposed as white and so on).

You may adjust thresholds for underexposure and overexposure, or you can disable zebras while recording.

Note: when using the Technicolor CineStyle picture style, luma will have values between 16 and 255; therefore, you will have to set the underexposure threshold to 16 or greater.

Focus Peak

Focus assist function. High-contrast lines will be marked by blinking dots showing which part of the image is in focus.

Methods:

- `D1xy`: computes first image derivative on X and Y and takes the max value. May work better in low light or on noisy sensors.

- `D2xy`: approximates second image derivative with a 3x3 Laplacian kernel. May be more accurate in good light.

Other parameters:

- **Threshold**: how many pixels are considered in focus (percentage).

- **Color**: either fixed color, or a color coding according to focus intensity.

- **Grayscale img**: if enabled, LiveView will displayed as grayscale (but still recorded as color).

To see how it works, check this article from Luminous Landscape.

Magic Zoom

Displays a zoom box for focus assist. Can be used while recording.

Trigger modes (not all modes are available on all cameras):

- **HalfShutter**: triggered when you press the shutter button halfway.

- **Focus Ring**: triggered by turning the focus ring.

- **Zoom.REC**: triggered by pressing `Zoom In` button while recording. If your camera has a LCD sensor, you may also cover it and press `Zoom In`.

- **FocusR+HalfS**: triggered by turning the focus ring, or by pressing shutter halfway.

- **Focus+ZREC**: triggered by turning the focus ring, or by pressing `Zoom In` while recording.

- **Zoom In (+)**: triggered by `Zoom In` button (overrides Canon's default zoom modes). To bypass magic zoom, press both zoom buttons at the same time or cover the LCD sensor.

- **Always On**: no trigger key needed. You can use both Canon's 5x/10x zoom and Magic Zoom.

When ML believes you have achieved perfect focus, Magic Zoom will display a focus confirmation (customizable):

- **Green Bars**

- **Split Screen**: when the image is out of focus, the zoom box looks like a split focusing screen from old film cameras.

- **Split Screen with ZeroCross**: will reverse the split direction whenever you achieve perfect focus.

Other parameters: size, position, magnification.

Notes:

- Zebras, focus peaking and false color are disabled automatically when the zoom overlay is active.

- Focus triggering **only** works with lenses that report Focus distance, or when you use follow focus / rack focus.

- In some modes, half-pressing the shutter may temporarily hide the zoom overlay.

Original implementation: Magic Circles by AJ.

Cropmarks

Cropmarks or custom grids for framing and composition.
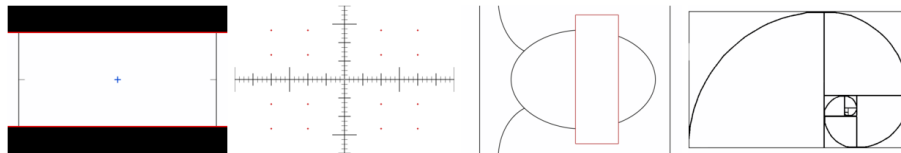
Notes:

- If you use custom cropmarks, place them in `ML/CROPMKS` folder on your SD card and give them short 8.3 names. You can place at most 9 cropmarks on the card.

- Get more cropmarks from the ML cropmark repository or draw your own (see Cropmarks).

Ghost image

Shows a transparent overlay which can be created from any image in Play mode.

Usage:

- To select the image, go to Play mode and press the `LiveView` button.

- Move the ghost image in LiveView with arrow keys; center or hide it with `SET` or joystick press.

Defishing

Preview the rectified (defished) image from the Samyang 8mm fisheye lens, using rectilinear or Panini projection.

This feature works best in photo mode (outside LiveView).

Spotmeter

Measure brightness from a small spot in the frame.

Possible measurement units:

- **Percent** (0..100%)

- Raw 8-bit levels (**0..255**)

- **IRE -1..101** (formula used by AJ, which maps 0-255 luma levels to approx. -1..101 IRE)

- **IRE 0..108** (formula proposed by Piers, which maps 16-235 luma levels to 7.5-100 IRE)

- **RGB** (displays HTML-like color codes)

False color

This is a tool for evaluating the exposure. It shows different luma (Y) levels using a color map. You may select one of the following color maps:
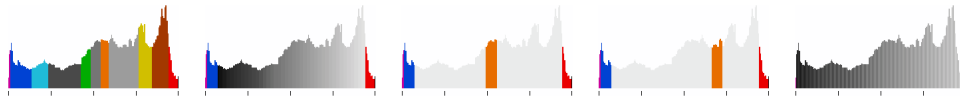
Tips:

- you may configure a display preset with False Color and toggle it with a single button press.

- you may also use false colors to highlight 50% and 70% brightness levels, or to reveal color banding, or to check for uniform green screen lighting.

Histogram and Waveform

These exposure tools will show the distribution of image brightness levels.
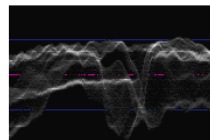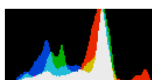
To learn how to read these graphs, see Understanding Histograms and Final Cut Waveform Monitor.

Vectorscope

This tool shows the color distribution with an U-V plot. Useful for color grading.

To learn how to read it, see Introducing Color Scopes: The Vectorscope.
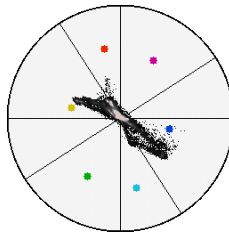
Movie

Functions specific to movie mode.

Bit Rate

Controls H.264 bitrate used for video recording.

Possible modes:

- **CBR**: constant bitrate. You specify a factor for multiplying default video bitrate, between 0.1x and 3x. CBR 1x is the firmware default setting.

- **QScale**: constant quality, variable bitrate (VBR). Available values: -16 ... +16. Lower numbers mean higher bitrates.

- **Firmware default**: completely disable bitrate control.

Notes:

- Increasing the bitrate **may cause recording to stop**. You need a fast card.

- CBR actually works by adjusting QScale on the fly; the instant value is displayed near the recording dot.

- In QScale mode, bitrate is completely out of control (don't use it!).

- In CBR mode, QScale will not go outside [-16...+16]. When QScale reaches the extreme values (-16 or +16), bitrate **will be different** than your CBR setting. Watch the bitrate indicators. This is not a bug, please do not report it.

- You can push the bitrate higher if you record without sound, then use Audio RemoteShot to sync the video with an external audio track.

- You can't change this setting during recording.

- If buffer usage gets too high, ML will pause all CPU-intensive graphics. Change the `BuffWarnLevel` setting to customize this.

Time Indicator

When recording a movie, ML will display a small time counter in the upper right corner, which can be:

- **Elapsed**: duration of the current clip

- **Remain.Card**: estimated amount of recording time remaining on the card.

- **Remain.4GB**: estimated amount of recording time until reaching 4GB (or until filling the card, whichever comes first).

Unlike Canon's timer which assumes constant bitrate, ML timer assumes variable bitrate and works even if QScale is enabled. However, due to variations in bitrate, the estimated value will fluctuate a lot, and **this is normal**.

Movie Logging

If this setting is ON, Magic Lantern will write out a metadata file for the each movie to MVI_1234.LOG (numbered after the movie). The log file contains lens and exposure info, as well as a timestamp every time any of the parameters is changed during recording.

Log files are placed in the same folder as the movies: DCIM/100CANON/, 101CANON etc.

Tip: you can rename LOG files to CSV and import them in MS Excel.

Movie Restart

While this setting is on, movie recording will restart automatically, unless you stop it. There will be a few seconds skipped during restarting.

REC/STBY notify

Custom notifications for recording or standby:

- **Red Crossout** (highly recommended if you forget to press record);

- **Message** (it shows STBY or REC);

- **Beeps** (it will beep when recording starts or stops);

- **Blue LED** (obvious if your camera has it).

Movie REC key

This option enables you to start/stop movie recording by half-pressing the shutter button.

Tip: with this, you can use a wired remote to start/stop recording.

Force LiveView

Force LiveView in Movie mode (bypass the dialog saying *Press LV button to activate movie shooting*).

- **Always**: force LiveView even if you use an unchipped lens, or no lens at all. Be careful, you may get dust on the sensor while changing lenses.

- **Start & CPU lenses**: it will force LiveView at startup, regardless of the lens used. After this, it will only bypass the dialog when a chipped lens is attached (i.e. it will enter LiveView as soon as you attach a chipped lens).

Shutter Lock

This option locks the shutter value in movie mode, so you don't change it by mistake (you will be able to change it only from ML menu).

FPS override

This setting alters FPS for all video modes. Only undercranking works well.

FPS is changed by altering two timer values (let's call them Timer A and Timer B). Increasing any of these values results in lower FPS. Aside from FPS, changing these timers may alter shutter speed and rolling shutter.

Options:

- **Desired FPS**: choose a value from 0.2 fps to 65 fps. If the desired value is not possible, ML will choose the closest safe option (look at 'Actual FPS' below).

- **Optimize for**:

    - **Low light**: use this option for recording timelapse with shutter speeds close to 1/fps (360 degrees); at high FPS values, you may be able to use other shutter speed values.

    - **Exact FPS**: tries to achieve an exact FPS value, such as 24.000 or 30.000 or 12.500. If more exact solutions are found, ML will choose the one with lowest jello effect.

    - **High FPS**: changes FPS without altering shutter speed and allows a slight over-cranking (60D, 600D).

    - **LowJello, 180d**: tries to minimize the jello effect (caused by rolling shutter), while allowing you to expose at 180 degrees (0.5/fps) if possible.

    - **High Jello**: maximizes the jello effect and enables fast shutter speeds. You can use this mode for recording slit-scan frames (distorted images like these, which use the extreme jello effect in creative ways).

- **Shutter range**: displays the available shutter speed range with current settings. When you use FPS override, Canon menu will still display 1/30 ... 1/4000, but the actual shutter speed will be different; read it from ML displays. You can alter shutter speed range by changing the ratio between the two timer values (decreasing timer B will result in faster shutter speeds available).

- **Timer A**: displays the value of timer A and lets you fine-tune it. ML will re-adjust timer B to match your FPS choice.

- **Timer B**: displays the value of timer B and lets you fine-tune it. ML will not re-adjust timer A, so this option will let you fine-tune the exact FPS value.

- **TG Frequency**: displays the crystal oscillator frequency of the FPS circuit driver (read-only, depends on your camera).

- **Actual FPS**: this displays the current FPS, computed as TG_FREQ / timerA / timerB (read-only).

- **Sound Record**: by default, ML will disable sound recording when FPS override is enabled; otherwise, audio will go out of sync and recording will stop. Only enable sound if you know what you are doing.

Notes and tips:

- This function will **not** change the frame rate from the video header; the video will playback at the setting from Canon menu.

- Recommended usage: set FPS to a very low value (for example, 3fps) to record a time-lapse.

- To get 180-degree shutter speed at very low FPS, simply discard half of the frames in post.

- If 0.2 FPS is not enough, use Frame Merger (a VirtualDub plugin).

- Exact frame rate may be "rounded" to be an exact multiple of PAL/NTSC frame rates.

    - PAL modes: 25p/50p. Rounded frame rates: 33.333fps, 12.5fps, 11.111fps and so on.

    - NTSC modes: 30p/60p/24p. Rounded frame rates: 29.97fps, 23.976fps, 11.988fps and so on.

- For fine-tuning and calibrating custom frame rates, use EOSTimerGen.

- Tip: this feature **also works in photo mode**, making LiveView usable in dark environments. Combine it with display gain.

HDR video

This feature allows you to shoot a high dynamic range video by alternating ISO every other frame. Select the two ISO values from the submenu.

Possible postprocessing workflows:

- Interframe script: user-friendly version and bare-bone version;

- GingerHDR (plugin for Adobe After Effects and Premiere)

- Magic Lantern HDR Compose generator for FCP X

- HDR Glogger Web Service

- etc (please help me filling the list!)

See also the postprocessing thread on the forum.

Note: this feature does not work on 500D/T1i.

Image Effects...

Custom image effects found by investigating DIGIC registers:

- **Desaturate** (tip: this lets you record grayscale with any picture style);

- **Negative** image;

- **Swap U-V** (red becomes blue);

- **Cartoon look** (for this to work, set sharpness in your picture style to any nonzero value).

Movie Record (50D)

Enable movie recording on 50D (1920x1080, 30fps, without sound). To start recording, go to LiveView (P/Tv/Av/M) and press SET.

WARNING: Canon 50D was **NOT** designed to record movies. Keep in mind:

- This feature was not thoroughly tested by Canon and may be unstable (even if you record without ML).

- Always disable movie recording when you don't use it.

- Battery will drain quickly when recording; also, the camera may overheat.

Limitations:

- The camera will not record sound. You can use an external recorder (for example, Zoom H1, H2 or H4n) and sync the sound in post with a clapperboard.

- You can't play back movies in the camera.

This setting remains active even if you start the camera with standard firmware (until you clear your settings).

Shutter Button (50D)

- **Leave unchanged**: obvious :)

- **Block during REC**: blocks the shutter and related (AF, *) buttons while recording. In 50D, taking pictures while recording would result in ERR99; with this option, you can avoid taking pictures while recording by mistake. Side effect: this will disable image stabilization during recording.

- **Hold during REC (IS)**: ML will keep the shutter button pressed half-way during recording, which will enable image stabilization (IS). Side effect: you need to press the shutter button half way to turn IS off before the camera will let you stop recording.

Exposure Lock (50D)

Locks the exposure in movie mode. You can also use the * button (you don't have to hold it pressed).

Shoot

Functions for stills shooting (some of them work for movies, too).

HDR Bracketing

Exposure bracketing for HDR images and timelapses.

- In `M` mode, this function does shutter and/or ISO bracketing. In the other modes it does exposure compensation bracketing.

- To start bracketing, **take only the first picture** and ML will continue the sequence.

- To preview HDR images in camera, set SET+MainDial: ExposureFusion from Prefs menu, Image review settings, then go to playback mode, hold `SET` and turn the main dial (wheel).

- For each HDR picture set, Magic Lantern may also write a bash script for stacking the exposures with enfuse (version 4.x), with optional alignment (align_image_stack). More info: Exposure Fusion: What is it? How does it Compare to HDR? How Do I Do It?.

Intervalometer

Take pictures or movies at fixed intervals.

You can stop the intervalometer by rotating the mode dial, by pressing `MENU` or `PLAY`, or by turning off the camera.

Settings (in submenu):

- Duration between two shots.

- Start delay (up to 8 hours).

- Stop after X pictures.

- In movie mode only: duration of a movie clip.

Turning on Intervalometer displays a calculation for how long the time lapse will shoot for, how many frames it will take and the playback time, based on your image quality setting, free space and video frame rate selected in Canon menus.

Example; 1h33m, 563 shots, 24fps => 00m23s

Turning on Intervalometer displays a calculation for how long the time lapse will shoot for, how many frames it will take and the playback time, based on your image quality setting, free space and video frame rate selected in Canon menus.

Example; 1h33m, 563 shots, 24fps => 00m23s

Tips:

- To avoid flicker, shoot in **manual** mode, use **manual white balance**, **avoid short exposure** times and **use a manual lens** (if you use an EF lens, lock the aperture and **unscrew** it).

- To make a timelapse without increasing shutter count, do not use the intervalometer; instead, set FPS override to a very low value (for example, 3fps) and start recording.

- When using the intervalometer in LiveView with "noisy" mode, your shutter will wear twice as fast than outside LiveView.

- If the intervalometer can't be stopped (it may happen in `crazy` mode), turn the camera off or open the card door.

Power Saving:

- When not in LiveView, press `DISP` or `INFO` to turn the display off.

- In LiveView, ML will turn the display and the sensor off during idle times if you enable this option from `Powersave` menu.

- While the intervalometer is running, the card led will blink once per second to let you know it's alive and kicking.

Bulb/Focus Ramping

Bulb Ramping allows the capture of a timelapse that gradually changes exposure, compensating for the transition from day to night.

Options:

- Auto exposure ramping: this option will adjust shutter and ISO automatically, by looking at image brightness of previous shots.

- Manual exposure ramping: this option will adjust shutter and ISO to follow a fixed exposure ramp (a fixed amount of EV change per shot). Can be used as standalone or combined with auto ramping.

- Manual focus ramping: this lets you adjust focus gradually while shooting the timelapse. It requires a lens with autofocus and it can only work in LiveView.

Settings for auto ramping:

- Mode: sunset / sunrise / auto. In sunset mode, the exposure will always increase. In sunrise mode, the exposure will always decrease. This idea was suggested by Tom Lowe on RedUser.net forum.

- Maximum ramping speed: this parameter is used for computing the optimal smoothness factor. A lower value will reduce flicker, but if the value is twice as low as the real rate of brightness change, ML will lose the ability to ramp correctly. For example, if you set a maximum ramping speed of 0.1 EV / shot, and the scene requires a ramping of 0.2 EV / shot, ML will start flickering heavily.

Quick start guide for auto ramping:

1. Take a picture of your scene. ML will use it as an example of: "I want my timelapse to be exposed like this picture".

2. Enable Bulb Ramping and Intervalometer.

3. Leave the camera still while ML runs a calibration step:

- Make sure you have a static and well-lit scene (any static scene which does not require long exposure should be fine).

- After calibration, you should get a nice S-curve on the screen.

4. Now you will have to say what tone range to meter for (i.e. highlights, midtones...). Follow the wizard:

- Use arrow keys to select your reference picture (which you just took).

- Use the main dial to select the tone range to meter for. You can't perfectly match two images just by varying one parameter (exposure), so you have to choose what's important for you in this picture.

- For lowest flicker, meter for midtones (choose the 50th percentile, i.e. median, because it's a robust estimation, unlike simple averaging). Leave some headroom for highlights (underexpose a bit).

- If highlights are important, meter for them (choose 80th percentile for example). You will have to shoot RAW and remove flicker when you develop the RAW files.

- The algorithm works best when brightness is close to 50% (try not to choose extreme values for it).

- When you are ready to start, press SET.

5. Sit back and relax :)

Limits:

- ISO is chosen between 100 and maximum auto ISO value from Canon menu.

- Shutter speed is chosen between 1/8000 (lower limit) and the delay between two shots minus two seconds (upper limit). Example: for 10-second intervals, shutter speed will be between 1/8000 and 8 seconds.

- Aperture is fixed (you can change it manually).

Tips:

- Don't adjust ISO and shutter before the timelapse, they are fully automatic.

- Use a ND filter to reduce flicker during daylight.

- Reduce flicker in post. We recommend VirtualDub with MSU Deflicker plugin (free, works with Windows and Wine). See also Timelapse workflow using free software tutorial.

Technical notes:

- Exposure is metered using a condition like this (for example): *70% of pixels should be below 50% brightness*.

- Exposure for every shot is computed from previous shots, using a feedback controller algorithm with a smoothing factor.

- ISO is chosen using the 180 degree rule, so the resulting shutter speed stays between 90 and 270 degrees (that is, between 1/4 and 3/4 of the delay between two shots).

- Only full-stop ISOs are used (you are supposed to shoot RAW).

- Shutter speed can be adjusted with a resolution of 10ms.

- Frames with fast shutter speeds (less than 1 second in Rebel cameras, less 0.1 seconds in 60D) are taken in Manual mode. You will get flicker.

- It can go from 1/8000s @ ISO 100 (daylight) to several minutes of exposure time @ ISO 6400 (complete darkness).

- Exposure algorithm is a feedback controller designed with pole placement - the closed loop response will have two real poles placed at the smoothing factor value. Smoothing factor is computed in such a way that, when scene ramping speed matches the speed selected in menu, ramp is followed at exactly 1 EV behind it.

- If the lighting changes suddenly a few stops between two shots (for example, you change the ND filters or the aperture), the algorithm should recover completely after 2 or 3 shots. A sudden exposure change is considered when the exposure difference is greater than 2 stops.

Logging:

- When you use bulb ramping, Magic Lantern will save a log file with the exposure parameters, metered values and so on. Please send this file to developers.

- These log files can be used to see how well the ramping went and to fine-tune the algorithm.

Bulb Timer

Very long exposures with Bulb mode and ML timer. This feature is useful for night shots and astrophotography.

Bulb timer is started by holding the shutter pressed halfway for one second, or by remote triggers / intervalometer.

Tip: you can cancel the exposure earlier by half-pressing the shutter button.

LCDsensor Remote

Start/stop remote shutter release mode with the LCD sensor.

- ⊗ **Near**: To take a picture, put your hand near the LCD sensor.

- ⊙ **Away**: Picture is taken when you get your hand away from the sensor. You may combine this setting with Mirror Lockup.

- ⋀ **Wave**: Picture is taken after you wave your hand 3 times near the sensor. You can leave it on without interfering (too much) with normal shooting.

This feature is useful for avoiding camera shake.

In Movie mode, the `Wave` ⋀ setting is able to start and stop recording movies. The other modes can only start recording (because it's too easy to stop recording by mistake).

While recording, the `Near` and `Away` modes can trigger the rack focus operation.

Audio RemoteShot

Start/stop remote audio trigger. To take a picture (or start recording a movie), make some loud noise, for example, clap your hands or pop a balloon.

Tip: with the audio trigger you can sync a video *recorded without sound* with an *external audio track* (see this topic)

Be careful: this may trigger the shutter from the sounds made by camera (like focus beep or noise from operating the buttons).

Motion Detect

Motion detection in LiveView.

Trigger modes:

- **Exposure change**: it only reacts to brightness changes. Detects large moving subjects which cause significant change in exposure.

- **Frame difference**: it computes the difference between last two frames A and B (luma channel only); this detects smaller movements which do not change exposure.

Detection time is somewhere between 200 and 300 ms according to DataGhost's speed test; it's faster with silent pictures.

Silent Picture

This feature is reserved to very advanced users. It can take pictures in LiveView mode without moving the mirror. When enabled, it saves uncompressed YUV422 frames from the LiveView image buffer when you press the shutter halfway.

- Make sure you don't have autofocus assigned to half-shutter press (put it on * or turn it off)

Modes:

- **Simple**: low-resolution mode where the LiveView image buffer is simply saved on the card. Image resolution is usually around 1 or 2 MPix, and depends on the current mode (zoom or not, recording or not, and movie resolution).

- **Burst**: similar to Simple, but images are saved continuously as long as you keep the shutter pressed halfway.

- **Hi-Res**: emulates high-resolution by taking a matrix of small silent pics, in zoom x5 mode. You need to have the camera on a tripod and the subject should be static (a picture is taken in a few seconds). Could be useful for focus stacking or for timelapse without increasing shutter count.

Silent picture setting is applied to intervalometer and remote triggers. It will also go to LiveView when you press the shutter half-way in regular photo mode. Therefore, you should only enable this setting when you actually use it.

Images are saved in `DCIM/1xxCANON/` after the following rules:

- If intervalometer is `OFF`, silent pics are named after last picture/movie taken without this function (e.g. `12340001.422`). You are limited to 10000 silent pictures for each "noisy" picture.

- If intervalometer is `ON`, silent pics have names like `12345678.422`. Tip: use `File Numbering` → `Manual Reset` from Canon menu to increase folder number (to sort them easier).

To convert a 422 image to JPEG on the PC, use one of the following programs:

- 422-jpg.py (command-line tool, runs on all platforms, you need to install Python, PIL and numpy).

- 422toimage (Windows only, source code available).

- YUV422 Convertor (Windows only, closed source).

Mirror Lockup

Mirror lockup. See Canon user guide for details.

`Timer+Remote` will auto-enable MLU under one of the following conditions (and disable it otherwise):

- self-timer mode is on (either 2 second or 10 second, but not continuous)

- LCDsensor Remote is in `Away` mode.

Flash tweaks...

A few tweaks for flash users:

- **Flash expo compensation** (-10..+3 EV). Tip: you may use -10EV to trigger an external flash without putting light on the scene coming from the onboard flash.

- **Flash / No flash**: use this when you are not sure whether to use flash or not. Odd pictures (by file number) will be taken with flash, even pictures without flash.

- **3rd party flash in LV**: a trick for enabling non-Canon flashes in LiveView on Rebel cameras. This trick disables LiveView temporarily on half-shutter press, therefore you should **DISABLE this option when you don't use it!!!**

EyeFi Trick (visible only with an EyeFi card inserted)

This feature lets you transfer RAW files with a non-pro EyeFi card. You can rename those files from CR2 to AVI, so the EyeFi card will send you raw picture to your PC as a movie file. Once transfered, just rename them back to CR2 on your PC.

To rename the files back on camera, choose `Rename AVI to CR2`.

Focus

Trap Focus

For MF users: takes a picture when the subject comes into focus.

Modes:

- **Hold AF button**: you need to hold the autofocus button (half-shutter, ∗ or AF-ON, depending on your settings).

- **Continuous**: you don't need to hold any button; ML will "hold" the half-shutter pressed for you. This will also block most buttons; press the shutter halfway to unlock them for two seconds.

Notes:

- Outside LiveView, it only works with lenses with chip.

- In LiveView it only works for photos, and it will take a picture when the focus indicator has (almost) maximum value on the focus graph.

Notes for LiveView trap focus:

- You may have to turn the lens back and forth a few times in order to let ML compute the correct focus scaling factor for the current scene.

- If you move from a high-contrast scene to a low-contrast one, you will also have to wait a bit until the high-contrast data disappears from the focus graph.

- Press SET to temporarily disable automatic scaling of focus magnitude.

Focus Patterns

Custom focus patterns which can be used either with autofocus or trap focus.

To change the focus pattern:

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- Set your camera in photo mode, non-LiveView;

- Look through the viewfinder and make sure the main display is off;

- Change the focus pattern with the arrow keys and SET; you may or may not receive visual feedback.

- Press the Zoom In button twice to see the current selection.

You can use the custom focus patterns in LiveView Quick Focus mode, too, but the pattern won't be displayed on the screen.

This feature was ported from 400plus.

Follow Focus

Very simple follow focus (like a rack focus controlled manually).

- **Arrows**: you will be able to focus with the arrow keys.

- **LCD Sensor**: on 550D/500D, focus by placing your hand near the LCD sensor (avoiding shake). To use this, you may need to disable LCDsensor Remote.

Recommended focus step settings:

- Focus StepSize: 1 or 2

- Focus StepDelay: small values, without Wait flag.

- If the motion is not smooth, try larger delays (100ms)

Quick rack focus **while recording**:

- Press MENU to save current focus point (this means "I want to return here");

- Use follow focus to change focus point (focus somewhere else);

- Press PLAY to go to saved focus point;

- Press PLAY again to go back.

Focus StepSize

Step size for one focus command, as used by EOS Utility.

Focus StepDelay

Delay between two successive focus commands, with an optional waiting flag.

- If Wait is not active, ML will only wait a for fixed delay before sending next focus command. This will reduce stutter, but may affect rack focus accuracy. This setting is recommended if you only use follow focus.

- If Wait is active, ML will wait until each focus command is completed, and then it will wait for a fixed delay, as configured here. This will increase rack focus accuracy, but may cause stutter with certain lenses.

Focus End Point

This is end point of rack focus (X focus steps from the start point, i.e. from current focus point).

First you have to set the end point. Focus the lens, then press SET on this menu item.

After pressing SET, ML will display `Focus End Point:  0 (here)`. This means the end point is now assigned to current focus position.

At this point, you will see the LiveView image and set the start point using left and right keys (just like with follow focus) or the main dial (scrollwheel). The start point will be always the current focus point (which you are changing); the end point will remain fixed.

Rack Delay

Sets the number of seconds before starting a rack focus. This lets you film the start point first, then initialise the rack focus without touching the camera.

Rack Focus

Triggers the rack focus operation that moves between the start and end focus points. After the move is complete pressing again reverses the move.

- SET: rack focus will start after 2 seconds;
- Q: rack focus will start immediately;
- PLAY: ML will automatically record a short clip with the rack focus operation;
- **Outside ML menu, while recording**, press PLAY to start rack focus.

Step-by-step:

1. Pick the end point of rack focus by focusing on it (manually or with AF).
2. Configure focus parameters (step size and delay). Different lenses may require different parameters.
3. Open the Focus menu, go to Focus End Point and press Set to zero it out.
4. Pick the start point by focusing on it with the LEFT/RIGHT buttons while the Focus menu is active. Make sure the number from Focus End Point is changing as you focus. Fine-tune the position with scrollwheel.
5. Go to Rack Focus and press SET or PLAY to start rack focus.
6. To return to the starting point, run rack focus again.

Tip: when LCDsensor Remote is set on Near or Away, you can trigger rack focus from the LCD sensor, avoiding camera shake.

Recommended focus step settings:

- Focus StepSize: 1 or 2
- Focus StepDelay:
    - without Wait flag: large delays (around 100 ms) => will ignore small position errors
    - with Wait flag: small delays (only lens is in very good mechanical condition)

Stack focus

This selection will shoot a series of photographs with varying focus points. It is used in macro photography to assemble sharper final images by merging photos where each has a different focus point.

This function can also create scripts named like named FST_1234.SH, which can be used for stacking the images with enfuse. See Exposure bracketing for details on how to use these scripts, and the focus stacking section from Enfuse reference manual. To enable (or disable) the post-processing scripts, go to HDR bracketing submenu.

Usage:

1. Configure rack focus and use it to preview the focus range.

2. Select the number of focus steps to skip. This will determine the number of pictures to be taken.

3. Press PLAY to start the focus sequence (PLAY mode) or take the first picture (SNAP mode).

You can also combine this function with HDR bracketing and silent pictures.

Recommended focus step settings: same as for rack focus.

Focus distance and DOF info

These items are read-only:

- **Lens info**: displays lens name, current focal length and current aperture.

- **Focus Dist**: The distance to the focal point. Most newer newer Canon lenses report this value, but not all.

- **Hyperfocal**: The hyperfocal distance is the point of focus where everything from half that distance to infinity falls within the depth of field. This is the largest depth of field possible for the current f-number.

- **DOF Near**: The nearest distance in which objects appear in focus.

- **DOF Far**: The farthest distance in which objects appear in focus.

Display

Options for display (most of them are for LiveView).

LV contrast

Adjusts the contrast in LiveView. It does not affect recording. This helps when focusing with very flat picture styles.

Choices: *Normal* (no effect), *High*, *Very high*, *Low*, *Very low*, *Zero*.

LV saturation

Adjusts the saturation in LiveView. It does not affect recording. This helps you focus without being distracted by color.

Choices: *Normal* (no effect), *High*, *Very high*, *Zero (grayscale)*.

LV display gain

Photo mode only: this feature increases the brightness in LiveView, making it usable in very dark scenes (where Canon's LiveView would be pitch black). Combine this with FPS override for better low-light performance.

Range: 0 ... +7 EV.

For movie mode, use ML digital ISOs for a similar effect.

Color scheme

This affects the colors and brightness for on-screen information (including LiveView overlays, Canon menus and ML menus).

Choices: *Default*, *Dark*, *Bright Gray*, *Dark Gray*, *Dark Red*, *Dark Green*.

Tip: dark themes may reduce the eye strain during night shooting.

Clear overlays

Clear bitmap overlays from LiveView display.

- **HalfShutter**: LiveView overlays are cleared when you hold the shutter button pressed halfway for one second. You can also use the * button or the `DOF preview` button.

  Tip: assign autofocus to * button (from Custom Functions, set `Shutter/AE lock button = AE lock/AF`).

- **WhenIdle**: In this mode, all the overlays are erased from the screen (100% clean display) when the camera is idle (i.e. a few seconds after last button press).

- **Always**: In this mode, all the overlays are erased. Menus will work normally.

  Tip: this feature may be useful with External Recorders, since it removes the focus box and other graphics from the display.

Focus box (LV)

With this setting you can choose to show the Focus box in LiveView or hide it when not needed.

Force HDMI-VGA

This option will force a low-resolution mode on HDMI displays (720x480), which avoids blank screen when you start/stop recording.

Screen layout settings...

Screen orientation, positioning fine tuning, adjustments for external monitors...

Screen Layout   Choose screen layout (position of ML top and bottom bars), for different cameras or for external monitors.

Top/bottom layouts:

- **Inside 3:2**: default layout for 3:2-screen cameras (550D and newer).

- **Inside 16:10**: for 16:10 HDMI monitors.

- **Inside 16:9**: for 16:9 HDMI monitors.

- **4:3 movie**: for 5D Mark II, 500D and 50D in movie mode.

Bottom-only layouts:

- **Under 3:2**: useful for 4:3-screen cameras (500D, 50D, 5D Mark 2) in photo mode.

- **Under 16:9**: suitable for low-resolution external monitors and for 4:3-screen cameras in movie mode.

Image position   This may make the image better visible from different angles (especially on cameras without flip-out screen).

UpsideDown mode   This mode is useful if you want to mount your camera upside-down.

Auto Mirroring   For cameras with flip-out LCD, this options prevents mirroring the display when you open it at 180 degrees.

Display: Normal/Reverse/Mirror   For cameras with flip-out LCD, you may select a different flipping/mirroring option.

Level Indicator (60D)

Shows if the picture levels with the horizon. Can be used while recording.

Kill Canon GUI

For 50D only: disable Canon graphics elements to avoid conflicts with ML graphics in Live-View.

- **Idle/Menus**: only enable Canon graphics when some transparent menu from LiveView is active.

- **Idle/Menus+Keys**: only enable Canon graphics when you press some keys or navigate the transparent menus from LiveView.

Prefs

Image review settings...

Customize the image review (playback) mode:
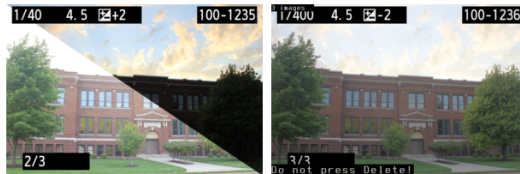
SET+MainDial When you hold `SET` pressed and turn the main dial (scrollwheel), ML may perform one of these functions:

- **Play 422**: display silent pictures from `DCIM/100CANON` (low-res only).

- **Exposure Fusion**: combine two or more images, useful for previewing HDR images or multiple exposures.

- **Compare Images**: compare two images with a diagonal split view. The current image will always end up in the top half.

- **Timelapse Play**: scroll through all your pictures quickly.

Image review

- **QuickReview default**: just like in standard firmware.

- **CanonMenu:Hold→PLAY**: if you set `ImageReview:Hold` in Canon menu, it will go to `PLAY` mode instead. This allows you to zoom in as soon as you take the picture (without having to press `PLAY`). Credits goto Ken Rockwell for hint ("You have to hit PLAY").

Quick Zoom Faster zoom in PLAY mode, for checking critical focus:

- **OFF**

- **ON (fast zoom)** - zooms faster than Canon firmware.

- **SinglePress → 100%**: a single press of `Zoom In` will zoom all the way in (to 100%) - on center point. Next press will zoom out (full screen image).

- **Full zoom on AF point**: similar, but it will zoom on currently selected autofocus point.

- **Full zoom on last position**: similar, but it will remember the last position of the zoom box.

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LV button   Customize the LiveView button in `PLAY` mode:

- **Default** (enter LiveView)

- **Protect image**

- **Rate image**

Quick Erase   Shortcut for erasing images without confirmation (hold SET and press ERASE). Be careful!

LiveView Zoom Settings...

Customize Canon's x5/x10 zoom in LiveView:

- **Zoom x5, x10**: you can disable one of them, so the first `Zoom In` press will zoom in, and the second will zoom out;

- **Auto exposure on zoom**: auto adjusts exposure while zoom is active. This lets you adjust aperture freely on a manual lens, without the image going too bright or too dark (so it helps when focusing);

- **Increase SharpContrast**: when zoom is active, sharpness and contrast are maximized. Increased sharpness works somewhat like focus peaking.

- **Zoom on HalfShutter**: zoom is enabled when you press the shutter halfway.

- **Zoom with Focus Ring**: if your Canon lens reports focus distance, you can enable zooming just by turning the focus ring. If you'd like the zoom to stay enabled for a longer time, press and hold the shutter halfway.

Arrow/SET shortcuts...

Select the features you want to adjust quickly with arrow keys:

- Audio gain

- ISO/Kelvin

- Shutter/Aperture

- LCD Brightness/Saturation

You can also enable quick functions for the SET button, coupled with the corresponding arrow adjustments:

- Audio input (internal mic, external mic, balanced...)

- Push-button white balance

- 180-degree shutter speed (or the closest approximation)

- Reset LCD brightness to 5 and saturation to Normal.

Misc key settings...

LCD Sensor Shortcuts   Use the LCD face sensor as an extra key in ML (e.g. for triggering arrow keys, for blocking follow focus or for bypassing magic zoom key).

To fully disable the LCD sensor in Magic Lantern, disable `LCD auto off` from Canon menu (Wrench 1). You need to do this if you are using a device which covers the LCD sensor (e.g. a loupe).

Sticky DOF Preview   This will make the DOF preview button sticky (so you no longer have to hold it pressed).

Note: enabling DOF preview will block most other buttons.

Tip: enable Exposure Override to preview DOF without blocking the buttons.

Sticky HalfShutter   This will make the half-shutter press sticky (so you no longer have to hold it pressed).

Tip: use this to prevent the camera from turning off LiveView after 30 minutes.

Swap MENU ↔ ERASE (60D)   Swaps `MENU` and `ERASE` buttons. This feature allows one-handed navigation in ML menu on 60D, but will have to use `MENU` button to delete the pictures.

DigitalZoom Shortcut (600D)   On 600D/T3i, this lets you customize the behavior of `DISP +` `Zoom In / Zoom Out` shortcut key in movie mode:

- `1x,3x` : toggle between 1x and 3x digital zoom modes (FullHD)

- `3x...10x`: default Canon setting (change digital zoom value between 3x and 10x).

Note: by default, Magic Lantern **disables digital zoom values greater than 3x** in order to avoid image quality degradation.

Auto BurstPicQuality

When enabled, it will temporarily reduce picture quality in burst mode in order to maintain a decent frame rate even when the buffer becomes almost full.

This function will reduce picture quality if the buffer has space for less than 4 pictures:

- `RAW+JPG` → `JPG Large Fine` → `JPG Medium Fine`

- `RAW` → `JPG Large Fine` → `JPG Medium Fine`

- `JPG Large Coarse` → `JPG Medium Coarse`

Possible results (550D, Transcend Class 10, your mileage may vary):

- `RAW+JPG`, `JPG-L`, all others `JPG-M`

- `RAW`, `RAW`, all others `JPG-M`

Powersave in LiveView...

Options for maximizing battery life when using LiveView.

- **Enable power saving**: on Standby, during Recording, or always.

- **Use LCD sensor**: you can use it to wake up from powersave (wave your hand near it), or to force powersave mode (cover the sensor for a few seconds).

- **Dim display**: In LiveView, if the camera is idle, Magic Lantern will reduce the LCD backlight level to minimum in order to save power.

- **Turn off LCD and LV**: this will turn off the display and the sensor activity in LiveView. Mirror will not be moved. If the camera is recording or motion detection is enabled, only the display will be turned off (so recording will not stop).

- **Turn off GlobalDraw**: if the camera is idle, ML overlay graphics will be disabled to reduce CPU usage.

Config file...

Magic Lantern saves its settings in a configuration file named `MAGIC.CFG`, located under `ML/SETTINGS` directory on your card. This submenu lets you customize how these settings are saved.

- **Config Autosave**: If enabled, settings are saved automatically to "MAGIC.CFG" whenever you change a setting in ML menu. Config saving process will take place as soon as you close the menu.

- **Save config now**: Save ML settings to `ML/SETTINGS/MAGIC.CFG`.

- **Delete config file**: use this to restore ML default settings. After deleting the config file, restart your camera.

LV Display Presets

This feature lets you use up to 4 display presets for the settings in the Overlay menu.

On the top bar, you will see `DISP` 0, 1, 2 or 3. Each of those is a preset for the settings in `Overlay` menu. So you can, for example, configure `DISP 0` with false colors, `DISP 1` with zebras and focus peaking, and `DISP 2` with cropmarks.

This menu item sets the maximum number of available display presets. To disable this feature, set the number of presets to 1.

To change the current display preset, press `INFO/DISP` in LiveView, or `[Q]` on the GlobalDraw entry in the Overlay menu.

Crop Factor Display

If enabled, ML bottom bar will display the 35mm equivalent focal length, including crop factor (1.6x).

For example, a 50mm lens at f1.8 will be displayed as:

- `50mm f/1.8` with this option disabled;

- `80eq f/1.8` with this option enabled.

Debug

Functions for troubleshooting, development, and possibly unstable features.

Screenshot - 10s

Print screen after 10 seconds. This option saves a BMP file for the overlays and a 422 file (silent picture) for the LiveView image. The BMP does not contain transparency data. You can combine the two files in GIMP or other image editing programs.

The card LED will blink every second, until the screenshot is taken.

Don't click me!

Don't click it :)

Stability tests...

This option runs various tests to make sure Magic Lantern is stable and will not crash. You can use it to test your particular configuration.

If it crashes, report an issue.

Show tasks...

Displays the tasks started by Canon and Magic Lantern.

Save CPU usage log

Saves a log with the CPU usage for all tasks.

Free Memory

Displays the amount of available RAM.

Shutter Count

Displays the number of shutter actuations (number of pictures taken plus number of liveview actuations).

CMOS temperature

Displays the internal CMOS temperature, in raw units.

Ambient light (5D Mark II)

Displays the value from ambient light sensor (under LCD display), expressed in EV steps. The scale is arbitrary (not calibrated in any way).

Battery level (60D and 5D Mark II)

Displays battery percentage, estimated time remaining and battery discharging rate.

For accurate readings, wait until the percentage indicator decreases by at least 2% since powering on.

FAQ

General

What is it?

Magic Lantern is an enhancement atop of Canon's firmware that frees your Canon DSLR, allowing you to use many useful features. It is an open (GPL) framework for developing extensions to the official software.

Does Magic Lantern completely replace Canon firmware?

No. Magic Lantern runs from the card, as an *add-on* over standard firmware. You will still be able to access all Canon functionality.

To go back to Canon firmware, you may:

- Press and hold SET at startup to bypass ML only once (for the current session).

- Format your card in the camera and choose to remove Magic Lantern.

- Disable the bootflag (this will uninstall ML from the camera; to do this, run Firmware Upgrade and follow the instructions).

Is Magic Lantern only for video?

No. Early versions were developed by independent filmmakers and tailored for video production on 5D Mark II. Things changed when Magic Lantern was ported to smaller (APS-C) cameras, like 550D, 60D, 600D and 500D, which attracted developers interested in both still photography and DSLR video.

Visit the gallery for photo examples.

Is it legal?

This is a "clean room" / "black box" reverse engineering effort and as such should be OK. Frequently asked questions about reverse engineering addresses the legality question; producing an interoperable product is one of the explicit allowances enshrined in law.

Magic Lantern **does not contain any Canon code**. Furthermore, we **do not distribute any copyrighted code or cryptographic secrets**, neither from Canon nor from any other third party. All the knowledge used for development was obtained by analyzing ARM code from the firmware, by experimenting, and from lawfully obtained documentation.

Is it safe?

No. Magic Lantern was created by reverse engineering an undocumented system that controls hardware. Therefore, **we can't be certain that it's 100% safe**.

Magic Lantern does not replace Canon code (which is stored in ROM), but it **does change the settings** (which are saved to a non-volatile memory). If Magic Lantern would set incorrect values for certain settings, this may cause the camera not to boot (even without ML).

The same risk is present if you use third party software for USB remote control. These programs use the same API for changing camera settings (properties), and Canon code does not always check the validity of the settings before saving them to NVRAM. Here's a proof. Even developers of USB control software, who use Canon's own SDK, agree with this.

Imagine that your config file gets corrupted and you can't just delete it and start from scratch. We consider this a design flaw in Canon software. We did encounter such problems during development, but we were able to recover from them. For technical details, see Unbricking.

Probably the safest way to run Magic Lantern (or any third party camera control software) is to use custom modes - in these modes, Canon code does not save user settings to NVRAM.

In practice, we are doing our best to prevent these situations, and thousands of users are enjoying it without problems. However, this does not represent a guarantee - **use it at your own risk**.

Actually, using Magic Lantern we have successfully unbricked a 5D Mark II damaged by a USB remote controller app.

Does it void my warranty?

A Magic Lantern user posted this on dpreview:

> I've spoken to canon Cps (pro service in UK) and they've advised me that it's quite possible to downgrade firmware from new version to older version BUT they advised me to send it in to Canon for them to do it and test. Small service charge would be involved but could be done while I wait.
>
> Interestingly enough, they also advised me that Magic Lantern firmware would not invalidate my Canon Warranty as it's not a hardware modification. Though I'm reluctant to find out for sure :-)

And another user posted this on t2iforum:

> I contacted Canon Support Portugal about using ML, the answer was the following:
>
> Quote
>
> (...) the use of custom firmware or any other third party acessory with our equpment will void the warranty of the product IF PROVEN that the malfunction of the device was caused by the use of those. Canon respects the rights that their customers have to decide what accessories or firmware to use, although **we do not recommended their use, and we are not responsible for any damage to the equipment**.

The Magic Lantern firmware is distributed with **NO WARRANTY** and **NO GUARANTEES** are provided. It might work. It might not. It hasn't destroyed any cameras yet, but who knows.

How will it interact with future upgrades from Canon?

We have updated it to work with the latest version of Canon firmware on all supported cameras. This is a manual process to find the symbols in each new version, although tools like patchdiff2, Gensig/Finsig and GPL Tools/match.py make it much easier. Each new version must be statically linked against addresses in the firmware ROM as if it were a library, which requires locating the entire set of symbols.

Despite this tight integration, **Magic Lantern software does not contain any Canon code**. It is entirely a clean-room implementation that runs along side the official Canon firmware as a separate DryOS task.

Installation

How do I install it?

Follow the install guide. You will have to copy Magic Lantern files on your card and run Update firmware from the menu. The running firmware shuts down, loads the file into RAM and starts it running. Rather than reflashing the ROMs, this new program starts the DryOS boot process to install itself.

What happens during installation?

There are two ways of running user code on Canon DSLR cameras:

1. Using the update process with a `.fir` file, which must be digitally signed.

2. Using the bootdisk process: if the camera finds `AUTOEXEC.BIN` on the card, this file is loaded and executed. This file does not have to be signed, but the `BOOTDISK` flag must be enabled in the camera and the card must be prepared in a special way (labeled as "bootable").

When you run ML installer via *Firmware Update*, it will do the following:

- it will enable the `BOOTDISK` flag in the camera, by calling `EnableBootDisk` function from Canon firmware; this flag is stored in ROM, so the modification is persistent, but can be reverted easily;

- it prepares the card (makes it bootable) by writing the following strings in the boot area: `EOS_DEVELOP` and `BOOTDISK`;

- it **does not reflash the original firmware**.

Do I have to install Magic Lantern on all my cards?

Yes, because Magic Lantern runs from the card.

If you prefer, you can use cards with Magic Lantern loaded, and cards without it. Just make sure you don't delete Magic Lantern files from the card; always format them from the camera, if possible.

ML saves settings on the card. Can I use the same settings for all my cards?

You have to copy the configuration files (from `ML/SETTINGS` directory) on all your cards.

Can I use the same card in two compatible cameras?

It will work, but it's not a good practice. We do not recommend doing this.

How do I uninstall it?

Simply format the card. The boot flag will be still there, but it will not affect normal operation (except for EyeFi cards).

To remove the boot flag (for using EyeFi cards), run *Firmware Update* from a ML card and follow the instructions.

Does ML do any persistent changes to my camera?

Yes. Besides the bootflag (which is required for auto-boot), there are a couple of other changes which are saved into NVRAM. These are:

- ISO, shutter, aperture, white balance;

- Exposure compensation, exposure simulation, drive mode, AF points, AF mode;

- Picture style and associated parameters;

- Flash settings (enabled/disabled, exposure compensation, red eye reduction);

- Backlight level (for example, it's lowered temporarily if you use Dim display for power saving);

- Autofocus is moved temporarily to back (∗) button whenever ML has to take a picture without autofocusing. This includes HDR bracketing and bulb exposures.

- Autofocus is moved temporarily to half-shutter when you use AF patterns, while changing the AF point;

- Sound recording is disabled temporarily when you use FPS override;

- On 600D, video mode may be changed via ML shortcut key;

- On 50D, movie recording function is changed from ML menu (yes, this is a persistent Canon setting, but it's not present in Canon menus).

With few exceptions, these settings can also be changed from Canon menus or controls.

A few settings are changed temporarily during certain operations (for example, autofocus for bracketed shots), but these settings are saved by Canon firmware in NVRAM. If you take the battery out in the middle of the operation (for example, in the middle of taking a picture), ML won't be able to restore these settings back to your initial values, and you'll have to change them back from Canon menus.

To the best of our knowledge, all these settings are restored to default values when you run "Clear camera settings" and "Clear custom functions" from Canon menu.

All persistent changes can be seen in ML source code by examining the calls to `prop_request_change`. Some of the changes are not persistent (for example, LiveView zooming), and they were not included in the above list.

Usage

How do I bring up the Magic Lantern menus?

Press the DELETE button.

What! So many options in the menu, I'm lost!

Press MENU to hide what you don't use. Press INFO/DISP to get context help.

How do I restore ML default settings?

Delete the config file (MAGIC.CFG) from Prefs menu and restart the camera.

How do I erase all of the images without removing ML?

Canon menu → Format → Format card, keep Magic Lantern.

How do I record for more than 12 minutes?

- Lower the bitrate (CBR 0.4 will let you record continuously for 30 minutes).

- Use Movie restart, but you will lose a few seconds when a new file is created.

- To record continuously for more than 30 minutes, you need to use a HDMI recorder. Enable the Clear Overlays feature to hide the focus box and the 16:9 bars, and make the half-shutter button sticky to prevent the camera from turning off LiveView after 30 minutes.

Technically, there's no 12 minute limit. There's a 30 minute limit and a 4 GB limit, whichever comes first. With default bitrate settings, the 4 GB limit is reached after around 12 minutes (more or less).

How do I get exposure times longer than 30 seconds?

You may use:

- Bulb timer (for a single photo).

- HDR bracketing in manual mode.

- Bulb ramping (for timelapse).

How do I see shutter counter / CMOS temperature?

Look in Debug menu.

Can I use LiveView in complete darkness?

Yes. Increase display gain (from Display menu), use a low FPS (with FPS override), or both.

Also check out the dark color schemes optimized for night shooting, or try disabling exposure simulation.

How do I shoot timelapse?

You have a couple of options:

- Intervalometer - the classic way. You will have to postprocess the shots in order to create the final movie. With this method, you also have access to advanced options like bulb and focus ramping, HDR timelapse or very long exposures.

- FPS override - simply select a low FPS value (down to about 0.2 FPS) and ML will record a timelapse.

- Silent picture timelapse. Only for very advanced users.

I want to use my camera as quickly as possible. Can ML help me?

Yes. Check out these features:

- Shortcut keys for commonly used functions.

- Display presets - create custom LiveView modes (for example, your favorite settings for checking exposure, focus, framing and so on).

- Quick zoom in playback (image review) mode.

- Change image review mode to PLAY - after taking a picture you can press Zoom In right away and check critical focus in a split-second.

- Navigate the menu using the scrollwheels - much faster than with arrow keys.

- Hide unused menu items, so you don't have to scroll through all of them (press `MENU`).

Does Magic Lantern consume more power than standard Canon firmware?

In LiveView it draws 3-5% more power (measured on 60D and 5D Mark II with zebra and focus peaking active). You can do your own tests if you have a 60D.

Magic Lantern can reduce power consumption by dimming or turning off the LCD screen, or by pausing LiveView without moving the mirror. See Power saving for details.

In plain photo mode with display off, the power draw is a bit higher, because Magic Lantern disables CPU powersaving features (otherwise, intervalometer and other ML functions would stop running). We have measured 6% / hour on 60D (compared with 4% / hour with Canon firmware), and 10% / hour on 5D Mark II (compared with 5% / hour with Canon firmware).

Why the audio is so quiet / noisy after disabling AGC?

You will have to adjust the volume manually; use the audio meters to determine the proper level.

Best audio is obtained by use of a preamp system fed to the camera. As a general rule, the use of a quiet preamp to send the signal to the camera will result in better the sound recorded in camera. Use of a preamped XLR adapter like the JuicedLink CX231 or a field mixer will give superior results. You may also use a recorder like Zoom H1, H2 or H4n, but since the line out level is much higher than the mic level, you will have to turn the output down from your recorder or use a pad cable.

For more info, check out the Canon DSLR Audio thread on dvxuser and AGC Disable - Magic Lantern vs. Juicedlink? on dvinfo.

Troubleshooting

It won't boot!

- If the LED is blinking continuously, **you have the wrong Canon firmware version**.

- Make sure you didn't delete AUTOEXEC.BIN from your ML card. If you did, format the card, take the battery out, and reboot.

- If you still have problems, ask on the forum.

After shutdown, it won't power on unless removing battery!

You are removing the card too early. **Always wait for LED blinking confirmation** (or for 5 seconds) before removing the card!

What's going on: on certain cameras, a few seconds after you open the card door, Canon firmware *is accessing the card without any LED activity*. If you remove the card during this period, the camera will get stuck in an infinite loop, will slowly drain your battery, and will not reboot until you take the battery out and you put back in.

Magic Lantern v2.3 will show a confirmation LED blink after this process ended. With older versions, after you open the card door, wait for 5 seconds before removing the card.

This problem can't be fixed without rewriting Canon bootloader code (which we won't do), so you really have to **be patient when removing the card**.

What happened with movie mode remap?

We had serious problems with it, so it was disabled. The problems were confirmed with a minimal example code, so the issue is either in Canon firmware (which was probably not designed for dynamic mode remapping) or in the way we request the mode remapping procedure.

The only way to get it back is to show us a safe way to change the shooting mode. For this you need to point out what's wrong with this call: "prop_request_change(PROP_SHOOTING_MODE, &new_mode, 4)", and suggest a different method - which can only be done by examining Canon code and understanding how mode switching works.

Testing will not help - the probability of things going wrong is very low, but nonzero.

Why does the camera take pictures when pressing the shutter half-way?

Trap focus may be active.

Why do I have to press the shutter button twice to take a picture?

Mirror Lockup (MLU) is active.

Why is the LED blinking every 5 seconds?

You have forgotten your camera on... with the main display off.

Why did the autofocus stop working?

It was probably moved to back button (* or AF-ON). Check your custom functions. It may happen if you take the battery out in the middle of photo shooting.

Why picture style X does not appear in movie mode?

You may need to register it from Canon menu. This is not related to ML, but people tend to blame ML for Canon quirks.

My camera freezes / I get ERR70/80/99 / I get corrupted files. Why?

- **Format your card from your camera**. Some of these problems are caused by filesystem corruption or cheap card readers. Always use the safe removal feature before you unplug your card from your computer.

- If you get **ERR70**, you will also get a crash log on your card (`ML/LOGS/CRASHnn.LOG`). Please send this file to developers.

- Run the stability tests from the Debug menu. If it fails, report a bug and send your config file to developers.

What about ERR20 when taking pictures?

This problem is not related to (or caused by) Magic Lantern. You will get this error when your shutter mechanism no longer works properly. Contact your Canon service center.

Consider entering your shutter count in the Camera Shutter Life Database.

Why feature X doesn't work properly?

- Read the manual. Some features may not be 100% intuitive, or it may be a known issue.

- Look in the forum. If you don't find the solution, ask for help.

Technical

Does it work with CHDK?

We have used some of the CHDK tools to learn about Canon firmware files, but this is all new code. They have done an amazing job of supporting hundreds of different camera models across multiple architectures and operating systems. CHDK is a great project for Canon's Point-and-Shoot cameras. Without their initial effort in understanding DryOS, Canon's firmware files and the boot process, we wouldn't have been able to make as much progress as quickly as we did. While we were able to use modern tools to analyze dump files of ROM images thanks to their efforts, they got started bitbanging a UART via the status LED on a camera body. That's truly hardcore.

What is it written in? Can I get the source?

The firmware hack is in C, with some inline assembly for boot strapping. The firmware build tools are in Perl and use Makefiles for dependency tracking. You need an arm-linux-elf build of gcc and binutils. Most of the code analysis has been done with objdump, strings and the IDA demo. No tech support will be provided. If it breaks you get to keep both pieces. If you know what all of these terms mean and aren't scared of the possibility of breaking your camera, you can download the Magic Lantern firmware source code.

How do I get a ROM0.bin firmware image?

We do not distribute ROM images, nor IDA .idb files, since they are verbatim copies of Canon's copyrighted code. You can generate the ROM images from your own camera by enabling `CONFIG_DEBUGMSG=1` in `debug.c` and then selecting `Dump ROM` from Debug menu.

What are all of the 0xff81beef things and funny names like EP_SetManualMovieMode()?

These are the addresses in the official ROM firmware for different functions and names that we have given to functions. If you load the ROM0.bin image into IDA or use objdump you can trace through the instructions to determine how the software works. If you are just using the camera, they don't need to mean anything to you, but they give other developers a place to look in the firmware image.

The function names are unlikely to be the same as the ones in Canon's source code, which we have never seen. We name functions based on what they seem to do, or debugging / diagnostic strings embedded in the function. It isn't perfect, but it is sufficient to locate the important things for task creation, file I/O and GUI operation.

Misc

Has Canon contacted you?

No one at Canon has contacted us regarding Magic Lantern or software development for their DSLR cameras. We are very eager to discuss the project with them, however, so if you have any technical contacts inside of Canon's software team, please put them in touch with us.