



ITSCAM 450

HIGH PROCESSING, CONNECTIVITY AND EMBEDDED SOFTWARE

| Product

Pumatronix Equipamentos Eletrônicos Ltda.

Rua Bartolomeu Lourenço de Gusmão, 1970. Curitiba, Brasil

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Changes History

Date	Revision	Updated content
11/30/2023	1.1	Update of the estimated range for the lens models; Update of the distance applied to the installation; Referring to firmware version 1.5.0
04/26/2024	2.0	Update for firmware versions 1.5.1, 1.6.0 and 1.7.1; Inclusion of Encryption and Digital Signature information; Correcting the supply voltage; Update of the optional lenses for the CS Mount model and the L8 lens code; Update of Image Processing Specifications
10/30/2024	2.1	Inclusion of new models; Update of image sensors
11/27/2024	2.2	Description of the Digital Signature
04/17/2025	2.3	Added models with S11 sensor; Added L10 lens (SAD-740); Fixed internal memory and storage (SAD-816)

Overview

The ITSCAM 450 Family from Pumatronix represents an important advance in the product portfolio, offering exceptional solutions for a variety of applications, including: non-metrological speed enforcement, weighing scale enforcement, customs enclosure, toll collection, security and electronic fencing of cities. With onboard license plate reader (LPR/OCR) capabilities, the image capture architecture of this family of devices stands out for its ability to read license plate characters, along with some crucial features that facilitate identification, such as the type, model and color of the vehicles.

The ITSCAM 450 device is designed to operate in a wide variety of conditions, providing accurate readings and images of vehicles at both high and low speeds, during the day and at night, in road and urban scenarios. It has the ability to recognize a diverse range of license plates, including reflective, non-reflective, red and non-reflective red plate models, through *Multiple Exposures* in a single shot, even considering the new Mercosur standard. Furthermore, the image capture system also reads motorcycle license plates.

A feature of the ITSCAM 450 Family is that it can capture images of up to two lanes of the road simultaneously, with an assertiveness rate of over 95%. This translates into unrivaled efficiency and precision.

The software-driven image capture system eliminates the need to install and maintain costly physical loops. In addition, it allows the configuration of regions of interest in the image, which delimit, among other things, in which part of the image the license plate reading should be carried out, preventing unnecessary information from being processed and optimizing the operation of the device.

With flexibility in the choice of lenses, Pumatronix offers a choice of models with external lenses C, CS, as well as models with a powered lens LM, all equipped with a CMOS sensor with Global shutter for drag-free images. In this way, the system is able to capture images of vehicles with speeds of up to 150 km/h, providing accurate readings in high-speed scenarios.



*Figure 1 - ITSCAM 450 line
with CS Mount lenses*



*Figure 2 - ITSCAM 450 line
with motorized lenses*

Energy efficiency is a priority and the ITSCAM 450 is designed for low energy consumption. It communicates via IP protocols and offers optional PoE power, ensuring ease of integration and total security and integrity of the data captured.

Equipped with a Digital Signature, it guarantees that the information received by the end user can be validated and, in the event of an attempt to alter or manipulate the data, it will be promptly identified, providing absolute confidence in the authenticity of the information. In addition, the ITSCAM 450 family features Data Encryption, which can be used as an additional layer of protection when accessing the device and sending data to servers, ensuring that only authorized recipients have access to the images. This

security measure prevents unauthorized individuals from intercepting or viewing the information, maintaining the privacy and confidentiality of the data at all times.

With nationwide technical support and the possibility of settings and installation by a specialized technical team, the ITSCAM 450 from Pumatronix is the definitive choice for your high-speed license plate reading needs. Consult your salesperson to find out more about how this solution can optimize your operations and improve security in your environment.

Handling Risks



This equipment must be powered by a direct current (DC) source with a voltage between 9 and 28 VdC. Do not connect any of the inputs directly to the mains (AC)!



Oxidation Risk: Power and data connections must be protected in a terminal box or similar structure to prevent oxidation of the connections and unwanted infiltration of liquids into the cable.



This equipment can be accompanied by lenses, which are sensitive to mechanical impacts such as falls and extreme vibrations.



Installation Site: In cases where the installation specifications cannot be met, it is recommended to consult Pumatronix Technical Support.

Models

Available models	Resolution	Lens Type	Estimated range (in meters) *
ITSCAM 450 CS (S09L0AJ)	1920x1200px	Manual CS Mount	10 to 50m (9-40mm) **
ITSCAM 450 LM (S09L8AJ)		Integrated motorized	8 a 50m (5-50mm)
ITSCAM 450 CS (S11L0AJ)	2048x1536px	Manual CS Mount	3 to 14 m (2.7-13.5 mm) or 10 to 39 m (9-40 mm)
ITSCAM 450 LM (S11L10AJ)		Integrated motorized	8 to 70 m (5-50 mm)

* The estimated range is defined according to the lens selected and identifies at what distance range the license plate characters remain legible in the OCR reading. When the device is used in conjunction with the illuminator, the range may be limited to the model applied. For models with a powered lens, the lens cannot be modified. For CS Mount-type lenses, the lens models shown are for reference purposes only.

** For this estimated range, we recommend using the Theia 9-40 mm lens.



Illuminator Installation: When using an illuminator in conjunction with the ITSCAM 450 device, check the product specifications for the minimum and maximum distance that must be observed in relation to the position of the object to be illuminated.

Image Sensors	Lens	Optional
S09: CMOS 1920x1200px S13: CMOS 2048x1536px	L0: CS Mount-type manual lens - LC2: 2.7- 13.5mm 2MP 1/2.7" - LC3: 9- 40mm SL940a L8: 5-50mm (DC Iris) L10: 5-50mm (P Iris)	A: Digital Signature (TPM1.0) J: Embedded LPR C: Rating



Digital Signature functionality: ITSCAM 450 has high security with Digital Signature and Data Encryption, ensuring the integrity and confidentiality of the information captured. Further information can be obtained from Technical Support.

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1. About the Product

The ITSCAM 450 range of image capture and processing devices has been developed for traffic management, enforcement, public safety, Smart City Applications, mobility systems, parking lots and applications that require image capture. The ITSCAM 450's 2.3MP and 3MP image sensors allows up to two lanes of images to be captured and processed. The sensor is combined with a set of lenses, which can be motorized or fixed (CS Mount standard). In the models that support fixed lenses, there are circuits that detect and control irises of the DC models.

The quality and level of detail of the images captured with ambient and artificial lighting on the ITSCAM 450 comes from the additional functionalities of the optical assembly (image sensor with lenses). *Multiple Exposures* can be captured for each photo request made to the equipment. This feature captures and processes more than one sequential image, with automatic variation of capture parameters.

The ITSCAM 450 keeps images standardized, even when there are significant variations in lighting conditions. This is possible by toggling the image settings *Profiles*. Profile changes are made by the equipment, based on the level of the image and the time of day.

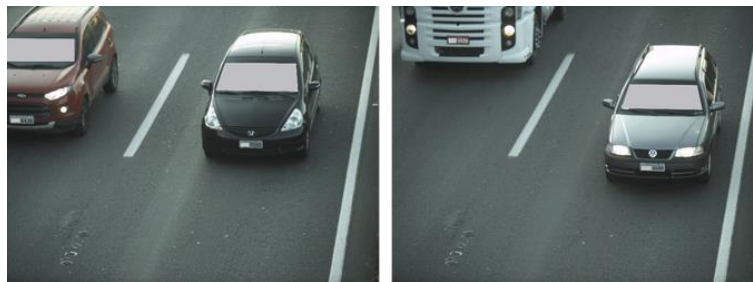


Figure 3 - Examples of daytime images captured with the ITSCAM 450

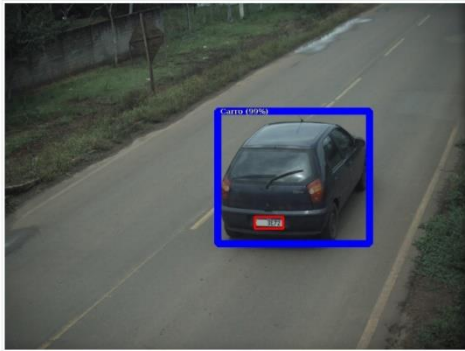


Figure 4– Examples of nighttime images captured with the ITSCAM 450

The ITSCAM 450 hardware has 2 (two) digital inputs for connecting external sensors, such as loops, doppler sensors and optical barriers, and 2 (two) digital outputs that can be used to control external devices or to trigger infrared lighting devices used in low light situations. However, the ITSCAM 450 can capture images without the need for external sensors by enabling software capture (or enable the *Enable object tracking with Classifier* option).

All the images captured by the ITSCAM 450 pass through the Quad Core ARM processor with neural network processor, which scans them for vehicles and license plates. At the same time as a vehicle is detected, it is classified as a motorcycle, car, truck or bus. This functionality is called *Classifier*, which can be performed with high precision, detecting vehicles even in situations where the license plate is missing or the characters are poorly distinguished. Together with the identification of the vehicle type in the *Classifier*, it is possible to define regions that operate the Virtual Loop in the image (virtual trigger regions). In addition to the characterization of the vehicle in the image, automatic character recognition (OCR) of the license plates in

the images is available, considering all Brazilian, Argentinian, Chilean, Colombian, French, Mexican, Dutch, Paraguayan, Peruvian and Uruguayan standards. Contact the Pumatronix Sales Department for the availability of OCR recognition for additional countries.



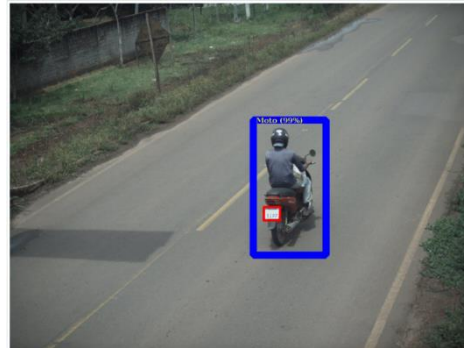
Classifier identifies a car



Classifier identifies a truck



Classifier identifies a bus



Classifier identifies a car

ITSCAM 450 delivers photos in JPEG format and within these files the comments field is filled in with the data relating to each capture, containing the license plates recognized, the type of vehicle identified and the instantaneous settings of the equipment.

The ITSCAM 450 line offers 1 Fast Ethernet port of 100Mbit/s to facilitate connectivity at monitoring points and allow remote and simultaneous access by multiple users. Access can be via the device's Web Interface or applications can connect using the REST API Client, the FTP (File Transfer Protocol), the ITSCAMPRO server or the Lince(R) platform. Access to equipment is managed by specifying the network's firewall rules or by specifying *Routes*. The commands available via the API REST are detailed in the ITSCAM 450 Integration Manual.

2. Generated Information

The ITSCAM 450 line captures images of up to two lanes in JPEG format and automatically provides the license plate characters for Brazil, Argentina, Chile, Colombia, France, Mexico, the Netherlands, Paraguay, Peru and Uruguay. To have license plates from additional countries recognized, please contact the Pumatronix Sales department.

The license plates read from the images, the data on the type, make, model and color* of the vehicle captured, as well as information on the configuration of the equipment are stored within the image files, in the JPEG field for storing comments. The quality of the JPEG files generated is adjustable and the images

can be overlaid with a caption with configurable content in each Profile. For each photo request, sequential captures can be sent with changes to the capture parameters (Multiple Exposures). The captures obtained can be viewed through the interface on the Snapshot and Trigger screens, which present the user with the image metadata, such as the vehicle type data (whether Car, Motorcycle, Bus or Truck), the brand, model and color of the vehicle identified by the Classifier and the license plates identified in *OCR Recognition*.

The images captured by the ITSCAM 450 can be redirected via a wired data network using the Fast Ethernet port. Using the communication interfaces, ITSCAM 450 images can be sent automatically via the device's Web Interface or applications can connect using the REST API Client, the FTP (File Transfer Protocol) protocol, the ITSCAMPRO server, the LINCSE server and APIs that allow integration with security agency systems** such as PM-PR, PRF (SPIA), PM-MG (Helios), Detecta-SP and C rtex.

In addition, the equipment and captures can be monitored in real time using the Web Interface. The video with the capture images is available in MJPEG format with adjustable quality, in addition to the live view available in a floating window, which can be scrolled or minimized and which optionally displays only the images of the captures made, with the possibility of adjusting the zoom and focus for the current profile.

Information on the device's *Current Status* is available on the home screen, which displays the device's data, such as the Device ID (or Serial Number), the installed versions, the performance status of the CPU, memory and storage and the 2 Digital Inputs and 2 Digital Outputs.

**Functionality depends on an agreement between the customer and the responsible public body.*

3. Additional Documentation

Product	Link	Description
ITSCAM 450	Integration Manual	Programming and integration manual containing the information needed to integrate ITSCAM 450 with an application
	Installation and Maintenance Guide	Guide containing the information needed to install and maintain the ITSCAM 450
ITSLUX	Product Manual	ITSLUX lighting manual

4. Mechanical Specifications

- Material: Aluminum and polycarbonate;
- IP protection: IP40 (requires protective box for external use);
- Mounting: *Mounting Mechanism* located at the bottom of the device

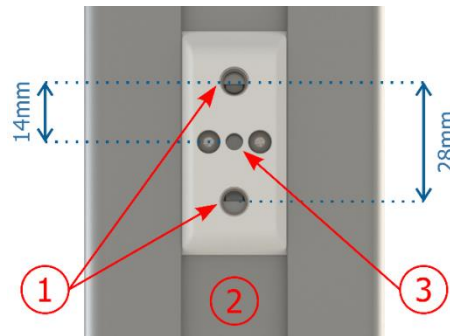


Figure 5 - Mounting Mechanism Specifications: 1) Thread for 1/4" screws; 2) Rail for changing the fixing point; 3) Ø4 mm hole for guide pin

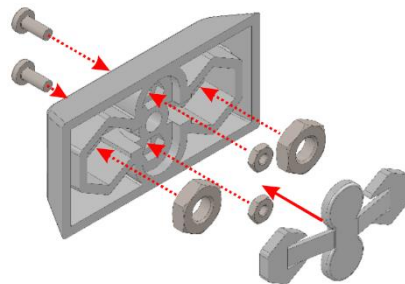


Figure 6 - Assembly diagram of the components of the Mounting Mechanism

- Interfaces: The ITSCAM 450 shows the connectors available on the rear panel:



Figure 7 - Interfaces available on the device: 1) Ethernet; 2) Microfit 16-way (power connector, IOs, RS-232)

- Ambient Operating Temperature:
 - DC power supply: -10 to 65 °C with relative humidity of 5 to 95% and no condensation (tests carried out in accordance with IEC 60068-2-2);
 - PoE power supply: -10 to 55 °C.
- Weight:

Model	Weight
ITSCAM 450 CS (S09L0AJ)	270 g + weight of the lenses*
ITSCAM 450 LM (S09L8AJ)	391 g
ITSCAM 450 CS (S11L0A)	270 g + weight of the lenses*
ITSCAM 450 LM (S11L10AJ)	391 g

*The lens models compatible with the ITSCAM 450 CS, supplied by Pumatronix, have an approximate weight:

- LC2 lens (2.7- 13.5mm 2MP 1/2.7"): 55g
- LC3 lens (9- 40mm SL940a): 71g
- Dimensions:
 - a. The ITSCAM 450 CS versions use CS Mount lenses and have the same dimensions, with overall length depending on the lens model chosen.



Figure 8 – ITSCAM 450 CS

- b. The ITSCAM 450 LM models feature integrated powered lenses with a focal length depending on the lens applied to the model, and a filter to control infrared light:



Figure 9 – ITSCAM 450 LM

5. Electrical specifications

- Power Supply: Power over Ethernet - PoE 802.3af (Power 7 W/48 V) or with 9~28 Vdc source (recommended 12 Vdc $\pm 20\%$ or 24 Vdc $\pm 20\%$);
- Maximum input current: 0.65 A;
- Typical consumption (daytime profile): 7 W;
- Typical consumption (nighttime profile): 18W (considering an ITSLUX 3016 or 3022 illuminator);
- Maximum power supplied by internal power supply: 30W;
- Protection against reverse polarity: 28 V;
- Overvoltage protection (max.): 28 V;
- Overcurrent protection: 0.5 A;
- Protection against inrush current: 1.1 A.

ITSCAM 450 interfaces	Electrical specifications
1 Fast Ethernet port	5 kVAC dielectric insulation, electrostatic discharge protection of ± 30 kV by contact - Level B (IEC 61000-4-2) and ± 30 kV by air (IEC 61000-4-2), EFT for direct peak current in 5/50 ns up to 40 A ± 5 % (IEC 61000-4-4) and surge current protection of 4 A (tP = 8/20 μ s) (IEC 61000-4-5)
2 Input and 2 outputs (IOs on Microfit connector)	Digital with 3.75 kV insulation (maximum current 50 mA, maximum voltage 28 Vdc and impedance 10 k Ω)
2 RS-232 EIA/TIA Serial Ports (conector Microfit)	2 ports with a maximum transmission rate of 115,200 kbps and protection against electrostatic discharge of ± 8 kV by contact (IEC 61000-4-2) and ± 15 kV by air (IEC 61000-4-2)

Interface	Connectivity Specifications
1 Fast Ethernet port	100Mbit/s
Iris control (ITSCAM 450 CS models)	Supports lenses with DC-type irises

Component	Image Processing Specifications
CPU	Quad core ARM
RAM memory	LPDDR4 8Gbit x 32bit speed 2667Mbps
2.3 MP image sensor	2.3 MP Global Shutter (1920x1200 px), Day/Night mode (generates color images during the day and monochrome images at night) Physical size of the sensor: 1/2.6" Internal frame rate: 30 fps Minimum Shutter of 48 μ s and maximum of 30000 μ s (or 30 ms)
3 MP image sensor	3 MP Global Shutter (2048x1536px), Day/Night mode (generates color images during the day and monochrome images at night) Physical size of the sensor: 1/3.1" Internal frame rate: 25 fps Minimum Shutter of 24 μ s and maximum of 30000 μ s (or 30 ms)
Internal storage	Total of 6 GB free for the user, without possibility of expansion
NPU	2.0Tops
Watchdog	on hardware with a period of 50 seconds



Oxidation Risk: Electrical and data connections must be protected in a terminal box or similar structure to prevent oxidation of the connections and unwanted infiltration of liquids into the cable.

5.1. Electrical Connections

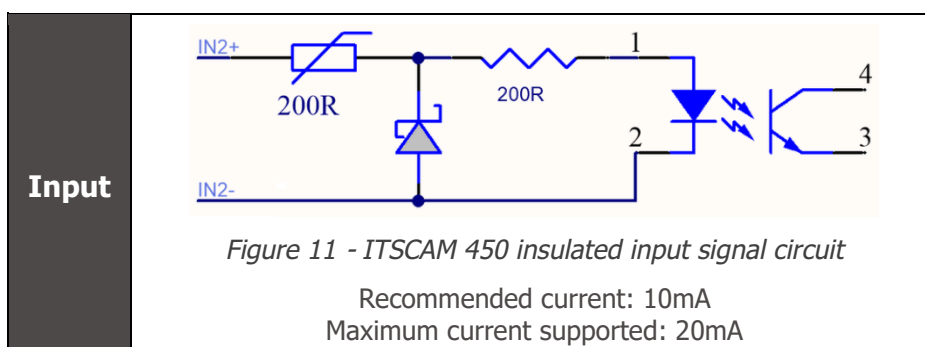
There are two connectors on the rear panel: Ethernet for data communication and Microfit 16-way Molex 43025-1600 (datasheet available at <http://www.molex.com>). The electrical connections are made to the terminals of the Microfit connector, in accordance with the specifications:

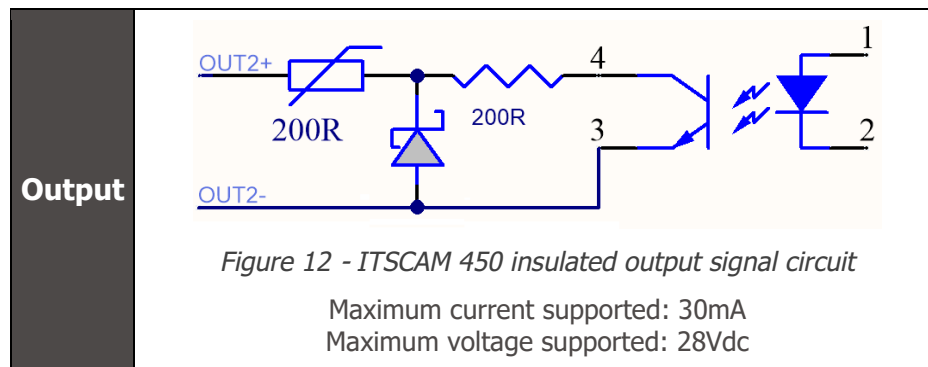


Figure 10 – ITSCAM 450 power and signal connector terminals (Microfit)

Terminal/Color	Signal	Description
1 - Green+White	RS232_RX1	RX RS232 1*
2 - Purple+White	RS232_TX1	TX RS232 1*
3 - Black+White	GND(RS232_1)	GND RS232 1*
4 – Purple	RS232_TX2	TX RS232 2*
5 – White	RS232_RX2	RX RS232 2*
6 - Brown+White	GND (RS232_2)	GND RS232 2*
7 - Gray	IN2+	Insulated Input Positive Terminal 2
8 - Black	IN2-	Insulated Input Negative Terminal 2
9 - Red+White	OUT2+	Insulated Output Positive Terminal 2
10 - Blue+White	OUT2-	Insulated Output Negative Terminal 2
11 – Green	IN1+	Insulated Input Positive Terminal 1
12 – Blue	IN1-	Insulated Input Negative Terminal 1
13 – Orange	OUT1+	Insulated Output Positive Terminal 1
14 - Yellow	OUT1-	Insulated Output Negative Terminal 1
15 – Brown	GND	Ground
16 – Red	Vin	Positive voltage of 12 Vdc or 24 Vdc

The input and output signals are optically insulated, and the circuits are shown in the figure:





The 200ohms resistors at the input and output provide basic protection for the circuit. However, it is up to the user to ensure that the current flowing through both the output and input does not exceed **20mA**. Additional resistors should be inserted to reduce currents above the established limit. The circuit is designed so that the device can be connected to 5Vdc voltage sources without the need for an additional resistor, as is the case with the ITSLUX illuminator's trigger signal. Voltages above 5Vdc require additional resistors to limit the current:

Power supply voltage	Additional resistor indicated
12Vdc	470 ohms
24Vdc	1000 ohms



Oxidation Risk: The electrical and signal connections made to the ITSCAM 450 bundle and the data network cable must be protected in a junction box or similar structure to prevent oxidation of the connections and unwanted liquid infiltration into the bundle.

5.1.1. Shot on IOs

The ITSCAM 450 has 2 outputs dedicated to controlling the triggering of the lighting and 2 inputs for installing external sensors, such as loops and light barriers, which identify when the images are captured (trigger).

The setup process is done by software, using the device's web interface or communication protocol. The inputs on the ITSCAM 450 can be sensitized by: Rising Edge, Falling Edge, High Level and Low Level.



IOs specification: Maximum supported current of 50 mA and maximum supported voltage of 28 Vdc, but it is recommended to activate the circuit with 10 mA.

5.2. Ethernet Connection

The ITSCAM 450 allows communication with other devices using the TCP/IP protocol. For this connection, the equipment provides a Fast Ethernet port (RJ-45 connector). It is recommended to use the EIA/TIA-568A standard for connections.

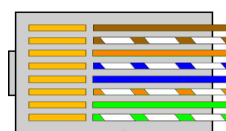


Figure 13 - EIA/TIA-568A standard RJ-45 connector

6. Software Specifications

ITSCAM 450 has a web interface for evaluating the images generated and making settings. Access to the interface requires information:

User	admin
Password	1234



Figure 14 - ITSCAM 450 web interface access screen

6.1. Image Capture Architecture

To meet the needs of Intelligent Transportation Systems (ITS) applications, the ITSCAM 450 has several features associated with image capture. These functionalities make up a general architecture and can be disabled by accessing the image *Profiles* configured on the device. The image acquisition process begins with how the images are requested (*Trigger*). This request can be made via external sensors connected to one or more ITSCAM 450 ports (*Inputs*). In the settings for the ports, you can specify whether the capture trigger will be by edge (up, down or both) or level (high and low).

There is an alternative to using external sensors connected to the inputs of the ITSCAM 450, which is the settings of the trigger for capturing a software-triggered image. In this case, it can be triggered at a Constant time interval or when the device identifies movement in the image (*Motion* trigger), enabling the *Motion Detector* feature.

Once the ITSCAM 450's image capture workflow has been defined, the *Multiple Exposures* feature can be enabled on request. This technology allows two to four sequential images to be configured, with the capture parameters varying with each request.

The license plates of the vehicles in the image can be identified by enabling the OCR functionality, which is available for the countries specified in [Generated Information](#). To increase the accuracy of the reading, the *Majority Vote* feature can be enabled. The feature that promotes more complete recognition of vehicles in images is the *Classifier*, which is responsible for identifying the type of vehicle detected in the image.

6.1.1. Motion Detector

The definition of movement between two consecutive ITSCAM 450 images depends on the set variation parameter, which considers for the *Motion Detector* a minimum time interval between triggers and a Variation *Threshold* required to be activated. In addition, it allows the specification of a *Region of Interest*,

which delimits the portion of the image in which the movement will be evaluated, corresponding to a polygon with four vertices, drawn over the visualization image.

6.1.2. Classifier

ITSCAM 450 is capable of analyzing captured images in real time and evaluating the content present in the images. This analysis aims to distinguish motorcycles, cars, trucks and buses from images that show only the road. This analysis has a degree of certainty of classification, considering samples of images that were used to generate this analytic. It is important to specify the correct type of installation, as the ITSCAM 450 can be used to capture two or one lane simultaneously. In the case of two lanes, the Panorama scenario must be chosen.

The *Classifier's Enable object tracking* option allows you to define regions that operate the *Virtual Loop (Virtual Trigger Regions)*, by configuring the direction in which vehicles travel in each lane of the monitored road, with capacity for up to four lanes.

6.1.3. Multiple Exposures

The ITSCAM 450's *Multiple Exposures* feature generates two to four sequential images per capture request, with different parameter settings. This feature can increase the hit rate in automatic license plate identification and identify vehicles that were covered up when the first image was captured. The settings that may vary are:

- Flash intensity, always corresponding to a percentage of the initial shot. This option is available for the Pumatronix ITSLUX range of illuminators designed to deliver the best results with *Multiple Exposures*;
- The exposure time of the image sensor (*Shutter*), generating images with a variation in the amount of light captured;
- Digital post-processing (*Gain*), which allows images to be lightened or darkened.

Thus, varying the *Gain*, *Shutter* and *Flash* settings in each of the exposures allows, for example, the non-reflective plates to be clearly visualized in the first capture, while adjusting the flash to low in the second capture allows the reflective plates to be better visualized by preventing them from being saturated in the image:



Figure 15 - Daytime Multiple Exposures



Figure 16 - Nighttime Multiple Exposures

6.1.4. OCR

ITSCAM 450 can recognize license plates from Brazil (in the Brazilian and Mercosur standards), Argentina, Chile, Colombia, France, Mexico, the Netherlands, Paraguay, Peru and Uruguay simultaneously. When enabled, recognition is performed on all captured images. To have license plates from additional countries recognized, please contact the Pumatronix Sales department.

Depending on the flow of vehicles and the processing demands of the ITSCAM 450, the number of *Processing Threads* can be changed. It is important to set a *Processing Time Limit* in order to discard the images in which it was not possible to read the license plate. The effort spent identifying the card can be set in *Processing Mode*.

OCR Recognition allows the definition of a ROI (Region of Interest) in the image in order to reduce the processing of regions of the image where it is not desired to find plates. In the ROI visualization image, the size of the license plate characters can be evaluated by configuring the size of the enabled grid, overlaid on the image visualization.

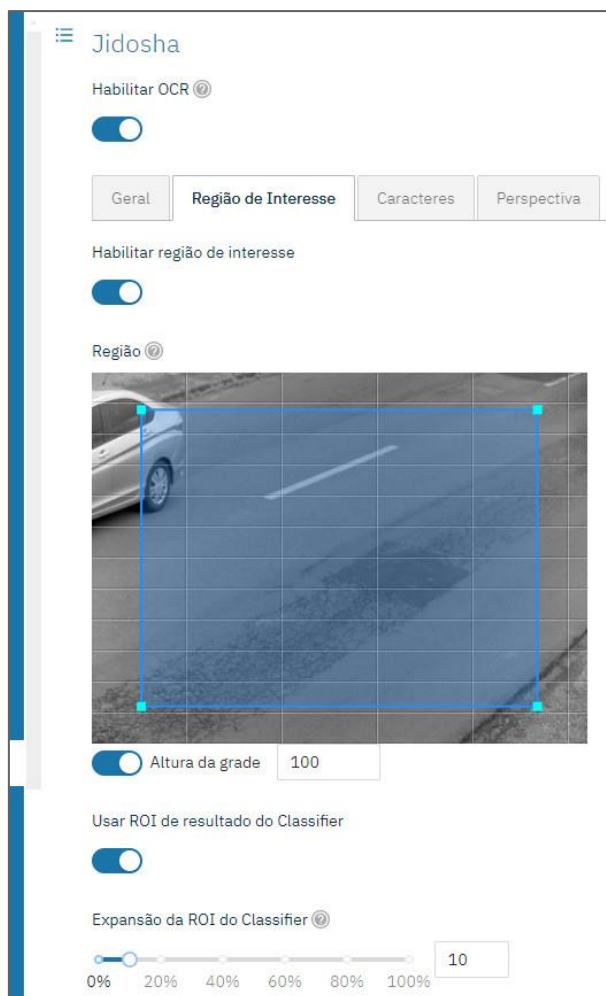


Figure 17 – ITSCAM 450 web interface for configuring the OCR Region of Interest

6.1.4.1. Majority Vote

The Majority Vote is a feature applied to the results of the automatic license plate character reading stage (OCR) and/or the *Classifier*. This analyzer determines which sequence of characters best describes the license plate captured in the image. The algorithm compares the identification *Reliability* of each character, based on the image of the character in perfect reading condition. This analysis can be done only on the set of *Multiple Exposures* images or using sequential images.

6.1.5. Automatic Transition Between Image Profiles

ITSCAM 450 allows registering up to four sets of equipment configurations, called *Profiles*. These settings correspond to image adjustments, framing (zoom and focus) and the transition conditions between the registered profiles. Switching between profiles is automatic when a time and/or image *Level* value is reached, which makes it easier to obtain images of the ideal quality in any lighting situation. It is recommended to use one profile for captures with ambient light (daytime) and another for captures with artificial lighting (nighttime).

See the Integration Manual for suggested settings for a profile's *Transitions*.

6.2. Information Security

Digital Signature and *Data Encryption* are the security mechanisms for the information generated by the ITSCAM 450 family of devices. Digital Signature technology ensures that the information received by the end user can be validated and in the event of an attempt to alter or manipulate the data, it will be promptly identified. *Data Encryption* ensures that only authorized recipients have access to the images, preventing unauthorized individuals from intercepting or viewing the information.

6.2.1. Digital Signature

ITSCAM 450 intelligent capture devices are capable of signing all the images captured by the device. The digital signature mechanism uses asymmetric cryptography, using a public key in the PEM or P12 formats.

The public key can be generated internally by the ITSCAM device using a random seed mechanism or it can be generated externally and sent to the capture device via the graphical interface or the M2M API.

When the key is generated by ITSCAM, this process is first done in RAM and only the public key is then sent to the client on the web interface. The private one goes directly into the database.

If the key is generated externally, the storage process follows a similar procedure. The user only sends the public key to the device and this content, after format validation, is stored directly in the database from RAM memory.

The key is stored compressed in a Redis database that resides on the equipment's eMMC. Since the eMMC is a memory welded inside the device, the only way to compromise the key would be to physically remove the chip, find the Redis database file and exploit this file to locate the compressed key.

6.2.2. Encryption

Encryption is the security mechanism that can be set up to access the device and send data to servers via secure protocols such as https, FTPS and SFTP, which are responsible for data security when TLS/SSL encryption is applied. This technology ensures that only authorized recipients have access to the images, maintaining the confidentiality of the data generated by the ITSCAM 450 family devices.

6.3. Receiving Images

ITSCAM 450 can send captured images to vehicle storage and monitoring centers in the ways described:

Server	Interaction with ITSCAM 450
FTP	The FTP server makes it possible to receive images captured by the ITSCAM 450
ITSCAMPRO	The ITSCAMPRO-type server is used to send images and license plates read by the on-board OCR. ITSCAMPRO is an application that concentrates images and license plates. Various types of reports can be viewed and generated (consult Pumatronix for more information on the application)
Cougar	The Cougar sending protocol is TCP (port 60000), proprietary to Pumatronix, which guarantees the greatest degree of configuration and flexibility in integration. See the Integration Manual for more information
Lince	The Lince server is Pumatronix's SaaS cloud platform, ideal for concentrating large numbers of devices and implementing electronic image fencing.

Server	Interaction with ITSCAM 450
REST API Client	The REST API Client allows the device to be integrated with a WEB REST server. Through a template language, the body of the submission and the headers can be customized to meet the server's needs

7. Licensing

The ITSCAM 450 license covers the hardware of the image capture and processing device, with automatic on-board recognition of the license plates present in the images (OCR) in the standards of Brazil, Argentina, Chile, Colombia, France, Mexico, the Netherlands, Paraguay, Peru and Uruguay, in addition to the functionalities presented in this manual. To activate license plate recognition for additional countries, please contact Pumatronix Sales Department.

New features and bug fixes are made available in the new firmware versions, provided by Pumatronix Technical Support.

8. Initial Settings

8.1. Installation Pre-Requisites

The conditions at the monitoring site, prior to installation, are indispensable to the equipment's operation.

8.1.1. Equipment Installation Site

To extract the best performance from the ITSCAM 450, it is recommended that it be installed parallel to the track and with little horizontal inclination. Parts of the image should not be obscured by objects such as trees or vehicles in other lanes.

The zoom and focus adjustment aim to produce images in which the characters on the license plate are approximately 20 pixels high. However, the height of the characters can vary from 15 pixels to 30 pixels, with the best recognition rates corresponding to a height of 20 pixels.

In traffic enforcement applications, the ITSCAM 450 can be installed on poles or gantries with a minimum height of 3.5 meters and a maximum height of 6 meters. The minimum vertical angle of 15° and the maximum of 45° between the center of the lens and a line parallel to the ground must be respected, adjusting zoom and focus for the best visibility of the license plate. Higher angles of vertical inclination generate significant deformations in the images, which implies a reduction in the automatic recognition rate of the license plates detected in the images.

The distance from the ITSCAM 450 to the vehicle crossing point varies between ITSCAM 450 CS Mount models, depending on the lens used. On models with an ITSCAM 450 LM powered lens, the distance applied must consider the estimated range for the lens, specified in [Models](#). In night operations, this distance varies according to the model of illuminator used.



Illuminator Installation: When using an illuminator in conjunction with the ITSCAM 450 device, check the product specifications for the minimum and maximum distance that must be observed in relation to the position of the object to be illuminated.



Installing the ITSCAM 450 without following the stated distances compromises the quality of the captured images and reduces OCR recognition. If the requirements cannot be met at the installation location, it is recommended to consult Pumatronix Technical Support.

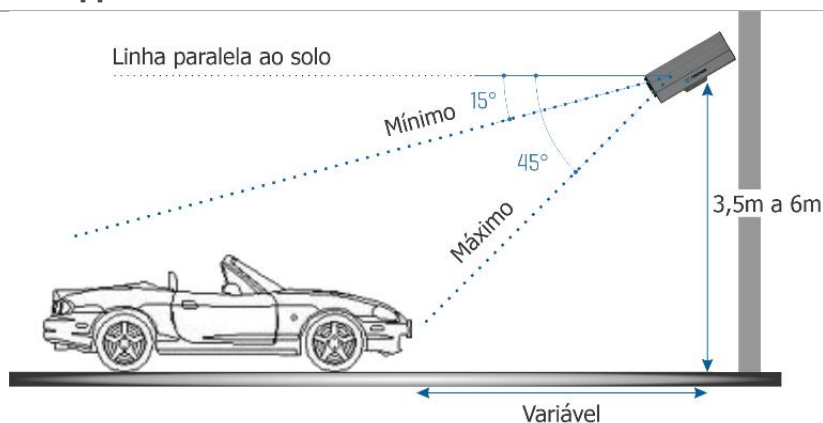


Figure 18 - Side View of the Installation

The captured license plate must have a maximum horizontal angle of 30° to the side of the road:

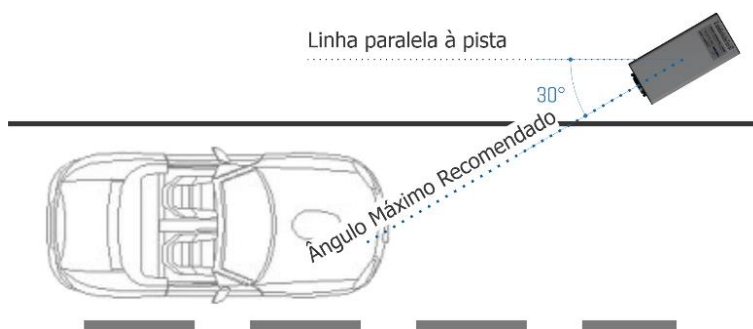


Figure 19 - Top View of the Installation

8.1.2. Necessary Infrastructure

At the equipment's fixing point, there must be:

- Power supply point in accordance with the [Electrical Specifications](#), close to the equipment installation point;
- Data network connectivity near the equipment installation point (based on the chosen mode);
- Sheltered location for cable splices, e.g. terminal box, close to the equipment installation point;
- Hole for fixing the protective box bracket;
- Appropriate bolts for fixing the ITSCAM 450 protection box to the installation site;
- Availability of an *Auxiliary Setting Equipment* (for checking framing and image adjustments), with the Google Chrome browser (version 85 or higher) installed.

8.2. Necessary Conditions for Installation

To extract the best performance from the ITSCAM 450, installation should be carried out with a low horizontal inclination and avoiding parts of the image being obscured by objects such as trees or vehicles in other lanes.

Check in the Installation and Maintenance Guide how to make the necessary connections.



Installation Site: In cases where the installation specifications cannot be met, it is recommended to consult Pumatronix Technical Support.

8.2.1. Network Interface Parameterization

Ethernet Port Setup	Default value
IP address	192.168.0.254
Maintenance IP address	192168254254
Netmask	255.255.255.0

In situations where the ITSCAM 450's network configuration differs from the standard, it is advisable to change the settings before physically installing the equipment on site. The changed network settings are saved in the flash memory, but are effectively applied after the equipment is restarted. When the change is made via the web interface, the restart is automatic once the change has been confirmed.

The ITSCAM 450 has a recovery IP address (192.168.254.254) for cases in which the user changes the IP address by mistake and loses connection with the device. The use of this IP address for access recovery is only available in a point-to-point connection with the device, when connected to the Ethernet port.



The maintenance IP address of ITSCAM 450 (192.168.254.254) is disabled when the primary IP address conflicts with it. Therefore, when manually configuring the device's network interface (Ethernet), values other than the maintenance IP must be applied, as there will be no way to recover the connection in extraordinary situations when the primary IP is lost.

The most common situations in which the primary and maintenance IP addresses conflict are:

- Primary IP of ITSCAM 450 in the 192.168.254.x range and netmask 255.255.255.0
- Primary IP of ITSCAM 450 in the 192.168.x.x range and netmask 255.255.0.0
- Primary IP of ITSCAM 450 in the 192.x.x.x range and netmask 255.0.0.0
- Netmask set to 0.0.0.0

8.2.2. Installation Guidelines

- 1) Fit the ITSCAM 450 into the protective box bracket, leaving the lenses as close as possible to the glass of the holder;
- 2) Respecting the positioning distances of the ITSCAM 450 (as indicated in [Equipment Installation Location](#)), secure the protective box. When mounting on a ceiling (upside down), the equipment can be set to *Rotate the image by 180°* via the web interface;
- 3) Adjust the positioning of the protective box so that images of the area where vehicles are traveling are captured. If necessary, it is possible to crop the image, selecting only the region of interest (ROI) of the image where the vehicles are actually visible to generate the images.

With this option, the conversion time to JPEG is improved and does not affect Streams or live viewing;

- 4) Connect the Microfit connector bundle to the ITSCAM 450 if DC power or the equipment's IOs are used:

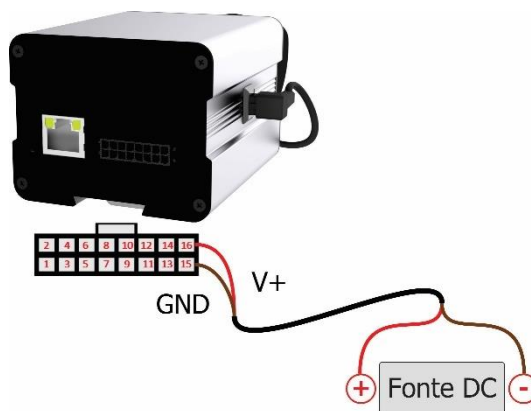


Figure 20- ITSCAM 450 power and signal connector (Microfit)

9. First Access

The ITSCAM 450's web interface can be used to quickly check the equipment's status and monitor images in real time. However, the equipment must be powered, following the Electrical Specifications. An *Auxiliary Setting Equipment* (for checking framing and image adjustments) the Google Chrome browser (version 85 or higher) installed shall be used.

In addition, the *Auxiliary Setting Equipment* must be on the same data network as the ITSCAM 450 (with network settings compatible with the ITSCAM 450). If a point-to-point connection is used, ITSCAM 450 can be accessed via the maintenance IP address 192.168.254.254. When typing the IP address of the ITSCAM 450 into the address bar of the *Auxiliary Setting Equipment's* browser, it must be entered:

User	<i>admin</i>
Password	<i>1234</i>



Figure 21– ITSCAM 450 web interface access screen

10. Care and Maintenance

Certain precautions are necessary to ensure the product's performance and extend its useful life.



Product Risks: The use of the product presents risks, which are presented in the section [Handling Risks](#).

10.1. Firmware Update

Pumatronix periodically makes available* updates for the ITSCAM 450 with defect corrections and feature additions, by contacting Technical Support on the Pumatronix website. The device update process requires connection to an *Auxiliary Configuration Equipment* that allows access to the ITSCAM 450 Web Interface, using one of the Web browsers:

- Microsoft Edge 109 or higher;
- Google Chrome version 85 or higher;
- Firefox version 21 or higher;
- Opera 25 or higher;
- Safari 8 or higher.

Updating the ITSCAM 450 firmware requires some security measures during the procedure to prevent the file from being corrupted and the ITSCAM 450 device from stopping working:

- 1) Keep the ITSCAM 450 device inactive during the update process, ensuring that it is not requested by any service or other equipment on the network where it is installed;
- 2) Keep the ITSCAM 450 device switched on at all times while the update is running, taking the necessary measures to prevent it from restarting or being switched off;

Request the firmware file by filling in the form available in the *Technical Support* menu on the company's website [Pumatronix](#):



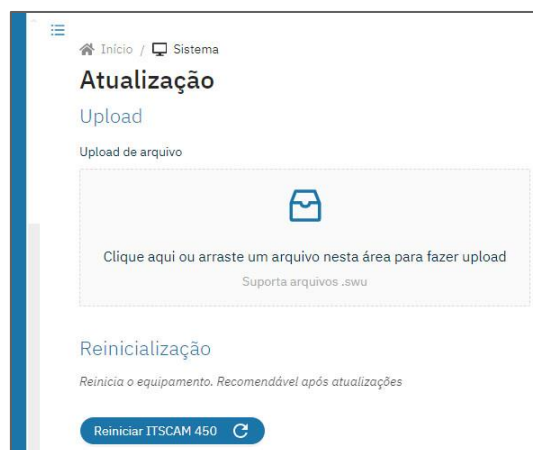
Figure 22 – Firmware Request Form

If you have any questions, please contact Technical Support via e-mail suporte@pumatronix.com or WhatsApp +55 (41) 9203-8327.

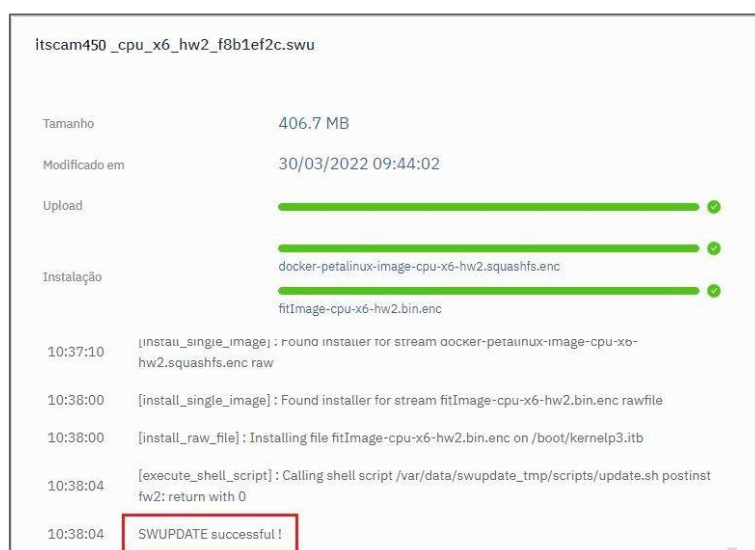
*Pumatronix will provide versions with bug fixes or security improvements for up to 3 years after the product is discontinued and removed from the portfolio.

10.1.1. ITSCAM 450 Firmware Update via Web Interface

- 1) Download the firmware file received by e-mail (which starts with the name *itscam450* and has the extension *.swu*) to the Auxiliary Configuration Equipment that will be used to connect to the ITSCAM 450;
- 2) Connect the *Auxiliary Configuration Equipment* on the same data network as the ITSCAM 450;
- 3) Open the *Auxiliary Configuration Equipment* browser;
- 4) Enter the IP address of the ITSCAM 450 (the default IP address is 192.168.0.254 and point-to-point connections can be made via 192.168.254.254);
- 5) Enter your username and password;
- 6) Go to the *System menu > Update* of the ITSCAM 450 web interface



- 7) Select or drag the firmware file (the update starts automatically and takes place in three stages, which are signaled by the progress bar);
- 8) Monitor that the *Upload* reaches 100%, and then the *Installation*, making sure that the device is not restarted or disconnected and that it is not being requested by any service or other equipment on the network during the process. This security is necessary when performing this procedure to prevent the update from corrupting the firmware and the equipment from stopping working;
- 9) Check the *SWUPDATE successful!* message, which indicates that the installation is complete



- 10) Click on the *Restart ITSCAM 450* button;
- 11) Wait for the equipment to restart so that the new firmware changes are applied;

- 12) Finish the update procedure by checking the firmware version indicated in the top bar of the page.

10.2. Updating Analytics Licenses

Licenses for the *Classifier* and OCR image analytics libraries can be updated directly via the web interface. When receiving the *.lic* file provided by Technical Support, access the *System > Licenses* menu in the interface:

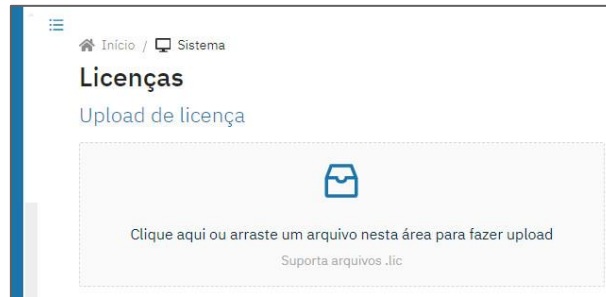


Figure 23 – ITSCAM 450 web interface for updating licenses

10.3. Preventive Maintenance of the ITSCAM 450 Device

The ITSCAM 450 image capture and processing device must provide artifact-free images. However, if there is any dirt on the outside surface of the lenses or housing, the cleaning procedure should be carried out:

- 1) Spray lens cleaning liquid on the surface of the lenses or water on the glass of the protective case, so that excess dirt adhering to the surface can be removed.
- 2) Use a soft, lint-free cloth to remove dirt, moving the cloth in one direction only
- 3) Wipe with a dry cloth to finish cleaning and do not use force as this can damage the surface.

11. General Warranty Conditions

Pumatronix guarantees the product against any defect in material or manufacturing process for a period of 1 year from the date of issue of the invoice, provided that, at the discretion of its authorized technicians, it is found to be defective under normal conditions of use.

The replacement of defective parts and the execution of services resulting from this Warranty will only be carried out at Pumatronix Authorized Technical Assistance or a third party expressly indicated by Pumatronix, where the product must be delivered for repair.

This Warranty will only be valid if the product is accompanied by a *Maintenance Form* that has been duly filled in and has not been erased and is accompanied by an Invoice.

11.1. Situations in Which the Product Loses its Warranty

- 1) Using software/hardware not compatible with the specifications in the Manual;
- 2) Connecting the product to the mains outside the standards set out in the product manual and installations with excessive voltage variation;
- 3) Infiltration of liquids from opening/closing the product;

- 4) Damage caused by natural agents (electric shock, flooding, salt spray, excessive exposure to climatic variations, among other factors) or excessive exposure to heat (beyond the limits established in the Manual);
- 5) Using the product in environments subject to corrosive gases, excessive humidity and/or dust;
- 6) Showing signs of tampering with security seals;
- 7) Showing signs of opening or modification by the Customer in places of the product not authorized by Pumatronix;
- 8) Damage caused by accidents/falls/vandalism;
- 9) Displaying a tampered and/or removed serial number;
- 10) Damage resulting from the Customer's transportation and packaging of the product in conditions incompatible with it;
- 11) Misuse and not in accordance with the instruction manual.

12. Privacy Policy

In compliance with the General Data Protection Law (LGPD) - Law No. 13709, dated August 14, 2018, this product has programmable functions for capturing and processing images that may infringe the LGPD when used in conjunction with other equipment to capture personal data.

The equipment does not collect, use or store personal information, whether sensitive or not, for its operation.

Pumatronix is not responsible for the purposes, use and treatment of the images captured, and control of the information and ways of operating the product are the sole decision of the user or purchaser of the product.





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