

TECHNICAL DOCUMENTATION

OPTV OPTIC IMAGING PROBE

PART 1: PROBE INFORMATION & USE

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IMPORTANT SAFETY INFORMATION



This probe is powered by a supply voltage of up to 110 Vdc supplied by the EMINDLOGGER surface module. To avoid the risk of electric shock, the operator should verify that the probe power supply is switched off before connecting the probe to the logging cable, or before disconnecting the probe after use.

Maintenance of this equipment should only be carried out by competent personnel. If the probe is powered on with the outer housing removed, voltages of up to 1000 Vdc may be present on exposed contacts.



This equipment should always be operated in line with the recommendations contained in this document. Use of this equipment outside recommended limits may present a safety risk.

INTRODUCTION

This documentation presents the principal features of the OPTV optical imaging probe and explains its operation with the EMINDLOGGER acquisition module and OPTV software package. For more detailed information concerning the OPTV acquisition software, please consult the OPTV Software Reference Manual.

PROBE APPLICATIONS

The probe provides orientated optical image data of the borehole wall used for:

- determination of geological formation dip angles and dip directions
- fracture analysis (frequency, degree of opening, fracture dip angles and dip directions)
- lithological characterisation (rock type, colour, grain size ...) and clay content (with optional natural gamma detector)
- assisting with core sample orientation
- steel or PVC casing surface inspection
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DATA EXAMPLES

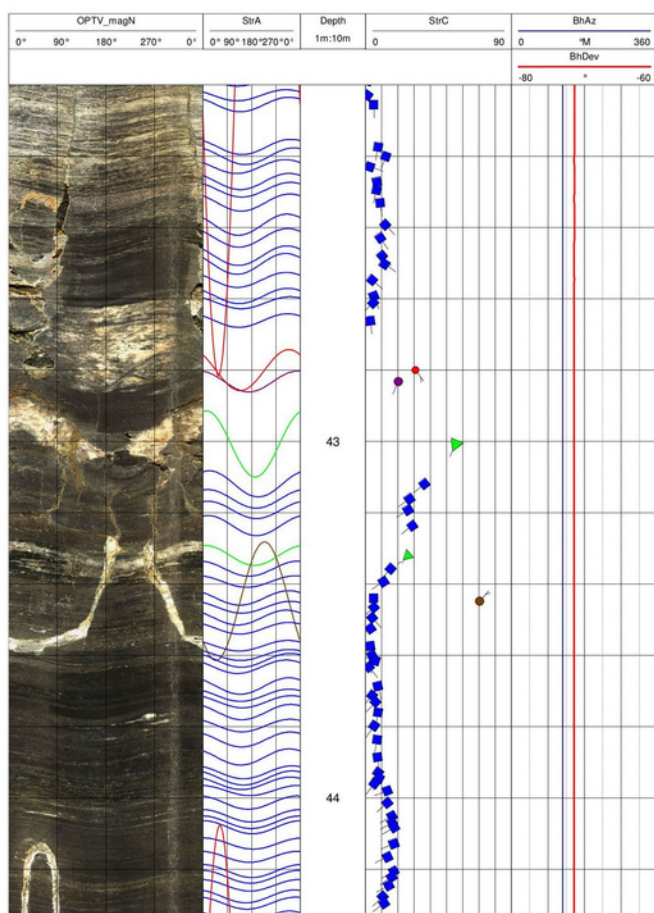


Figure 1: OPTV data with structural geological interpretation

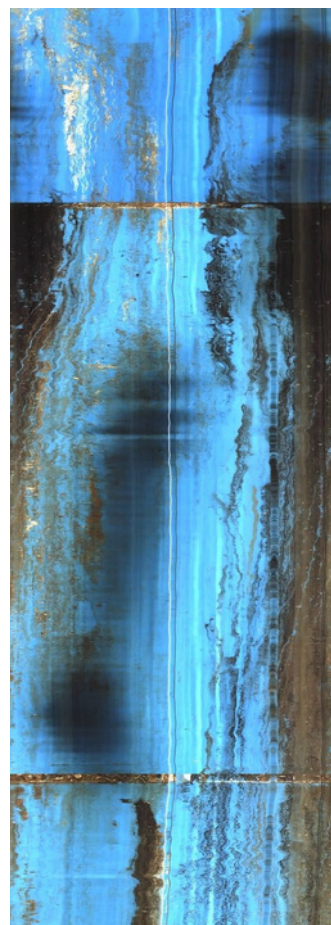


Figure 2: OPTV data from a PVC casing inspection

PROBE DESCRIPTION & SPECIFICATIONS



A precision wide angle lens and a CMOS camera assembly permit the **OPTV38** and **OPTV52** probes to capture a high- definition video image of the borehole wall in a variety of horizontal and vertical resolutions. The resulting image data is digitised in the probe and combined with orientation sensor parameters for transmission to the surface.

The orientated image log provides a wealth of information relevant to a wide variety of applications. These include fracture detection and analysis, bedding or foliation dip and direction, lithological characterisation and core sample orientation.

As an option, the probes can be supplied with a natural gamma detector to provide additional lithological information or for horizon correlation purposes. A high-pressure kit for the **OPTV52** (200 bar / $\phi 62$ mm) is also available.

Specifications

	OPTV38	OPTV52
✓ Diameter:	38 mm/1.5"	52 mm/2"
✓ Length:	1620 mm/64"	1630 mm/64.2"
✓ Weight:	6 kg/13 lbs	7 kg/15.4 lbs
✓ Max operating T°C:	60°C/140°F	60°C/140°F
✓ Max. operating pressure:	100 bar/1450 psi	100 bar/1450 psi
✓ Recommended max. cable length:	4-Go 3/16" cable, 2000 m (6500 ft) Monocable 1/10", 1000 m (3281 ft)	
✓ Housing:	Titanium & non-magnetic brass	

Data / sensor parameters

✓ Camera:	1280 x 1024 pixels CMOS
✓ Image format:	24-bit RGB
✓ Horizontal resolution:	360 to 1440 pixels
✓ Vertical resolution:	defined by logging speed (3.6 m/min for 1 mm resol.)
✓ Orientation sensor:	triple magnetometers / accelerometers
✓ Orientation precision:	$\pm 0,5^\circ$ inclination, $\pm 1^\circ$ azimuth

Accessories / options

✓ Natural gamma detector:	$\phi 25 \times 50$ mm NaI(Tl) crystal
✓ High Pressure kit OPTV52 :	$\phi 62$ mm / 200 bar (± 2000 m)
✓ Non magnetic centralisers	
✓ Sinker weight	
✓ Image reference calibrator	

Borehole conditions

✓ Open borehole:	Either dry or clean water-filled	
✓ Sonde must be centralised	OPTV38	OPTV52
✓ Recommended diam.range:	60 to 300 mm	75 to 600 mm

PROBE DATA PARAMETERS AND MEASURE POINTS

The measure point offsets indicated in the table below are measured from the bottom of the sonde.

The data parameters below are those obtained after data export to LGX format.

SEQUENCE NUMBER	PARAMETER DESCRIPTION	PARAMETER MNEMONIC	DATA UNIT	OFFSET (cm)
1	Record depth	DPTH	mm	0
2	Log time	TIME	ms	0
3	Image shift angle	SHAN	0.1°	0
4	X-axis magnetometer value	HX	*100μT	107
5	X-axis accelerometer value	GX	mg	107
6	Y-axis magnetometer value	HY	*100μT	107
7	Y-axis accelerometer value	GY	mg	107
8	Z-axis magnetometer value	HZ	*100μT	107
9	Z-axis accelerometer value	GZ	mg	107
10	Natural gamma	NGAM	counts/sec	145
11	Camera temperature	CTEM	*0.5°C	0
12	Optical data (RGB values)	PIC	-	8

PROBE CONNECTION CONFIGURATIONS

The probe can be operated in monocable or four conductor modes (as selected from the BHTV acquisition software).

 Pin configuration (looking into probe top from above)	WL n°	MONOCABLE MODE	FOUR CONDUCTOR MODE
	1	Probe power and data up/down	Uphole data (probe to surface)
	2	Not connected	Downhole data (surface to probe)
	3	Not connected	Not connected
	4	Not connected	Probe power

The yellow dot identifies WL1 which **must be positioned next to the alignment keyway for correct operation.**

OPERATING PRINCIPLES

The means by which the principle data parameters provided by the probe are obtained are described below.

OPTICAL IMAGE DATA

The optical sensor incorporates a CMOS digital camera that images the borehole wall at up to 60 frames/sec via an afocal wide-angle lens assembly. A dedicated optical processor board extracts the part of the image corresponding to the position in the perpendicular plane to the lens. The consecutive image slices are compressed and transmitted to the surface where they are re-assembled as a continuous image by the OPTV acquisition software. In this way it is possible to record OPTV data at up to 3.6 m/min while maintaining a vertical resolution of 1 mm.

The image data is generally presented orientated with respect to either the earth's magnetic North (when the borehole is vertical or slightly inclined) or the borehole high-side (when borehole inclination exceeds 30° from the vertical).

BOREHOLE INCLINATION AND AZIMUTH

The OPTV probe incorporates an orientation sensor based on tri-axial accelerometer and magnetometer detectors. This data allows the spatial orientation of the probe in terms of inclination and azimuth to be determined.

NATURAL GAMMA (OPTION)

The naturally occurring radioactivity generated by rock formations is in the main caused by the presence of potassium, uranium or thorium. The gamma radiation emitted by these elements is detected by means of a sodium iodide scintillation crystal. Incident gamma rays generate light flashes in the crystal material that are subsequently captured and transformed into electrical pulses by a photomultiplier tube. These pulses are counted by the probe electronics and sent to the surface together with the timing information required to calculate a counts-per-second value.

PROBECALIBRATION AND/OR VALIDATION

OPTICAL IMAGE DATA

In respect of the optical data, the only parameter that can be user-calibrated is the marker angle reference value. This requires a specific accessory (part n°. 52106) and the procedure is explained in the OPTV software reference document (page 27).

BOREHOLE INCLINATION AND AZIMUTH

The probe's on-board orientation sensor can not be calibrated by the user.

The sensor's performance can be checked periodically by setting up the probe in a known orientation (as given by a compass and/or inclinometer) and comparing the probe data with the reference values. If the probe values are not within normal limits ($\pm 0.5^\circ$ for inclination, $\pm 1^\circ$ for azimuth), please contact us for assistance.

NATURAL GAMMA (OPTION)

As standard, the probe is supplied with the gamma detector uncalibrated (output in counts-per-second).

Optionally, this parameter can be calibrated to the API unit standard in our reference borehole before shipping. In this case, the probe output should be referenced to a test source or local test borehole immediately on reception at the customer location. By periodic re-testing, the overall sensitivity can be checked and, if necessary, the relevant parameter adjusted in the OPTV software (see OPTV software reference document page 9 for more information).

PROBE OPERATION

SETTING UP/CONNECTIONS/STARTING THE SYSTEM



- Set up the winch and position the pulley over the borehole, either using the support legs or by hanging it from a suitable cable on the drilling machine (if present). If the pulley is to be used for depth measurement, connect it to the winch with the appropriate cable. Connect the winch to its power source **after checking that speed and direction controls are set so that the winch will not start unexpectedly.**
- Connect the eMindLogger module to the winch (MIL-19 cable) and to the logging PC or laptop with an appropriate USB cable. Connect the eMindLogger module to an appropriate source of power (220Vac mains power using the supplied transformer, or to a suitable 12Vdc supply eg. car battery).
- Start the PC or laptop, power on the eMindLogger module and double-click on the OPTV program icon to start the software :

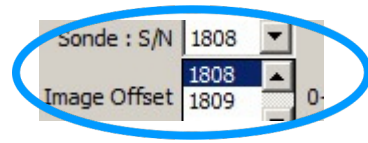


PREPARATIONS FOR RECORDING A LOG

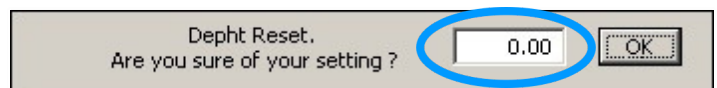
- Check in the OPTV program depth display that the depth increments in the correct direction when turning the pulley (positive depth increase = downwards).
- Fix centralisers to the probe and connect the probe to the logging cable taking care to align the cable-head correctly with respect to the probe (if probe has a gamma ray detector position the upper centraliser at least 20 cm from the top of the probe body).
- Unwind sufficient cable from the winch, then place the probe in the borehole taking care to avoid striking the probe against the drilling machine, tripod or surface casing.
- Using the winch, align the probe with the chosen depth reference (the alignment point on the probe corresponds to the bottom edge of the cable-head locking collar).
- If the currently configured probe is not the correct one, select the probe to be used from the probe



selection menu accessed by clicking on the  icon and then selecting the **Probe** tab in the **Logger Setup** dialogue box :



- Click on the  icon located in the top left corner of the program window. Enter the depth offset between the reference used to align the probe and the depth datum to be used for logging. If the probe alignment level is **above** the logging depth datum enter a **negative** value. If the probe alignment level is **below** the logging depth datum enter a positive **value**.



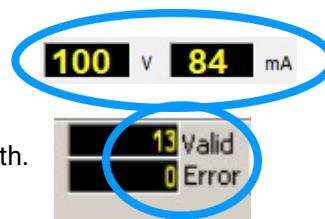
Check that the probe is connected and power it on by clicking on the icon :



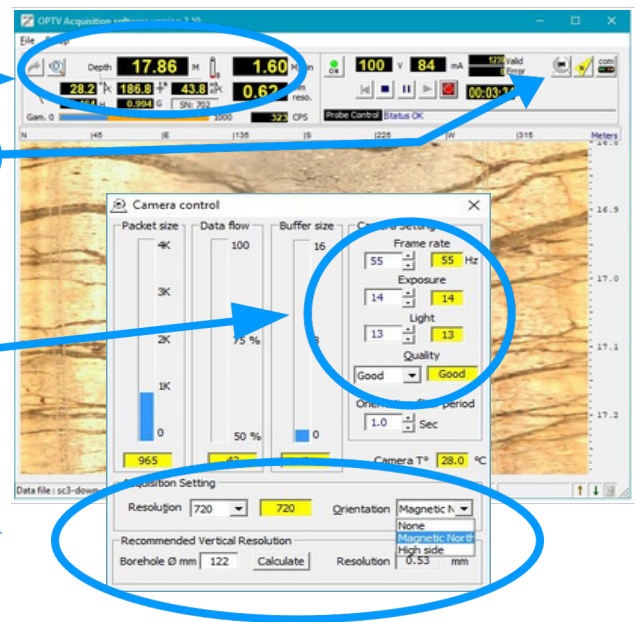
- The sonde voltage and current consumption are then displayed in the program window.

Check that valid data is being obtained :

- Lower probe in the borehole to the log starting depth.

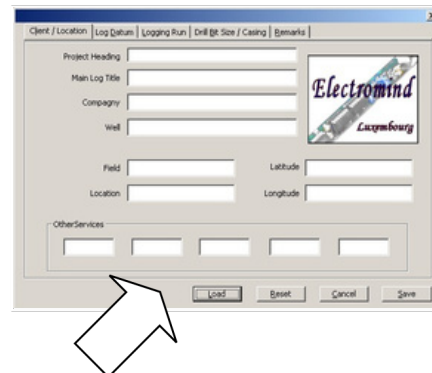
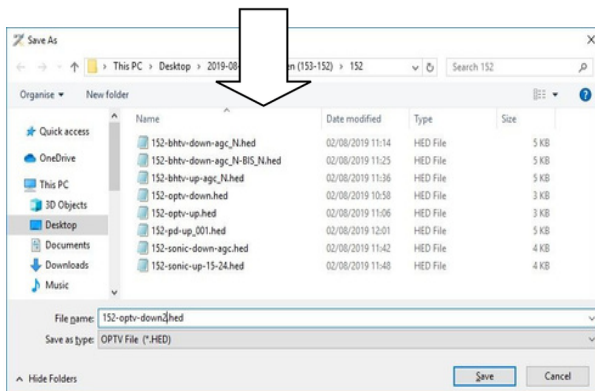
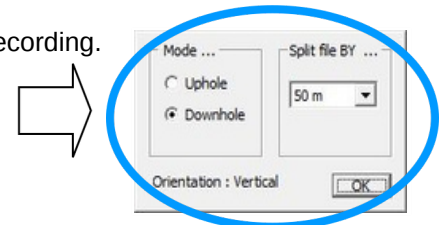


- The current depth, logging speed, image resolution and probe orientation parameters are displayed here :
- Check and adjust the acquisition parameters if necessary by clicking here : (it is recommended to keep this window open during recording).
- Set the image frame rate and exposure/light and image quality parameters (Good recommended) :
- Set the desired horizontal pixel value and log orientation mode here, check the recommended vertical resolution by entering the borehole diameter :



LOG RECORDING & REPLAY

- Click on the record button  or navigate to **File, New log** to begin a recording.
- Confirm the type of log (uphole or downhole), at this point it is also possible to specify that the log be split into sections.
- Specify a file name in the dialog box.



- If you wish to complete the information in the log header dialog, enter the relevant data in the form, then click on **Save**, or not then click directly on **Cancel**.
- Start the winch and check that the data status remains valid. The image data will appear on the screen and the viewer windows – adjust the logging speed so that the desired vertical resolution is obtained.
- When the probe arrives at the log end depth, stop the recording by clicking on the icon : 
- Switch off sonde power by clicking on the icon **before disconnecting the probe** : 
- To replay the log for QC purposes, click on **File, Open** then select the required file. Use the replay control buttons to start, pause and halt the data replay:
- If required, click on **File, Export** to generate LGX/BMP/JPG format image files or a LAS format file containing the orientation data and gamma-ray (if present) values for later processing.



For additional information, consult the OPTV software manual delivered with your system