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|  | **Technical Handbooks of FRM4VEG Instrumentation**  **(TR-1): Canon EOS 6D Digital Single Lens Reflex Camera and Sigma 8 mm F3.5 EX DG Fisheye Lens**  version 1.0  National Physical Laboratory  University of Southampton  EOLAB  28 May 2020 |
| [Related image](https://www.google.co.uk/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0ahUKEwjRx6alu5PYAhXL1xQKHcWbBx4QjRwIBw&url=https://www.bodet.co.uk/news/269-the-national-physical-laboratory-selects-bodet-to-provide-a-wireless-time-solution.html&psig=AOvVaw3HTJAk3pVRL7SYyC5vdX23&ust=1513683146214264) | This document was produced as part of the ESA-funded project “Fiducial Reference Measurements for Vegetation Phase 2 (FRM4VEG 2)” under ESA contract number: 4000129823/20/I-NS |

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##### Acronyms

|  |  |
| --- | --- |
| **Abbreviation** | **Stands For** |
| AC | Alternating current |
| AE | Automatic exposure |
| AEB | Automatic exposure bracketing |
| AF | Automatic focus |
| AI | Artificial intelligence |
| AWB | Automatic white balance |
| CIPA | Camera and Imaging Products Association |
| CT | Cross-type |
| DHP | Digital hemispherical photography |
| DPOF | Digital print order format |
| DSLR | Digital single lens reflex |
| EF | Electro-focus |
| EOLAB | Earth Observation Laboratory |
| ESA | European Space Agency |
| E-TTL | Evaluative TTL |
| EV | Exposure value |
| EXIF | Exchangeable image file format |
| FAPAR | Fraction of absorbed photosynthetically active radiation |
| FE | Flash exposure |
| FIPAR | Fraction of intercepted photosynthetically active radiation |
| FOV | Field-of-view |
| FRM4VEG | Fiducial Reference Measurements for Vegetation |
| HDMI | High-definition multimedia interface |
| HDR | High dynamic range |
| ISO | International Standards Organisation |
| JPEG | Joint Photographic Experts Group |
| LAD | Leaf angle distribution |
| LAI | Leaf area index |
| LAN | Local area network |
| LCD | Liquid crystal display |
| Li-ion | Lithium-ion |
| NTSC | National Television System Committee |
| PAL | Phase alternating line |
| PCM | Pulse code modulation |
| SD | Secure digital |
| SDHC | SD high capacity |
| SDXC | SD extended capacity |
| SIR | Secondary image registration |
| SP | Service pack |
| sRGB | Standard red green blue |
| TFT | Thin film transistor |
| TTL | Through the lens |
| UHS | Ultra high speed |
| USB | Universal serial bus |
| WB | White balance |

# Introduction

## Purpose and Scope

This document forms part of deliverable D-60 of the European Space Agency (ESA) project ‘Fiducial Reference Measurements for Vegetation (FRM4VEG)’ and it should be used as a guide to operating the Canon EOS 6D digital single lens reflex (DSLR) camera and Sigma 8 mm F3.5 EX DG fisheye lens.

Its purpose is to provide an instrument technical description, together with information about maintenance and calibration history, pre-deployment uncertainties estimates, and steps required to achieve the FRM status.

The document is organized into 7 key sections:

* **Section 1** provides a summary of the document.
* **Section 2** overviews the technical characteristics of the camera together with a description of its functioning.
* **Section 3** refers to the-deployment calibration carried out at EOLAB.
* **Section 4** describes all the procedures that need to be followed when using the camera, both in the field and during the data processing.
* **Section 5** lists useful advices for care and storage of the camera as provided by the manufacturer.
* **Section 6** lists the reasons for and solutions to common problems with the use of the camera.
* **Appendix A:** provides the calibration results mentioned in Section 3.

# Technical Description

## Overview

The Canon EOS 6D is a digital single lens reflex (DSLR) camera that can be operated with a fisheye lens such as the Sigma 8 mm F3.5 EX DG fisheye lens for the purposes of digital hemispherical photography (DHP). Technical characteristics of the camera provided by the manufacturer are detailed in Table 1, whilst those of the lens are detailed in Table 2.

Table 1: Technical characteristics of the Canon EOS 6D DSLR camera [1].

|  |  |
| --- | --- |
| **Characteristic** | **Details** |
| Image sensor type | 36 mm x 24 mm complementary metal-oxide semiconductor (CMOS) |
| Effective pixels | 20.2 megapixels |
| Total pixels | 20.6 megapixels |
| Aspect ratio | 3:2 |
| Low-pass filter | Built-in/fixed with fluorine coating |
| Sensor cleaning | EOS integrated cleaning system |
| Colour filter type | Primary colour |
| Image processor | DIGIC 5+ |
| Lens mount | Electro-focus (EF) |
| Focal length | Equivalent to 1.0 x the focal length of the lens |
| Focussing type | Through-the-lens (TTL) cross-type (CT) secondary image registration (SIR) (TTL-CT-SIR) with a dedicated CMOS sensor |
| Automatic focus (AF) system/points | 11 points (f/5.6 cross type at centre, extra sensitivity at f/2.8) |
| AF working range | Exposure value (EV) -3 to -13 (at 23° C and ISO100) |
| AF modes | Artificial intelligence (AI) focus, one shot, AI servo |
| AF point selection | Automatic selection, manual selection, AF points can be selected separately for vertical and horizontal shooting |
| Selected AF point display | Superimposed in viewfinder and indicated on top liquid crystal display (LCD) panel and quick control screen |
| AF lock | Locked when shutter button is pressed half way in one shot AF mode or AF-ON button is pressed |
| AF assist beam | Emitted by an optional dedicated Speedlite |
| Manual focus | Selected on lens |
| AF microadjustment | C.Fn II-9, ± 20 steps (wide and tele setting for zooms), adjust all lenses by same amount, adjust up to 40 lenses individually, adjustments remembered for lens by serial number |
| Exposure metering modes | TTL full aperture metering with 63 zone dual layer SPC; evaluative metering (linked to all AF point), partial metering (approximately 8% of viewfinder at centre), spot metering (approx. 3.5% viewfinder at centre), centre weighted average metering |
| Metering range | EV 1 to 20 (at 23° C with 50 mm lens and International Standards Organisation (ISO) 100) |
| Automatic exposure (AE) lock | Automatic: in 1-shot AF mode with evaluative metering exposure is locked when focus is achieved, manual: by AE lock button in creative zone modes |
| Exposure compensation | ± 5 EV in 1/3 or 1/2 stop increments (can be combined with automatic exposure bracketing (AEB)) |
| AEB | 2, 3, 5 or 7 shots ± 3 EV in 1/3 or 1/2 stop increments |
| ISO sensitivity | Automatic (100-25600), 100-25600 (in 1/3-stop or whole stop increments), ISO can be expanded to L: 50, H1: 51200, H2: 102400; during movie shooting: automatic (100-12800), 100-12800 (in 1/3-stop or whole stop increments), ISO can be expanded to H: 25600 |
| Shutter type | Electronically-controlled focal-plane shutter |
| Shutter speed | 30-1/4000 s (1/2 or 1/3 stop increments), bulb (total shutter speed range, available range varies by shooting mode) |
| White balance (WB) type | Automatic WB (AWB) with the imaging sensor |
| WB settings | AWB, daylight, shade, cloudy, tungsten, white, fluorescent light, flash, custom, colour temperature setting; white balance compensation: blue/amber (± 9) and magenta/green (± 9) |
| Custom WB | Yes, 1 setting can be registered |
| WB bracketing | ± 3 levels in single level increments, 3 bracketed images per shutter release, selectable blue/amber bias or magenta/green bias |
| Viewfinder type | Pentaprism |
| Viewfinder coverage | 97% |
| Viewfinder magnification | 0.71 x |
| Viewfinder eyepoint | 21 mm (from eyepiece lens centre) |
| Dioptre correction | '- 3 to 1 m-1 (dioptre) |
| Focusing screen | Interchangeable (3 types, optional), standard focusing screen precision matte Eg-A II |
| Mirror | Quick-return half mirror (transmission:reflection ratio of 40:60, no mirror cut-off with EF600 mm f/4 or shorter) |
| Viewfinder information | AF information: AF points, focus confirmation light; exposure information: shutter speed, aperture value, ISO speed (always displayed), AE lock, exposure level/compensation, spot metering circle, exposure warning, AEB;  Flash information: Flash ready, high-speed sync, flash exposure (FE) lock, flash exposure compensation; image information: highlight tone priority (D+), maximum burst (2-digit display), card  Information; battery check: composition information; electronic level; warning symbol: displayed if any of the following is set: monochrome, white balance  correction, expanded ISO speed, or spot metering. |
| Depth of field preview | Yes, with depth of field preview button |
| Eyepiece shutter | On strap |
| LCD monitor type | 7.7 cm (3.0 ") clear view thin film transistor (TFT), approximately 1040K dots |
| LCD monitor coverage | 100% |
| LCD monitor viewing angle (horizontally/vertically) | 170° |
| LCD monitor coating | Dual anti-reflection |
| LCD monitor brightness adjustment | Adjustable to one of seven levels |
| LCD monitor display options | Quick control screen, camera settings, electronic level |
| Flash modes | Evaluative TTL (E-TTL) II automatic flash, metered manual |
| X-sync | 1/180 s |
| Flash exposure compensation | ± 3 EV in 1/2 or 1/3 increments |
| Flash exposure bracketing | Yes, compatible with external flash |
| Flash exposure lock | Yes |
| Second curtain synchronisation | Yes |
| Hotshoe/PC terminal | Yes/no |
| External flash compatibility | E-TTL II with EX series Speedlites, wireless multi-flash support (with optional accessory) |
| External flash control | Via camera menu screen |
| Shooting modes | Scene intelligent automatic, no flash, creative automatic, portrait, landscape, close-up, sports, night portrait, handheld night scene, high dynamic range (HDR) backlight control, program AE, shutter priority AE, aperture priority AE, manual |
| Picture styles | Automatic, standard, portrait, landscape, neutral, faithful, monochrome, user defined (x 3) |
| Colour space | Standard red green blue (sRGB) and Adobe RGB |
| Image processing | Highlight tone priority, automatic lighting optimizer (4 settings), long exposure noise reduction, high ISO speed noise reduction (4 settings), multi shot noise reduction, automatic correction of lens peripheral illumination, chromatic aberration correction, resize to M, S1, S2 or S3, RAW image processing - during image playback only, multiple exposure, HDR images |
| Drive modes | Single, continuous, self timer (2 s + remote, 10 s + remote), silent single shooting, silent continuous shooting |
| Continuous shooting | Maximum 4.5 fps (speed maintained for up to 1250 images (Joint Photographic Experts Group (JPEG)) or 17 images (RAW)) (with ultra high speed (UHS-I) card) |
| Live view mode type | Electronic viewfinder with image sensor |
| Live view coverage | 100% (horizontally and vertically) |
| Live view frame rate | 30 fps |
| Live view focusing | Manual focus (magnify the image 5 x or 10 x at any point on screen); autofocus: quick mode, live mode, live face detection mode |
| Live view metering | Real-time evaluative metering with image sensor; active metering time can be changed |
| Live view display options | Grid overlay (x 3), histogram, aspect ratios, electronic Level |
| Still image type | JPEG: fine, normal (exchangeable image file format (EXIF) 2.21 (EXIF Print) compliant)/design rule for camera file system (2.0), RAW: RAW, M-RAW, S-RAW (14bit, Canon original RAW 2nd edition), digital print order format (DPOF) version 1.1 compliant |
| RAW + JPEG simultaneous recording | Yes, any combination of RAW + JPEG, M-RAW + JPEG, S-RAW + JPEG possible |
| Image size | JPEG: (L) 5472 x 3648, (M) 3648 x 2432, (S1) 2736 x 1824, (S2) 1920 x 1280, (S3) 720 x 480; RAW: (RAW) 5472 x 3648, (M-RAW) 4104 x 2736, (S-RAW) 2736 x 1824 |
| Movie size | 1920 x 1080 (29.97, 25, 23.976 fps) intra or inter frame, 1280 x 720 (59.94, 50 fps) intra or inter frame, 640 x 480 (59.94, 50 fps) inter frame |
| Movie type | MOV (video: H.264 intra frame / inter frame, sound: linear pulse-code modulation (PCM), recording level can be manually adjusted by user) |
| Movie length | Maximum duration 29 minutes 59 s |
| Folders | New folders can be manually created and selected |
| File numbering | Consecutive numbering, automatic reset, manual reset |
| Custom functions | 21 custom functions |
| Metadata tag | User copyright information (can be set in camera), image rating (0-5 stars), GPS coordinates |
| LCD panel/illumination | Yes/yes |
| Water/dust resistance | Yes (equal to EOS-1N) |
| Sound memo | No |
| Intelligent orientation sensor | Yes |
| Playback zoom | 1.5 x to 10 x |
| Display formats | Single image with information (2 levels), single image, 4 image index, 9 image index, jump display |
| Slide show | Image selection: all images, by date, by folder, movies, stills, rating; playback time: 1/2/3/5/10 or 20 s; repeat: on/off |
| Histogram | Brightness: yes, RGB: yes |
| Highlight alert | Yes |
| Image erase/protection | Erase: single image, all images in folder, checkmarked images, unprotected images; protection: erase protection of one image at a time |
| Menu categories | Shooting menu (x 6), playback menu (x 3), setup menu (x 4), custom functions menu, my menu |
| Menu languages | 25 languages: English, German, French, Dutch, Danish, Portuguese, Finnish, Italian, Norwegian, Swedish, Spanish, Greek, Russian, Polish, Czech, Hungarian, Romanian, Ukrainian, Turkish, Arabic, Thai, Simplified Chinese, Traditional Chinese, Korean and Japanese |
| Firmware update | Update possible by the user |
| Computer interface | High speed universal serial bus (USB) |
| Other interfaces | High-definition multimedia interface (HDMI) mini output, video output (phase alternating line (PAL)/National Television System Committee (NTSC)), external microphone (stereo mini jack) |
| Canon printers | Canon compact photo printers and PIXMA printers supporting PictBridge |
| PictBridge | Yes, PictBridge compliant (USB and wireless local area network (LAN)) |
| Storage type | Secure digital (SD), SD high capacity (SDHC) or SD extended capacity (SDXC) (UHS-1) card |
| Supported operating system | Windows XP including service pack (SP) 3/Vista including SP1 and 2 (excluding starter edition) /7 (excluding starter edition), OS X version 10.6 to 10.7 (Intel processor required) |
| Browsing and printing software | ImageBrowser EX |
| Image processing software | Digital Photo Professional |
| Other software | PhotoStitch, EOS Utility (including Remote Capture), Picture Style Editor |
| Batteries | Rechargeable lithium-ion (Li-ion) battery LP-E6 (supplied) |
| Battery life | 1090 (at 23°C, AE 50%, FE 50%), 980 (at 0°C, AE 50%, FE 50%) |
| Battery indicator | 6 levels + percentage |
| Power saving | Power turns off after 1, 2, 4, 8, 15 or 30 minutes |
| Power supply and battery chargers | Alternating current (AC) adapter kit ACK-E6, battery charger LC-E6, car battery charger CBC-E6 |
| Body materials | Magnesium alloy front and read body covers, polycarbonate top cover |
| Operating environment | 0 °C to 40 °C, 85% or less humidity |
| Dimensions (W x H x D) | 144.5 mm x 110.5 mm x 71.2 mm |
| Weight (body only) | 755 g (Camera and Imaging Products Association (CIPA) testing standard, including battery and memory card) |

Table 2: Technical characteristics of the Sigma 8 mm F3.5 EX DG fisheye lens [2].

|  |  |
| --- | --- |
| **Characteristic** | **Details** |
| Lens construction | 11 elements in 6 groups |
| Ange of view | 180° |
| Number of diaphragm blades | 6 |
| Minimum aperture | f22 |
| Minimum focusing distance | 13.5 cm/5.3 “ |
| Filter | Insertion-type gelatin filter into rear of the lens |
| Maximum magnification | 1:4:6 |
| Dimensions (diameter x length) | 73.5 mm x 68.6 mm/2.9 “ x 2.7 “ |
| Weight | 400 g/11.14 oz. |
| Mount | EX DG |

## Theory of Operation

DHP is used to provide multi-angular measurements of gap fraction, from which variables such as leaf area index (LAI) can be derived. Angular sampling is facilitated by a fisheye lens, which provides a 180° field-of-view (FOV). Using information on the lens characteristics (i.e. its position with respect to the imaging sensor (the optical centre) and its projection function), the zenith angle associated with each pixel of the image can be determined. Gap fraction is quantified by classifying the image into the vegetation canopy and its background (i.e. the soil or sky).

Using DHP, LAI can be derived according to the theory proposed by [3], which states that

where is the gap fraction at zenith angle . By determining gap fraction in angular bins, a discretised version of this integral can be solved according to [4]. An alternative method of determining LAI may also be adopted, making use of measurements of gap fraction at a single zenith angle [5]. At 57.5°, also known as the hinge angle, the gap fraction can be considered nearly independent of leaf angle distribution (LAD). Thus, LAI can be determined according to [5] as

where is the gap fraction at 57.5°.

In addition to LAI, DHP can also be used to approximate the fraction of intercepted photosynthetically active radiation (FIPAR), a quantity closely related to the fraction of absorbed photosynthetically active radiation (FAPAR). In this case, angular variations in canopy transmittance can be used to reconstruct diurnal variation in FIPAR.

# Calibration History and Uncertainty Budget

## Calibration History

Pre-deployment calibration was carried out by EOLAB, following the method of [6] to determine the optical centre and lens projection function. Associated calibration results can be found in Appendix A.1.

# Instrument Operation

## Camera Setup

1. To attach the fisheye lens, remove the rear lens cap and the body cap by turning them as indicated by the arrows. Align the red dots on the lens and camera, and then turn the lens as shown by the arrow so that it clicks securely into place.
   1. Switch the lens to manual focus by moving the switch on the lens to ‘MF’, and turn the focus ring so that the focus is set to infinity (∞). It may be useful to place a piece of tape on the focus ring to prevent subsequent accidental adjustment.
2. Ensure the memory card and batteries are installed, then turn the camera on. Automatic sensor cleaning will take place.
   1. If a new memory card is being used, it should be formatted. Press the ‘MENU’ button, then using the arrow buttons, select the seventh tab. Select ‘Format card’, and press the ‘SET’ button.
   2. To confirm, press the arrow buttons to select ‘OK’, the press the ‘SET’ button.
3. Ensure the date and time are set correctly. Press the ‘MENU’ button, then using the arrow buttons, select the eighth tab. Select ‘Date/Time/Zone’ and press the ‘SET’ button.
   1. Press the arrow buttons to select time zone field, then press the ‘SET’ button. Press the arrow buttons to select the desired time zone, then press the ‘SET’ button again.
   2. To set the date and time, press the arrow buttons to select the field, then press the ‘SET’ button. The field can then be adjusted using the arrow buttons, before pressing the ‘SET’ button again.
   3. Once the desired date and time is set, press the arrow buttons to select ‘OK’, then press the ‘SET’ button to store the settings.
4. Set the camera to the programmed automatic shooting mode by turning the mode dial on the top of the camera so that ‘P’ is selected. The centre button needs to be pressed to allow the dial to turn.
5. To ensure only the required settings are adjusted, it may be worthwhile to revert the camera to its default settings before making further changes.
   1. Press the ‘MENU’ button. Using the arrow buttons, select the thirteenth tab, then select ‘Clear all camera settings’ and press the ‘SET’ button. Select ‘OK’ and press the ‘SET’ button again.
6. The camera should to be configured to store uncompressed RAW images. Press the ‘MENU’ button. Using the arrow buttons, select the first tab, then select ‘Image Quality’ and press the ‘SET’ button.
   1. Ensure ‘RAW’ is highlighted by turning the quick control dial on the back of the camera, and that ‘JPEG –‘ is highlighted by pressing the arrow buttons, so that only a RAW image and no JPEG image is stored. Press the ‘SET’ button to save the settings.
7. If measurements are to be performed below the canopy facing upwards, the exposure compensation should be adjusted to prevent overexposed images. A value of -1 exposure values relative to automatic in-canopy exposure is recommended by [7] for images acquired in RAW.
   1. Using the arrow buttons, select the third tab, then ‘Expo. comp./AEB’. Press the ‘SET’ button, and use the arrow buttons to select an exposure compensation of -1 relative to automatic exposure. Press the ‘SET’ button again.
   2. If measurements are to be performed above the canopy facing downwards, the exposure compensation should be set back to 0.
8. It may be useful to set enable the multifunction lock by moving the ‘LOCK’ switch on the back of the camera to the right. This will prevent accidental adjustment of settings.

## Performing a Measurement

1. Hold the camera level, facing either upwards or downwards, and ensure the exposure compensation is set accordingly (see Section 3.1).
   1. A monopod or tripod may be used to help level and stabilise the camera, although it is not required. Hand levelling was shown to be equally appropriate by [8]. If a monopod is used, it can be placed on the ground, or held perpendicular to the ground at shoulder height.
2. If acquiring an upwards facing image, try to avoid being in the FOV of the camera. For downwards facing images, ensure you are at the bottom of the image, to simplify operator masking in subsequent post-processing.
3. Press the ‘START/STOP’ button on the back of the camera to switch from the viewfinder to the display.
4. Fully press the shutter button on the top of the camera to acquire an image.
   1. It is good practice to examine the image, to ensure it was correctly acquired.

## Downloading Data

1. Data are stored on the memory card as Canon RAW Version 2 files (CR2). To download them, connect the camera to a computer using the supplied cable, or remove the memory card and place it into a suitable memory card reader. The files may then be copied to the desired location as you would a normal mass storage device.

# Care and Storage

The following care and storage advice is adapted from that provided by the manufacturer [9]:

* The camera should not be dropped or subjected to physical shock. The camera is not waterproof and cannot be used under water. Keep the terminal, battery compartment, and memory card slot covers closed to maximise dust and drip resistance. Do not allow dirt, dust, water or salt to get on the camera.
* Water should be wiped off with a dry, clean cloth, whilst dirt, dust or salt should be wiped off with a clean, well-rung wet cloth. Clean the camera after use, and do not allow dirt, dust, water or salt to remain on it.
* Never leave the camera near anything with a strong magnetic field (i.e. a magnet or electric motor) and avoid leaving or using the camera near anything emitting strong radio waves (i.e. a large antenna).
* Do not subject the camera to excessive heat (i.e. leaving it in a car in direct sunlight).
* Do not attempt to disassemble the camera.
* Do not drop, bend or wet the memory card, or subject it to excessive force, physical shock or vibration. Avoid touching its electronic contacts with your fingers or anything metallic. Do not affix any stickers to the card, or store it near anything with a strong magnetic field or in places prone to static electricity. Do not leave it in direct sunlight, near a heat source, or in hot, dusty or humid locations.
* After detaching the lens, put it down with the rear end up and attach the lens caps to avoid scratching the lens surface or electrical contacts.

# Troubleshooting

Reasons for and solutions to common problems with the EOS 6D are provided by the manufacturer [9], and are listed in Table 3.

Table 3: Reasons and solutions to common problems with the EOS 6D [9].

|  |  |  |
| --- | --- | --- |
| **Problem** | **Reason** | **Solution** |
| The battery pack does not recharge | The battery’s remaining capacity is 94% or higher | The battery will not be recharged if its remaining capacity is 94% or higher |
| The charger’s lamp blinks at high speed | The battery charger or battery pack has a problem; communication with the battery pack failed | Unplug the charger’s power plug from the power outlet, detach and reattach the battery pack to the charger, wait a few minutes, then reconnect the power plug to the power outlet |
| The charger’s lamp does not blink | The internal temperature of the battery pack is high | When the battery temperature goes down, charging will resume automatically |
| The camera does not operate even when the power switch is set to ‘ON’ | The battery is not properly installed in the camera; the battery compartment cover is open; the card slot over is open; the battery is exhausted | Ensure the battery is properly installed and the battery compartment cover and memory card slot cover are closed; ensure the battery is charged |
| The access lamp still blinks even when the power switch is set to ‘OFF’ | The power was turned off while an image is being recorded to the memory card | When the image recording is complete, the power will turn off automatically |
| The battery becomes exhausted quickly | The battery performance may have degraded | Ensure the battery pack is fully charged, replace the battery pack with a new one |
| The camera turns off by itself | Automatic power off is enabled | Disable the automatic power off setting |
| No images can be shot or recorded | The memory card is not properly inserted, write protected, or full | Make sure the memory card is properly inserted; slide the memory card’s write-protect switch to the write/erase position; if the card is full, replace it or delete unnecessary images to make space |
| Even though I set a decreased exposure compensation, the image comes out bright | The automatic lighting optimiser is enabled | Disable the automatic lighting optimiser setting |
| During Live View, a white icon is displayed | The camera’s internal temperature is high |  |
| Settings cannot be changed | Multifunction lock is enabled | Move the ‘LOCK’ switch on the back of the camera to the left |
| The camera button/dial’s function has changed | Custom controls have been set | Check the custom controls setting |
| The menu shows few tabs and options | Basic Zone modes are enabled | In Basic Zone modes, certain tabs and menu options are not displayed |
| The file name’s first character is an underscore | The colour space is set to Adobe RGB | Set the colour space to sRGB |
| The file numbering does not start from 0001 | The memory card already contains recorded images |  |
| The shooting date and time is displayed incorrectly | The correct date and time is not set | Ensure the correct date and time is set; check the time zone and daylight savings settings |
| ‘###’ is displayed | The memory card has recorded a greater number of images than the camera can display |  |
| The display does not show a clear image | The display is dirty, low or high temperatures | Use a soft cloth to clean the display; the display will return to normal at room temperature |
| Part of the image blinks in black | The highlight alert setting is enabled |  |
| A red box is displayed on the image | The autofocus point display setting is enabled |  |
| The image cannot be erased | The image is protected |  |
| The raw image cannot be processed | ‘M RAW’ and ‘S RAW’ images cannot be processed with the camera | Use the provided Digital Photo Professional software to process the images |
| The image cannot be resized | ‘S3 JPEG and ‘RAW’, ‘M RAW’ and ‘S RAW’ images cannot be resized with the camera |  |
| Automatic sensor cleaning does not work | The power switch has been repeatedly turned on and off |  |

# Applicable and Reference Documents

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###### Appendix

Optical Centre and Lens Projection Function Calibration

