



LVMC

Digital Light Curtain
for Detecting, Counting, Measuring, and Classifying

User Manual **Interface A2**

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1 Safety

1.1 Intended Use

The LVMC digital light curtain is a sensor for detecting, counting, measuring and classifying arbitrary objects. Use the device only for the purpose stated in this documentation. At any time, the light curtain may only be used within the limits of the prescribed and specified technical data and operating conditions.

The light curtain is particularly not suitable for subsequent applications: Under water, in potentially explosive areas, in hot (more than +50°C) or cold (less than 0°C) areas, in condensing humidity, and in areas with flying sparks.

The light curtain must not be used in safety applications, in particular not to protect against personal injury. It must not be used as a safety component in accordance with the EU Machinery Directive.

In the event of improper use, modification or manipulation, any warranty is void, and any responsibility and liability of OPTRONIC AG for any damage or consequential loss caused thereby is excluded.

Only use original OPTRONIC AG accessories or accessories recommended by OPTRONIC AG. Read the relevant documentation carefully before putting the device into operation.

The operator of the system in which the light curtain is integrated is responsible for compliance with national and international safety and accident prevention regulations (e.g. EN292, EN60204).

1.2 Safety Instructions

1.2.1 General Safety Instructions to Protect Against Physical Damage

The instructions for the power supply must be observed. No other type of power supply than that described in this manual may be used

All cables must be routed in such a way that nobody can step on them or trip over them

Work on electrical equipment poses a safety risk and must be specially secured. The light curtain may therefore only be installed and connected by a specialist in a voltage-free state. During this time, the machine must be switched off and secured against being switched on again.

1.2.2 General instructions to Avoid Damage to the Device

In case of faulty connection with other devices or a faulty power supply, there is a risk that the light curtain will be damaged. Read the relevant instructions before establishing the connection and read the documentation before commissioning.

2 Overview

The digital light curtain LVMC is used for detecting, counting, measuring and classifying arbitrary objects. It has a gapless sensing area for position and orientation independent registration of passing objects. With a suitable parameterization, even complicated shapes (spiral springs, rings, partially translucent objects, etc.) do not lead to multiple counts. The device, which is available in various sensing area dimensions, can reliably detect balls with a minimum diameter of 1mm. Objects that are permanently within the sensing area (conveyors, machine parts, etc.) can be faded out by specifying a statically covered area. The light curtain LVMC offers four independent counting channels for simultaneous detection of different objects. Selectively, the device classifies passing objects by automatically assigning them to a channel. The integrated automatic function learns independently by continuously analyzing objects passing the sensing area. Based on the learned information, the light curtain is automatically reconfigured at runtime, so that faulty objects, for example, can be sorted out without user intervention. For problem analysis and parameterization, a large number of helpful measured values are displayed. Detected objects are visualized in a two-dimensional picture. The integrated statistics function collects statistical data and illustrates it in a histogram. Two high-resolution timers (the maximum resolution is 30us) enable to capture the time interval between two events. In this way, for example, the speed of an object can be determined by connecting two light curtains in series.

Continuous contamination of the optics, the transmission and reception power of the sensing area, as well as changes in lighting conditions and temperature are continuously monitored and automatically taken into account during operation. Correct functioning of hardware and software is continuously monitored. Objects stuck in the sensing area can be detected by specifying the maximum permitted passing time. By means of configurable oversampling, the suppression of interferences (electromagnetic fields, light flashes, vibrations, etc.) can be optimized by increasing the minimum possible object passing time. Occurred errors that are preserved when power is turned off and can be read out at any time.

For communication with the outside world, the device is equipped with galvanically isolated optocoupler inputs and optocoupler outputs (available on a 9 pin D-Sub connector), an USB interface, and an Ethernet interface. The light curtain also offers a three-color status LED for quick determination of the status or, alternatively, a toggle switch for channel selection. How many optocoupler inputs and outputs are available depends on the device type. Overall, a total of five signal lines are available, their assignment is configurable. For example, counting and status information can be supplied in real time via the optocoupler outputs and, via the optocoupler inputs, a channel can be selected, the automatic function can be restarted, or a timer can be stopped.

Configuration, operation, analysis and monitoring of the always independently operating light curtain is done by use of the Microsoft Windows-based software LVMC CMT ("LVMC Configuration and Monitoring Tool"). The CMT can address the LVMC via USB and Ethernet. Beside this, it is possible to remotely control the device via Ethernet. The configuration and the status of the device can be retrieved by use of a web browser. For security reasons, communication via Ethernet is always encrypted.

The Ethernet interface can be configured statically or dynamically by DHCP. The clock integrated in the LVMC is reset when power is turned off, but date and time can be synchronized by use of a NTP server via the Ethernet network.

Power is supplied to the device by 24V DC via the D-Sub connector, or can alternatively be implemented by Power over Ethernet (PoE).

3 Get Started Right Away - The Quick Start

The aim of this chapter is to help you get started using the LVMC. It shows how you can proceed step by step to capture the first objects as quickly as possible.

3.1 Device Selection

3.1.1 Selection of the Dimension

The first choice to make concerns the dimension of the sensing area. It should be selected as small as possible, but minimally in such a manner, that no object penetrates the sensing area close to an edge or even touches the boundary. Since the minimum object size that can be detected by the LVMC also depends on the dimension of the sensing are, this size must also be taken into account. See Chapter 8 for information on dimensions, and Chapter 12 for information on available dimensions and associated minimum object sizes.

3.1.2 Connectors, Status LED and Toggle Switch

Each LVMC is equipped with a D-Sub connector, which is equipped with digital outputs and possibly digital inputs and which can be used to supply power. In addition, the device offers an USB port for communication with a PC running Microsoft Windows, as well as an Ethernet port to integrate it into an Ethernet network and to supply power via Power over Ethernet (PoE). On delivery, the USB and the Ethernet port are protected with a cap against contamination. They can be removed manually. Depending on the version, a toggle switch or a three-color status LED is integrated. All these elements are located on the front of the device:



The three-color status LED provides information about the current device status. It is statically green when the device is ready for object detection. If there is an object in the sensing area, it will be static blue. If the maximum permitted passing time of an object in the sensing area is exceeded, the LED flashes red-blue. A static red LED indicates that an error is pending. It flashes red, when the LVMC has been stopped by the user, for example, for configuration.

Each LVMC is equipped with at least three digital outputs on the D-Sub connector: Output 1 is permanently assigned to the readiness signal "Monitoring 2", outputs 2 and 3 are freely configurable. Whether the light curtain has two additional inputs, outputs, or dynamically configurable inputs/outputs depends on the design variant.

Chapter 10 describes how the part number can be determined based on the dimension and the design variant. Chapter 11 explains the structure of the assigned part number.

3.2 Software

The Microsoft Windows based software suite LVMC CMT is used for configuration, operation, analysis and monitoring of the light curtain. It is available in several versions to match the interface version of the firmware of your LVMC. The interface version is labeled with a capital letter followed by a numeral. It changes when essential new functions have been integrated into the firmware, resulting in changes in the interface between the LVMC firmware and the CMT. This document refers to the interface version A2.

3.2.1 Downloading

The installation file can be downloaded from the OPTRONIC homepage www.optronic.ch in section „DOWNLOAD“. Take the latest version with the highest version number that matches the interface version of your LVMC. If you do not know the interface version, select the most recent one, i.e. the one with the letter furthest back in the alphabet and the highest numeral. If the software does not match your LVMC, it will tell you as soon as you try to connect to the LVMC.

Alternatively, you can download the appropriate file for interface versions A1 and A2, which are available at the time of this document's completion, directly from one of the following links:

Interface version A1: http://www.optronic.ch/downloads/sensors/lvmc/cmt/lvmc_cmt_a1_latest_setup.exe

Interface version A2: http://www.optronic.ch/downloads/sensors/lvmc/cmt/lvmc_cmt_a2_latest_setup.exe

Any number of software versions can be installed on your PC at the same time.

3.2.2 Installing

Install the software on your PC by running the installer. The installer will guide you through the installation so that it should be completed in a few seconds. If you are not logged in with administrator rights on your PC, the installer will ask you to enter the administrator password. During installation, you will be asked if you want to create a desktop icon. Decide for it, so that you can start the software later comfortably by a double-click on the thereby created new icon on your desktop.



lvmc_cmt_a2_v2.037_setup.exe



LVMC CMT A2 V2.037

3.3 Power Supply

Now the LVMC must be supplied with power. This can be done in two ways: Via the D-Sub connector or via the Ethernet port.

3.3.1 Supplying Power via D-Sub Connector

For the supply via the D-Sub plug, you need a 24V DC power supply as well as a connection cable with 9-pin D-Sub socket. Make the wiring as described in Chapter 14.

3.3.2 Supplying power with PoE via Ethernet

If you have an Ethernet switch with Power over Ethernet (PoE) functionality, you can power the LVMC directly from this switch. To do this, connect a free PoE port to the Ethernet port of the LVMC via a network cable.

3.4 Readiness

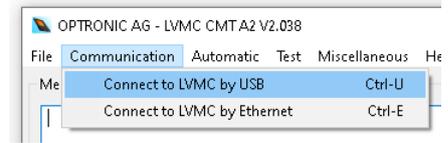
The green status LED on the front panel indicates that the LVMC is ready for operation. The light curtain is now ready to detect objects. If the LED remains dark, please check the power supply first. If it is red, an error is pending. Make sure that the sensing area is free.

3.5 Establishing a Connection

3.5.1 Via USB

Connect the LVMC to your PC using a standard USB 2.0 cable (USB A to USB B).

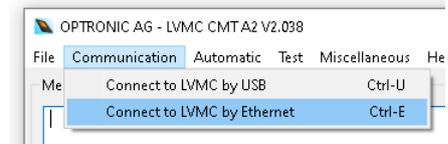
Start the CMT software by double-clicking on the newly created icon  on the desktop, or start the program via the start menu. Select entry "Connect to LVMC by USB" in menu "Communication" of the CMT. The connection to the LVMC should be established immediately.



3.5.2 Via Ethernet

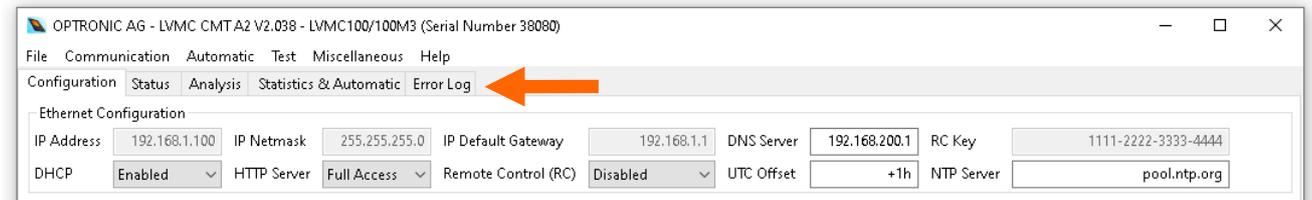
Connect the LVMC to your Ethernet network using an Ethernet cable, if this is not already the case, because you are feeding the device via PoE. By default, DHCP is activated in the LVMC at delivery. Therefore, the LVMC attempts to automatically configure the Ethernet network interface. This requires a DHCP server to be reachable, which is the case in many installations today. In order to connect to the LVMC via Ethernet, you need to know its IP address. The easiest way to do this is to connect to the LVMC via USB as described in the previous chapter 3.5.1. The currently used address is displayed on the status page in the "Ethernet State" section. How to get to the status page is described in the following chapter 3.5.3. If no IP address is displayed (the field "IP Address" is empty), the network interface could not be configured automatically via DHCP. In this case, your LVMC is not correctly connected to your network or no DHCP server can be reached. Without a DHCP server, the network configuration must be done manually, which will not be discussed further in this chapter.

If it works and you know the IP address, you can start the CMT software by clicking on the maybe available icon  on the desktop, or by calling the program from the start menu. Select entry "Connect to LVMC by Ethernet" in menu "Communication". You will be asked for the IP address of the LVMC. After you have completed the entry by pressing the "OK" button, you must enter the password. The password given on delivery is "1234". After pressing the "OK" button, the connection to the LVMC should be established immediately.

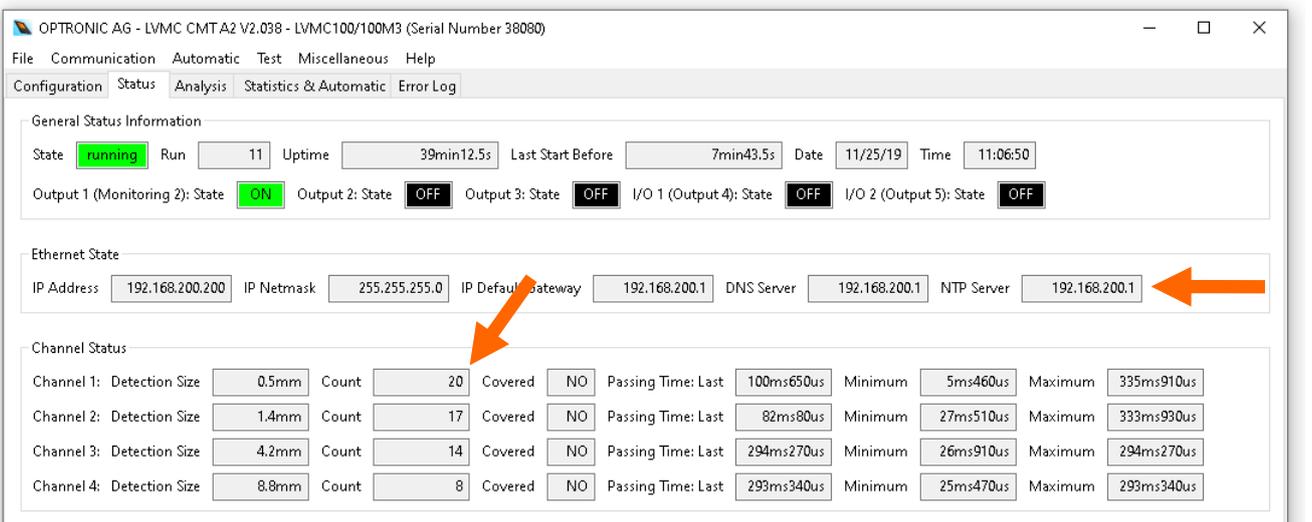


3.5.3 Operation

In the CMT, the five tabs “Configuration”, “Status”, “Analysis”, “Statistics & Automatic” and “Error Log” are arranged directly below the menu bar. Clicking on a tab brings the corresponding page to the foreground.



On the configuration page you will find all configuration settings. For example, in the “Channel Configuration” section, you will see the minimum sizes of all four existing channels. These are the given minimum object sizes, starting from which the channels count an object passing the sensing area. On the status page you will find a lot of information about the device status. For example, you can read per channel how many objects it has counted. Or you can see the currently used network settings.



For many display elements, so-called tool-tips are available. The display of the tool-tips can be switched on in the menu “Help” via the entry “Show Tool Tips”. If you hover with the mouse over an input or output field and hold briefly, information and explanations of contexts and functioning appear.

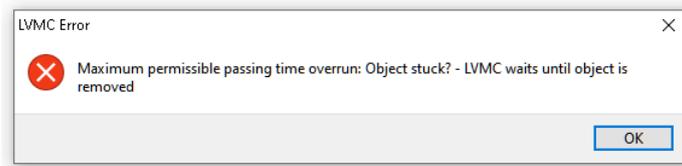


The entry “Disconnect from LVMC” in menu “Communication” allows you to disconnect from the LVMC at any time.

3.6 Counting Objects

Each light curtain is delivered preconfigured, so that it is ready for use immediately: Counting channel 1 counts objects that are larger than the minimum required object size for this device, e.g. objects from 1mm in size. Output 2 (pin 7 on the D-Sub connector) is linked to channel 1 and its polarity is positive. The opto-coupler of the output outputs a 10ms pulse after an object detected by this channel has left the sensing area, i.e. it is conductive for 10ms.

Now hold an object, e.g. a ballpoint pen, in the sensing area for a short time. You must pay attention that you do not cover the sensing area for longer than one second, as the maximum permitted passing time is set to one second at delivery. If you stay longer in the sensing area, the monitoring is activated and an appropriate entry will be created in the fault memory. The CMT displays the error message directly in a separate window. In addition, the error message can also be viewed on page "Error Log".



Once the sensing area is free again, the light curtain will be ready to detect further objects after about three seconds.

While you cover the sensing area with the object, the status LED will light blue. In addition, in section "Channel Status" of the status page, entry "Covered" for channel 1 and possibly even further channels is set to "YES".

Channel Status												
Channel 1:	Detection Size	0.5mm	Count	31	Covered	YES	Passing Time: Last	29ms190us	Minimum	12ms600us	Maximum	145ms290us
Channel 2:	Detection Size	1.4mm	Count	28	Covered	YES	Passing Time: Last	28ms620us	Minimum	8ms940us	Maximum	144ms930us
Channel 3:	Detection Size	4.2mm	Count	24	Covered	YES	Passing Time: Last	27ms690us	Minimum	27ms690us	Maximum	144ms300us
Channel 4:	Detection Size	8.8mm	Count	18	Covered	YES	Passing Time: Last	25ms200us	Minimum	25ms200us	Maximum	143ms310us

In addition, the counter readings are also displayed, and e.g. how long the object detected by the channel covered the sensing area.

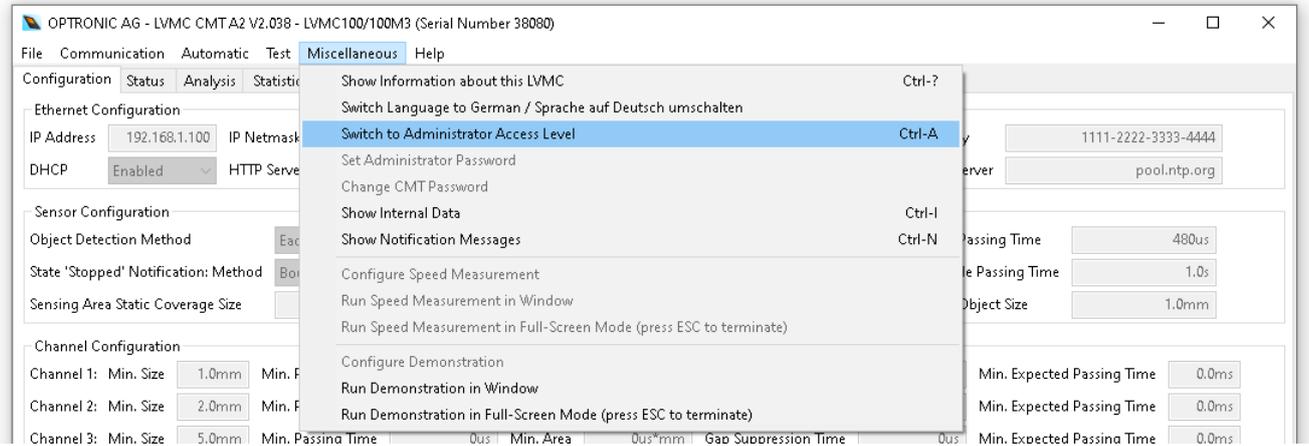
In the section "General Status Information" you will find information on the status of the device as well as status images of all available digital input and output signals. Entry "State", which is set to "running" and highlighted in green, indicates that the light curtain is ready to detect objects.



If you exceed the standard maximum permissible passing time of 1s as described above, the entry "Output 1 (Monitoring 2): State" will change from "ON" to "OFF" and be highlighted in red instead of green. When the sensing area is free again, the light curtain changes back to the ready state with a delay of about three seconds, and entry „Output 1 (Monitoring 2): State“ changes to „ON“ with a green background.

3.7 Modifying Settings

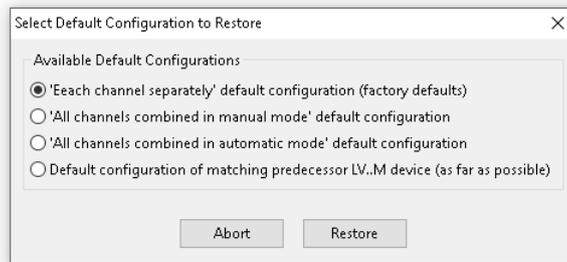
After each restart of the light curtain, all inputs and controls are disabled, i.e. you can only observe the light curtain. One reason for this is that the light curtain knows two access levels, the user access level and the administrator access level. Only at the administrative access level you have full access to all functions and inputs. A password can be set for switching to the administrator access level, but none is set on delivery. To switch from the user access level to the administrator access level, select entry "Switch to Administrator Access Level" in menu "Miscellaneous".



But you still probably can not change any input values. The reason is that the LVMC is in "run" mode, i.e. it detects passing objects and processes the recorded data according to the settings. No entries can be made in this mode. You must "stop" it first and this is done by pressing the "Stop" button.



Now you can, for example, change the minimum size of channel 1 or load the factory settings via the "Restore Default Configuration" entry in the "File" menu and thus return all settings to the factory settings.



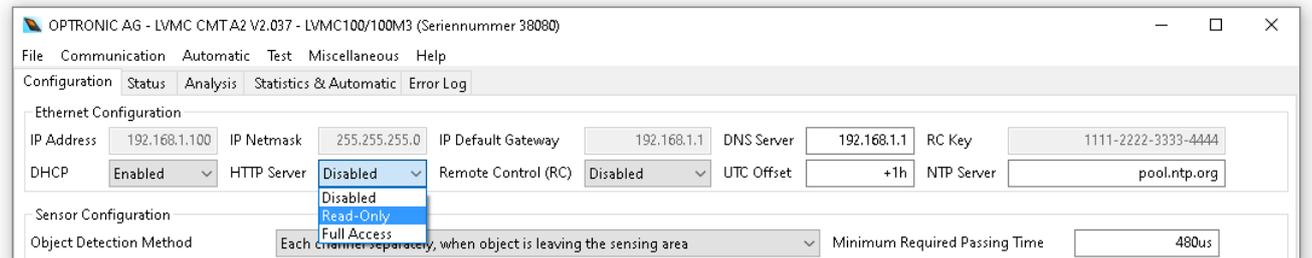
Press the "Start" button to put the LCMC back in "running" mode.



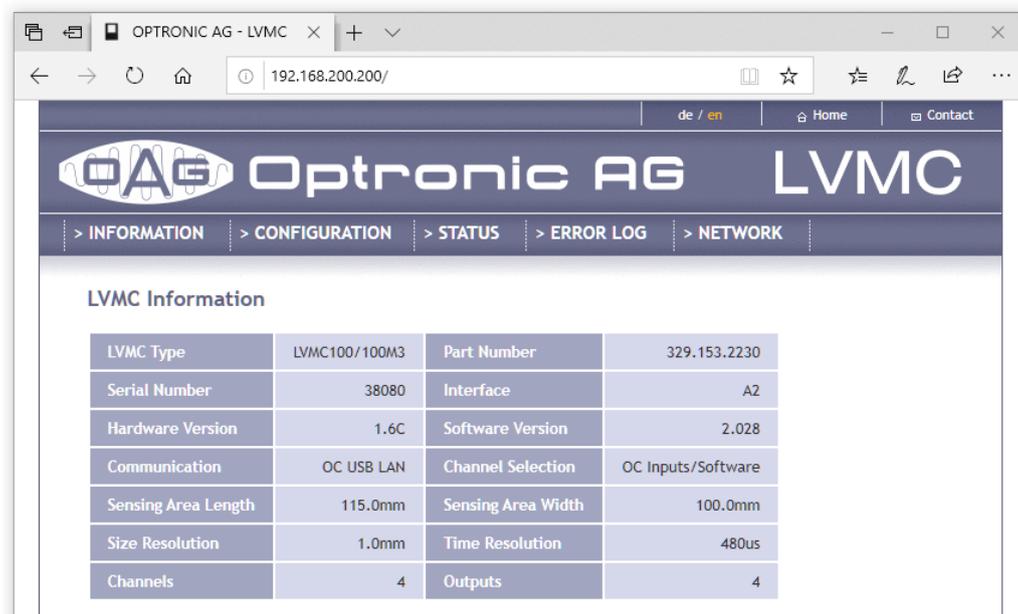
It takes about a second for the start to complete.

3.8 Monitoring via Web Browser

If you have integrated the LVMC into your Ethernet network, you can also access it using any web browser. All you have to do is activate the HTTP server on the configuration page. You can find the setting in the section "Ethernet Configuration" under "HTTP Server". Select the setting "Read-Only".



Once you have made the change, type the IP address of the LVMC into the address bar of the web browser. Depending on your browser, you may have to put the abbreviation "http://" in front of the address. The browser should now immediately display the information page of the LVMC in English.



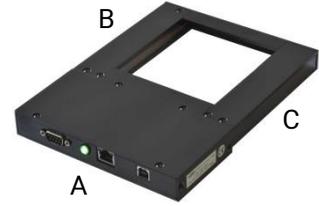
Click on "CONFIGURATION" to view the current configuration, or on "STATUS" to see, for example, how many objects each channel has counted.

Parameter	Channel 1	Channel 2	Channel 3	Channel 4
Detection Size	0.5mm	1.4mm	4.2mm	8.8mm
Count	11	11	7	2
Covered	NO	NO	NO	NO
Passing Time: Last	50ms640us	49ms800us	47ms850us	95ms370us
Passing Time: Minimum	33ms570us	32ms550us	47ms790us	45ms990us
Passing Time: Maximum	110ms580us	110ms250us	109ms500us	95ms370us

4 Operation of the LVMC

4.1 Sensing Area

The light curtain LVMC consists of a middle carrier A, as well as a transmitter fork B and a receiver fork C. The transmitter fork emits radiation, which is received by the receiver fork. Transmitter and receiver fork form a homogeneous sensing area. When an object enters the sensing area, it reduces the amount of radiation received by the receiver fork. This shadowing corresponds to the extent projected onto the receiver fork of the section of the object that is currently in the sensing area. The light curtain determines a new projected extent every 30us and combines these 30us wide stripes into a projected image of the object (the extent is plotted horizontally and the time vertically) and into a projected area of the object (in seconds by meters; s*m). The LVMC can thus create a two-dimensional image of the object. The maximum extent, hereinafter referred to as the object size, and the calculated area can be used as criteria for classification.



4.2 Operating Modes

The LVMC knows the two operating modes “stopped” and “running”. In “running” mode, it detects passing objects and processes the recorded data according to the settings made in advance. In this mode, no changes can be made to the configuration and no operating functions can be triggered. In “stopped” mode, the situation is reversed: The light curtain does not detect any objects, but adjustments can be made to the configuration and functions can be executed. If no error occurs, the LVMC automatically switches to the “running” mode after a restart. If the LVMC is in “running” mode and an error occurs, it automatically switches to the “stopped” mode. Depending on the type of fault, the light curtain will:

- stay in “stopped” mode.
- after eliminating the cause of the error, automatically switch back to the “running” mode.
- after a short pause of a few seconds repeatedly try to switch back to the “running” mode.

When switching to the “running” mode, the LVMC checks that data is consistent, performs function checks and calibrates the sensing area. This process takes approximately one second. During this time, the light curtain must be uncovered.

4.3 Access Levels

Two access levels are implemented in the LVMC, the user access level and the administrator access level. You have full access to all functions and inputs only at the administrative access level. Switching to the administrator access level can be password protected. No password is assigned at delivery. The change between the levels is initiated via the CMT software package, but for security reasons it is carried out entirely in the LVMC, which operates independently at all times.

4.4 Counting Channels

The LVMC provides four counting channels for simultaneous detection of different objects. Each channel can be parameterized individually and detects the objects matching the parameters. The following parameters can be specified for each channel:

- “Minimum Size“: The minimum object size that is detected by the channel. The LVMC subtracts a safety margin from this value, and in reality uses the lowered value as lower limit, in order to guarantee, that no objects get missed.
- “Minimum Passing Time“: The minimum time an object must cover the sensing area so that it is counted by the channel.
- “Minimum Area“: The minimum area an object must have so that it is counted by the channel. To calculate the area, the LVMC sums up the measured object size (the covered part of the sensing area) over the time the object passes the sensing area. Therefore, the area must be entered in unit time multiplied by length. This parameter can be used as a replacement for channel parameters “Minimum Size” and “Minimum Passing Time”, as they also define a simplified area.
- “Gap Suppression Time “: An object may have one or more locations with size smaller than the minimum size entered for the channel. By use of this parameter, this form of gaps can be suppressed. Enter the maximum time a gap that should be suppressed can last.
- “Minimum Expected Passing Time“: The minimum time a part is assumed to cover the sensing area. If an object is detected by the channel, the channel does not count another object until this time has passed. If this time expires while the sensing area is already covered by another object, this part is also not counted. This parameter is available for compatibility with the previous device generation. It is replaced by parameter “Gap Suppression Time”.

For analysis purposes, several measured values are recorded per channel: The passing time for the last counted object, as well as the shortest and longest passing time of all counted objects. The values are deleted when the LVMC is restarted, or when the values are manually reset via the CMT.

4.5 Minimum Required Passing Time / Oversampling

The minimum required dwell time specifies the minimum amount of time that an object must cover the sensing area to be detected. The time can be adjusted in 30us steps, the minimum value (referred to as “Time Resolution” in the CMT) depends on the light curtain type. The standard version supports a minimum passing time of 480us, special versions with up to 30us are available on request.

With the minimum required passing time, the oversampling rate of the LVMC is internally determined: A longer minimum required passing time gives the light curtain more time to acquire measurement data, internally several scans are combined into one measurement value. This makes the light curtain less sensitive to interference such as electromagnetic fields, light flashes or vibrations.

4.6 Maximum Permissible Passing Time / Stuck Objects

If an object remains for longer than the predefined maximum allowed passing time in the sensing area, the LVMC evaluates this as a stuck object. If this occurs, the LVMC leaves the operating mode "running", generates an entry in the error memory (error message "Maximum permissible passing time overrun: Object stuck? - LVMC waits until object is removed") and waits until the object leaves the sensing area or has been removed from the sensing area. It then automatically switches back to the "running" operating mode.

4.7 Minimum Required Object Size

The minimum required object size is the minimum object size to be detected by the LVMC. The value must be equal to or greater than the size resolution of the LVMC. The size resolution is the minimum object size that the light curtain can detect. The entered minimum required object size directly affects all functions of the LVMC. It may be useful to increase it if you want to permanently fade out interfering objects. If, for example, a conveyor belt is guided through the light curtain and the conveyor belt is not sufficiently flat, the moving belt may be detected under certain circumstances and may lead to a considerable number of disturbing object detections. In this case, increase the minimum required object size until the conveyor belt no longer leads to unwanted detections.

4.8 Sensing Area Static Coverage

Smaller objects (conveyors, machine parts, etc.) that are permanently in the sensing area can be hidden by specifying a statically covered area in the configuration. Enter the length of the statically covered area in mm.

4.9 Manual Calibration of the Sensing Area

The sensing area is not completely homogeneous. Therefore, the measured size of an object depends on where it penetrates the sensing area. If a very exact measurement is required and it can be guaranteed that an object always passes through the sensing area in a defined (small) zone, then the measured size can be automatically corrected by a pre-definable calibration factor in percent.

A further application is the blanking out of translucent handling devices located in the sensing area. An example of this is an acrylic plastic tube, which leads statically through the sensing area and in the interior of which the objects pass the light curtain. The tube absorbs part of the light and, as a result, the light curtain no longer correctly detects the size of the objects. The measured size can be corrected again using the provided calibration factor.

4.10 Object Detection Methods

The LVMC knows different methods how objects can be detected by the channels and when the detection of an object is reported. Basically, two modes are supported: "single" and "combined":

In "single" mode, each channel operates independently of all others. A channel detects a passing object if the geometry and the passing time match the configuration parameters set for the channel. A passing object can therefore be detected simultaneously by several channels.

In "combined" mode, a passing object is always detected by only one channel. First, all channels are identified that detect the passing object. A channel detects a passing object if the geometry and the passing time match the configuration parameters set for the channel. Among the identified channels, the one with the largest minimum size is selected. If the same highest minimum size is set for more than one of the channels that have detected the passing object, the channel with the lowest channel number is selected.

For example, if the minimum sizes for channels 1 through 4 are set to 1, 2, 4, and 8mm, and the size of the passing object is 5mm, channels 1 through 3 are selected first, but not channel 4. Among the selected channels, channel 3 now has the largest minimum size (4mm) and the object is therefore assigned to this channel.

Five object detection methods are available:

- "Each channel separately, while object within sensing area":
Each channel works separately. A channel reports detection during the whole time the object is in the sensing area.
- "Each channel separately, when object is entering the sensing area":
Each channel works separately. A channel reports detection when the object enters the sensing area.
- "Each channel separately, when object is leaving the sensing area":
Each channel works separately. A channel reports detection, when the object is leaving the sensing area.
- "All channels combined, manual mode, when object is leaving the sensing area":
When the object leaves the sensing area, the channel that has set the highest minimum size among the channels that have detected the object reports the detection. If the same highest minimum size is set for more than one of the channels that have detected the passing object, the channel with the lowest channel number is selected.
- "All channels combined, automatic mode, when object is leaving the sensing area":
In automatic mode, the light curtain autonomously parameterizes the settings "Minimum Area" and optionally "Gap Suppression Time" at runtime. It is assumed that only one object type passes the sensing area during a run. The task is to filter out faulty objects whose size deviates from the standard. Therefore, the LVMC continuously collects data about the objects that pass through the sensing area and learns from them.

4.11 Automatic Mode

In the automatic mode, the light curtain analyzes constantly passing objects and, based on this learned information, autonomously configures the settings "Minimum Area" and optionally "Gap suppression time" of channels 2 to 4 at runtime. The task is to filter out faulty objects whose size deviates from the standard. It is assumed that only one object type passes the sensing area during a run.

The meaning of each channel is fixed:

- Channel 1 counts objects, that have been classified as too small.
- Channel 2 counts objects with correct size.
- Channel 3 is used to count objects that have been classified as too large, or to count two objects of correct size, that follow each other too closely, thus passing the sensing area without gap.
- Channel 4 is used to count objects that have been classified as too large, or to count three objects of correct size, that follow each other too closely, thus passing the sensing area without gap.

The values entered for channel 1 in parameters "Minimum Area" and "Gap Suppression Time" are taken as minimum values for the automatically determined corresponding values for channels 2 to 4. The channel parameters "Minimum size", "Minimum Passing Time" and "Minimum Expected Passing Time" are automatically set to the same values for all channels. They can therefore only be entered for channel 1.

The parameters „Minimum Area“ and „Gap Suppression Time“ are calculated automatically and continuously for channels 2 to 4 using the given parameter "Bad Rate", the entered percentage of objects that should be rejected due to a too small or too large area.

Two methods are available for collecting data: By means of all objects that have passed the sensing area since the automatic mode was started, or rolling over a specified number of objects that have passed the sensing area. The rolling mode compensates for continuous changes, which may be desirable or undesirable.

Selectively, the light curtain can start the object detection without prior knowledge, or with stored initial values. The initial values are calculated on the basis of collected data from a previous run in which a sufficiently large number of objects, if possible only correct objects, have passed the sensing area. The calculation of the initial values must be triggered via the CMT.

It is possible to specify the number of objects, that must have passed the sensing area, before the minimum area and, if selected, the gap suppression time of channels 2 to 4 are automatically adjusted by the automatic mode. Before this number of objects has passed the sensing area, the values entered in channel 1, with the exception of the minimum area, are taken over to channels 2 to 4. The minimum areas for channels 2 to 4 are defined so that all objects are treated as correct objects and thus assigned to channel 2, assuming that these values are greater than the minimum area entered for channel 1.

To enable a change to another object type, for example, it is possible to restart the automatic mode via a digital input or independently after a given time during which no object has passed the sensing area.

4.12 Monitoring Signals

The LVMC provides the two signals "Monitoring 1" and "Monitoring 2". These are used to check whether the device is functioning faultlessly and whether maintenance is necessary.

4.12.1 Signal „Monitoring 1“: (Pollution-) Warning

Signal "Monitoring 1" is active when the light curtain is in the operating mode "running" and the signal intensity of the sensor has fallen below the warning limit permanently stored in the device. There are two main reasons for this:

- The sensing area optics is dirty: In this case, the optics of the light curtain should be cleaned in order to increase the light intensity again.
- Due to aging, the sender or receiver power of the sensor has decreased so far that the warning limit has been reached. This is to be understood as an advance warning that the light curtain could soon reach the limit at which correct functioning can no longer be guaranteed. The LVMC must then be replaced or sent in for revision, respectively.

4.12.2 Signal „Monitoring 2“: Operational Readiness

Signal "Monitoring 2" is used to signal readiness for operation. The output is active when the light curtain is in the operating mode "running", and:

- The maximum permissible degree of contamination has not been exceeded. Possibly, operational readiness can be restored by cleaning the optics.
- The sender or receiver power required for reliable operation of the sensing area is not fallen below the required values.
- The light curtain has not detected any internal malfunction and is not defective. Various monitoring functions are implemented in the LVMC, which constantly monitor the correct functioning of the hardware and software.

If the light curtain is in operating mode "stopped", the signal is inactive.

If no readiness for operation is signaled, the light curtain must be replaced, or returned for inspection or repair.

4.13 Digital Inputs and Outputs

A total of 5 wires for digital optocoupler input and output signals are available on the 9-pin D-Sub connector. All versions of the LVMC have at least three outputs: Output 1 is permanently assigned to the signal "Monitoring 2", the other two outputs can be freely configured. Various functions are available for this purpose: For example, the signal "Monitoring 1" can be assigned to output 2 Or output 3 can be assigned to one of the channels, whereby, for example, each time this channel detects an object, a pulse is output.

Depending on the version of the LVMC, two additional outputs, two inputs or two bidirectional inputs/outputs (I/Os) are available in addition to the three outputs. These are also freely configurable.

4.14 External Channel Selection via Digital Inputs or Toggle Switch

Light curtains with digital inputs or digital inputs/outputs (I/Os) offer the possibility of dynamically selecting a channel via an external device. At variants with toggle switch, the dynamic assignment can be done by manually toggling the switch. For example, an output can be configured in such a way that a pulse is output each time the currently selected channel detects an object.

4.14.1 Channel Selection via Digital Inputs

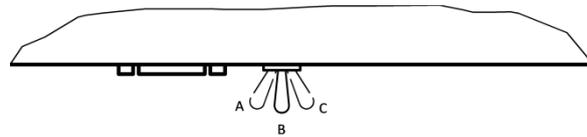
Via the inputs or inputs/outputs (I/Os), each of the four available channels can be selected. The following table provides information on the assignment of the status of the two inputs to the channel number:

Input 2 or I/O 2	Input 1 or I/O 1	Corresponding Binary Code	Selected Channel
0	0	00	1
0	1	01	2
1	0	10	3
1	1	11	4

4.14.2 Channel Selection via Toggle Switch

By the toggle switch, one of the channels 1 to 3 can be selected. The following table provides information about the assignment of the toggle switch position to the channel number:

Toggle Switch Position	Selected Channel
Position A	1
Position B	2
Position C	3



4.15 Configuration of the Inputs and Outputs

Depending on the version, the LVMC offers a different number of inputs, outputs and bidirectional inputs/outputs (I/Os) to which a parameterizable function can be assigned. The following functions are available:

"not assigned":	Configured as unused output that is never set.
"Monitoring 1 (Warning)":	The output is assigned to the warning signal "Monitoring 1".
"Object Stuck":	The output is assigned to the stuck object detection. The signal is set when an object is covering the sensing area for longer than the given 'Maximum Permissible Passing Time'.
"Object has entered the sensing area":	The signal is set when an object has entered the sensing area.
"Channel x: Detection":	The output is assigned to channel x in mode "detection": The signal is set when an object is detected by the assigned channel.
"Channel x: Quantity":	The output is assigned to channel x in mode "quantity": The signal is set when the by parameter "Quantity" defined number of objects is detected by the assigned channel.
"Channels 1, 3, and 4: Detection":	The output is assigned to channels 1, 3, and 4 in mode "detection": The signal is set when an object is detected by any of these three channels.
"Channels 3 and 4: Detection":	The output is assigned to channels 3 and 4 in mode "detection": The signal is set when an object is detected by any of these two channels.
"All Channels: Detection":	The output is assigned to all channels in mode "detection": The signal is set when an object is detected by any channel.
"All Channels: Quantity":	The output is assigned to all channels in mode "quantity": The signal is set when the by parameter "Quantity" defined number of objects is detected by all channels together.
"All Channels: Detection, Length-Coded":	The output is assigned to all channels in mode „detection“, the duration the signal is set depends on the number of the channel that detected the object: The signal is set when an object is detected by any channel. The duration the signal is set is given by the channel number multiplied by the value set in parameter "Duration".
"All Channels: Detection, Pulse-Coded":	The output is assigned to all channels in mode "detection". The signal is repeatedly set according to the number of the channel that has detected the object. (Channel 1: signal is set once, channel 4: signal is set four times.) The signal is set for the time specified by parameter "Duration". The time between two pulses is also equal to the value set in parameter „Duration“
" All Channels: Detection, Pulse-Coded, w/o Channel 1":	The output is assigned to all channels in mode "detection". The signal is repeatedly set according to the by 1 decremented number of the channel that has detected the object. (Channel 1: signal is not set, channel 1: signal is set once, channel 4: signal is set three times.) The signal is set for the time specified by parameter "Duration". The time between two pulses is also equal to the value set in parameter "Duration".

“All Channels:
Detection, Binary-Coded”:

Outputs 3 to 5 are assigned to all channels in mode „detection“, output 3 is set when an object is detected, outputs 4 and 5 are set according the number of the channel that detected the object:

Channel	Output 3	Output 4	Output 5
0	1	0	0
1	1	0	1
2	1	1	0
3	1	1	1

The channel number minus 1 is output in binary notation on outputs 4 and 5. Output 4 is the lower bit, output 5 the higher one. Output 3 is set while the channel number is valid on outputs 4 and 5.

“Reset Counters”:

On detection of the active edge of this input signal (the active edge is selected by the polarity), the object counters of all channels and signals are reset to 0.

“Automatic Mode Restart”:

On detection of the active edge of this input signal (the active edge is selected by the polarity), the automatic mode is restarted. All collected data and learned information about objects that have previously passed the sensing area is flushed.

“Automatic Mode
Restart/Reset Counters”:

On detection of the active edge of this input signal (the active edge is selected by the polarity), the automatic mode is restarted and the object counters of all channels and signals are reset to 0.

“Stop Object Detection
Timer”:

On detection of the active edge of this input signal (the active edge is selected by the polarity), the object detection counter is stopped.

“Start General Purpose
Timer”:

On detection of the active edge of this input signal (the active edge is selected by the polarity), the general purpose timer is started.

“Stop General Purpose
Timer”:

On detection of the active edge of this input signal (the active edge is selected by the polarity), the general purpose timer is stopped.

“Start & Stop General
Purpose Timer”:

On detection of the active edge of this input signal (the active edge is selected by the polarity), the general purpose timer is started and stopped.

“Channel Selection”:

I/Os 1 and 2 are used as digital inputs to select the active channel. The active channel is used for assignments “Channel by Inputs: Detection” and “Channel by Inputs: Quantity”.

“Channel by Switch:
Detection”:

The output is assigned to the channel selected by the switch in mode „detection“: The signal is set when an object is detected by the assigned channel.

“Channel by Switch:
Quantity”:

The output is assigned to the channel selected by the switch in mode “quantity”: The signal is set when the by parameter “quantity” defined number of objects is detected by the assigned channel.

“Channel by Inputs: Detection”:	The output is assigned to the channel selected by the digital optocoupler inputs in mode “detection”: The signal is set when an object is detected by the assigned channel.
“Channel by Inputs: Quantity”:	The output is assigned to the channel selected by the digital optocoupler inputs in mode “quantity”: The signal is set when the by parameter “quantity” defined number of objects is detected by the assigned channel.

For all inputs and outputs or I/Os, the polarity can be selected arbitrarily. For an output that is assigned to a channel, you can also specify whether a signal should only be generated once, how long a signal should be present at the output, and whether it should be output with a delay. If a counting function is assigned to the output (mode “quantity”), the quantity up to which to be counted to before the signal is output can be specified.

4.16 Timer

The LVMC provides two timers: A so-called "Object Detection Timer" and a "General Purpose Timer". If activated, the "Object Detection Timer" will start when an object enters the sensing area. It is stopped by a positive or negative edge of the signal of an optocoupler input. The general purpose timer is started and stopped by a positive or negative edge of the signal from an optocoupler input, either by the same input or by a different input.

For example, by connecting two light curtains and using the object detection timer, it is possible to determine the speed of an object passing the sensing areas of the two light curtains.

4.17 Speed Measurement

An LVMC with connected CMT can be used for speed measurement. It is based on the two timers. The speed that can be displayed via the CMT is determined according to the formula $v=s/t$ (speed = distance per time) using a measurement distance that can be specified for each activated timer.

A possible arrangement consists of two interconnected LVMCs. An object first falls or flies through the sensing area of the first light curtain and subsequently through the sensing area of the second. The second LVMC is configured so that the signal of an optocoupler output is set, when the object enters the sensing area. This optocoupler is connected via a wire to an optocoupler input of the first LVMC. This input is assigned to the “Stop Object Detection Timer” function in the first LVMC, the object detection method is set to “Each channel separately, when object is entering the sensing area”. As soon as the object enters the sensing area of the first light curtain, the object detection timer of the second is started. When it enters the sensing area of the second light curtain, the timer is stopped again. Thus, the object detection timer measures the time the object takes to bridge the distance between the sensing areas of the two light curtains. Based on the entered distance between the two LVMCs, the speed can be determined.

4.18 Date and Time

The clock implemented in the LVMC does not continue to run when power is turned off. Available is the time that has elapsed since the LVMC was switched on or restarted, as well as the time that has elapsed since the LVMC switched to the “running” state. If the light curtain is connected to an Ethernet network, the firmware attempts to reach an NTP server and obtain the current date and time from it.

4.19 Analysis Function

In addition to the four counting channels for simultaneous detection of different objects, the LVMC light curtain offers another channel, which is reserved exclusively for the integrated analysis function. This additional channel always works with the entered minimum required object size. There is no input for the minimum area, the minimum passing time and the minimum expected passing time, however, the gap suppression time can be defined.

The projected image of an object detected by this channel is recorded by the LVMC and displayed visually in the CMT in a two-dimensional image. Horizontally, the extent and vertically, the time are plotted. Recorded images can be stored via the CMT in a folder on a drive of the computer on which the CMT is running. Due to the limited transfer rate between LVMC and CMT and the limited computing power of the LVMC (and possibly the computer on which the CMT is running), not all of the captured objects may be visually displayed and not all images may be stored.

In addition, the LVMC provides various information about the last detected object and statistical data for all detected objects. Examples are the passing time and the maximum size of the last detected object, or the highest passing time and the highest maximum size measured since the last restart of the LVMC or the reset of the statistics.

4.20 Histogram and Statistical Data

During operation, the LVMC continuously collects statistical data on the area and the passing time of the objects passing the sensing area. Among other purposes, this data is used for automatic configuration in automatic mode. The measured areas of all passing objects are also plotted in a histogram.

4.21 Error Log

The light curtain logs errors that have occurred and stores them non-volatile. Together with the error code, the so-called run number and the time elapsed since the last restart are stored. Stored errors with the same run number occurred in the same run. If the LVMC was able to obtain date and time from an NTP server, the date and time are also stored.

In order to enable the interpretation of an occurred error when date and time are not available, the firmware maintains a so-called run number, which is stored in the LVMC also in the non-volatile memory. Based on the combination of run number and time of occurrence of the error since the last restart, the error log can be interpreted.

Each time the LVMC is restarted, a new run begins and the run number is incremented by 1. However, the run number is only stored in the non-volatile memory if an error has occurred in this run. If the device is switched off without an error having occurred in the current run, the next run starts with the same run number after switching on again. Thus, not every run is counted. This is due to the fact that the number of possible write accesses to the non-volatile memory is physically limited. For the same reason, only the first occurrence of an error with the same error code after the last restart is stored non-volatile, but subsequent identical errors are only transiently stored. Therefore, the error log contains only the first occurrence of each error with the same error code for the previous runs, but all errors that occurred in the current run.

4.22 Measurement Inaccuracy and Repeat Accuracy

A light curtain is specified for a given resolution. This corresponds to the minimum object size that can be detected by the LVMC. The maximum measuring inaccuracy depends mainly on the object size, but also on the dimension of the light curtain.

As the measurement at the edges of the sensing area is affected, the measuring inaccuracy can only be specified in an area with a minimum distance r from the edges of the sensing area. The distance r depends on the width of the sensing area and is defined as follows:

For light curtains up to and including 150mm sensing area width: $r=5\text{mm}$

For light curtains with a sensing area width greater than 150mm: $r=10\text{mm}$

For a light curtain with sensing area width b , the expected maximum measuring inaccuracy, i.e. the maximum deviation d from the real object size g , can be calculated according to the following formula, assuming that the environmental conditions are good:

$$d = (0.0006*b/1.0\text{mm}+0.02)*g+(0.002*b+0.2\text{mm})$$

Thus, under good environmental conditions, a light curtain with 100mm sensing area width measures an absolutely vertically inserted and pulled out non-transparent and non-reflecting cylinder with a given diameter g at a minimum distance of 5mm from the edges of all four sides of the sensing area as follows:

Maximum deviation: $d = 0.08*g+0.4\text{mm}$

Minimum value: $a = g-d = 0.92*g-0.4\text{mm}$

Maximum value: $b = g+d = 1.08*g+0.4\text{mm}$

Diameter g	Maximum Deviation d	Minimum Value a	Maximum Value b	Relative Maximum Deviation
1mm	0.5mm	0.5mm	1.5mm	+48%
2mm	0.6mm	1.4mm	2.6mm	+28%
5mm	0.8mm	4.2mm	5.8mm	+16%
10mm	1.2mm	8.8mm	11.2mm	+12%
20mm	2.0mm	18.0mm	22.0mm	+10%

In order to be able to achieve the stated values, good environmental conditions are required. Environmental influences such as electromagnetic fields, light flashes, vibrations and pollution must be within tolerable limits. In addition, the object must not be translucent or reflective.

If an object to be detected passes the sensing area reproducibly at the same position and in the same orientation, then the measurement repeatability under good environmental conditions is $\pm 0.2\text{ mm}$.

4.23 Configuration Sets

A configuration set contains all settings (adjustable parameters) of the light curtain. The LVMC knows two such sets: A volatile and a non-volatile set. The contents of the volatile set will be lost if power is turned off, or the LVMC is restarted. The non-volatile set is stored in the non-volatile memory of the LVMC and is kept via power off. When the LVMC is turned on, the non-volatile set is copied to the volatile set and the light curtain works with the non-volatile set. If a configuration parameter is changed, it is first stored in the volatile set only. The transfer to the non-volatile memory is never automatically done, it must be triggered manually.

4.24 Communication via USB

The LVMC is equipped with a USB 2.0 interface for communication with the CMT. When using Microsoft Windows 8 and newer, no special driver is required for operation, the LVMC is automatically recognized immediately after it has been connected to the PC via a USB 2.0 cable. If the CMT cannot establish a connection with the LVMC, or if a USB-specific error message is displayed (e.g. "USB device not recognized"), try to solve the problem by unplugging the USB cable for a short time. If the problem persists, the LVMC maybe is defective, or there is a software or hardware problem on your PC.

If the connection is lost, CMT tries to re-establish the connection automatically. If this does not succeed, the USB connection can be re-initialized by briefly disconnecting the USB cable. The connection should then be re-established automatically.

4.25 Communication via Ethernet

On delivery, the Ethernet network interface of the LVMC is configured to automatically obtain the network configuration from an accessible DHCP server. The currently used configuration is displayed in the CMT on the status page. Connect to the LVMC via USB to view it. If supported by the DHCP server, the IP address, IP netmask, IP default gateway, DNS server address and NTP server address are obtained automatically. If automatic configuration via DHCP is activated, the DHCP server must provide at least IP address, IP netmask and IP standard gateway. If the DHCP server does not provide a DNS server address or NTP server address, then the particular address entered in the CMT on the configuration page is used. The NTP server address can be specified via the CMT as hostname (e.g. "pool.ntp.org") or directly as IP address. If a hostname has been entered and the NTP server address has not been assigned via DHCP, an accessible DNS server is required to resolve the hostname to an IP address.

The data transmission between CMT and LVMC is encrypted for security reasons. In addition, when establishing a connection, the CMT password stored in the LVMC must also be entered for authentication. The CMT password can be changed via the CMT. The previously assigned password does not have to be known, i.e., if connecting via USB, a new password can be assigned at any time.

If the connection is lost, CMT tries to re-establish the connection automatically.

4.26 Power Supply

The power supply can be realized with 24V DC via the D-Sub connector, or alternatively with Power over Ethernet (PoE) via Ethernet. Simultaneous power supply via the D-Sub connector and the Ethernet socket is not supported.

4.27 Visual Status Indication via Sensor Light

The LVMC light curtain can use the visible red light of the sensor to inform the user about the current operating mode. In "running" mode, the sender appears continuously illuminated along its entire length for a human eye. It is possible to configure how the device behaves in "stopped" mode. This feature can be used to distinguish several LVMCs. Five procedures are implemented:

"Light Turned Off":	The red light of the sensor statically stays off.
"Flashing Light":	The red light of the sensor is turned on and off. The time it is on and the time it is off is equal, the duration can be defined in the CMT.
"Running Light Type A":	The sensor shows a running light, starting at the side where the electronics is located. The duration of a pass can be defined in the CMT.
"Running Light Type B":	The sensor shows a running light, ending at the side where the electronics is located. The duration of a pass can be defined in the CMT.
"Bouncing Light":	The sensor shows a running light that bounces from one end to the other. The duration of a pass can be defined in the CMT.

4.28 Visual Status Indication via Status LED

The three-color status LED on the front panel provides information about the current device status:

Off:	Device switched off or defective, no objects are detected.
Statically red:	Device stopped due to an error. Depending on the error, the device tries to restart automatically. No objects are detected.
Blinking red:	Device stopped by the user, no objects are detected.
Green:	Device started error-free and ready to detect objects. There is no object in the sensing area.
Blinking green:	The light intensity of the sensor has fallen below the internally predefined warning limit. The device is ready for object detection. There is no object in the sensing area.
Blue:	Object has been detected or is in the sensing area. The status LED remains blue as long as the object is in the sensing area.
Blinking red/blue:	An object is in the sensing area and the maximum passing time of an object in the sensing area has been exceeded. The LVMC waits for the object to be removed and then restarts.

5 LVMC CMT – LVMC Configuration and Monitoring Tool

Configuration, operation, analysis and monitoring of the LVMC are performed via the Microsoft Windows based software LVMC CMT (“LVMC Configuration and Monitoring Tool”). The software can be downloaded from the OPTRONIC website www.optronic.ch in section DOWNLOAD. Select the latest version with the highest version number that matches the interface version of the firmware of your LVMC. The interface version is labeled with a capital letter followed by a numeral. It changes when the firmware incorporates significant new features that bring changes to the interface between the LVMC firmware and the CMT.

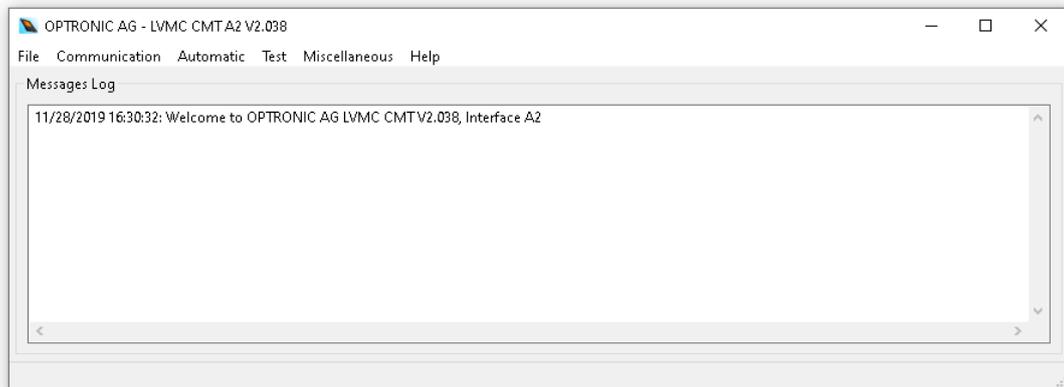
5.1 Requirements

The LVMC CMT runs on PCs with Windows 8 or Windows 10 operating systems. There are no special requirements for computing power, main memory and disk storage. The screen resolution should be at least Full HD (1920x1080 pixels).

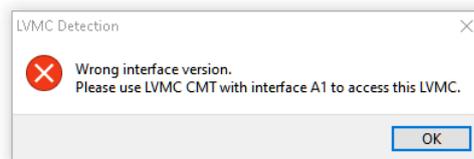


5.2 Interface Compatibility

The interface versions of the CMT and the light curtain firmware must match so that the CMT can communicate with the light curtain. CMT displays the interface version directly after the start in the title bar and in the message log window (“A2” in the picture below).



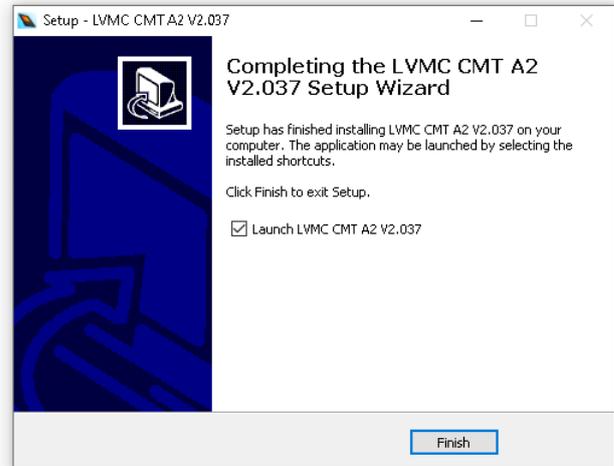
When establishing a connection with the LVMC, the interface version of the light curtain is read out and checked for conformity with the interface version of the CMT. If they do not match, an error message pops up and the connection is terminated. There is thus no danger of accessing an LVMC with an incompatible CMT.



5.3 Installing the Software

You can find the interface version and the software version in the file name of the installation file. An example of a valid file name is: "lvmc_cmt_a2_v2.037_setup.exe". This installation file is used to install software version V2.037, which has interface version A2. It is possible to have any number of software versions installed at the same time and also to uninstall each one separately.

After starting the installation, you will be prompted to enter the administrator password, unless you are logged in as an administrator. You can select the language to be used during the installation and decide if you want to create a desktop icon. Press the "Install" button to start the installation process. Once the installation has been completed, you can decide whether the CMT that has just been installed should be started directly. You end the installation routine by pressing the "Finish" button.



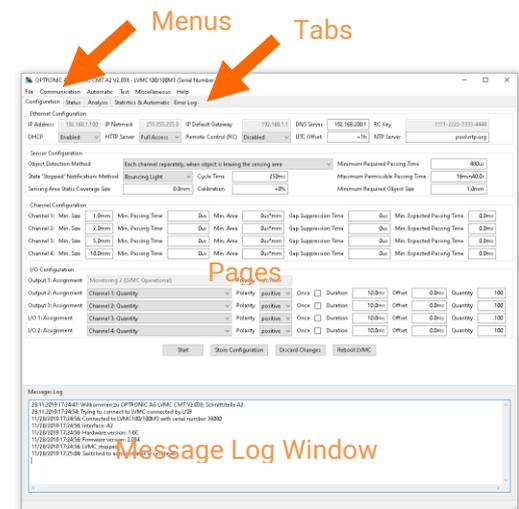
5.4 Uninstalling the Software

Each installed CMT software version can be uninstalled separately. Uninstalling can be done via the Control Panel or directly via the specific entry in the menu. For example, execute entry "Remove LVMC CMT A2 V2.037" in the menu under "All Programs" / "LVMC CMT".

5.5 Build-Up of the Software

The CMT program window is divided into three areas:

- Six menus: "File", "Communication", "Automatic", "Test", "Miscellaneous", and "Help". Depending on the state, not all menu entries are available.
- Five pages, each with a tab: "Configuration", "Status", "Analysis", "Statistics & Automatic", and "Error Log". These are only available when the CMT is connected to an LVMC.
- The message log window, which displays status and error messages in chronological order.



For many display elements in the CMT program window, so-called tool-tips are available. Displaying the tool-tips can be activated by the entry "Show Tool-Tips" in the "Help" menu. If you hover with the mouse over a display item and hold briefly, information and explanations of contexts and functioning appear. Immediately after starting the software, only the log window and the menu are shown. The five pages "Configuration", "Status", "Analysis", "Statistics & Automatics", and "Error Log" are not yet available. Not all menu entries can be selected at any time. Non-selectable entries are shown in gray.

5.6 Access Levels

The software provides two access levels: The user access level and the administrative access level. At the user access level, the light curtain can only be observed. It can not be controlled and no adjustments can be made to the configuration. Unavailable functions are shown in gray. At the administrator access level, the user has full access to the LVMC.

Even at the administrator access level, not all functions are always available. The availability depends on the state of the LVMC. For example, no adjustments can be made to the configuration if the LVMC is in the "running" operating mode. Changes are only possible in the "stopped" state.

Switching between the two access levels is done via the "Miscellaneous" menu: The entry "Switch to Administrator Access Level" is used to switch to the administrator access level, the entry "Switch Back to User Access Level" is used to switch back to the user access level.

Switching to the administrator access level can optionally be secured by a password. If an administrator password is set, it must be entered to authorize the change. A password is defined via the entry "Set Administrator Password" in the "Miscellaneous" menu. The entry can only be selected at the administrator access level and when the LVMC is in the "stopped" operating mode. To assign a new password, the old one must be known. The new password must also be entered twice to avoid input errors. If you leave both input fields empty, changing to the administrator access level is no longer password protected. If you have forgotten the password, the LVMC must be sent to OPTRONIC AG in order to reset it.

5.7 Units of Inputs and Outputs

Many inputs and outputs have units such as "s" for seconds or "mm" for millimeters. These are part of an input and therefore must be entered. Valid units for linear measures and time measures are:

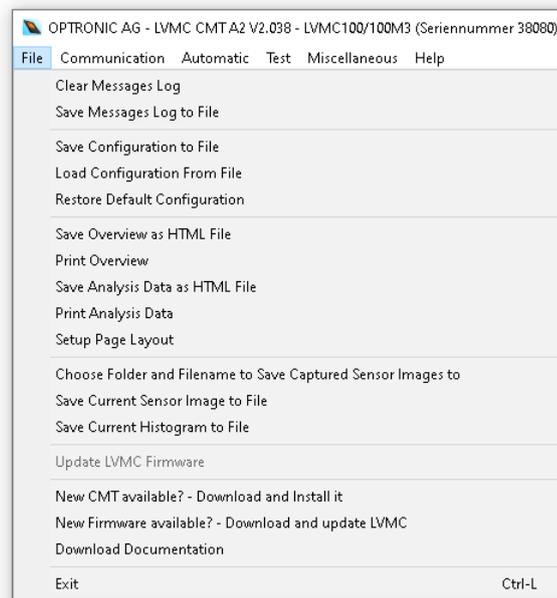
„m“:	Meter	„d“:	Days	„s“:	Seconds
„mm“:	Millimeter	„h“:	Hours	„ms“:	Milliseconds
„um“:	Micrometer	„min“:	Minutes	„us“:	Microseconds

It is up to you which unit you enter. The CMT will check your entry for validity and adjust it if necessary. It may also be that your input is converted to a different representation. For example, if you enter "1000s" for a period of time, the value will be converted to "16min40.0s". If you enter "0.01s" in an input field that has to be changed in 30us steps, then this value will be converted to "10ms20us".

5.8 Menus

Each of the six menus “File”, “Communication”, “Automatic”, “Test”, “Miscellaneous” and “Help” contains menu entries that are selectable or unavailable depending on the device state. Non-available entries are grayed out. The menu entries are presented and explained in the following subchapters.

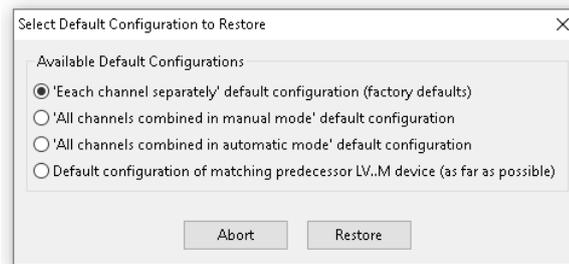
5.8.1 Menu „File“



Explanations of the available menu entries:

- Via the entry “Clear Message Log” the content of the message log window can be cleared.
- Via the entry “Save Message Log to File” you can save the current content of the message log window to a text file. The storage location can be freely selected via a file selection window.
- Via the entry “Save Configuration to File” the current configuration of the LVMC can be saved to a file. The storage location can be freely selected via a file selection window.
- Via the entry “Load Configuration from File”, a configuration previously stored in a file can be loaded into the connected LVMC. The file to load can be selected via a file selection window.
- Via the entry “Restore Default Configuration” a standard configuration stored in the device can be loaded. The selectable configurations differ in the preselected object detection method, the channel configuration, and the I/O configuration. There are four configurations to choose from:
 - “‘Each channel separately’ default configuration (factory defaults)”:
The configuration a LVMC is delivered with as standard, unless customer-specific settings have been requested. Each channel works independently of all others. If there are four outputs, each output has a channel assigned to it.
 - “‘All channels combined in manual mode’ default configuration”:
The channels work combined in manual mode, a passing object is only detected by one channel at a time. If there are four outputs, each output has a channel assigned to it.

- “All channels combined in automatic mode’ default configuration”:
The channels work in combination in automatic mode, the light curtain autonomously configures the settings “Minimum Area” and “Gap Suppression Time” at runtime by use of collected data on the objects passing the sensing area. No initial values are taken into account. The device starts automatic assignment to a channel after 25 objects have passed the sensing area. After 10 minutes without an object having passed the sensing area, the automatic mode is restarted automatically.
- “Default configuration of matching predecessor LV..M device (as far as possible)”:
If the LVMC replaces a device of the series LV..M with the same sensing area size, then this option allows to load a configuration which corresponds as far as possible to the standard configuration of the LV..M.

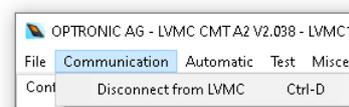
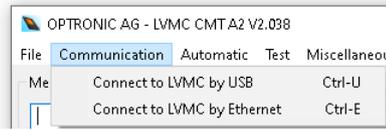


- Via the entry “Save Overview as HTML File”, information about the configuration, the status, and occurred errors is saved in a HTML file. The storage location can be freely selected via a file selection window.
- Via the entry “Print overview”, information about the configuration, the status, and occurred errors can be printed on a connected printer.
- Via the entry “Save Analysis Data as HTML File”, the currently available analysis data are saved in an HTML file. The storage location can be freely selected via a file selection window.
- Via the entry “Print Analysis Data”, the currently available analysis data are printed on a connected printer.
- Via the entry “Setup Page Layout”, the page layout for print functions can be defined. You can specify the paper size, orientation and margins.
- Via the entry “Choose Folder and Filename to Save Captured Sensor Images to”, a folder and a file name can be selected that will be used to save images captured using the analysis function.
- Via the entry “Save Current Sensor Image to File”, the captured sensor image currently displayed on the page “Analysis” is saved. The storage location can be freely selected via a file selection window.
- Via the entry “Save Current Histogram to File”, the histogram currently displayed on the “Statistics & Automatic” page is saved. The storage location can be freely selected via a file selection window.
- Via the entry “Update LVMC Firmware”, the firmware of a LVMC connected by USB can be updated. For this entry to be available, the CMT must not be connected to the LVMC.
- Via the entry “New CMT available? - Download and Install it” can be checked if a new version of the CMT is available. If so, the installation file can be downloaded and the software automatically installed.
- Via the entry “New Firmware available? - Download and update LVMC” can be checked if new firmware is available for the light curtain currently connected to the CMT. If so, it can be downloaded and automatically installed.

- Via the entry “Download Documentation”, the current documentation for the light curtain can be downloaded from the internet.
- Via the entry “Exit”, the CMT software ist terminated. Alternatively, you can click on the red “close” icon in the upper right corner of the window.



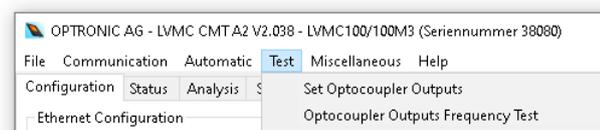
5.8.2 Menu „Communication“



Explanations of the available menu entries:

- Via the entry “Connect to LVMC by USB” the connection to a light curtain connected via USB can be established. Once the connection has been established, the five pages “Configuration”, “Status”, “Analysis”, “Statistics & Automatic” and “Error Log” are available in the program window, in addition to the menu and the message log.
- Via the entry “Connect to LVMC by Ethernet” the connection to a light curtain accessible via Ethernet can be established. Once the connection has been established, the five pages “Configuration”, “Status”, “Analysis”, “Statistics & Automatic” and “Error Log” are available in the program window, in addition to the menu and the message log. The default password that is set at deliver time, which is required for authentication, is „1234“.
- Via the entry "Disconnect from LVMC", the CMT is disconnected from the LVMC. The five pages “Configuration”, “Status”, “Analysis”, “Statistics & Automatic” and “Error Log” are no more available, the program window only consists of menu and message log.

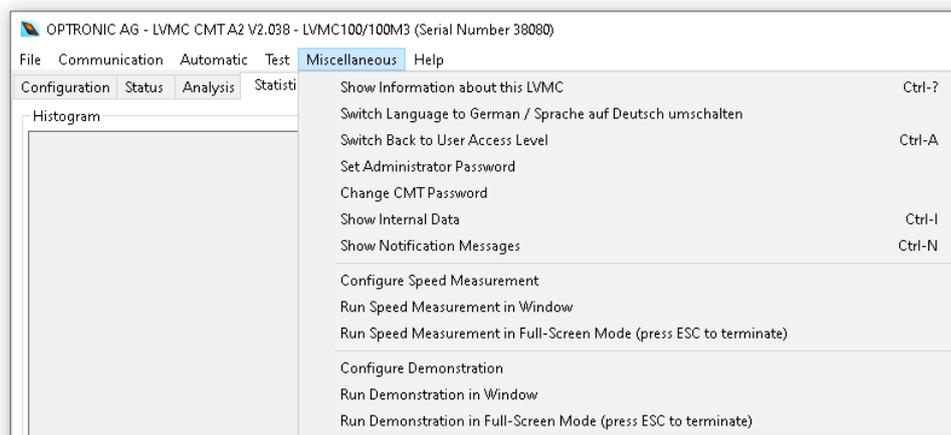
5.8.3 Menu „Test“



Explanations of the available menu entries:

- Via the entry “Set Optocoupler Outputs”, a dialog window is opened, by which the optocoupler outputs, with the exception of output 1 (permanently assigned to signal “Monitoring 2 (LVMC Operational)”), can be switched manually. Detailed information can be found in chapter 0.
- Via the entry “Optocoupler Outputs Frequency Test”, a dialog window is opened, by which a frequency test of the optocoupler outputs, with the exception of output 1 (permanently assigned to signal “Monitoring 2 (LVMC Operational)”), can be carried out. Detailed information can be found in chapter 0.

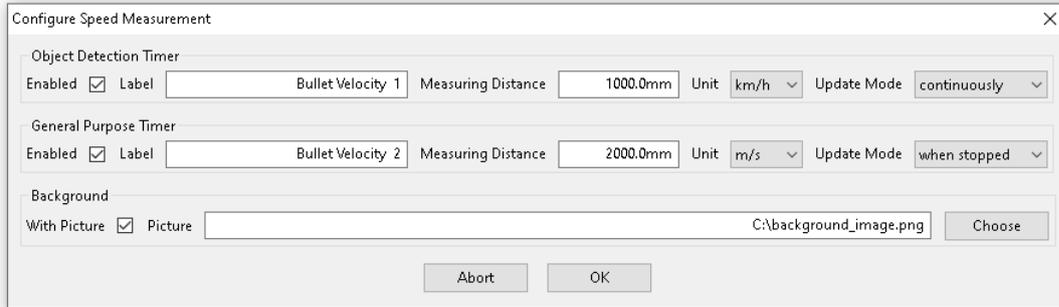
5.8.4 Menu „Miscellaneous“



Explanations of the available menu entries:

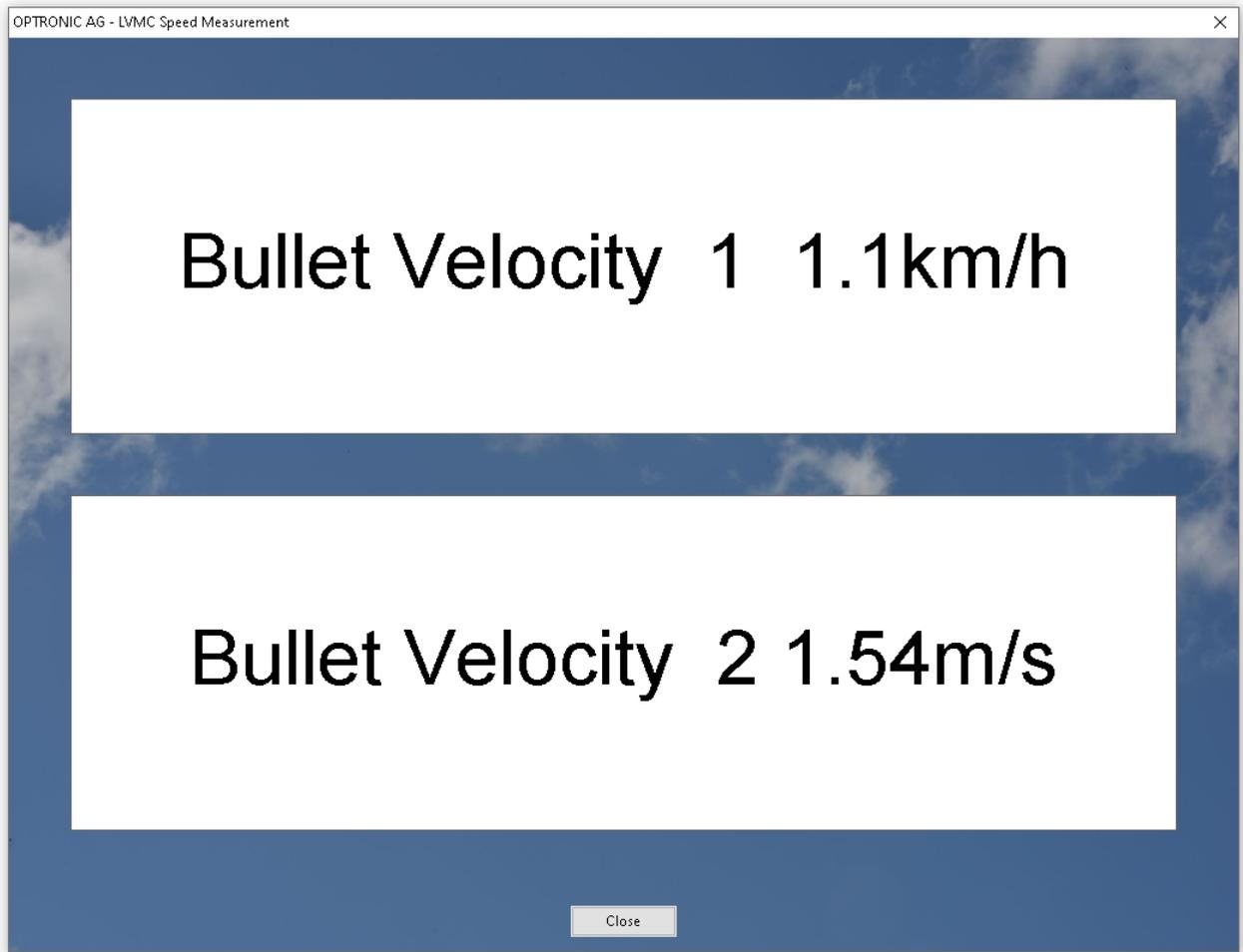
- Via the entry “Show information about the LVMC”, detailed information about the fixed properties of the light curtain can be viewed. Detailed information can be found in chapter 5.15.
- Via the entry “Switch Language to German” the language used in the CMT can be switched to German. The menu and the five pages are immediately rebuilt in German. Messages already in the log remain in German, new messages appear in English. The entry “Switch Language to English” switches the language back to English.
- Via the entry “Switch to Administrator Access Level”, the access level can be switched to administrator. If an administrator password is set, it must be entered to authorize the switch. The entry “Switch Back to User Access Level” can be used to switch back to the user access level.
- Via the entry “Set Administrator Password”, the administrator password required to switch to the administrator access level can be set. No password is set on delivery. If a password is set, it must be entered before assigning a new password. For security reasons, the new password must be entered twice.
- Via the entry “Change CMT Password”, the password required for access control when establishing a connection via Ethernet can be set. This is useful because the LVMC can be accessed via Ethernet from any network node.
Connection via USB is possible at any time without entering a password.
- Via the entry “Show Internal Data”, displaying additional values on the status page can be enabled. The additional values displayed are not relevant for normal operation and will not be discussed further in this manual. If necessary, OPTRONIC AG will ask you to activate the display of these values for a deeper problem analysis. Entry “Stop Showing Internal Data” can be used to deactivate again the display of these additional values. The setting made is saved beyond the CMT has been terminated, i.e. after a restart of the CMT, the last setting made is automatically selected again.
- Via the entry “Show Notification Messages”, displaying notification messages can be enabled. These messages often provide you with additional important information, but can hinder a fast operation. You can disable the display of these notification messages via the entry “Stop Showing Notification Messages”. The setting made is saved beyond the CMT has been terminated, i.e. after a restart of the CMT, the last setting made is automatically selected again.

- Via the entry “Configure Speed Measurement”, the integrated speed measurement for the activated timer(s) can be configured. For each timer, the measurement distance, i.e. the distance between the LVMCs sensing area and the location of the second sensor involved in the measurement, must be specified. The speed can be displayed in units of km/h or m/s. The update mode determines when the displayed speed value is updated. It can be selected between “continuous” and “when stopped”. In the “continuous” mode, the displayed speed is periodically updated beginning from the moment the timer is started. Once the timer has been stopped, the displayed value stops at the value calculated by use of the measured duration. In between, the hypothetical speed corresponding to the currently elapsed time is displayed. In the “stopped” mode, a speed value is not displayed until the timer has been stopped.

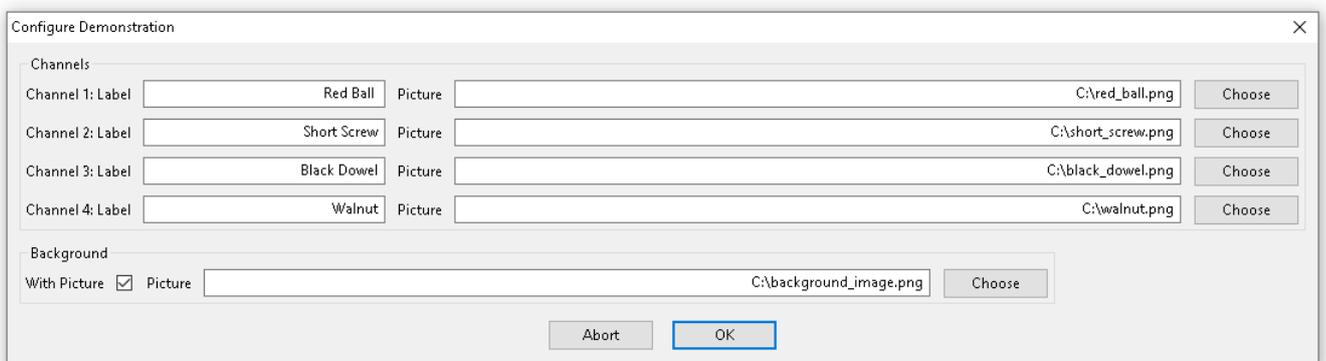


For each timer, the selection box “Enabled” can be used to decide whether a speed measurement should be carried out or not. In addition, a label can be specified. In the background, an image can be displayed instead of a white plane. To enable it, the selection box “With Picture” must be marked. By pressing the “Choose” button, you can choose any image to be displayed. If no picture is selected, the picture stored internally in the CMT is displayed.

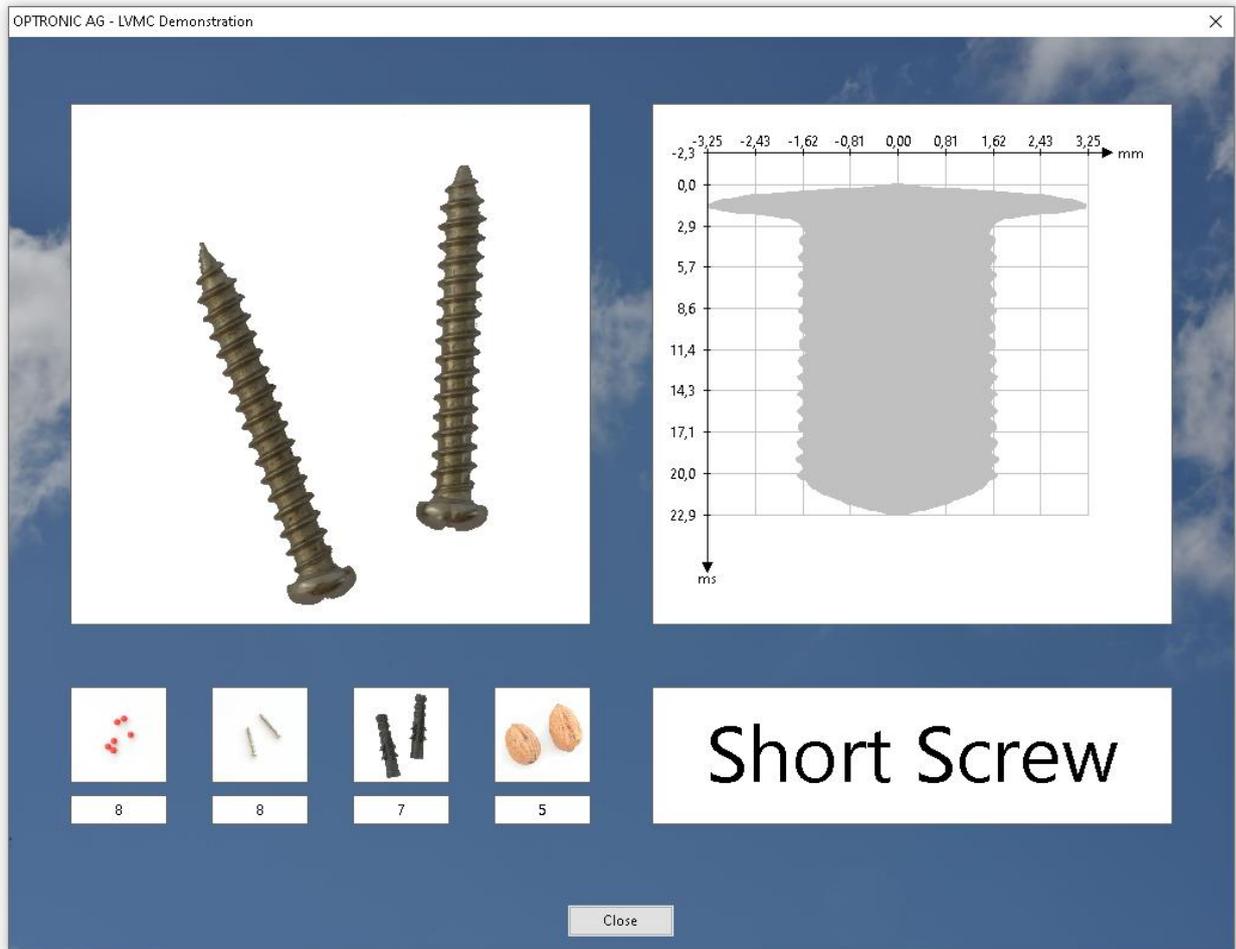
- Via the entries “Run Speed Measurement in Window” and “Run Speed Measurement in Full-Screen Mode (press ESC to terminate)” the speed measurement is started. A new window opens when the first entry is selected. The second entry starts the measurement in full screen mode, which can be terminated by pressing the Escape key. When the timer is stopped, either a white area is displayed, or the label and the calculated speed of the last time measurement are displayed, if the speed measurement was already running during the last time measurement.



- Via the entry “Configure Demonstration”, the integrated demonstration mode can be configured. This mode is used to demonstrate the classification of objects: A label and an image can be specified per channel. The picture and the label of a channel are displayed in the demonstration, if an object that has passed the sensing area has been assigned to this channel. In addition, the counter readings of all channels are displayed. In the background, an image can be displayed instead of a white surface. To enable it, the selection box “With Picture” must be marked. By pressing the “Choose” button, you can choose any image to be displayed. If no picture is selected, the picture stored internally in the CMT is displayed.

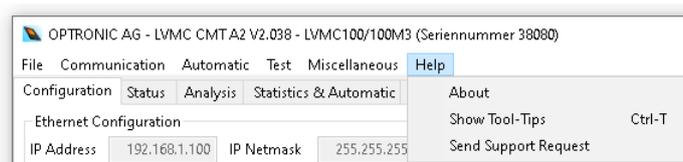


- Via the entries “Run Demonstration in Window” and “Run Demonstration in Full-Screen Mode (press ESC to terminate)” the demonstration is started. A new window opens when the first entry is selected. The second entry starts the demonstration in full screen mode, which can be terminated by pressing the Escape key.



At the left bottom, the counter readings of the individual channels are displayed together with the images assigned to the channels. The image of the channel to which the last object was assigned is displayed again in the upper left corner. At the right bottom the label assigned to this channel is shown. The captured sensor image appears in the upper right corner.

5.8.5 Menu „Help“



Explanations of the available menu entries:

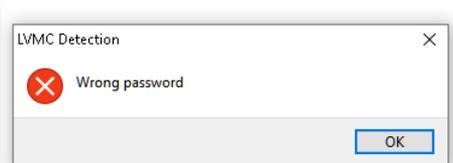
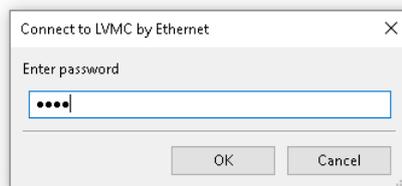
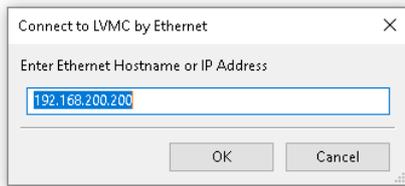
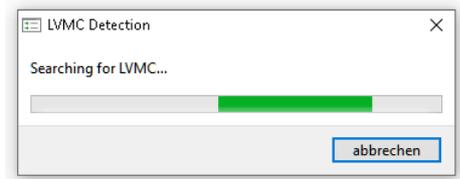
- Via the entry "About", information about the CMT software can be shown. The software version and the interface version are displayed besides other information.
- Via the entry "Show Tool-Tips", the display of tool-tips can be enabled. Via the entry "Stop showing Tool-Tips", the display of tool-tips can be disabled again.
- Via the entry "Send Support Request", you can send a support request to OPTRONIC AG via the email program installed on your PC. If you are connected to an LVMC via USB or Ethernet, the current configuration settings of the LVMC are automatically sent as well.

5.9 Establishing a Connection with a LVMC

Via the menu entries "Connect to LVMC by USB" and "Connect to LVMC by Ethernet" in the menu "Communication", the connection to an LVMC connected to the computer via USB or accessible via Ethernet can be established.

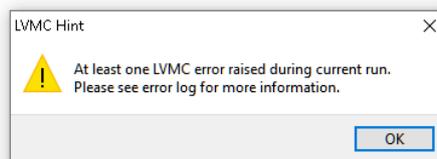
When connecting via USB, a dialog box with a progress bar appears immediately. It is closed again as soon as the connection has been established. The CMT connects to the first light curtain that is found. The search continues until a free LVMC is found or the "Cancel" button is pressed in the dialog box.

When connecting via Ethernet, the Ethernet host name or IP address must be entered first. The CMT remembers the last input made and automatically offers it again at the next connection attempt. Then the CMT asks for the password the connection is secured with. The CMT password can be set in the CMT via the menu entry "Change CMT Password" in menu "Miscellaneous". The default password at delivery is "1234". Similar to the connection via USB, a dialog box with a progress bar appears. It is closed again as soon as the connection has been established. The search for this LVMC continues until it is found or the "Cancel" button is pressed in the dialog box. If the entered password does not match the one stored in the LVMC, a dialog box will appear and the connection will be rejected.



When the connection is successfully established, the five pages "Configuration", "Status", "Analysis", "Statistics & Automatic" and "Error Log" are available. The configuration page is first displayed in the foreground.

If the LVMC has detected and logged an error in the current run, and showing notification messages is activated (menu "Miscellaneous", entry "Show Notification Messages"), a dialog box prompts you to check the error log:



5.10 Configuration Page

The configuration page is divided into several sections. In the first section “Ethernet Configuration”, the settings for the Ethernet network connection can be found. The second section “Sensor configuration” contains settings for the sensor, including the object detection method. If the object detection method “All channels combined, automatic mode, when object is leaving the sensing area” is selected, the third section “Automatic Mode Configuration” contains the settings for the automatic mode. In the following section “Channel configuration”, the four available channels can be parameterized and in the last section “I/O Configuration”, the settings for the optocoupler inputs and outputs can be found.

Ethernet Configuration

IP Address: 192.168.1.100 | IP Netmask: 255.255.255.0 | IP Default Gateway: 192.168.1.1 | DNS Server: 192.168.1.1 | RC Key: 1111-2222-3333-4444
 DHCP: Enabled | HTTP Server: Disabled | Remote Control (RC): Disabled | UTC Offset: +1h | NTP Server: pool.ntp.org

Sensor Configuration

Object Detection Method: All channels combined, automatic mode, when object is leaving the sensing area | Minimum Required Passing Time: 480us
 State 'Stopped' Notification: Method: Bouncing Light | Cycle Time: 250ms | Maximum Permissible Passing Time: 1.0s
 Sensing Area Static Coverage Size: 0.0mm | Calibration: +0% | Minimum Required Object Size: 1.0mm

Automatic Mode Configuration

Starting Count: 10 | Preset Values: | Quantity: 100 | Gap Suppression: | Time: 0us | Captured Quantity: 0 | Average Area: 0us*mm
 Sharpness: 10 | Rolling: | Quantity: 1000 | Self-Restart: | Delay: 10min | Minimum Areas: 3us*mm, 99999.99s*mm, 99999.99s*mm

Channel Configuration

Channel	Minimum Size	Minimum Area	Gap Suppression Time
Channel 1	1.0mm	0us*mm	0us
Channel 2	1.0mm	3us*mm	0us
Channel 3	1.0mm	99999.99s*mm	0us
Channel 4	1.0mm	99999.99s*mm	0us

I/O Configuration

Output 1: Assignment: Monitoring 2 (LVMC Operational) | Polarity: positive
 Output 2: Assignment: Object Stuck | Polarity: positive
 Output 3: Assignment: All Channels: Detection, Pulse-Coded, w/o Channel 1 | Polarity: positive | Once: | Duration: 10.0ms | Offset: 0.0ms
 I/O 1: Assignment: Channel 1: Detection | Polarity: positive | Once: | Duration: 10.0ms | Offset: 0.0ms
 I/O 2: Assignment: Automatic Mode Restart | Edge: positive

Buttons: Start, Store Configuration, Discard Changes, Reboot LVMC

Messages Log

```

06/14/2021 15:37:17: Trying to connect to LVMC connected by USB
06/14/2021 15:37:19: Connected to LVMC100/100M3 with serial number 12345
06/14/2021 15:37:19: Interface: A2
06/14/2021 15:37:19: Hardware version: 1.6C
06/14/2021 15:37:19: Firmware version: 2.115
06/14/2021 15:37:19: LVMC stopped
06/14/2021 15:37:24: Switched to administrator access level
  
```

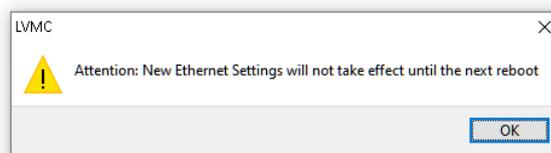
5.10.1 Section "Ethernet Configuration"

Ethernet Configuration							
IP Address	192.168.1.100	IP Netmask	255.255.255.0	IP Default Gateway	192.168.1.1	DNS Server	192.168.1.1
DHCP	Enabled	HTTP Server	Disabled	Remote Control (RC)	Disabled	UTC Offset	+1h
						NTP Server	pool.ntp.org
						RC Key	1111-2222-3333-4444

In the section "Ethernet Configuration", the necessary settings for communication via Ethernet can be found. The Ethernet configuration is preferably adjusted when the connection to the LVMC is established via USB. If the password for accessing the LVMC via Ethernet has been lost, the connection can be established via USB and a new password can be assigned. If the DHCP server is activated (setting "DHCP"), the "IP Address", "IP Netmask" and "IP Default Gateway" settings cannot be changed, as they are determined via the DHCP server. Therefore, they are displayed in grey. The setting "RC key" can only be adapted if the remote control (setting "Remote Control (RC)") is activated.

Ethernet Configuration							
IP Address	192.168.200.100	IP Netmask	255.255.255.0	IP Default Gateway	192.168.200.1	DNS Server	192.168.200.1
DHCP	Disabled	HTTP Server	Full Access	Remote Control (RC)	Encrypted	UTC Offset	+1h
						NTP Server	pool.ntp.org
						RC Key	1111-2222-3333-4444

Please note that any changes made to the network configuration will not become active until the next reboot. If the display of notification messages is activated, you will be notified by a message::



Explanation of the available settings:

- "IP Address": The Ethernet IP address that is used when DHCP is turned off. Modifying this setting is only possible if DHCP is deactivated. A change will not be active until the next restart.
- "IP Netmask": The Ethernet IP netmask that is used when DHCP is turned off. Modifying this setting is only possible if DHCP is deactivated. A change will not be active until the next restart.
- "IP Default Gateway": The Ethernet IP default gateway that is used when DHCP is turned off. Modifying this setting is only possible if DHCP is deactivated. A change will not be active until the next restart.
- "DNS Server": The DNS Server that is used when it is not assigned by DHCP. A change will not be active until the next restart.
- "DHCP": Defines if the Ethernet interface is dynamically configured by DHCP at power on or reboot, or if the entered static settings are used. A change will not be active until the next restart.
- "HTTP Server": Defines if the HTTP Server is enabled or disabled. It can be activated in two modes: In read-only (select "Read-Only") and in read/write (select "Full Access") mode. Settings can be modified only in read/write mode. Be aware that the read-write mode is insecure, as there is no authorization monitoring implemented. Use this mode only in a secured network. A change of this setting will take effect immediately.

- “Remote Control (RC)”: Defines if remote controlling over Ethernet is enabled or disabled. It can be enabled in unencrypted mode or in encrypted mode.
A change will take effect immediately.
- “RC Key”:
The key used for encrypting remote control data transfers over Ethernet. The key must consist of four four character long strings, which must be separated by dashes.
Modifying this setting is only possible if the remote control activated.
- “UTC Offset”:
The offset between Coordinated Universal Time (UTC) and the local time. A changed value will take effect at the next date and time synchronization.
- “NTP Server”:
The NTP Server that is used for date and time synchronization, when it is not assigned by DHCP. A changed value will take effect at the next date and time synchronization.

5.10.2 Section “Sensor Configuration”

Sensor-specific settings can be found in the “Sensor Configuration” section.

Sensor Configuration			
Object Detection Method	All channels combined, automatic mode, when object is leaving the sensing area	Minimum Required Passing Time	480us
State 'Stopped' Notification: Method	Bouncing Light	Cycle Time	250ms
Sensing Area Static Coverage Size	0.0mm	Calibration	+0%
		Maximum Permissible Passing Time	1.0s
		Minimum Required Object Size	1.0mm

Explanation of the available settings:

“Object Detection Method”:
To select the method used to detect objects, and to define when object detection is reported. Basically, two methods are supported: “separately” and “combined”.

In mode “separately”, each channel works independent from all others. A channel detects a passing object, if its geometry and the passing time match the channel configuration parameters. Therefore, a passing object can be detected by several channels at the same time.

In mode “combined”, a passing object is always only detected by one channel. First, all channels that detect the passing object are determined. A channel detects a passing object, if its geometry and the passing time match the channel configuration parameters. Among these channels, the one with the highest minimum size is selected. If this highest minimum size is set for more than one of the channels that have detected the passing object, then the channel with the lowest channel number is selected. For example, if the minimum sizes for channels 1 to 4 are set to 1, 2, 4, and 8mm, and the size of the passing object is 5mm, channels 1 to 3 are initially selected. Among these channels, channel 3 has the highest minimum size (4mm) and is therefore selected.

Possible detection modes are:

- “Each channel separately, while object within sensing area”:
Each channel works separately, the channel reports detection during all the time the object is passing the sensing area.
- “Each channel separately, when object is entering the sensing area”:
Each channel works separately, the channel reports detection when the object is entering the sensing area.

- “Each channel separately, when object is leaving the sensing area”:
Each channel works separately, the channel reports detection when the object is leaving the sensing area.
- „All channels combined, manual mode, when object is leaving the sensing area”:
When the object leaves the sensing area, the channel that has set the highest minimum size among the channels that have detected the object is selected. If this highest minimum size is set for more than one of the channels that have detected the passing object, then the channel with the lowest channel number is selected.
- “All channels combined, automatic mode, when object is leaving the sensing area”:
When the object leaves the sensing area, the channel that has the highest minimum size among the channels that have detected the object is selected. If this highest minimum size is set for more than one of the channels that have detected the passing object, then the channel with the lowest channel number is selected. For each channel, the minimum area an object must have so that it is detected by this channel, and, if enabled, the gap suppression time are automatically determined and contiguously adjusted. In automatic mode, it is expected that only one object type is passing the sensing area. The task is to filter out faulty objects with an area deviating from the standard. Therefore, the LVMC contiguously learns by use of the collected information on the objects that are passing the sensing area. For each channel, parameter “Minimum Area” and, if enabled, the gap suppression time are automatically and contiguously calculated. The values entered in parameters “Minimum Area” and “Gap Suppression Time” of channel 1 are taken as lower limits for the automatically determined corresponding values of channels 2 to 4. Channel parameters “Minimum Size”, “Minimum Passing Time”, and “Minimum Expected Passing Time” are automatically set to the same values for all channels. Therefore, they can only be entered for channel 1.
Two methods of data collection are available: Using all objects that passed the sensing area since the automatic mode has been started, or rolling over a given quantity of objects which have last passed the sensing area. The rolling mode compensates changes that happen over time, which may be desired or unwanted. The meaning of each channel is predefined:
 - Channel 1 counts objects that are classified as too small.
 - Channel 2 counts objects with correct area.
 - Channel 3 serves to count objects that are classified as too large, or to count two correct objects that follow too close and therefore pass the sensing area without a gap.
 - Channel 4 serves to count objects that are classified as too large, or to count three correct objects that follow too close and therefore pass the sensing area without a gap.

"State 'Stopped' Notification: Method":	<p>To select how and if the LVMC notifies that it is in "stopped" state. This can be used to distinguish several LVMCs. The functionality is turned off when "Light Turned Off" is selected. If notification is desired, you can choose between four methods:</p> <ul style="list-style-type: none"> • "Flashing Light": The red light of the sensor is turned on and off. The time it is on and the time it is off is equal. It is defined by parameter "Cycle Time". • "Running Light Type A": The sensor shows a running light, starting at the side where the electronics is located. The time for one pass is defined by parameter "Cycle Time". • "Running Light Type B": The sensor shows a running light, ending at the side where the electronics is located. The time for one pass is defined by parameter "Cycle Time". • "Bouncing Light": The sensor shows a running light that bounces from one end to the other. The time for one pass is defined by parameter "Cycle Time".
"State 'Stopped' Notification: Cycle Time":	This is the cycle time used for the selected state "stopped" notification method. The minimum value is 250ms, and the value must be a multiple of 250ms.
"Minimum Required Passing Time":	The minimum passing time of an object. By increasing this value, the LVMC gets more robust against harsh environments.
"Maximum Permissible Passing Time":	The maximum permissible passing time of an object. After this time has elapsed, the LVMC stops running and the error message "Maximum permissible passing time overrun: Object stuck? - LVMC waits until object is removed" is issued.
"Minimum Required Object Size":	The minimum object size that should be detectable by the LVMC. The value must be equal to or higher than the size resolution of the LVMC. The size resolution is shown in the LVMC Information window that can be opened by menu entry "Show Information about this LVMC".
"Sensing Area Static Coverage Size":	<p>By use of this input value, it is possible to define the size of an area of the sensing area that is statically covered. This is useful, if for example a conveyor or other machine parts reach into the sensing area.</p> <p>Attention: The measuring function of the device s maybe limited if an object is statically in the sensing area.</p>
"Calibration":	The entered value in percent is used to calibrate the sensor in order to increase accuracy. If objects pass the sensing area always in the same predefined narrow area, this factor can be used to correct the detected object size by the given percentage.

5.10.3 Section "Automatic Mode Configuration"

The parameterization of the automatic mode is done via the section "Automatic Mode Configuration".

Automatic Mode Configuration													
Starting Count	<input type="text" value="10"/>	Preset Values	<input checked="" type="checkbox"/>	Quantity	<input type="text" value="100"/>	Gap Suppression	<input checked="" type="checkbox"/>	Time	<input type="text" value="0us"/>	Captured Quantity	<input type="text" value="0"/>	Average Area	<input type="text" value="0us*mm"/>
Sharpness	<input type="text" value="10"/>	Rolling	<input checked="" type="checkbox"/>	Quantity	<input type="text" value="1000"/>	Self-Restart	<input checked="" type="checkbox"/>	Delay	<input type="text" value="10min"/>	Minimum Areas	<input type="text" value="3us*mm"/>	<input type="text" value="99999.99s*mm"/>	<input type="text" value="99999.99s*mm"/>

Explanation of the available settings:

- "Starting Count": The number of objects that must have passed the sensing area before the minimum area settings and, if selected, the gap suppression time settings of the channel 2 to 4 are automatically adjusted by the automatic mode. Before this number of objects has passed the sensing area, the values entered for channel 1, except the value for the minimum areas, are overtaken in channels 2 to 4. The minimum areas of channels 2 to 4 are predefined in such a way that all objects are treated as correct objects and are therefore assigned to channel 2, assuming that these values are greater than the entered minimum area in channel 1.
- "Preset Values: Mode": If this checkbox is marked, the automatic mode is initialized by use of stored preset values. These preset values are adjusted to the number of objects entered in parameter "Quantity". The preset values for the automatic mode are calculated by use of information learned about a number of objects that have passed the sensing area before.
- "Preset Values: Quantity": The quantity of objects the preset values are adjusted to during automatic mode initialization, when checkbox "Preset Values" is marked. The entered quantity of objects must be smaller or equal the quantity entered in input field "Quantity" of the rolling mode.
- "Gap Suppression: Mode": If this checkbox is marked, the gap suppression time of channels 2 to 4 is automatically adjusted. The lower limit of the gap suppression time of channels 2 to 4 is the value entered in input field "Gap Suppression Time" of channel 1. If checkbox "Preset Values" is also marked, the value in output field "Gap Suppression: Time" is taken as preset value for the gap suppression time of channels 2 to 4.
- "Gap Suppression: Time": The lower limit for the gap suppression time of channels 2 to 4, calculated by use of the learned information.
- "Sharpness": Defines how sharp the classification of objects by their area should be performed. The lower the value, the more passing objects with borderline area are classified to channel 2, which counts object with correct area.
- "Rolling: Mode": If this checkbox is marked, data used for automatic mode is collected in rolling mode. This means that only information about the last n objects that passed the sensing area is taken into account. Value n must be entered in parameter "Rolling: Quantity". If this checkbox is not marked, all objects that passed the sensing area since the automatic mode has started are taken into account.

- “Rolling: Quantity”: This parameter is only used, if data about objects passing the sensing area is collected in rolling mode. The rolling mode can be enabled by marking checkbox “Rolling: Mode”.
- “Self-Restart: Mode”: If this checkbox is marked, the automatic mode is restarted when no object has passed the sensing area for more than the time entered in parameter “Self-Restart: Delay”. All collected data and learned information about objects that have previously passed the sensing area is flushed. This mode is useful, if no external device is present that can stop and thereafter start the LVMC again, in order to manually restart automatic mode. After the restart, the LVMC is ready to detect and count different objects.
- “Self-Restart: Delay”: This parameter is only used, if the self-restart function of the automatic mode is enabled. This function can be enabled by marking checkbox “Self-Restart: Mode”.
- “Captured Quantity”: The number of objects used for learning.
- “Average Area”: The average area calculated by use of the information learned.
- “Minimum Areas”: The three output fields „Minimum Areas“ show the minimum areas calculated from the learned information, which can be used to distinguish between too small, correct, two-chained and three chained objects.

5.10.4 Section “Channel Configuration”

The parameterization of the available channels is done in the section “Channel Configuration”. Each line contains the settings for one channel. Depending on the object detection method selected, not all settings are available:

- Appearance for the object detection methods “Each channel separately, while object within sensing area” and “Each channel separately, when object is entering the sensing area”:

Channel Configuration					
Channel 1: Minimum Size	<input type="text" value="1.0mm"/>	Gap Suppression Time	<input type="text" value="0us"/>	Minimum Expected Passing Time	<input type="text" value="0.0ms"/>
Channel 2: Minimum Size	<input type="text" value="2.0mm"/>	Gap Suppression Time	<input type="text" value="0us"/>	Minimum Expected Passing Time	<input type="text" value="0.0ms"/>
Channel 3: Minimum Size	<input type="text" value="5.0mm"/>	Gap Suppression Time	<input type="text" value="0us"/>	Minimum Expected Passing Time	<input type="text" value="0.0ms"/>
Channel 4: Minimum Size	<input type="text" value="10.0mm"/>	Gap Suppression Time	<input type="text" value="0us"/>	Minimum Expected Passing Time	<input type="text" value="0.0ms"/>

- Appearance for the object detection methods “ Each channel separately, when object is leaving the sensing area” and “All channels combined, manual mode, when object is leaving the sensing area”:

Channel Configuration									
Channel 1: Min. Size	<input type="text" value="1.0mm"/>	Min. Passing Time	<input type="text" value="0us"/>	Min. Area	<input type="text" value="0us*mm"/>	Gap Suppression Time	<input type="text" value="0us"/>	Min. Expected Passing Time	<input type="text" value="0.0ms"/>
Channel 2: Min. Size	<input type="text" value="2.0mm"/>	Min. Passing Time	<input type="text" value="0us"/>	Min. Area	<input type="text" value="0us*mm"/>	Gap Suppression Time	<input type="text" value="0us"/>	Min. Expected Passing Time	<input type="text" value="0.0ms"/>
Channel 3: Min. Size	<input type="text" value="5.0mm"/>	Min. Passing Time	<input type="text" value="0us"/>	Min. Area	<input type="text" value="0us*mm"/>	Gap Suppression Time	<input type="text" value="0us"/>	Min. Expected Passing Time	<input type="text" value="0.0ms"/>
Channel 4: Min. Size	<input type="text" value="10.0mm"/>	Min. Passing Time	<input type="text" value="0us"/>	Min. Area	<input type="text" value="0us*mm"/>	Gap Suppression Time	<input type="text" value="0us"/>	Min. Expected Passing Time	<input type="text" value="0.0ms"/>

- Appearance for the object detection method “ All channels combined, automatic mode, when object is leaving the sensing area”:

Channel Configuration					
Channel 1: Minimum Size	<input type="text" value="1.0mm"/>	Minimum Area	<input type="text" value="0us*mm"/>	Gap Suppression Time	<input type="text" value="0us"/>
Channel 2: Minimum Size	<input type="text" value="1.0mm"/>	Minimum Area	<input type="text" value="3us*mm"/>	Gap Suppression Time	<input type="text" value="0us"/>
Channel 3: Minimum Size	<input type="text" value="1.0mm"/>	Minimum Area	<input type="text" value="99999.99*mm"/>	Gap Suppression Time	<input type="text" value="0us"/>
Channel 4: Minimum Size	<input type="text" value="1.0mm"/>	Minimum Area	<input type="text" value="99999.99*mm"/>	Gap Suppression Time	<input type="text" value="0us"/>

Explanation of the available settings:

- “Minimum Size”:
The minimum object size that is detected by the channel. The LVMC subtracts a safety margin from this value, and in reality uses the lowered value as lower limit, in order to guarantee, that no objects get missed.
In automatic mode, the minimum object size can only be entered for channel 1. The entered value is the lower limit for the minimum object size of the other channels.
- “Minimum Passing Time”:
The minimum time an object must cover the sensing area so that it is counted by the channel.
- “Minimum Area”:
The minimum area an object must have so that it is counted by the channel. To calculate the area, the LVMC sums up the measured object size (the covered part of the sensing area) over the time the object passes the sensing area. Therefore, the area must be entered in unit time multiplied by length.
This parameter can be used as a replacement for channel parameters “Minimum Size” and “Minimum Passing Time”, as they also define a simplified area.
In automatic mode, the minimum area can only be entered for channel 1. The entered value is the lower limit for the minimum area of the other channels.
- “Gap Suppression Time”:
An object may have one or more locations with size smaller than the minimum size entered for the channel. By use of this parameter, this form of gaps can be suppressed. Enter the maximum time a gap that should be suppressed can last.
In automatic mode, the gap suppression time can only be entered for channel 1. The entered value is the lower limit for the gap suppression time of the other channels.
- “Minimum Expected Passing Time”:
The minimum time a part is assumed to cover the sensing area. If an object is detected by the channel, the channel does not count another object until this time has passed. If this time expires while the sensing area is already covered by another object, this part is also not counted.
This parameter is available for compatibility with the previous device generation. It is replaced by parameter “Gap Suppression Time”.

5.10.5 Section „I/O Configuration“

The digital optocoupler inputs and outputs, also referred to as I/O pin, can be parameterized in the “I/O Configuration” section. Depending on the object detection method selected, different settings are possible.

I/O Configuration						
Output 1: Assignment	Monitoring 2 (LVMC Operational)	Polarity	positive			
Output 2: Assignment	Object Stuck	Polarity	positive			
Output 3: Assignment	All Channels: Detection, Pulse-Coded, w/o Channel 1	Polarity	positive	Once <input type="checkbox"/>	Duration <input type="text" value="10.0ms"/>	Offset <input type="text" value="0.0ms"/>
I/O 1: Assignment	Channel 1: Quantity	Polarity	positive	Once <input type="checkbox"/>	Duration <input type="text" value="10.0ms"/>	Offset <input type="text" value="0.0ms"/>
I/O 2: Assignment	Automatic Mode Restart	Edge	positive			Quantity <input type="text" value="100"/>

Explanation of the available settings:

“Assignment”: This parameter defines what for an I/O pin is used. Possible settings are:

- “not assigned”:
Configured as unused output that is never set.
- “Monitoring 1 (Warning)”:
The output is assigned to the warning signal “Monitoring 1”.
- “Object Stuck”:
The output is assigned to the stuck object detection. The signal is set when an object is stuck in the sensing area.
- “Channel x: Detection”:
The output is assigned to channel x in mode “detection”: The signal is set when an object is detected by the assigned channel.
- “Channel x: Quantity”:
The output is assigned to channel x in mode “quantity”: The signal is set when the by parameter “Quantity” defined number of objects is detected by the assigned channel.
- “Channels 1, 3, and 4: Detection”:
The output is assigned to channels 1, 3, and 4 in mode “detection”: The signal is set when an object is detected by any of these three channels.
- “Channels 3 and 4: Detection”:
The output is assigned to channels 3 and 4 in mode “detection”: The signal is set when an object is detected by any of these two channels.
- “All Channels: Detection”:
The output is assigned to all channels in mode “detection”: The signal is set when an object is detected by any channel.
- “All Channels: Quantity”:
The output is assigned to all channels in mode “quantity”: The signal is set when the by parameter “Quantity” defined number of objects is detected by all channels together.
- “All Channels: Detection, Length-Coded”:
The output is assigned to all channels in mode “detection”, the duration the signal is set depends on the number of the channel that detected the object: The signal is set when an object is detected by any channel. The duration the signal is set is given by the channel number multiplied by the value set in parameter “Duration”.

- **“All Channels: Detection, Pulse-Coded”:**
The output is assigned to all channels in mode “detection”. The signal is repeatedly set according to the number of the channel that has detected the object. (Channel 1: signal is set once, channel 4: signal is set four times.) The signal is set for the time specified by parameter “Duration”. The time between two pulses is also equal to the value set in parameter “Duration”.
- **“All Channels: Detection, Pulse-Coded, w/o Channel 1”:**
The output is assigned to all channels in mode “detection”. The signal is repeatedly set according to the by 1 decremented number of the channel that has detected the object. (Channel 1: signal is not set, channel 1: signal is set once, channel 4: signal is set three times.) The signal is set for the time specified by parameter “Duration”. The time between two pulses is also equal to the value set in parameter “Duration”.
- **“All Channels: Detection, Binary-Coded”:**
Outputs 3 to 5 are assigned to all channels in mode “detection”, output 3 is set when an object is detected, outputs 4 and 5 are set according the number of the channel that detected the object: The channel number minus 1 is output in binary notation on outputs 4 and 5. Output 4 is the lower bit, output 5 the higher one. Output 3 is set while the channel number is valid on outputs 4 and 5.
- **“Reset Counters”:**
On detection of the active edge of this input signal (the active edge is selected by the polarity), the object counters of all channels and signals are reset to 0.
- **„Automatic Mode Restart“:**
On detection of the active edge of this input signal (the active edge is selected by the polarity), the automatic mode is restarted. All collected data and learned information about objects that have previously passed the sensing area is flushed.
- **“Automatic Mode Restart/Reset Counters”:**
On detection of the active edge of this input signal (the active edge is selected by the polarity), the automatic mode is restarted and the object counters of all channels and signals are reset to 0.
- **“Stop Object Detection Timer”:**
On detection of the active edge of this input signal (the active edge is selected by the polarity), the object detection counter is stopped.
- **“Start General Purpose Timer”:**
On detection of the active edge of this input signal (the active edge is selected by the polarity), the general purpose timer is started.
- **“Stop General Purpose Timer”:**
On detection of the active edge of this input signal (the active edge is selected by the polarity), the general purpose timer is stopped.
- **“Start & Stop General Purpose Timer”:**
On detection of the active edge of this input signal (the active edge is selected by the polarity), the general purpose timer is started and stopped.

- “Channel Selection”:
I/Os 1 and 2 are used as digital inputs to select the active channel. The active channel is used for assignments “Channel by Inputs: Detection” and “Channel by Inputs: Quantity”.
- “Channel by Switch: Detection”:
The output is assigned to the channel selected by the switch in mode “detection”: The signal is set when an object is detected by the assigned channel.
- “Channel by Switch: Quantity”:
The output is assigned to the channel selected by the switch in mode “quantity”: The signal is set when the by parameter “Quantity” defined number of objects is detected by the assigned channel.
- “Channel by Inputs: Detection”:
The output is assigned to the channel selected by the digital optocoupler inputs in mode “detection”: The signal is set when an object is detected. by the assigned channel
- “Channel by Inputs: Quantity”:
The output is assigned to the channel selected by the digital optocoupler inputs in mode “quantity”: The signal is set when the by parameter “Quantity” defined number of objects is detected by the assigned channel.

“Polarity”:

To select the polarity of the signal at the digital I/O pin.

For an output, a positive polarity means that the optocoupler of this output pin is conducting when the output is set, and open when it is not set.

For an output, a negative polarity means that the optocoupler of this output pin is conducting when the output is not set, and open when it is set.

For an input, a positive polarity means that the input is set when the optocoupler of this input pin is conducting, and that the input is not set when it is open. For edge triggered assignments, a positive polarity means that the positive edge is evaluated (transition of the optocoupler from open to conducting).

For an input, a negative polarity means that the input is set when the optocoupler of this input pin is open, and that the input is not set when it is conducting. For edge triggered assignments, a negative polarity means that the negative edge is evaluated (transition of the optocoupler from conducting to open).

“Once”:

If the checkbox “Once” is marked and the channel is assigned in mode “detection”, the corresponding counter counts up to 1 when the first object is detected by the channel. The signal is set and the counter stops counting when the first object is detected.

If the checkbox “Once” is marked and the channel is assigned in mode “quantity”, the corresponding counter counts up to the number given in parameter “Quantity” when the channel has detected an object. When this quantity is reached, the signal is set, and the counter stops counting.

If the checkbox “Once” is not marked and the channel is assigned in mode “detection”, the corresponding counter counts up when the channel has detected an object.

If the checkbox “Once” is not marked and the channel is assigned in mode “quantity”, the corresponding counter counts up to the number given in parameter “Quantity” when the channel has detected an object. When this quantity is reached, the signal is set, and the counter is automatically reset to 0.

- “Duration”: For assignment “All Channels: Detection, Length-Coded”, this parameter defines the time that will be multiplied with the channel number. Please read the description to parameter “Assignment” for more information.
For all other assignments, this parameter defines the duration for which the signal is set on the output.
- “Offset”: Setting the signal at the output can be delayed. The delay can be defined by this parameter.
- “Quantity”: The object quantity to count up to for the output.
This parameter is only available, if the output is assigned to a channel in mode “quantity”.

5.10.6 Buttons

The configuration page offers four buttons at the bottom, which appear differently depending on the access level and the operating mode:

None of the buttons are available at the user access level, so they are all grayed out:



All buttons are available in the administration access level in operating mode "stopped". The text of the button "Save Configuration" is red, if configuration changes have not yet been saved in the non-volatile memory:



In the administration access level in operating mode "running", only the "Stop" button can be pressed:



Explanation of the buttons:

- "Start" or "Stop":** If the LVMC is in operating mode "stopped", the "Start" button is displayed. Press the "Start" button to switch to the "running" operating mode. If the LVMC is in operating mode "Running", the "Stop" button is displayed. Press the "Stop" button to switch to the "stopped" operating mode.
- "Store Configuration":** The text of this button is shown in red when the content of the volatile configuration set differs from the content of the nonvolatile set, i.e. made configuration changes were so far not stored in nonvolatile memory. By pressing this button, the current contents of the volatile set will be copied into the nonvolatile set. The button is only available, if the LVMC is in operating mode "stopped".
- "Discard Changes":** By pressing this button, the contents of the volatile set will be overwritten by the contents of the nonvolatile. All changes made since the last time button "Store Configuration" is pressed get lost. The button is only available, if the LVMC is in operating mode "stopped".
- "Reboot LVMC":** Pressing this button restarts the LVMC. During the boot process, the connection between CMT and LVMC is interrupted. It is automatically restored after starting up. Be aware that you must press button "Store Configuration" prior to that, if you have made any changes to the configuration parameters and want to keep them. The button is only available, if the LVMC is in operating mode "stopped".

5.11 Status Page

The status page is divided into several sections. The first section “General Status Information” displays general information about the status of the light curtain. In the following section “Ethernet State” the currently used Ethernet parameterization can be read, the third section “Channel Status” contains information on the channels. The fourth section shows the counter readings of the available outputs. If one or even both timers are activated, the status of the timer(s) is displayed in a fifth section. If the entry “Show Internal Data” has been selected in the “Miscellaneous” menu, internal data on the LVMC is displayed in a further section. These are not discussed in more detail because they are not important for normal operation. It may be that these values are required for problem analysis by OPTRONIC AG.

OPTRONIC AG - LVMC CMT A2 V2.038 - LVMC100/100M3 (Serial Number 38080)

File Communication Automatic Test Miscellaneous Help

Configuration Status Analysis Statistics & Automatic Error Log

General Status Information

State **running** Run Uptime Last Start Before Date Time

Output 1 (Monitoring 2): State **ON** Output 2: State **OFF** Output 3: State **OFF** I/O 1 (Input 1): State **ON** I/O 2 (Input 2): State **OFF**

Ethernet State

IP Address IP Netmask IP Default Gateway DNS Server NTP Server

Channel Status

Channel 1: Detection Size Count Covered Passing Time: Last Minimum Maximum

Channel 2: Detection Size Count Covered Passing Time: Last Minimum Maximum

Channel 3: Detection Size Count Covered Passing Time: Last Minimum Maximum

Channel 4: Detection Size Count Covered Passing Time: Last Minimum Maximum

Output Counter Reading

Output 2: Count Output 3: Count

Timer Status

Object Detection Timer General Purpose Timer

Add Comment

Stop Reset Counters Reset Status Reset Object Detection Timer Reset General Purpose Timer

Messages Log

```
04.12.2019 08:50:08: Trying to connect to LVMC connected by USB
12/04/2019 08:50:10: Connected to LVMC100/100M3 with serial number 38080
12/04/2019 08:50:10: Interface: A2
12/04/2019 08:50:10: Hardware version: 1.6C
12/04/2019 08:50:10: Firmware version: 2.034
12/04/2019 08:50:10: LVMC running
12/04/2019 08:50:13: Switched to administrator access level
```

5.11.1 Section "General Status Information"

The "General Status Information" section displays general information about the status of the light curtain. The appearance of this section depends on the device type and the settings in the "I/O Configuration" section of the Configuration page.

Example of a device with 5 outputs, or a device with 3 outputs and 2 inputs/outputs (I/Os) where both I/Os have been configured as outputs:

State	running	Run	13	Uptime	1h38min49.1s	Last Start Before	6.5s	Date	12/04/19	Time	09:46:04
Output 1 (Monitoring 2): State	ON	Output 2: State	OFF	Output 3: State	OFF	I/O 1 (Output 4): State	OFF	I/O 2 (Output 5): State	OFF		

Example of a device with 3 outputs and 2 inputs, or a device with 3 outputs and 2 inputs/outputs (I/Os) where both I/Os have been configured as inputs:

State	running	Run	13	Uptime	1h36min58.5s	Last Start Before	55min27.0s	Date	12/04/19	Time	09:44:13
Output 1 (Monitoring 2): State	ON	Output 2: State	OFF	Output 3: State	OFF	I/O 1 (Input 1): State	OFF	I/O 2 (Input 2): State	OFF		

Explanation of the shown values:

- "State":** Shows if the LVMC is running or stopped. The LVMC detects objects only in state "running". Configuration changes can only be made in state "stopped". After a restart, the LVMC automatically enters state "running", if no error occurs.
- "Run":** This entry shows the number of the current run. A new run starts when the LVMC is restarted, but only runs during which an error has occurred are counted.
- "Uptime":** Shows how long it has been since the last power-up or restart of the LVMC.
- "Last Start Before":** Shows how long it has been since the LVMC has entered state "running".
- "Date":** Shows the current date, if the LVMC was able to fetch date and time from an NTP server.
- "Time":** Shows the current time, if the LVMC was able to fetch date and time from an NTP server.
- "Output 1 (Monitoring 2): State":** Current state of the optocoupler output 1 and the assigned signal "Monitoring 2". The color shows the signal state, the text the optocoupler output state. If the field is red, signal "Monitoring 2" is inactive. If it is green, the signal is active. "OFF" means that the optocoupler output is open, "ON" that it is conducting.
- „Output x: State“ or „I/O x (Output y): State“:** Current state of the optocoupler output and the assigned signal. The color shows the signal state, the text the optocoupler state. If the field is black, the signal is inactive. If it is yellow, the signal is active. "OFF" means that the optocoupler output is open, "ON" that it is conducting.
- „I/O x (Input y): State“:** Current state of the optocoupler input and the assigned signal. The color shows the signal state, the text the optocoupler state. If the field is black, the signal is inactive. If it is yellow, the signal is active. "OFF" means that the optocoupler input is open, "ON" that it is conducting.

5.11.2 Section "Ethernet State"

The section Ethernet-State shows the currently used Ethernet parameterization.

Ethernet State									
IP Address	192.168.200.200	IP Netmask	255.255.255.0	IP Default Gateway	192.168.200.1	DNS Server	192.168.200.1	NTP Server	192.168.200.1

Explanation of the shown values:

- "IP Address": The Ethernet IP address that is currently in use.
- "IP Netmask": The Ethernet IP netmask that is currently in use.
- "IP Default Gateway": The Ethernet IP default gateway that is currently in use.
- "DNS Server": The address of the DNS Server that is currently in use.
- "NTP Server": The address of the NTP Server that is currently in use.

5.11.3 Section "Channel Status"

The section "Channel Status" shows the status of the channels.

Channel Status												
Channel 1:	Detection Size	0.5mm	Count	21	Covered	NO	Passing Time: Last	79ms980us	Minimum	23ms340us	Maximum	129ms660us
Channel 2:	Detection Size	1.4mm	Count	19	Covered	NO	Passing Time: Last	79ms260us	Minimum	12ms960us	Maximum	128ms910us
Channel 3:	Detection Size	4.2mm	Count	15	Covered	NO	Passing Time: Last	63ms570us	Minimum	24ms840us	Maximum	127ms290us
Channel 4:	Detection Size	8.8mm	Count	10	Covered	NO	Passing Time: Last	62ms160us	Minimum	22ms290us	Maximum	123ms540us

Explanation of the shown values:

- "Detection Size": The lower limit the LVMC uses internally to detect objects of this channel. This value is lower than the minimum size set for this channel on the configuration page: A safety margin is subtracted, in order to guarantee, that no objects get missed.
- "Count": The number of objects counted by this channel. The value is cleared at power on, or by pressing one of the buttons "Reboot LVMC" or "Reset Counters". If an I/O is assigned to function "Reset Counters", the value can also be cleared by a positive or negative edge of this signal.
- "Covered": Indicates if the sensing area is currently covered by an object of size matching this channel or not.
- "Passing Time: Last": The passing time of the last object detected by this channel. The value is cleared when the LVMC is started (by power on, or pressing one of the buttons "Reboot LVMC" or "Start"), or when the statistics is reset (by pressing on button "Reset Status").
- "Passing Time: Minimum": The minimum passing time of all objects detected by this channel. The value is cleared when the LVMC is started (by power on, or pressing one of the buttons "Reboot LVMC" or "Start"), or when the statistics is reset (by pressing on button "Reset Status").

“Passing Time: Maximum”: The maximum passing time of all objects detected by this channel. The value is cleared when the LVMC is started (by power on, or pressing one of the buttons “Reboot LVMC” or “Start”), or when the statistics is reset (by pressing on button “Reset Status”).

5.11.4 Section “Output Counter Reading”

The section “Output Counter Reading” shows the counter readings of all available outputs and of the I/Os that are configured as outputs. The appearance of this section therefore depends on the device type and settings in the “I/O Configuration” section on the configuration page.

Example of a device with 3 outputs and 2 inputs, or a device with 3 outputs and 2 inputs/outputs (I/Os) where both I/Os have been configured as inputs:

Output Counter Reading

Output 2: Count Output 3: Count

Example of a device with 5 outputs, or a device with 3 outputs and 2 inputs/outputs (I/Os) where both I/Os have been configured as outputs:

Output Counter Reading

Output 2: Count Output 3: Count I/O 1 (Output 4): Count I/O 2 (Output 5): Count

Explanation of the shown values:

„Output x: Count“ Shows how often the output has been switched to active.
 or The value is cleared at power on, or by pressing one of the buttons “Reboot LVMC” or “Reset Counters”.
 “I/O x (Output y): Count”: If an I/O is assigned to function “Reset Counters”, the value can also be cleared by a positive or negative edge of this signal.

5.11.5 Section “Timer Status”

The “Timer Status” section is only available if one or both timers are activated. For each timer activated, it shows the time currently running and the time last stopped.

Example of a device with 3 outputs and 2 inputs/outputs (I/Os) where one of the two I/Os has been assigned the function “Stop Object Detection Timer”:

Timer Status

Object Detection Timer

Example of a device with 3 outputs and 2 inputs/outputs (I/Os) where one of the two I/Os has been assigned the function “Stop Object Detection Timer” and the other one of the functions “Start General Purpose Timer”, “Stop General Purpose Timer”, or “Start & Stop General Purpose Timer”:

Timer Status

Object Detection Timer General Purpose Timer

Explanation of the shown values:

“Object Detection Timer”:
Shows in the left field the current running time of the object detection timer. It is 0.0s, if the timer is never started since the LVMC was started (by power on, or pressing one of the buttons “Reboot LVMC” or “Start”), or when button “Reset Object Detection Timer” was pressed. It is counting up if the timing is running.

Shows in the right field the last stopped time of the object detection timer. It is 0.0s, if the timer is never stopped since the LVMC was started (by power on, or pressing one of the buttons “Reboot LVMC” or “Start”), or when button “Reset Object Detection Timer” was pressed.

“General Purpose Timer”:
Shows in the left field the current running time of the object detection timer. It is 0.0s, if the timer is never started since the LVMC was started (by power on, or pressing one of the buttons “Reboot LVMC” or “Start”), or when button “Reset Object Detection Timer” was pressed. It is counting up if the timing is running.

Shows in the right field the last stopped time of the general purpose timer. It is 0.0s, if the timer is never stopped since the LVMC was started (by power on, or pressing one of the buttons “Reboot LVMC” or “Start”), or when button “Reset General Purpose Timer” was pressed.

5.11.6 Buttons

The status page offers three to five buttons at the bottom, which appear differently depending on the access level, operating mode, and I/O configuration. Depending on the operating mode, the first button changes the label between “Start”, when the LVMC is started, and “Stop”, when it is stopped. In the user access level, only the “Reset Status” button is available, all others are grayed out and can not be pressed.

Example of a device without activated timers in operating mode “stopped”:



Example of a device in operating mode “started”, with both timers activated:



Explanation of the buttons:

“Start” or “Stop”:
If the LVMC is in operating mode “stopped”, the “Start” button is displayed. Press the “Start” button to switch to the “running” operating mode.

If the LVMC is in operating mode “Running”, the “Stop” button is displayed. Press the “Stop” button to switch to the “stopped” operating mode.

“Reset Counters”:
Press this button to reset the object counters of all channels and signals to 0.

“Reset Status”:
Press this button to reset the passing time information of all channels.

“Reset Object Detection Timer”:
Press this button to reset the object detection timer.

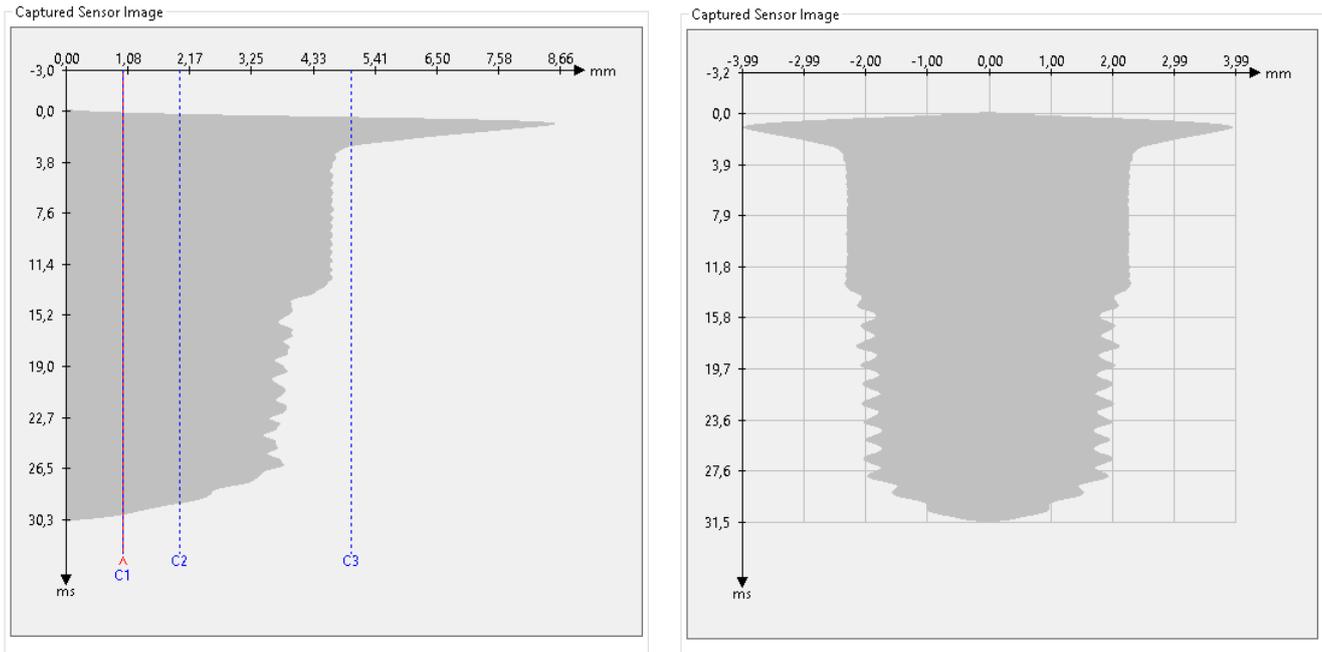
“Reset General Purpose Timer”:
Press this button to reset the general purpose timer.

5.12 Analysis Page

In addition to the four channels configurable on the configuration page, a fifth channel is implemented in the LVMC that is used for data acquisition and for visualization of objects passing the sensing area. This channel uses the “Minimum Required Object Size” value entered on the configuration page as the minimum object size to be detected. All other settings are located on the analysis page. The fifth channel has no minimum passing time, minimum area and minimum expected passing time. The gap suppression time can be specified.

The analysis page displays the captured image of the last detected object in the left half. The right half is divided into several sections. The first section “Last Object” displays information about the last object detected. In the “All Objects” section, statistical data available on the objects detected since the statistics were last reset is shown. The “Continuous Data” section continuously displays information on the actual sensor status. In the “Settings” section, the channel is parameterized and in the “Sensor Image Capturing” section, information on the captured and possibly saved images is displayed.

5.12.1 Captured Sensor Image



The captured image of the last object detected is displayed on the left side of the analysis page. Objects larger than the size entered under "Minimum Required Object Size" on the configuration page are detected. The sensor measures the extent of the object passing through the sensing area every 30µs and compiles these measured values into a pseudo-two-dimensional image. "Pseudo-two-dimensional" because the integrated sensor can not detect information about the position of the object.

The horizontal axis shows the object size, the vertical axis the elapsed time. The scaling of the horizontal axis can either be fixed or automatically adapted to the size of the captured object. The fixed scaling is determined on the basis of the minimum object sizes specified on the configuration page. The vertical axis is always automatically scaled based on the passing time of the captured object. The goal is to visualize the complete object without much time before and after.

The user has the choice whether the captured image should be displayed left-aligned or centered. The centered mode can be used to display symmetrical objects, such as a screw that has passed vertically through the sensing area, as realistically as possible.

In the left-justified view, it is possible to activate the display of auxiliary lines: A grid can be placed over the sensor image, and it is possible to visualize either the specified or the applied detection limits. Basically, the global detection limit exists, which is entered on the configuration page under "Minimum Required Object Size". In addition, a detection limit must be specified for each channel in entries "Minimum Size" on the configuration page. Internally, the LVMC does not directly use these values, but uses them to calculate the applied detection limits. This is necessary to take into account the measurement inaccuracy of the light curtain. The applied detection limits of the channels are displayed on the status page under „Detection Size“. In the "Settings" section on the analysis page, it can be selected whether the specified or the applied detection limits should be visualized. The global detection limit is displayed as a red vertical line. It is marked with a red "^". The detection limits of the channels are represented by blue hatched vertical lines. These lines are marked with a blue letter "C" followed by the channel number 1..4 in blue.

Captured sensor images can be stored on a data storage medium. Either this is done manually for the currently displayed sensor image via the menu item "Save Current Sensor Image to File" in the "File" menu, or automatically in real time with the maximum possible speed. If automatic storing is activated, images will be lost if objects follow each other faster than the files can be stored on the data storage medium. On the analysis page, the number of captured images and the number of stored images are displayed, so that it can be determined whether all files could be created.

5.12.2 Section "Last Object"

The "Last Object" section displays information about the last detected object. The displayed values are cleared when the LVMC is restarted (by switching power on or by pressing one of the „Reboot LVMC“ or „Start“ buttons), or when the analysis is reset (by pressing the „Reset Analysis“ button).

Last Object			
Minimum Size	9.8mm	Passing Time	30.5ms
Maximum Size	17.0mm	Area	339.78ms*mm
		Date	12/04/19
		Time	14:03:43

Explanation of the shown values:

- "Minimum Size": The minimum size of the last object detected, when 15 percent of the beginning and of the end of the object are cut-off.
- "Maximum Size": The maximum size of the last object detected.
- "Passing Time": The passing time of the last object detected.
- "Area": The area of the last object detected in time multiplied by length.
- "Date": The date when the last object was detected.
- "Time": The point in time when the last object was detected.

5.12.3 Section "All Objects"

In the section "All Objects", statistical data on the detected objects are available. The displayed values are cleared when the LVMC is restarted (by switching power on or by pressing one of the „Reboot LVMC“ or „Start“ buttons), or when the analysis is reset (by pressing the „Reset Analysis“ button).

All Objects			
Object Count	6	Estimated Speed	2.6km/h
Lowest Uncovered Time	72.5ms	Lowest Minimum Size	9.8mm
Lowest Passing Time	30.5ms	Lowest Maximum Size	17.0mm
Average Passing Time	43.4ms	Average Maximum Size	31.6mm
Highest Passing Time	59.1ms	Highest Maximum Size	48.1mm
Minimum Area	339.78ms*mm	Average Area	1.00s*mm
Maximum Area	1.88s*mm		

Explanation of the shown values:

- "Object Count": The number of objects that passed the sensing area.
- "Lowest Uncovered Time": The lowest time the sensing area was uncovered.
- "Estimated Speed": The estimated average passing speed of all objects that passed the sensing area. The average maximum size and the average passing time are used to carry out the calculation.
- "Lowest Passing Time": The lowest passing time measured.

“Average Passing Time”:	The average passing time measured.
“Highest Passing Time”:	The highest passing time measured.
“Lowest Minimum Size”:	The lowest minimum size measured, when 15 percent of the beginning and of the end of each object are cut-off.
“Lowest Maximum Size”:	The lowest maximum size measured.
“Average Maximum Size”:	The average of the maximum size of all object measured.
“Highest Maximum Size”:	The highest maximum size measured.
“Minimum Area”:	The minimum area measured.
“Average Area”:	The average area measured.
“Maximum Area”:	The maximum area measured.

5.12.4 Section “Continuous Data”

The “Continuous Data” section continuously displays information on the actual sensor status. The displayed values are cleared when the LVMC is restarted (by switching power on or by pressing one of the „Reboot LVMC“ or „Start“ buttons), or when the analysis is reset (by pressing the „Reset Analysis“ button).

Continuous Data			
Minimum Size	0.0mm	Current Size	0.0mm
Maximum Size	48.1mm	(Un-)Covered Time	6.9s

Explanation of the shown values:

“Current Size”:	The object size currently measured by the sensor.
“Minimum Size”:	The minimum object size measured since the LVMC was started.
“Maximum Size”:	The maximum object size measured since the LVMC was started.
“(Un-)Covered Time”:	If the sensing area is covered by a passing object, this value shows the elapsed time since it has entered the sensing area. If the sensing area is uncovered, this values shows the elapsed time since the last object has left the sensing area. If no object has passed the sensing area since the LVMC was started, the time the LVMC is in state “running” is shown.

5.12.5 Section “Settings”

In the section „Settings“, the fifth channel, the analysis function, and the display of the sensor image are configured.

Settings			
Scaling Mode	Dynamic	Gap Suppression Time	0us
Drawn Size Limit Lines	Specified	Grid	<input type="checkbox"/>
		Centered	<input type="checkbox"/>
Speed Estimation	By specified path	Path	1.0mm

Explanation of the available settings:

- “Scaling Mode”:
- To select the scaling mode of the horizontal axis in the captured sensor image. The horizontal axis shows the object size. Possible settings are:
- “Dynamic”:
The scaling of the horizontal axis is automatically adapted to the size of the object shown. The criterion is that the entire object is visible.
 - “Fixed”:
The highest minimum object size set for the channels on the configuration page is used to determine the scaling of the horizontal axis.
- “Gap Suppression Time”:
- An object to detect may have one or more locations with size smaller than the lowest object size that can be detected by the LVMC (value “Minimum Required Object Size” on the configuration page). By use of this parameter, this form of gaps can be suppressed.
Enter the maximum time a gap that should be suppressed can last.
- “Drawn Size Limit Lines”:
- On the captured sensor image graphics, the lowest object size that can be detected by the LVMC (value “Minimum Required Object Size” on the configuration page) is shown as red vertical line. Additionally, for each channel, a blue hatched vertical line shows the minimum object size the channel is configured to detect.
Two versions of these values/lines exist: The specified/entered values, and the values applied in reality by the LVMC. The LVMC subtracts a safety margin to the specified/entered values, and in reality applies these calculated values, in order to guarantee, that no objects get missed.
With this setting, the user can select if the specified/entered, or the calculated applied values are shown in the captured sensor image graphics.
- “Grid”:
- To select if a grid should be shown in the captured sensor image graphics or not.
- “Centered”:
- To select if the image should be drawn centered or not.
- “Speed Estimation”:
- The LVMC measures the time an object covers the sensing area. It also measures the object size in the direction parallel to the two arms of the fork. However, it does not know the object size vertical to the fork, i.e. the path that the object has traveled while it has covered the sensing area. This path, however, should be known for the exact calculation of the speed.
In order to be able to estimate the speed nevertheless, the LVMC offers two possibilities to specify the path:
- “By measured size”:
The measured object size is used as an estimation for the distance traveled. This method provides good results when the measurement is carried out with a large number of objects, and if the objects pass the sensing area in all possible orientations.

- “By specified path”:
The distance traveled is fixed.

“Path”:
Enter the path to be used for speed estimation.
This input is only available if the speed estimation is to be carried out with a specified path.

5.12.6 Section “Sensor Image Capturing”

The section “Sensor Image Capturing” displays information about the captured and possibly saved images.

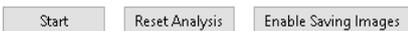
Explanation of the shown values:

- “Captured Sensor Images”:
The number of captured sensor images since CMT connected to the LVMC or since the analysis was reset (by pressing button “Reset Analysis”).
- “Saved Sensor Images”:
The number of saved images since CMT connected to the LVMC or since the analysis was reset (by pressing button “Reset Analysis”).
- “Next Filename”:
The filename (with absolute path) that is used to store the next sensor image. It can be set by entry „Choose Folder and Filename to Save Captured Sensor Images to” in menu “File”.

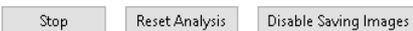
5.12.7 Buttons

The analysis page offers three buttons at the bottom. Depending on the operating mode, the first button changes the label between “Start”, when the LVMC is started, and “Stop”, when it is stopped. In the user access level, the first button is not available and therefore grayed out. It can only be pressed in administrator access level.

Example for a device with deactivated saving of sensor images in operating mode „stopped“:



Example for a device with activated saving of sensor images in operating mode „running“:

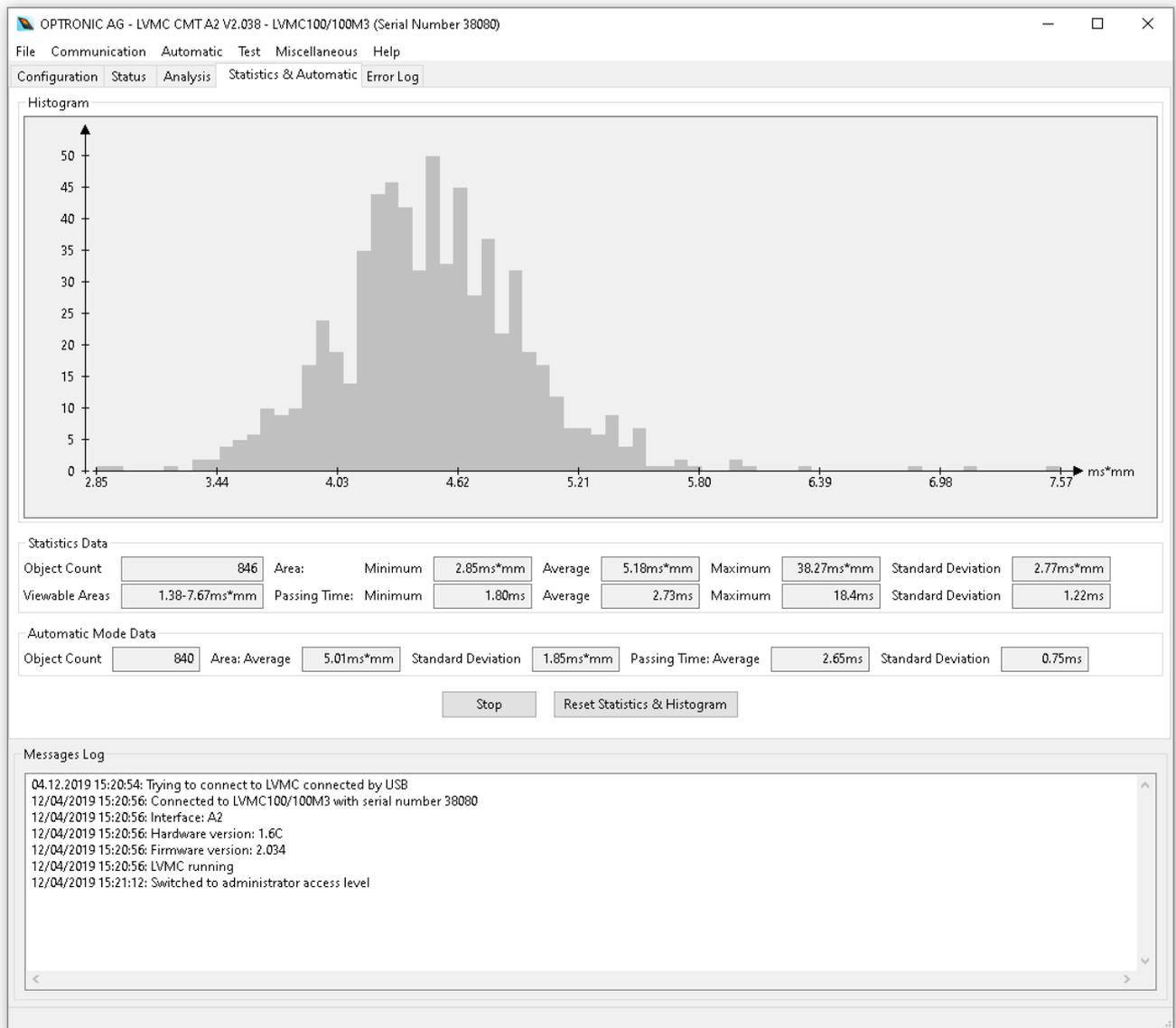


Explanation of the buttons:

- “Start” or “Stop”:
If the LVMC is in operating mode “stopped”, the “Start” button is displayed. Press the “Start” button to switch to the “running” operating mode.
If the LVMC is in operating mode “Running”, the “Stop” button is displayed. Press the “Stop” button to switch to the “stopped” operating mode.
- “Reset Analysis”:
Press this button to reset the collected analysis data.
- „Enable Saving Images” or „Disable Saving Images”:
Press this button to enable and disable saving captured sensor images.

5.13 Statistics & Automatic Page

On the "Statistics & Automatic" page, the collected statistical data with associated histogram are shown. If the object detection method "All channels combined, automatic mode, when object is leaving the sensing area" is selected, data for the running automatic configuration of the automatic mode are displayed. The page is divided into two or three sections: The top section "Histogram" displays the recorded histogram. The "Statistics Data" section below contains the recorded statistical data. When the automatic mode is activated, there is a third section named "Automatic Mode Data". It contains information on the running automatic configuration.



On the horizontal axis of the histogram, the area of the captured objects is applied. The vertical axis shows how many objects of a given area have passed the sensing area. The histogram is automatically scaled. The calculated area of the first 10 objects that passed the sensing area after resetting the histogram is used to determine the minimum and maximum area that can be displayed in the histogram. This indirectly determines the maximum resolution of the horizontal axis of the histogram. The histogram is displayed for the first time after these 10 first objects. Each additional object is plotted in the histogram, provided its area is

larger than the minimum and smaller than the maximum viewable area. Depending on this, not all objects can be displayed in the histogram, but they are still included in the statistics. The statistics include data on the area and the passing time, which are also used for automatic configuration. If automatic configuration is activated, the LVMC automatically determines the minimum area that can be defined for each channel and, optionally, the gap suppression time. The gap suppression time is determined on the basis of statistical information on the passing time.

5.13.1 Section "Histogram"

The top section "Histogram" shows the histogram of the area of all objects that have passed the sensing area since the LVMC switched to the "running" state or since the "Reset Statistics & Histogram" button was pressed. The horizontal axis is divided into object area regions. The vertical axis shows the number of objects in each of these regions. When the LVMC changes to the "running" state or the "Reset Statistics & Histogram" button is pressed, a histogram is not displayed until statistical data has been collected for 10 objects that have passed the sensing area. The data from these 10 objects is used to automatically determine the maximum and minimum area that can be displayed in the histogram. These two limits are displayed in the output field "Viewable Areas". The scaling of the two axes is continuously adjusted.

5.13.2 Section "Statistics Data"

The "Statistics Data" section displays the statistical data collected for the objects passing the sensing area.

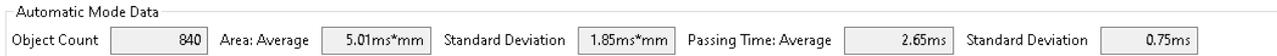
Statistics Data									
Object Count	846	Area: Minimum	2.85ms*mm	Average	5.18ms*mm	Maximum	38.27ms*mm	Standard Deviation	2.77ms*mm
Viewable Areas	1.38-7.67ms*mm	Passing Time: Minimum	1.80ms	Average	2.73ms	Maximum	18.4ms	Standard Deviation	1.22ms

Explanation of the shown values:

"Object Count":	The number of objects captured by the statistics function.
"Viewable Areas":	The area range that can be shown in the histogram.
"Area: Minimum":	The minimum area of all objects captured by the statistics function.
"Area: Average":	The average area of all objects captured by the statistics function.
"Area: Maximum":	The maximum area of all objects captured by the statistics function.
"Area: Standard Deviation":	The standard deviation of the area of all objects captured by the statistics function.
"Passing Time: Minimum":	The minimum passing time of all objects captured by the statistics function.
"Passing Time: Average":	The average passing time of all objects captured by the statistics function.
"Passing Time: Maximum":	The maximum passing time of all objects captured by the statistics function.
"Passing Time: Standard Deviation":	The standard deviation of the passing time of all objects captured by the statistics function.

5.13.3 Section "Automatic Mode Data"

The "Automatic Mode Data" section, available only if the object detection method "All channels combined, automatic mode, when object is leaving the sensing area" is selected, contains information on the running automatic configuration:



Explanation of the shown values:

- "Object Count": The number of objects captured in automatic mode.
- "Area: Average": The average area of all objects captured in automatic mode.
- "Area: Standard Deviation": The standard deviation of the area of all objects captured in automatic mode.
- "Passing Time: Average": The average passing time of all objects captured in automatic mode.
- "Passing Time: Standard Deviation": The standard deviation of the passing time of all objects captured in automatic mode.

5.13.4 Buttons

The page offers two buttons at the bottom. Depending on the operating mode, the first button changes the label between "Start", when the LVMC is started, and "Stop", when it is stopped. In the user access level, the first button is not available and therefore grayed out. It can only be pressed in administrator access level.



Explanation of the buttons:

- "Start" or "Stop":
If the LVMC is in operating mode "stopped", the "Start" button is displayed. Press the "Start" button to switch to the "running" operating mode.
If the LVMC is in operating mode "Running", the "Stop" button is displayed. Press the "Stop" button to switch to the "stopped" operating mode.
- "Reset Statistics & Histogram": Press this button to reset the collected analysis data.

5.14 Error Log Page

The error log page displays the errors that have occurred and are logged. Together with the error code and the message text, the run number and the time elapsed since the last restart are also displayed. In addition, the date and time of the occurrence of the error are displayed if the LVMC could obtain date and time from an NTP server. Since the number of possible write accesses to the non-volatile memory is limited, only the first occurrence of each error after the last restart is stored non-volatile, while subsequent occurrences are only stored volatile. For previous runs, the error log therefore only contains the first occurrence of each error. For the current run, all occurred errors are shown.

The screenshot shows the LVMC software interface with the following components:

- Window Title:** OPTRONIC AG - LVMC CMT A2 V2.038 - LVMC100/100M3 (Serial Number 38080)
- Menu Bar:** File, Communication, Automatic, Test, Miscellaneous, Help
- Tab Bar:** Configuration, Status, Analysis, Statistics & Automatic, Error Log (selected)
- Error Log Table:**

No.	Date & Time	Run	Time Stamp	Code	Message
1	12/04/19 16:30:50	14	1h11min2.6s	37	Maximum permissible passing time overrun: Sensing area free again, LVMC stopped and automatically restarted
2	12/04/19 16:30:50	14	1h11min2.0s	36	Maximum permissible passing time overrun: Object stuck? - LVMC waits until object is removed
- Buttons:** Start, Clear Error Log
- Messages Log:**

```
04.12.2019 16:31:10: Trying to connect to LVMC connected by USB
12/04/2019 16:31:11: Connected to LVMC100/100M3 with serial number 38080
12/04/2019 16:31:11: Interface: A2
12/04/2019 16:31:12: Hardware version: 1.6C
12/04/2019 16:31:12: Firmware version: 2.034
12/04/2019 16:31:14: LVMC running
12/04/2019 16:31:18: Switched to administrator access level
12/04/2019 16:31:19: Stop signal sent to LVMC
12/04/2019 16:31:19: LVMC stopped
```

5.14.1 Buttons

There are two buttons below the error message list. Depending on the operating mode, the first button changes the label between “Start”, when the LVMC is started, and “Stop”, when it is stopped. In the user access level, the first button is not available and therefore grayed out. It can only be pressed in administrator access level.

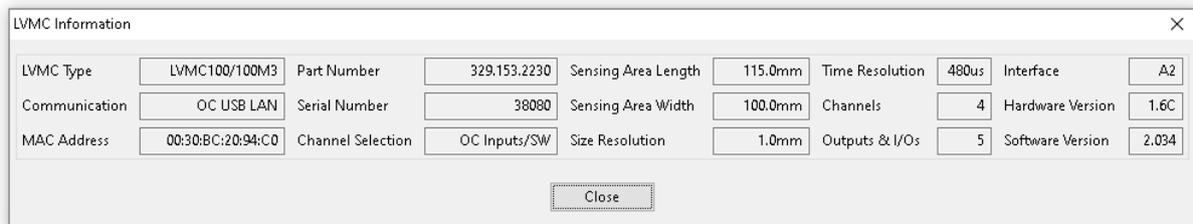


Explanation of the buttons:

- “Start” or “Stop”: If the LVMC is in operating mode “stopped”, the “Start” button is displayed. Press the “Start” button to switch to the “running” operating mode.
If the LVMC is in operating mode “Running”, the “Stop” button is displayed. Press the “Stop” button to switch to the “stopped” operating mode.
- “Clear Error Log”: Clears the volatile and also the nonvolatile error log.

5.15 Display of the LVMC Properties

Via the entry “Show Information about this LVMC” in the “Miscellaneous” menu, the fixed properties of the light curtain can be displayed.



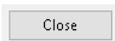
Explanation of the shown values:

- “LVMC-Type”: The type (name) of the LVMC. The first number contained in the name is the width, the second the length of the sensing area.
- “Communication”: The communication interfaces the LVMC is equipped with:
“OC”: Optocoupler interface (3 or 5 outputs, 0 or 2 inputs)
“USB”: USB 2.0 interface
„LAN”: 100Mbit/s IPv4 Ethernet interface
- “MAC Address”: The unique Ethernet MAC address of the LVMC.
- “Part Number”: The part number of the LVMC.
- “Serial Number”: The unique serial number of the LVMC.
- “Channel Selection”: Shows how a channel can be selected:
„OC Inputs”: By digital optocoupler inputs
„Switch”: By the switch
„SW”: By Software
- “Sensing Area Length”: The real length of the sensing area. The useable sensing area length is less because of the sensing area begin and end section.
- “Sensing Area Width”: The width of the sensing area.
- “Size Resolution”: The minimum object size that can be detected by the LVMC.

“Time Resolution”:	The minimum passing time of an object, and the minimum required time interval between successive objects supported by this LVMC and its firmware.
“Channels”:	The number of channels supported by the LVMC.
“Outputs & I/Os”:	The number of output signals supported by the LVMC.
“Interface”:	The version of the interface implemented in the LVMC. The interface version of the LVMC and the CMT must match.
“Hardware Version”:	The hardware version of the LVMC.
“Software Version”:	The software version of the firmware installed on the LVMC.

5.15.1 Button

There is one button at the bottom of the dialog box:

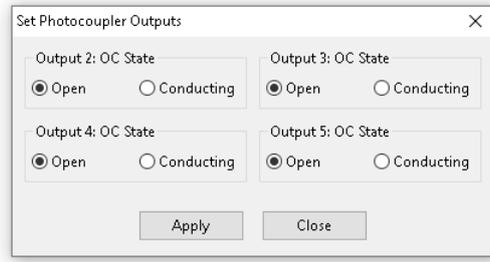


Explanation of the button:

“Close”: Press this button to close the window.

5.16 Set Optocoupler Outputs Test Function

Via the entry "Set Optocoupler Outputs" in the "Test" menu, a dialog window is opened by which the optocoupler outputs can be switched manually, with the exception of output 1 (signal "Monitoring 2": signaling of operational readiness). Immediately after opening the dialog box, all available optocoupler outputs are open. For each available output, the state can now be changed from "Open" to "Conductive". Changes are not immediately active, the "Apply" button must be pressed first.



5.16.1 Section "Output x: OC State"



Explanation of the available settings:

"Open": To select that the optocoupler output should be open.

"Conducting": To select that the optocoupler output should be conducting.

5.16.2 Buttons

There are two buttons at the bottom of the dialog box:



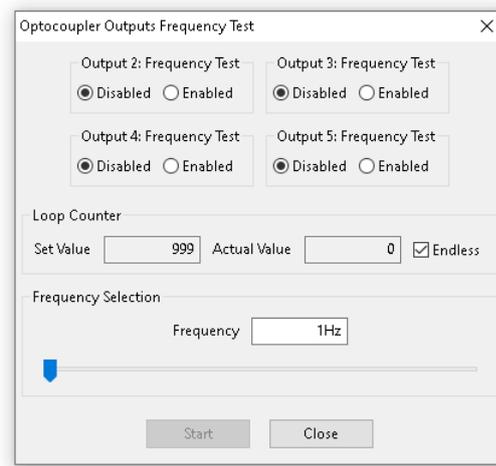
Explanation of the buttons:

"Apply": Press this button to accept changes.

"Close": Press this button to end the test and close the window.

5.17 Optocoupler Outputs Frequency Test

Via the entry "Optocoupler Outputs Frequency Test" in the „Test“ menu, a dialog window is opened by which a frequency test of the optocoupler outputs can be performed, with the exception of output 1 (signal "Monitoring 2": signaling of operational readiness). Immediately after opening the dialog box, the frequency test for all existing outputs is deactivated and the outputs are open. For each available output it can be defined whether the frequency test is to be activated. It can be decided whether the test should run endlessly or be terminated after a specified number of runs. The frequency the activated outputs are to oscillate with can be entered in Hertz, or set via a slider bar in the range from 1Hz to 16.6Hz. The input is automatically corrected if the frequency is not possible. The frequency test starts as soon as the "Start" button is pressed. Press the "Stop" button to stop the running test. The number of performed runs is displayed while the test is running.



5.17.1 Section "Output x: Frequency Test"

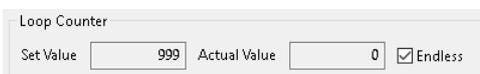


Explanation of the available settings:

"Disabled": To disable the frequency test on this optocoupler output.

"Enabled": To enable the frequency test on this optocoupler output.

5.17.2 Section "Loop Counter"



Explanation of the available settings:

"Set Value": To define the number of loops the test should run for. This value is only editable, if checkbox "Endless" is unmarked.

"Actual Value": The number of loops the test is already running.

"Endless": Mark this checkbox if the test should run endless. If the box is unmarked, the number of loops is given by the entered set value.

5.17.3 Section "Frequency Selection"



Explanation of the available settings:

"Frequency": To define the frequency the optocoupler outputs should toggle with. The slider is adjusted automatically.

Slider Bar: Move the slider to define the frequency the optocoupler outputs should toggle with. The value shown at entry "Frequency" is adjusted automatically.

5.17.4 Buttons

There are two buttons at the bottom of the dialog box:



Explanation of the buttons:

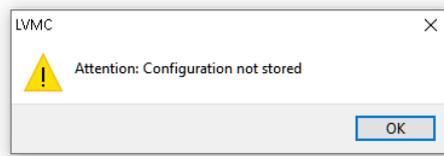
"Start" or "Stop": Press this button to start or stop the test.

"Close": Press this button to end the test and close the window.

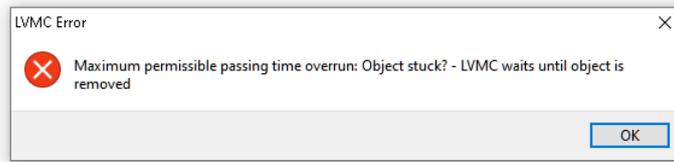
5.18 Hints & Error Messages

If the CMT wants to give you a hint or if the CMT or the LVMC has detected a problem, you will be informed by a message in an automatically opening dialog window. You must acknowledge this message by pressing the "OK" button before you can carry out further actions in the CMT. Notes are marked by a yellow triangle with an exclamation mark , an error message with a red framed x . Error messages generated by the LVMC are always also stored in the error log and can therefore also be viewed after acknowledgement. Showing notification messages can be deactivated via the "Stop Showing Notification Messages" entry in the "Miscellaneous" menu and, if necessary, activated again by selecting the "Show Notification Messages" entry.

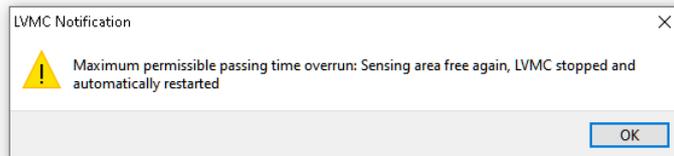
The most likely notice message you'll see informs you that you've made a change to the configuration but have not yet stored it in the non-volatile memory of the LVMC:



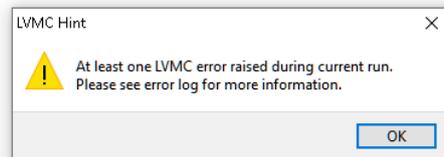
A likely common error message is the detection of stuck objects: If an object is within the sensing area longer than specified on the configuration page in the "Maximum Permissible Passing Time" parameter, the LVMC will detect this and store the error in the error log. If the LVMC is connected to the CMT at this time, the following dialog box opens:



The LVMC now waits until the sensing area becomes free again. As soon as this has happened, the LVMC stops and restarts automatically. The LVMC logs this in the error log and the following message is displayed in the CMT, provided that showing notification messages is activated:



If you reconnect the CMT to an LVMC and the LVMC has detected and logged an error in the current run, a dialog box prompts you to check the error log, if showing notification messages is activated:

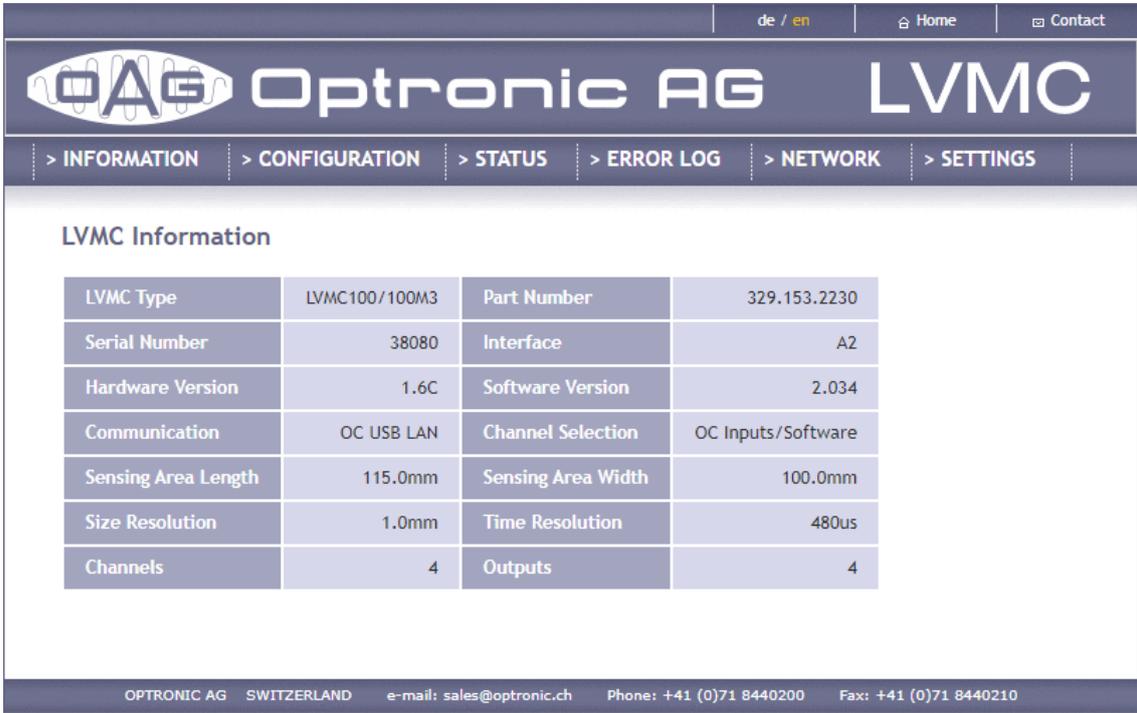


6 HTTP Server – Access by Web Browser

Information about the device and its status can be retrieved via any web browser. An HTTP server is integrated in the LVMC for this purpose, which is deactivated on delivery. It can be activated in the CMT on the configuration page.

Start by entering the IP address of the LVMC in the address bar of the web browser. Depending on your browser, you may have to put the abbreviation "http://" in front of the address. Your web browser should now display the information page in English. In the title bar you can switch the display language between English ("en") and German ("de"). The available pages "Information", "Configuration", "Status", "Error Log", "Network" and, if applicable, "Settings" are arranged under the company logo. The content displayed on each page is updated every 5 seconds.

The "Information" page displays the fixed properties of the light curtain, which can also be called up in the CMT via the entry "Show Information about this LVMC" in the "Miscellaneous" menu.



LVMC Information			
LVMC Type	LVMC100/100M3	Part Number	329.153.2230
Serial Number	38080	Interface	A2
Hardware Version	1.6C	Software Version	2.034
Communication	OC USB LAN	Channel Selection	OC Inputs/Software
Sensing Area Length	115.0mm	Sensing Area Width	100.0mm
Size Resolution	1.0mm	Time Resolution	480us
Channels	4	Outputs	4

On page "Configuration", the sections "Sensor Configuration", "Channel Configuration" and "I/O Configuration" are displayed according to the corresponding sections on the configuration page in the CMT. Please note that these are only outputs and that adjustments to the configuration must be made via the CMT.

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Optronic AG **LVMC**

> INFORMATION
> CONFIGURATION
> STATUS
> ERROR LOG
> NETWORK
> SETTINGS

Sensor Configuration

Detection Mode Each channel separately, when object is leaving the sensing area

State 'stopped' Notification: Method	Bouncing Light
State 'stopped' Notification: Cycle Time	250ms
Minimum Required Passing Time	480us
Maximum Permissible Passing Time	16min40.0s
Minimum Required Object Size	1.0mm
Sensing Area Static Coverage Size	0.0mm
Calibration Factor	+0%

Channel Configuration

Parameter	Channel 1	Channel 2	Channel 3	Channel 4
Minimum Size	1.0mm	2.0mm	5.0mm	10.0mm
Minimum Passing Time	0us	0us	0us	0us
Minimum Area	0us*mm	0us*mm	0us*mm	0us*mm
Gap Suppression Time	0us	0us	0us	0us
Minimum Expected Passing Time	0.0ms	0.0ms	0.0ms	0.0ms

I/O Configuration

Parameter	Output 2	Output 3	Output 4	Output 5
Assignment	Channel 1: Quantity	Channel 2: Quantity	Channel 3: Quantity	Channel 4: Quantity
Polarity	positive	positive	positive	positive
Only Once	NO	NO	NO	NO
Pulse Duration	10.0ms	10.0ms	10.0ms	10.0ms
Offset	0.0ms	0.0ms	0.0ms	0.0ms
Quantity	100	100	100	100

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The "Status" page contains the same information as the status page in the CMT, with the exception of the network-specific and the timer information.

The screenshot displays the 'STATUS' page of the Optronik AG LVMC interface. At the top, there is a navigation bar with tabs for INFORMATION, CONFIGURATION, STATUS, ERROR LOG, NETWORK, and SETTINGS. The main content area is titled 'General Status Information' and contains two tables. The first table shows LVMC State (running), Run count (12), Uptime (20min18.7s), and Last Start Before (20min17.9s). The second table shows the state of five outputs: Output 1 (Monitoring 2) is ON, while Output 2, Output 3, I/O 1 (Output 4), and I/O 2 (Output 5) are all OFF. Below this is the 'Channel Status' section, which features a table with four columns (Channel 1 to Channel 4) and seven rows of parameters including Detection Size, Count, Covered status, and various Passing Time measurements. The final section, 'Output Counter Reading', shows a table with five rows indicating the count for Output 2 (8), Output 3 (8), Output 4 (7), and Output 5 (3). The footer of the page provides contact information for Optronik AG in Switzerland, including an email address and phone/fax numbers.

The current error log is displayed on the "Error Log" page.

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OAG Optronic AG LVMC

> INFORMATION > CONFIGURATION > STATUS > **ERROR LOG** > NETWORK > SETTINGS

Error Log

No.	Date & Time	Run	Time Stamp	Code	Message
1	11/25/19 11:37:19	11	1h9min41.4s	37	Maximum permissible passing time overrun: Sensing area free again
2	11/25/19 11:37:18	11	1h9min40.9s	36	Maximum permissible passing time overrun: Object stuck?
3	11/19/19 09:12:05	10	56min22.5s	37	Maximum permissible passing time overrun: Sensing area free again
4	11/19/19 09:12:04	10	56min21.9s	36	Maximum permissible passing time overrun: Object stuck?

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The "Network" page provides network-specific information. In addition to the currently used network configuration, statistical data on packet transport and internal data on open network connections are also displayed.

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OPTRONIC AG
LVMC

> INFORMATION
> CONFIGURATION
> STATUS
> ERROR LOG
> NETWORK
> SETTINGS

Network Configuration

IP Address	100.111.099.117	IP Netmask	109.101.110.116
IP Default Route Address	046.119.114.105	MAC Address	00:30:BC:20:94:C0
DNS Server	116.101.040.118	NTP Server	097.108.049.055

Open Network Connections

Local	Remote	State	Retransmissions
80	192.168.200.85:60196	ESTABLISHED	0
80	192.168.200.85:60197	ESTABLISHED	0

Network Statistics

Protocol	Packets Sent	Packets Received	Packets Dropped	Errors
IP	2694	3631	40	0
ICMP	1	1	0	0
TCP	2696	3588	0	0
UDP	0	0	0	0

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Fax: +41 (0)71 8440210

The "Settings" page is only available, if the HTTP server is activated in "Full Access" mode and if at least one output is assigned a function in mode "quantity" (see section "I/O Configuration" on the configuration page; e.g. "Channel 1: Quantity"). On the page, the number of objects can be set for each output that is assigned a function in mode "quantity".

Outputs: Set Quantity		
Output 2: Quantity	<input type="text" value="100"/>	Set
Output 3: Quantity	<input type="text" value="100"/>	Set
Output 4: Quantity	<input type="text" value="100"/>	Set
Output 5: Quantity	<input type="text" value="100"/>	Set

7 LVMC RC - Remote Control via Ethernet

The LVMC can be remote controlled via Ethernet. The remote control function LVMC RC is deactivated on delivery, the activation is done via the CMT on the configuration page. The communication is either encrypted or unencrypted.

Ethernet Configuration

IP Address: 192.168.1.100 | IP Netmask: 255.255.255.0 | IP Default Gateway: 192.168.1.1 | DNS Server: 192.168.200.1 | RC Key: 1111-2222-3333-4444

DHCP: Enabled | HTTP Server: Full Access | Remote Control (RC): Disabled | UTC Offset: +1h | NTP Server: pool.ntp.org

Sensor Configuration

Object Detection Method: Each channel separately, when object is leaving the sensing area | Minimum Required Passing Time: 480us

The key used in encrypted mode is also displayed on the configuration page and can be re-entered there. The key must consist of four four-character strings, separated by hyphens. The default key at delivery is:

1111-2222-3333-4444

The remote control function implemented in the LVMC receives commands from the client, executes them, and returns a response to the client for each command executed. The interface definition used must match between the LVMC and the client. For simple consistency monitoring, a version number is defined in the interface definition which must be queried by the client and compared with its own version. It is the client's responsibility to ensure that the version numbers and thus the interface definitions used match.

The following commands are implemented in the interface version V2:

Command Name	Meaning
RC_COMMAND_GET_KEY	For querying the key for coding and decoding.
RC_COMMAND_GET_VERSION	To query the version number of the interface definition.
RC_COMMAND_GET_INFORMATION	To query the serial number of the LVMC, the number of channels it supports, and information about the digital outputs.
RC_COMMAND_GET_CONFIGURATION_SENSOR	To query the object detection method, the minimum required object size, the minimum required passing time, and the maximum permissible passing time.
RC_COMMAND_GET_CONFIGURATION_CHANNELS	To query the number of supported channels and the configuration per channel: The minimum size, the minimum area, the minimum passing time, the gap suppression time, and the minimum expected passing time.
RC_COMMAND_GET_CONFIGURATION_OUTPUTS	To query the set quantity of each output that is assigned a function in mode "quantity" (see field "Quantity" in section "I/O Configuration" on the configuration page).

RC_COMMAND_GET_STATUS	To query the operating state ("stopped" or "running"), the signal intensity of the sensor (OK or signal intensity of the sensor has fallen below the warning limit permanently stored in the device), the last error that occurred, the counter readings of the channels and the counter readings of the outputs.
RC_COMMAND_GET_TIMER	To query the timers.
RC_COMMAND_PUT_CONFIGURATION_SENSOR	To set the object detection method, the minimum required object size, the minimum required passing time, and the maximum permissible passing time.
RC_COMMAND_PUT_CONFIGURATION_CHANNELS	To set the configuration of all supported channels: the minimum size, the minimum area, The minimum passing time, the gap suppression time, and the minimum expected passing time.
RC_COMMAND_PUT_CONFIGURATION_OUTPUTS	To set the quantity of each output that is assigned a function in mode "quantity" (see field "Quantity" in section "I/O Configuration" on the configuration page).
RC_COMMAND_START	To switch to the operating mode "running".
RC_COMMAND_STOP	To switch to the operating mode "stopped".
RC_COMMAND_RESET_COUNTERS	To reset the counter readings of the available channels.
RC_COMMAND_AUTOMATIC_MODE_RESTART	To restart the automatic mode.

OPTRONIC AG provides a reference implementation in the form of a client running under Windows, which is also available as source code on request. The executable client is available for download on the OPTRONIC homepage www.optronic.ch in the DOWNLOAD section. The software can also be used directly productive, for example, by calling it from an application or batch file.

```

Z:\>lvmc_rc.exe
The required parameter 'command' was not specified.
LVMC Remote Control
Software Version V2.1, Interface Version 2
valid commands are: get_version, get_info, get_config_sensor,
get_config_channels, get_config_outputs,
put_config_sensor, put_config_channels,
put_config_outputs, get_status, start, stop,
reset_counters
Usage: lvmc_rc [-h] [-p] [-k <str>] [-a <str>] [-v] command...
-h, --help          show this help message
-p, --plain         plain data transfer, do not crypt
-k, --key=<str>    pass the crypt key of the remote LVMC
-a, --host=<str>   pass hostname or IP address of the remote LVMC
-v, --verbose      be verbose
Z:\>

```

By default, the communication is encrypted. If the client is called with the switch -p (or --plain), the communication is unencrypted. The addressed LVMC must also be configured for encrypted or unencrypted communication. The key transferred with the switch -k (or --key) must match the key stored in the LVMC. All available commands are implemented in the reference implementation. For example, the configuration of the channels can be queried as follows:

```

Z:\>lvmc_rc.exe -v -k 1111-2222-3333-4444 -a 192.168.200.200 get_config_channels
connect to LVMC: address 192.168.200.200, port 2000, key 1111-2222-3333-4444
connecting...
connection established
execute command 'get_version'
interface_version: 2
execute command 'get_config_channels'
channels count:                4
channel 1: minimum_size_in_100um:    10
channel 1: minimum_passing_time_in_us: 0
channel 1: minimum_area_in_us_x_100um: 0
channel 1: gap_suppression_time_in_us: 0
channel 1: minimum_expected_passing_time_in_100us: 0
channel 2: minimum_size_in_100um:    20
channel 2: minimum_passing_time_in_us: 0
channel 2: minimum_area_in_us_x_100um: 0
channel 2: gap_suppression_time_in_us: 0
channel 2: minimum_expected_passing_time_in_100us: 0
channel 3: minimum_size_in_100um:    50
channel 3: minimum_passing_time_in_us: 0
channel 3: minimum_area_in_us_x_100um: 0
channel 3: gap_suppression_time_in_us: 0
channel 3: minimum_expected_passing_time_in_100us: 0
channel 4: minimum_size_in_100um:   100
channel 4: minimum_passing_time_in_us: 0
channel 4: minimum_area_in_us_x_100um: 0
channel 4: gap_suppression_time_in_us: 0
channel 4: minimum_expected_passing_time_in_100us: 0
Z:\>_

```

The "-v" switch ensures that the output is displayed in easy-to-read form. This switch should be omitted for machine processing:

```

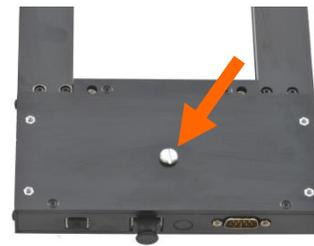
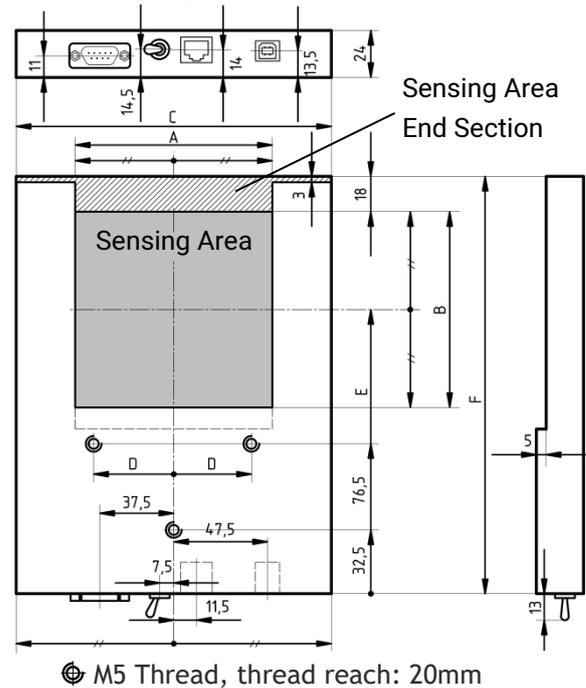
Z:\>lvmc_rc.exe -k 1111-2222-3333-4444 -a 192.168.200.200 get_config_channels
1 10 0 0 0 0 2 20 0 0 0 0 3 50 0 0 0 0 4 100 0 0 0 0
Z:\>_

```

Detailed information on the interface definition is available from OPTRONIC AG on request.

8 Dimensions & Mounting

Sensing Area Size in mm x mm	Dimensions in mm					
	A	B	C	D	E	F
100x100	100	100	160	40	145	213
100x200	100	200	160	40	195	313
150x100	150	100	210	65	145	213
200x100	200	100	260	65	145	213
250x100	250	100	310	90	145	213
300x100	300	100	360	115	145	213
100x50	100	52	160	40	121	165
150x50	150	52	210	65	121	165
150x150	150	150	210	65	170	263
200x200	200	200	260	65	195	313
250x250	250	250	310	90	220	363
300x200	300	200	360	115	195	313
400x400	400	400	460	165	295	513



The three M5 threads at the bottom side of the device can be used to mount the device reliably. The maximum thread reach is 20mm.

Attention: On delivery, there is a screw in the middle M5 thread at the bottom of the device as protection against contamination (orange arrow). It must be removed before the device is mounted. If this M5 thread is not needed for mounting, it must be guaranteed that the hole is covered.

9 Sensing Area End Section

Basically, the light curtain may be operated without end section. Please note, however, that this will affect the measurement accuracy and that the sensing area thereby will not increase in size. With mounted end section, the LVMC is better protected against vibrations and against twisting of the two arms.

To remove the end section, first unscrew the two screws shown in the picture. Then the end section can be easily removed. It is important to reinstall the screws afterwards, as they contribute significantly to the stability of the arms.



10 Part Name

The part name of an LVMC is structured as follows:

LVMCxxx/yyyMz

The placeholders "xxx", „yyy“ und „z“ have the following meanings:

Placeholder	Meaning								
xxx	<table border="1"> <tr> <td>Sensing Area Width in mm</td> <td> 100: 100mm 150: 150mm 200: 200mm 250: 250mm 300: 300mm 400: 400mm </td> </tr> </table>	Sensing Area Width in mm	100: 100mm 150: 150mm 200: 200mm 250: 250mm 300: 300mm 400: 400mm						
Sensing Area Width in mm	100: 100mm 150: 150mm 200: 200mm 250: 250mm 300: 300mm 400: 400mm								
yyy	<table border="1"> <tr> <td>Sensing Area Length in mm</td> <td> 50: 50mm 100: 100mm 150: 150mm 200: 200mm 250: 250mm 300: 300mm 400: 400mm </td> </tr> </table>	Sensing Area Length in mm	50: 50mm 100: 100mm 150: 150mm 200: 200mm 250: 250mm 300: 300mm 400: 400mm						
Sensing Area Length in mm	50: 50mm 100: 100mm 150: 150mm 200: 200mm 250: 250mm 300: 300mm 400: 400mm								
z	<table border="1"> <tr> <td>w/o:</td> <td> Selection of the channel by toggle switch or by software no digital optocoupler inputs 3 digital optocoupler outputs (embodiment WS) </td> </tr> <tr> <td>1:</td> <td> Selection of the channel by two digital optocoupler inputs or by software 2 digital optocoupler inputs 3 digital optocoupler outputs (embodiment DI) </td> </tr> <tr> <td>2:</td> <td> Selection of the channel by software, no digital optocoupler inputs, 5 digital optocoupler outputs (embodiment DO) </td> </tr> <tr> <td>3:</td> <td> Selection of the channel by two digital optocoupler inputs or by software, 3 digital optocoupler outputs, 2 bidirectional digital optocoupler inputs/outputs (embodiment DIO) </td> </tr> </table>	w/o:	Selection of the channel by toggle switch or by software no digital optocoupler inputs 3 digital optocoupler outputs (embodiment WS)	1:	Selection of the channel by two digital optocoupler inputs or by software 2 digital optocoupler inputs 3 digital optocoupler outputs (embodiment DI)	2:	Selection of the channel by software, no digital optocoupler inputs, 5 digital optocoupler outputs (embodiment DO)	3:	Selection of the channel by two digital optocoupler inputs or by software, 3 digital optocoupler outputs, 2 bidirectional digital optocoupler inputs/outputs (embodiment DIO)
	w/o:	Selection of the channel by toggle switch or by software no digital optocoupler inputs 3 digital optocoupler outputs (embodiment WS)							
	1:	Selection of the channel by two digital optocoupler inputs or by software 2 digital optocoupler inputs 3 digital optocoupler outputs (embodiment DI)							
	2:	Selection of the channel by software, no digital optocoupler inputs, 5 digital optocoupler outputs (embodiment DO)							
3:	Selection of the channel by two digital optocoupler inputs or by software, 3 digital optocoupler outputs, 2 bidirectional digital optocoupler inputs/outputs (embodiment DIO)								

11 Part Number

The part number of an LVMC is structured as follows:

329.153.wlfs

The placeholders „w“, „l“, „f“ und „s“ have the following meanings:

Placeholder	Meaning								
w	<table border="1"> <tr> <td>Sensing Area Width in mm</td> <td> 2: 100mm 3: 150mm 4: 200mm 5: 250mm 6: 300mm 7: 400mm </td> </tr> </table>	Sensing Area Width in mm	2: 100mm 3: 150mm 4: 200mm 5: 250mm 6: 300mm 7: 400mm						
Sensing Area Width in mm	2: 100mm 3: 150mm 4: 200mm 5: 250mm 6: 300mm 7: 400mm								
l	<table border="1"> <tr> <td>Sensing Area Length in mm</td> <td> 1: 50mm 2: 100mm 3: 150mm 4: 200mm 5: 250mm 6: 300mm 7: 400mm </td> </tr> </table>	Sensing Area Length in mm	1: 50mm 2: 100mm 3: 150mm 4: 200mm 5: 250mm 6: 300mm 7: 400mm						
Sensing Area Length in mm	1: 50mm 2: 100mm 3: 150mm 4: 200mm 5: 250mm 6: 300mm 7: 400mm								
f	<table border="1"> <tr> <td>1:</td> <td>Selection of the channel by two digital optocoupler inputs or by software 2 digital optocoupler inputs, 3 digital optocoupler outputs (embodiment DI)</td> </tr> <tr> <td>2:</td> <td>Selection of the channel by software no digital optocoupler inputs, 5 digital optocoupler outputs (embodiment DO)</td> </tr> <tr> <td>3:</td> <td>Selection of the channel by two digital optocoupler inputs or by software 3 digital optocoupler outputs, 2 bidirectional digital optocoupler inputs/outputs (embodiment DIO)</td> </tr> <tr> <td>4:</td> <td>Selection of the channel by toggle switch or by software no digital optocoupler inputs, 3 digital optocoupler outputs (embodiment WS)</td> </tr> </table>	1:	Selection of the channel by two digital optocoupler inputs or by software 2 digital optocoupler inputs, 3 digital optocoupler outputs (embodiment DI)	2:	Selection of the channel by software no digital optocoupler inputs, 5 digital optocoupler outputs (embodiment DO)	3:	Selection of the channel by two digital optocoupler inputs or by software 3 digital optocoupler outputs, 2 bidirectional digital optocoupler inputs/outputs (embodiment DIO)	4:	Selection of the channel by toggle switch or by software no digital optocoupler inputs, 3 digital optocoupler outputs (embodiment WS)
	1:	Selection of the channel by two digital optocoupler inputs or by software 2 digital optocoupler inputs, 3 digital optocoupler outputs (embodiment DI)							
	2:	Selection of the channel by software no digital optocoupler inputs, 5 digital optocoupler outputs (embodiment DO)							
	3:	Selection of the channel by two digital optocoupler inputs or by software 3 digital optocoupler outputs, 2 bidirectional digital optocoupler inputs/outputs (embodiment DIO)							
4:	Selection of the channel by toggle switch or by software no digital optocoupler inputs, 3 digital optocoupler outputs (embodiment WS)								
s	<table border="1"> <tr> <td>Additional Software Options</td> <td>0: Standard Device</td> </tr> </table>	Additional Software Options	0: Standard Device						
Additional Software Options	0: Standard Device								

12 Available Dimensions / Minimum Object Size

The following table provides information about the available standard dimensions (sensing area sizes) and the dedicated minimum object size (size resolution) that can be captured. Please see chapter 10 for information about the placeholder “z” in the part name.

Part Name	Minimum Object Size	Dimension (Sensing Area Width x Sensing Area Length)	External Dimensions (Width x Length)
LVMC100/50Mz	1mm	100mm x 52mm	160 mm x 165mm
LVMC100/100Mz	1mm	100mm x 100mm	160 mm x 213mm
LVMC150/50Mz	1mm	150 mm x 52mm	210 mm x 165m
LVMC150/100Mz	1mm	150 mm x 100mm	210 mm x 213mm
LVMC150/150Mz	1mm	150 mm x 150mm	210 mm x 263mm
LVMC200/100Mz	2mm	200 mm x 100mm	260 mm x 213mm
LVMC200/200Mz	2mm	200 mm x 200mm	260 mm x 313mm
LVMC250/100Mz	3mm	250 mm x 100mm	310 mm x 213mm
LVMC250/250Mz	3mm	250 mm x 250mm	310 mm x 363mm
LVMC300/100Mz	4mm	300 mm x 100mm	360 mm x 213mm
LVMC300/200Mz	4mm	300 mm x 200mm	360 mm x 313mm
LVMC400/400Mz	8mm	400 mm x 400mm	460 mm x 513mm

13 Replacement for a Light Curtain LV...M

Basically, many light curtains of the previous generation LV ... M can be replaced by an LVMC. Please note that that the two devices function completely differently, although they look very similar. They are not 100% compatible.

Please see the following table, to find out which LVMC can be used of a given LV..M:

LV...M	LVMC	LV...M	LVMC	LV...M	LVMC
LV100/50M*	LVMC100/50M1	LV150M3	LVMC150/100M1	LV200/150M1	LVMC200/150M1
LV100/50M1	LVMC100/50M	LV150M4*	LVMC150/100M1	LV200/200M	LVMC200/200M
LV100/50M2	LVMC100/50M1	LV150M11	LVMC150/100M1	LV200/200M1	LVMC200/200M1
LV100/50M3*	LVMC100/50M1	LV150ME	kein Ersatz	LV250M	LVMC250/100M
LV100/50M4*	LVMC100/50M1	LV150/50M2*	LVMC150/50M1	LV250M1	LVMC250/100M1
LV100M	LVMC100/100M	LV150/50M3	LVMC150/50M	LV250/250M	LVMC250/250M
LV100M1	LVMC100/100M1	LV150/50M4	LVMC150/50M	LV250/250M1	LVMC250/250M1
LV100M2	LVMC100/100M1	LV150/150M	LVMC150/150M	LV300M	LVMC300/100M
LV100M3*	LVMC100/100M1	LV150/150M1	LVMC150/150M1	LV300M1	LVMC300/100M1
LV100M4	LVMC100/100M1	LV150/150M2	LVMC150/150M1	LV300/200M	LVMC300/200M
LV100M5	LVMC100/100M1	LV150/150M3*	LVMC150/150M1	LV300/200M1	LVMC300/200M1
LV100/200M	LVMC100/200M	LV200M	LVMC200/100M	LV300/200M12	LVMC300/200M1
LV150M	LVMC150/100M	LV200M1	LVMC200/100M1	LV400/400M	LVMC400/400M
LV150M1	LVMC150/100M1	LV200/50M1	LVMC200/50M1	LV400/400M1	LVMC400/400M1
LV150M2	LVMC150/100M1	LV200/150M	LVMC200/150M	LV400/400ME	Kein Ersatz

*) At these LV ... M versions, the D-Sub connector is located on the housing top cover and not on the front profile. The D-Sub connector of the LVMC is always located on the front profile. Please check in advance whether you can mount the LVMC.

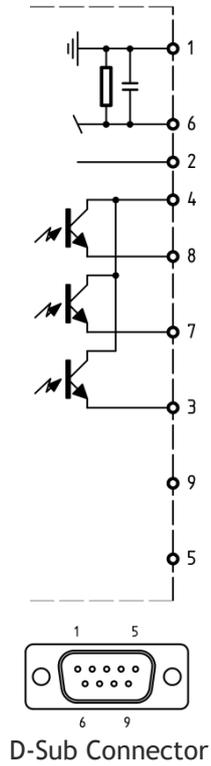
14 Connection Diagram D-Sub Connector

Four different embodiments with different pin assignments for the D-Sub connector are available:

Short Name	Embodiment
WS	Selection of the channel by toggle switch or by software 3 digital optocoupler outputs no digital optocoupler inputs
DI	Selection of the channel by two digital optocoupler inputs or by software 3 digital optocoupler outputs 2 digital optocoupler inputs
DO	Selection of the channel by software 5 digital optocoupler outputs no digital optocoupler inputs
DIO	Selection of the channel by two digital optocoupler inputs or by software 3 digital optocoupler outputs 2 bidirectional digital optocoupler inputs/outputs (I/O 1 and I/O 2)

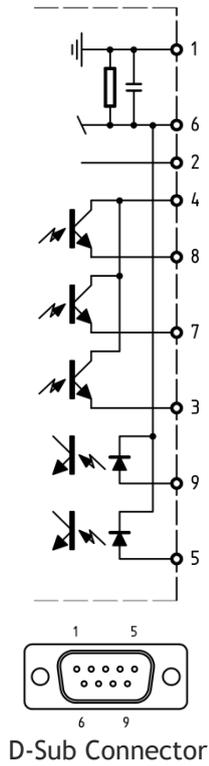
Depending on the embodiments, the assignment of pins 5 and 9 of the D-Sub connector differs.

14.1 Embodiment WS: Toggle Switch and 3 Digital Outputs



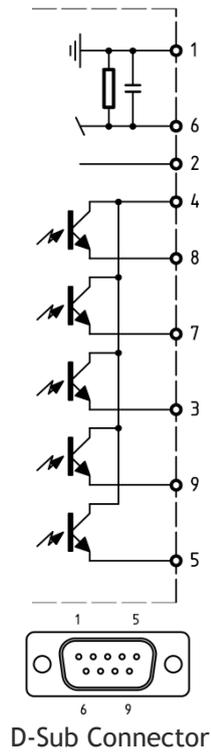
Assignment D-Sub Connector Embodiment WS		
Pin	Assignment	
1	Shield (The shield must be connected at both cable ends to the respective device housing.)	
6	Ground (0V)	
2	Power Supply (+24V)	
4	Common switching voltage for optocoupler outputs (Pin 3, 7 und 8)	
8	Output 3	Optocoupler outputs Positive polarity: When active, the transistor is conductive Negative polarity: When active, the transistor is not conducting
7	Output 2	
3	Output 1 (Monitoring 2)	
9	Not assigned No function assigned	
5	not assigned Leave these pins unconnected	

14.2 Embodiment DI: 3 Digital Outputs and 2 Digital Inputs



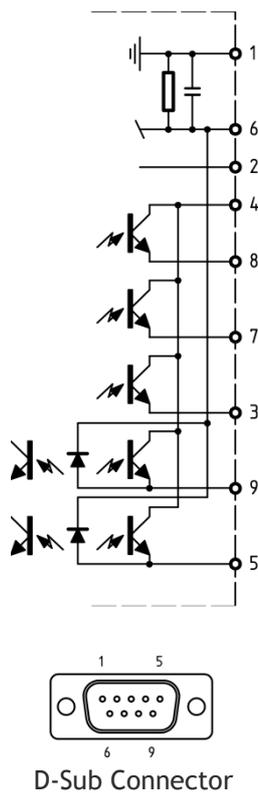
Assignment D-Sub Connector Embodiment DI		
Pin	Assignment	
1	Shield (The shield must be connected at both cable ends to the respective device housing.)	
6	Ground (0V)	
2	Power Supply (+24V)	
4	Common switching voltage for optocoupler outputs (Pin 3, 7 und 8)	
8	Output 3	Optocoupler outputs Positive polarity: When active, the transistor is conductive Negative polarity: When active, the transistor is not conducting
7	Output 2	
3	Output 1 (Monitoring 2)	
9	Input 1 (Bit 2 ⁰)	Optocoupler inputs
5	Input 2 (Bit 2 ¹)	

14.3 Embodiment DO: 5 Digital Outputs



Assignment D-Sub Connector Embodiment DO		
Pin	Assignment	
1	Shield (The shield must be connected at both cable ends to the respective device housing.)	
6	Ground (0V)	
2	Power Supply (+24V)	
4	Common switching voltage for optocoupler outputs (Pins 3, 5, 7,8 und 9)	
8	Output 3	Optocoupler outputs Positive polarity: When active, the transistor is conductive Negative polarity: When active, the transistor is not conducting
7	Output 2	
3	Output 1 (Monitoring 2)	
9	Output 4	
5	Output 5	

14.4 Embodiment DIO: 3 Digital Outputs and 2 Digital I/Os



Assignment D-Sub Connector Embodiment DIO		
Pin	Assignment	
1	Shield (The shield must be connected at both cable ends to the respective device housing.)	
6	Ground (0V)	
2	Power Supply (+24V)	
4	Common switching voltage for optocoupler outputs and optocoupler I/Os (Pins 3, 5, 7, 8 und 9)	
8	Output 3	Optocoupler outputs
7	Output 2	Positive polarity: When active, the transistor is conductive
3	Output 1 (Monitoring 2)	Negative polarity: When active, the transistor is not conducting
9	I/O 1 (Bit 2 ⁰)	Bidirectional optocoupler inputs/outputs (I/Os)
5	I/O 2 (Bit 2 ¹)	

Warning

If the bidirectional optocoupler inputs/outputs at pin 5 and pin 9 are used as inputs, it must be ensured that the voltage at these pins is never higher than the voltage at pin 4! If the voltage is higher, the in the LVMC integrated hardware protection circuit will be activated, which may damage externally connected components!

15 Electrical Characteristics

Characteristics					
Object	Parameter	Minimum	Typical	Maximum	Unit
Optocoupler Outputs	Operating Voltage	+10	+24	+30	V
	Load per Output			100	mA
	Isolation Voltage	5000			V _{rms}
Optocoupler -Inputs	Operating Voltage	+18	+24	+30	V
	Positive Switching Threshold			+15	V
	Positive Switching Threshold	+5			V
	Isolation Voltage	3000			V _{rms}
	Current (+24V Supply Voltage)			4	mA
Power Supply D-Sub Connector	Supply Voltage	+18	+24	+30	V DC
	Current Consumption			200	mA
Power Supply via Power over Ethernet (PoE)	Supply Voltage	+36	+48	+57	V DC
	Current Consumption			150	mA

16 Operating Conditions

Protection class:	IP53
Permissible ambient temperature:	0°C to +50°C

17 Limit Values for the Detection of Objects

The limit values of the standard version of the LVMC are as follows:

Minimum required distance between successive objects:	1mm
Minimum required dwell time of an object in the sensing area:	0.5ms*
Minimum required time lag between successive objects:	0.5ms*

*) The minimum required dwell time of an object in the sensing area and the minimum required time lag between successive objects are determined directly by the time resolution of the light curtain. It is 480us for the standard version. Special versions with higher resolution up to 30us are available on request.

18 System Requirements for CMT

The requirements for the computer used to run the CMT software are as follows:

Operating system:	Windows 8 or later, 32bit or 64bit version
Screen resolution:	Full HD (1920x1080 pixels) or better
Main Memory (RAM):	no special requirements
Mass storage (HDD, SSD, etc.):	no special requirements

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OPTRONIC AG was founded 1961 as company for development, manufacturing, as well as marketing of optoelectronic devices.

Nowadays, the service offering of OPTRONIC AG covers solutions for special requirements in the field of industrial control and sensor systems, as well as customer specific hardware and software development.



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