



PUMATRONIX

CAPTURE DEVICES

ITSCAM 600, ITSCAM 600 FHD, VTR600, ITSCAM 450 AND ITSCAM 450+

| Integration

Pumatronix Equipamentos Eletrônicos Ltda.

Rua Bartolomeu Lourenço de Gusmão, 1970. Curitiba, Brasil

Copyright 2020 Pumatronix Equipamentos Eletrônicos Ltda.

All rights reserved.

Visit our website <https://www.pumatronix.com>

Send comments on this document to suporte@pumatronix.com

Information contained in this document is subject to change without prior notice.

Pumatronix reserves the right to modify or improve this material without obligation to notify the changes or improvements.

Pumatronix grants permission to download and print this document, provided that the electronic or physical copy of this document contains the full text. Any changes to this content are strictly prohibited.

Changes History

Date	Revision	Updated content
06/28/2022	1.0.0	Initial Issue
04/02/2024	1.1.0	Inclusion of ITSCAM 600 FHD, VTR600 and ITSCAM 450 products; Updates for firmware versions 1.3.0 to 1.6.0
04/30/2024	1.1.1	Inclusion of ITSCAM 450+ product Update for firmware version 1.7.1;
06/18/2024	1.1.2	Update on the inclusion of ITSCAM 450+ product; Inclusion of the Automatic Iris application

Overview

The purpose of this document is to guide the developer in the use of the operating interfaces that allow configuration of the behavior of the ITSCAM 600, ITSCAM 600 FHD, VTR600, ITSCAM 450 and ITSCAM 450+ devices. This document details the options available via the web interface, the Pumatronix Protocol or the Cougar Protocol.



Depending on the firmware version applied to the device being accessed, the web access interface differs and some functions may only be available in the latest versions.

Summary

1.	Presentation of the Web Interface	6
	Web Interface Help	7
	Home Screen	8
	Changing the Interface Language	9
2.	Usability Settings	10
	Network Settings	10
	Ethernet Network Settings	11
	Wi-Fi Network Settings	11
	3G/4G Network settings	13
	HTTPS settings	14
	Firewall settings	15
	Route settings	16
	Integration with DDNS service	18
	Access Management	18
	Date and Time	19
	Servers	20
	FTP servers	20
	ITSCAMPRO Server	22
	Cougar Server	23
	Lince server	23
	REST API Client Server	24
	Plugins	26
	Image Profiles	28
	Lens	30
	Image Framing	33
	Live Viewing	36
	Streams	37
	Exposure	39
	Color	40
	Transitions between Image Profiles	41

Suggested Image Configuration for Profiles	42
Inputs and Outputs	44
Trigger	47
Checking the Images Generated	48
Multiple Exposures	50
Recognition (OCR Reading)	51
Licenses	58
Monitoring	59
Maintenance	59
3. API REST	61
<i>Color</i> Settings	62
<i>Exposure</i> Settings	62
<i>Lens</i> Settings	63
Movement Filter (<i>MovFilter</i>) Settings	63
Multiple Exposures (<i>multipleExposures</i>) Settings	63
<i>Transitions</i> Settings	63
Trigger Settings	64
White Balance (<i>Whitebalance</i>) Settings	64
4. COUGAR Communication Protocol (Socket)	64
Connection and Messages	65
General definitions	66
Operations	67
NACK	68
SHUTDOWN	68
SET_OPT_STR	68
AUTHENTICATE	69
SET_CALLBACKS	69
SET_JPEG_CFGS	69
EVT_PIPE_START	70
EVT_TRIGGER, EVT_SNAPSHOT, and EVT_PREVIEW	70
JPEG_TRIGGER, JPEG_SNAPSHOT, and JPEG_PREVIEW	71
TRIGGER_SNAPSHOT	72

GET_LASTFRAME	72
EVT_GPIO	72
SET_SERIAL_CFGS	73
EVT_SERIAL	73
SEND_SERIAL_DATA	73
SET_EQUIP_CFGS	74
APIs available	74
General Recommendations	75
5. Open Source Pumatronix Communication Protocol (Socket)	76

1. Presentation of the Web Interface

The Web interface makes it possible to evaluate the images generated and configure the devices. Access to the interface requires information:

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

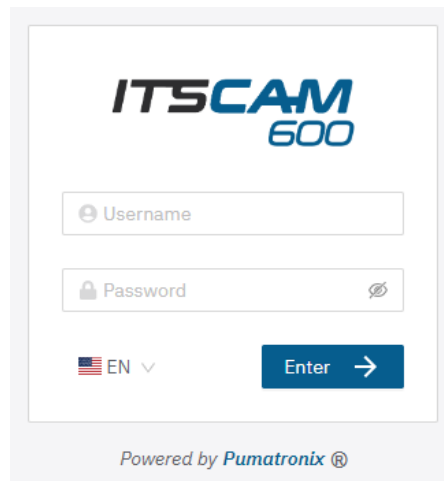


Figure 1 - Login screen

As a form of security, it is recommended to change the device's default password by accessing the *System > Users* menu:

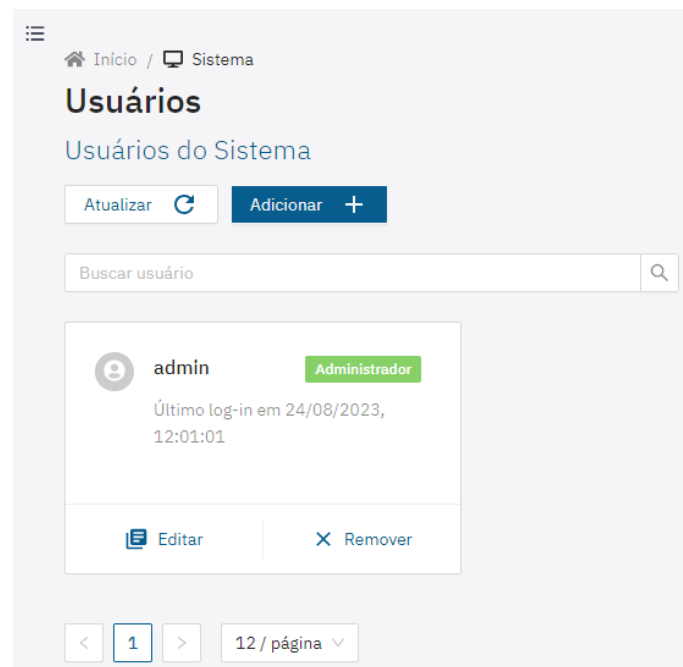
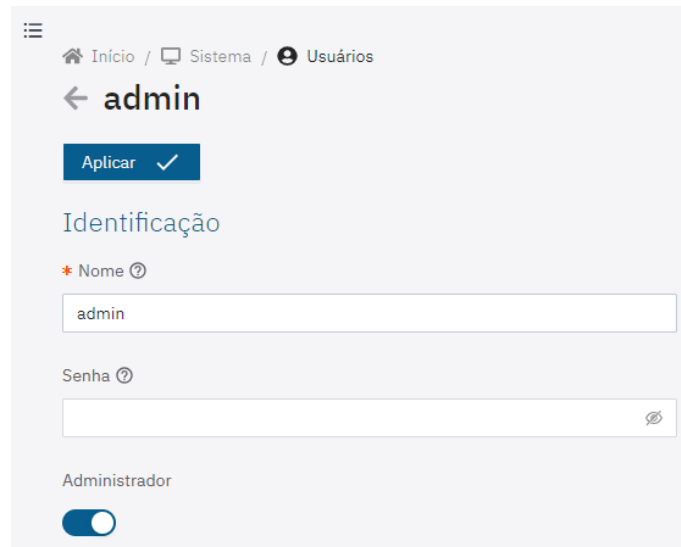


Figure 2 - Screen displayed when accessing *System > Users*

- 1) Click on *Edit*.
- 2) Enter a *Name* and create a new *Password*, which can contain between 4 and 200 characters, including numbers, letters and special characters;

3) Finish by clicking on *Apply*:



Web Interface Help

If there is any doubt about any setting on the web interface, there is a help symbol which, when placing the cursor over it, displays an explanation, examples or the recommended setting for the device:



Figure 3 - Help displayed by positioning the cursor on top

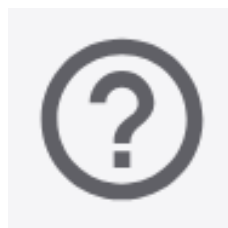
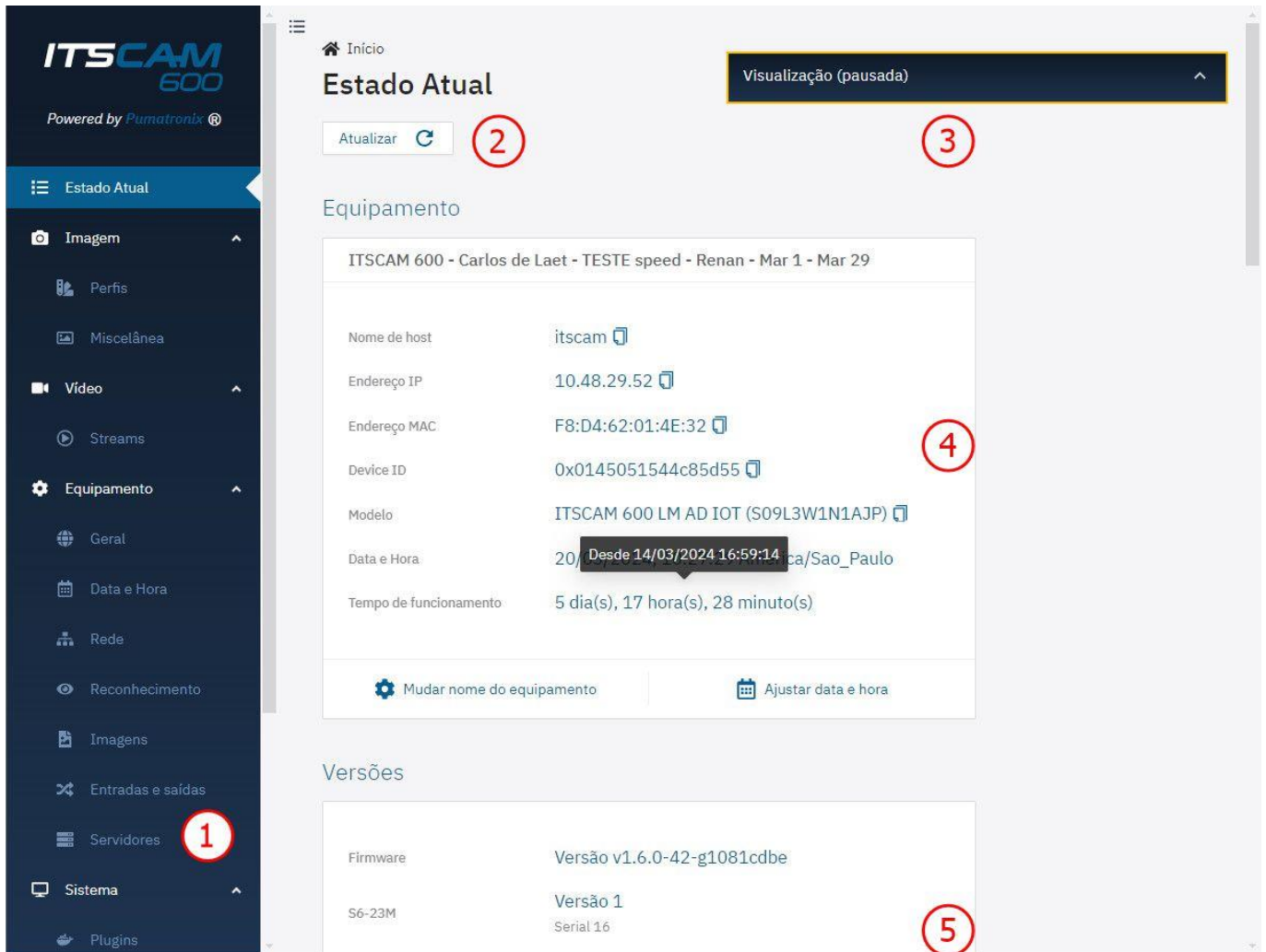


Figure 4 – Interface help

Home Screen

The home screen displays the Current Status screen of the device in operation, as well as the permanent usability options on the interface:



The screenshot displays the ITSCAM 600 web interface. On the left is a dark sidebar menu (1) with options like 'Imagem', 'Perfis', 'Miscelânea', 'Vídeo', 'Streams', 'Equipamento', 'Geral', 'Data e Hora', 'Rede', 'Reconhecimento', 'Imagens', 'Entradas e saídas', 'Servidores', 'Sistema', and 'Plugins'. The main content area is titled 'Estado Atual' (Current Status) and includes a home icon, a refresh button (2), and a 'Visualização (pausada)' (Paused View) pop-up window (3). Below this is the 'Equipamento' (Equipment) section, which shows details for 'ITSCAM 600 - Carlos de Laet - TESTE speed - Renan - Mar 1 - Mar 29'. The details include: Nome de host (itscam), Endereço IP (10.48.29.52), Endereço MAC (F8:D4:62:01:4E:32), Device ID (0x0145051544c85d55), Modelo (ITSCAM 600 LM AD IOT (S09L3W1N1AJP)), Data e Hora (20/ Desde 14/03/2024 16:59:14 ca/Sao_Paulo), and Tempo de funcionamento (5 dia(s), 17 hora(s), 28 minuto(s)). There are also buttons for 'Mudar nome do equipamento' and 'Ajustar data e hora'. The 'Versões' (Versions) section at the bottom shows 'Firmware' (Versão v1.6.0-42-g1081cdbe) and 'S6-23M' (Versão 1, Serial 16).

Figure 5 - Options available on the interface and in the Current Status window: 1) Menu bar; 2) Action button available for functionality; 3) Pop-up live view window; 4) Equipment data, including detailed Runtime and quick setting buttons, 5) Data on installed firmware versions

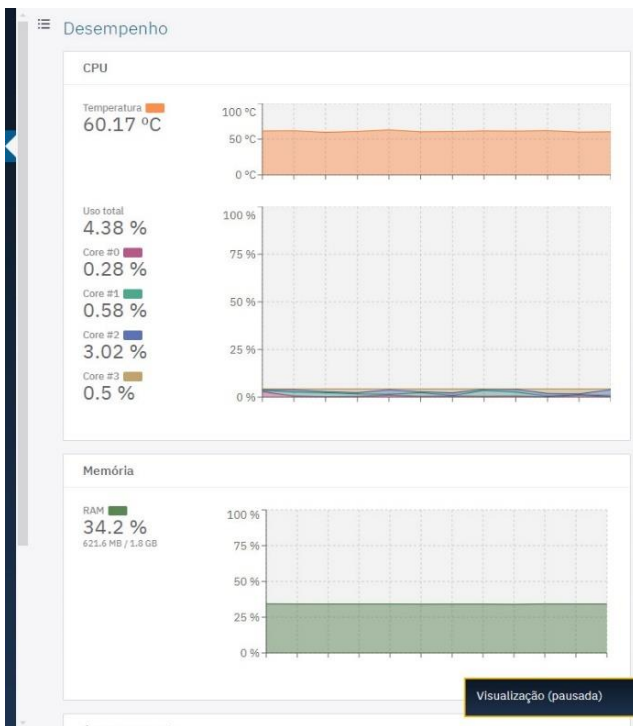


Figure 6 - Available data on the Current Status of CPU, Memory and Storage Performance

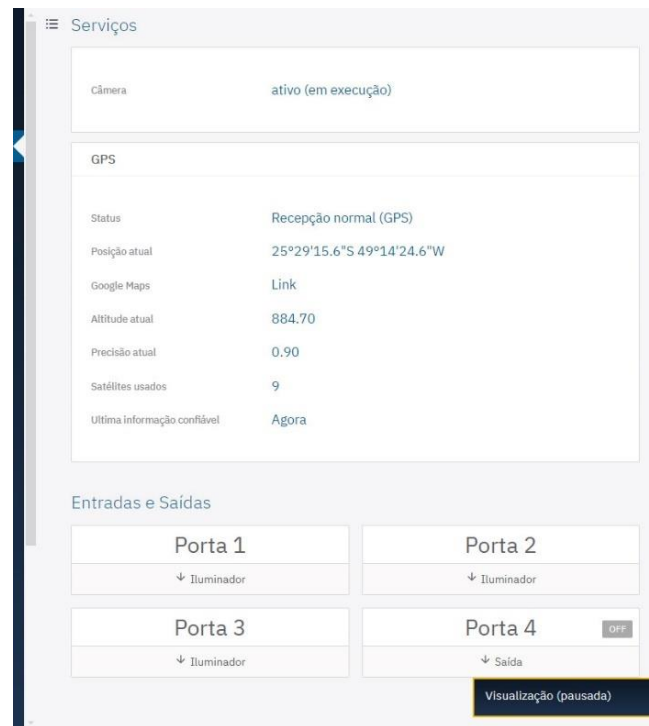


Figure 7 - Available data on the Current Status of Camera and GPS Services* and port connections

* When the device is able to establish communication with a GPS network, the main Geolocation information is displayed as the Figure 7 above.

Changing the Interface Language

The Web interface can be displayed in *Portuguese* or *English* by selecting it on the login screen or by accessing it from the *Equipment > General* menu.



Figure 8 – Equipment > General menu screen

2. Usability Settings



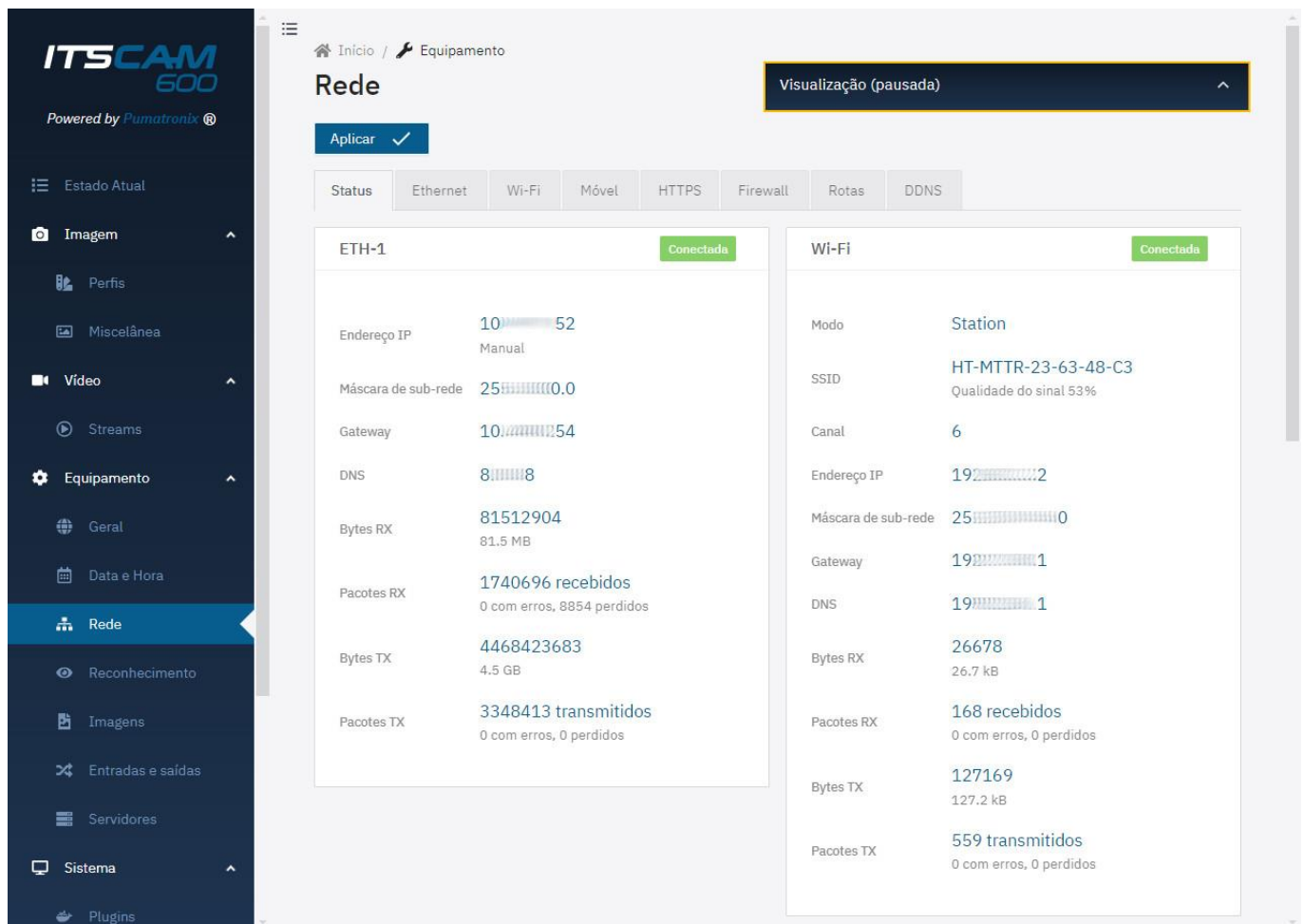
The steps for configuring the image capture devices are presented in the ideal order of settings and must be carried out after physical installation, respecting the *Prerequisites* and *Necessary Conditions* for installation presented in the Product Manual.

Network Settings

Network settings require the use of an *Auxiliary Configuration Equipment*.

- 1) Enter the factory default IP address in the browser;
- 2) Enter *user* admin and *password* 1234;
- 3) Access the menu *Equipment > Network*;
- 4) Access the tab for the network to be configured.

The initial network settings screen allows to visualize the *Status* of the connected networks and the diagram of the configured *Routes*:



The screenshot displays the 'Rede' (Network) settings page. At the top, there is a navigation bar with 'Início' and 'Equipamento'. Below it, the 'Rede' title is followed by a 'Visualização (pausada)' button. A 'Aplicar' button with a checkmark is visible. The main content is divided into two columns: 'ETH-1' and 'Wi-Fi', both with green 'Conectada' status indicators.

Network	Status
ETH-1	Conectada
Wi-Fi	Conectada

ETH-1 Configuration:

- Endereço IP: 10.1.1.52 (Manual)
- Máscara de sub-rede: 255.255.255.0
- Gateway: 10.1.1.54
- DNS: 8.8.8.8
- Bytes RX: 81512904 (81.5 MB)
- Pacotes RX: 1740696 recebidos (0 com erros, 8854 perdidos)
- Bytes TX: 4468423683 (4.5 GB)
- Pacotes TX: 3348413 transmitidos (0 com erros, 0 perdidos)

Wi-Fi Configuration:

- Modo: Station
- SSID: HT-MTTR-23-63-48-C3 (Qualidade do sinal 53%)
- Canal: 6
- Endereço IP: 192.168.1.2
- Máscara de sub-rede: 255.255.255.0
- Gateway: 192.168.1.1
- DNS: 192.168.1.1
- Bytes RX: 26678 (26.7 kB)
- Pacotes RX: 168 recebidos (0 com erros, 0 perdidos)
- Bytes TX: 127169 (127.2 kB)
- Pacotes TX: 559 transmitidos (0 com erros, 0 perdidos)

Figure 9 - Network settings home screen

Ethernet Network Settings

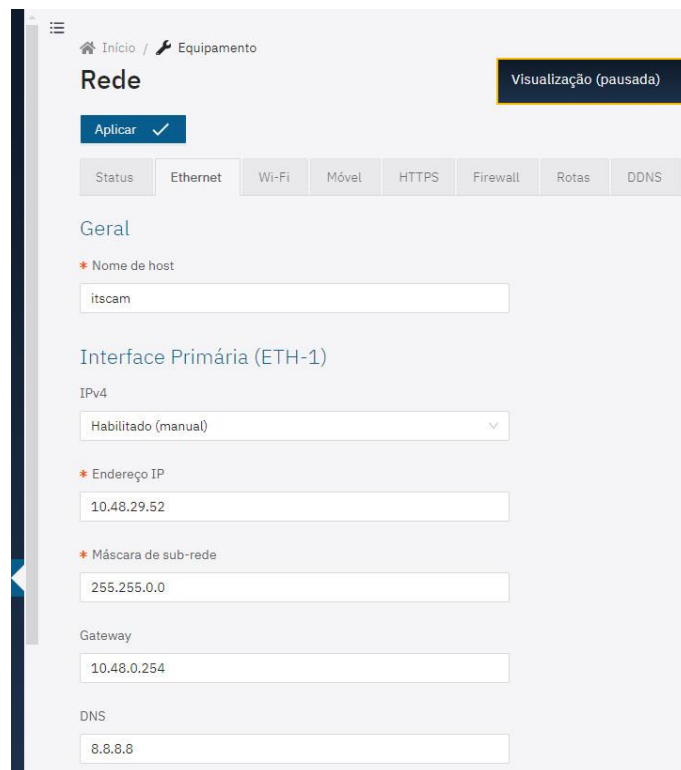
Some models of the ITSCAM 600 device have only one Ethernet connector, and the ITSCAM 600 FHD devices have 2 Ethernet connectors. For the ITSCAM 450 and VTR600 there is only 1 Ethernet interface for settings:

- 1) Select the *Ethernet* tab;
- 2) Identify the network in *Hostname*;
- 3) Fill in the data for the *Primary Interface (ETH-1)* when connecting to *ETH-1*;
 - a. Use a different IP address to the one used to access the device in order to avoid conflicts and malfunctioning of the data network;



The maintenance IP (192.168.254.254) is used to recover the connection in extraordinary situations when the primary IP is lost. For this reason, when manually configuring the device's network interface (Ethernet or Wi-Fi), values other than the maintenance IP must be applied.

- 4) Click on *Apply* after confirming the data entered:

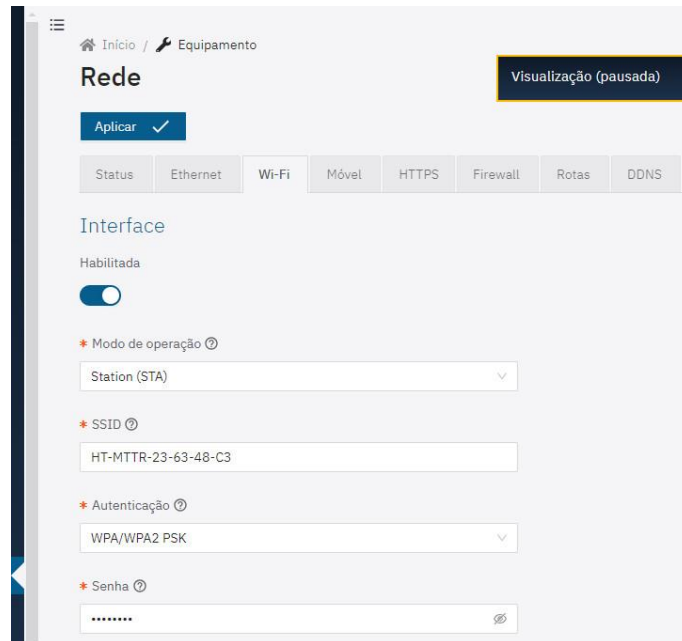


Wi-Fi Network Settings

Only the VTR600 devices and some models of the ITSCAM 600 and ITSCAM 600 FHD devices can be connected to a Wi-Fi network and configured:

- 1) In the *Wi-Fi* tab, select *Enabled* for the interface;
- 2) Under *Operating Mode* select the option *Station (STA)* to connect to an existing Wi-Fi network;
- 3) Click on the *SSID* field and select the Wi-Fi network that will be used;
- 4) Under *Authentication*, select the Authentication protocol to be used: *Open (no authentication, WEP or WPA/WPA2 PSK)*;
- 5) Enter the *Password* to access the selected Wi-Fi network;

6) Click on *Apply* after confirming the data entered:



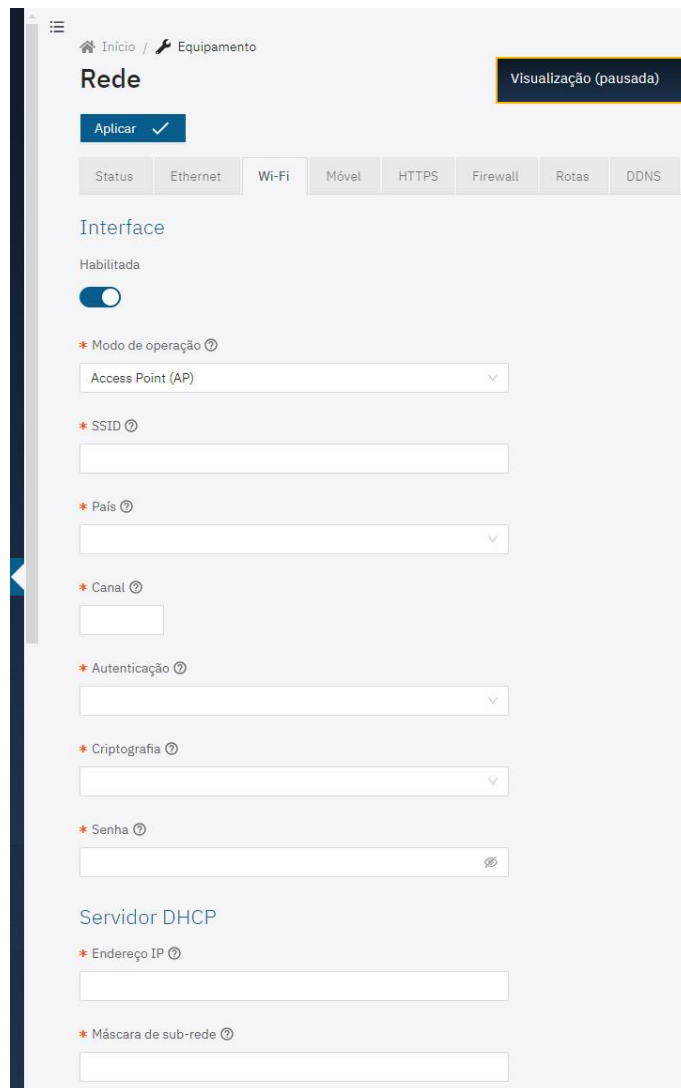
Select the *Access Point (AP)* option in the *Operation Mode* field only when the device is to be used as an access point to an available Wi-Fi network:

- 1) Enter the *SSID* identification data, the *Country*, the *Channel* and the type of *Authentication* that will be applied when distributing the Wi-Fi connection;
- 2) Select the type of *Encryption* on the connection between TKIP, AES or TKIP & AES;
- 3) Set a *Password* to access the *Access Point* network;
- 4) Enter the *IP Address* and *Subnet Mask* of the *DHCP Server* to determine the address range for the devices connecting to the *Access point*;



The maintenance IP (192.168.254.254) is used to recover the connection in extraordinary situations when the primary IP is lost. For this reason, when manually configuring the device's network interface (Ethernet or Wi-Fi), values other than the maintenance IP must be applied.

- 5) Click on *Apply* after confirming the data entered.



Início / Equipamento
Rede Visualização (pausada)
 Aplicar ✓
 Status Ethernet **Wi-Fi** Móvel HTTPS Firewall Rotas DDNS
Interface
 Habilitada
 * Modo de operação ⓘ
 Access Point (AP) ▾
 * SSID ⓘ

 * País ⓘ

 * Canal ⓘ

 * Autenticação ⓘ

 * Criptografia ⓘ

 * Senha ⓘ

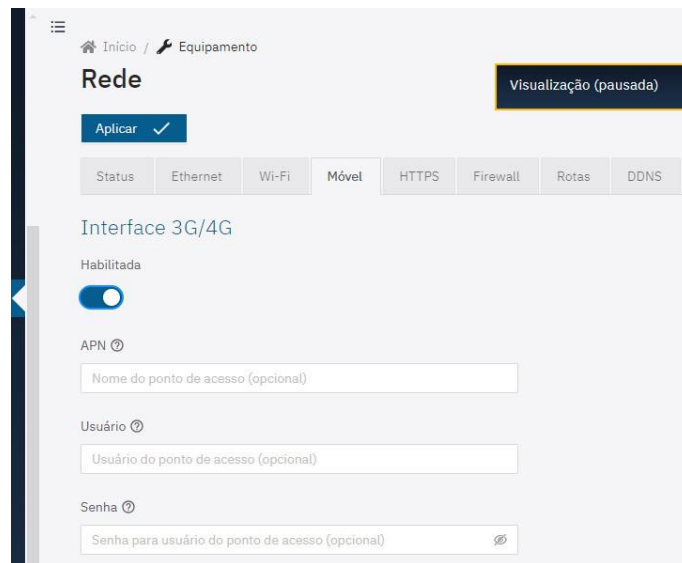
Servidor DHCP
 * Endereço IP ⓘ

 * Máscara de sub-rede ⓘ

3G/4G Network settings

Only the VTR600 devices and some models of the ITSCAM 600 and ITSCAM 600 FHD devices can be enabled for the mobile network, on the 3G/4G interface, and configured:

- 1) In the Mobile tab, select the option *Enabled* for 3G/4G interface;
- 2) Enter the APN data if there is no automatic detection, entering custom data whenever it is necessary to configure the operator's information. By default the information is:
 - a. *APN*: http://[operator name].com.br;
 - b. *User*: [operator name];
 - c. *Password*: [operator name];
- 3) Click on *Apply* after confirming the data entered:



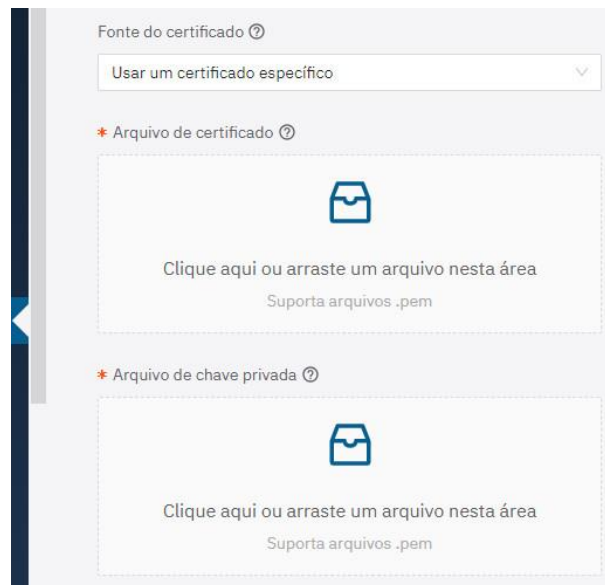
HTTPS settings

The ITSCAM 600, ITSCAM 600 FHD and VTR600 capture devices support the HTTPS protocol (port 443), which allows communication to be carried out in encrypted form, with a certificate created by the device itself or supplied by the user. ITSCAM 450 devices up to firmware version 1.7.0 do not support the HTTPS protocol.

1. In the *HTTPS* tab, select *Enabled*;



2. Specify the provider of the key files by selecting *Certificate source*:
 - a. *Use the standard certificate*: The system will use an embedded certificate generated by Pumatronix and a security message will appear in the browser on first access. For the settings to be applied, the device must be *Restarted* by going to *System > Update*;
 - b. *Use a specific certificate*: The system will use a certificate provided by the user, via a pair of public & private key files, by dragging in the *Certificate file* and *Private key file* areas.
3. Click on *Apply* after confirming the data entered.

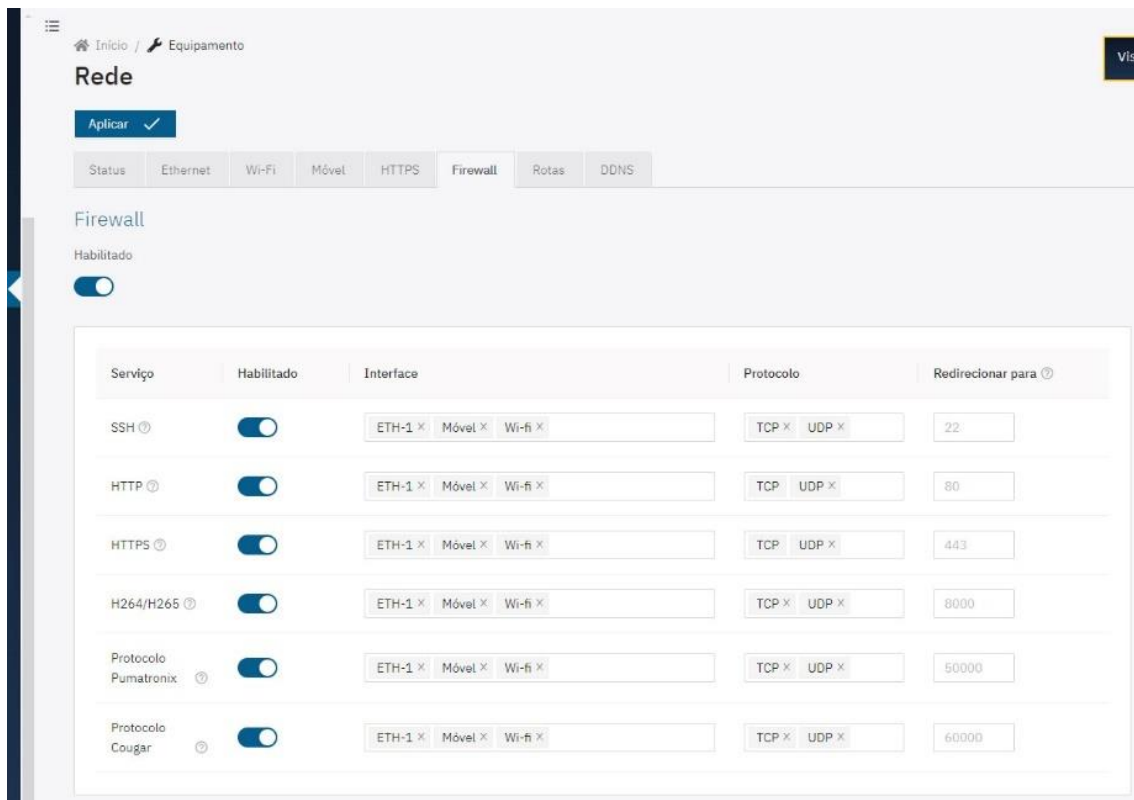


The use of HTTPS changes the access link to the device from `http://` to `https://` and the device must be *Restarted* for the change to be applied, by going to *System > Update*.

Firewall settings

Configure the network security firewall by going to the *Equipment > Network* menu:

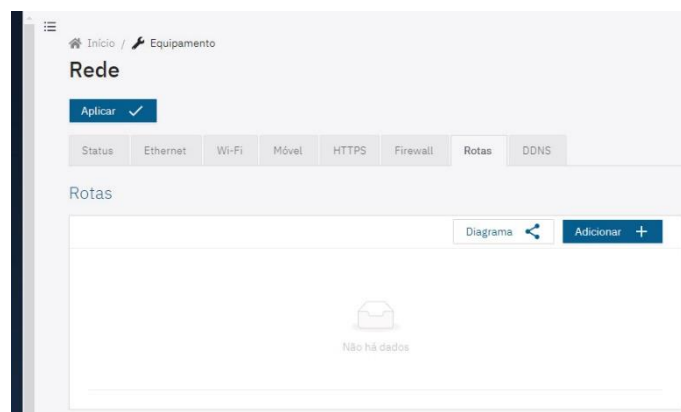
- 1) In the *Firewall* tab, select *Enabled*;
- 2) Select the connection *Interface* used with the port;
- 3) Select the *Protocol* to be applied;
- 4) In the *Redirect to* field, enter a value between 100 and 65535 for which port the service should use instead of the default (optional), or leave it blank to not redirect (the value should be different from other ports used by the system or plugin and other redirects);
- 5) Click on *Apply* after confirming the data entered.



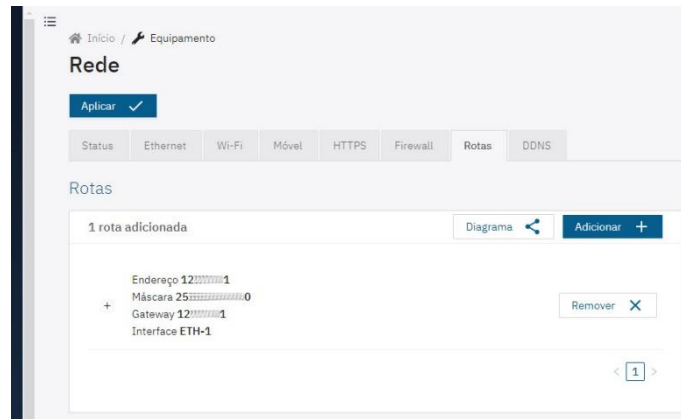
Route settings

Configure *Routes* when it is necessary to access remote IP subnets or those not directly connected to the network interface, which can be accessed using the Default Gateway or the specified route shown in the *Diagram*.

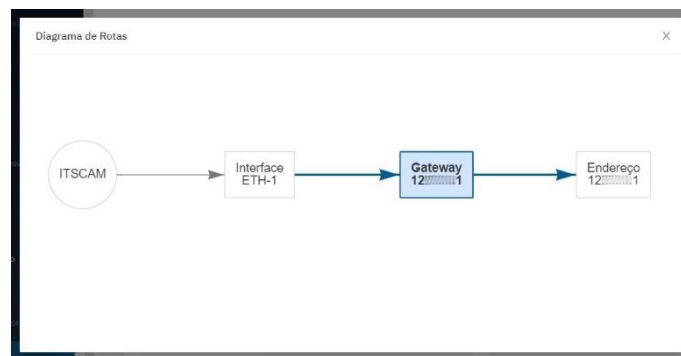
- 1) Select the *Route* tab;



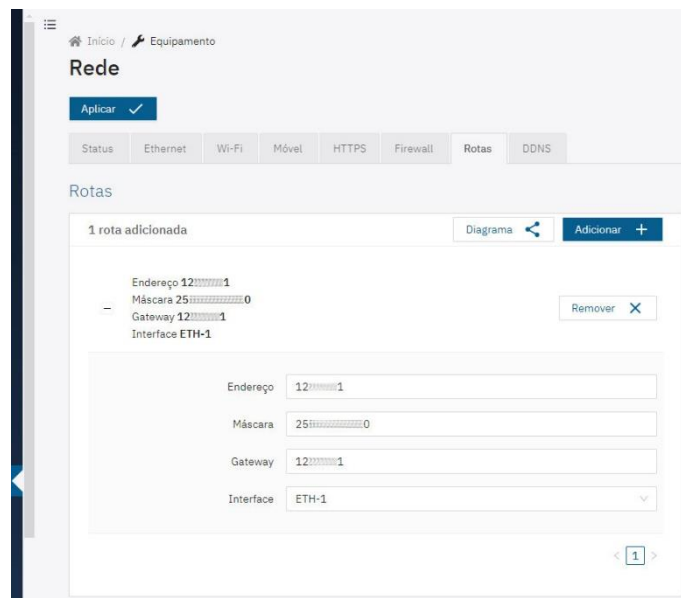
- 2) Add a route by clicking *Add+*;



3) View by clicking on Diagram;



- 4) Or edit the *Address, Mask, Gateway and Interface* data by clicking on the "+" to the left of the route;
- 5) Click on *Apply* after confirming the data entered.



Integration with DDNS service

By upgrading to firmware version 1.4.0 and above, it is possible to integrate the network connection with a DDNS (dynamic DNS) service provider:

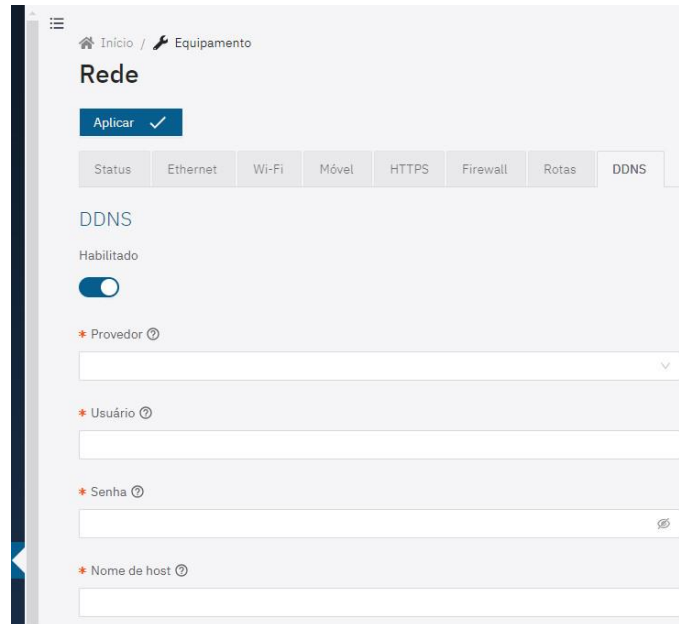


Figure 10 - Equipment > Network menu screen when configuring the DDNS network

- 1) In the *DDNS* tab, select the *Enabled* option;
- 2) Fill in the fields with the details of the DNS Service *Provider*, the *User* and *Password* for accessing the provider and the *Hostname*, including the domain name;
- 3) Click on *Apply* after confirming the data entered.

Access Management

Capture devices allow greater control of access and changes made to the device, as multiple users can be created. Users configured with the *Administrator* profile can configure the equipment, users and view images. Users with an *Operator* profile can view images and settings. To manage active users, access *System > Users*:

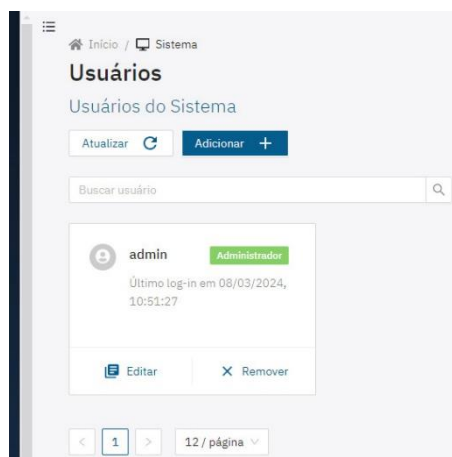
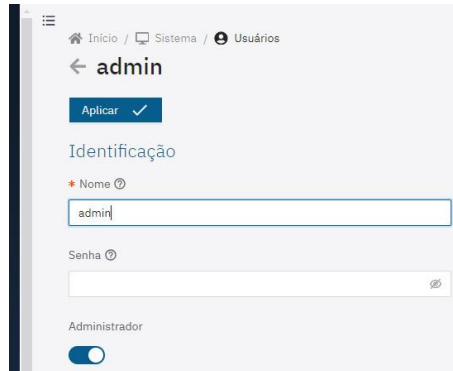


Figure 11 - User management home screen

- 1) Create a new user by clicking *Add+*;
- 2) Edit the data of the existing user by clicking on the *Edit* button;
- 3) Identify with a unique *Name* using between 4 and 200 characters, with letters and numbers and no spaces;
- 4) Create an access *Password* containing between 4 and 200 characters, numbers, letters and special characters or leave it blank to keep the current password;
- 5) Validate the edit by clicking *Apply*.



The factory default user and password should be changed for better access control and greater security.

Date and Time

The Date and Time settings can be accessed via the *Equipment > Date and Time* menu and can be made manually or via an NTP server.

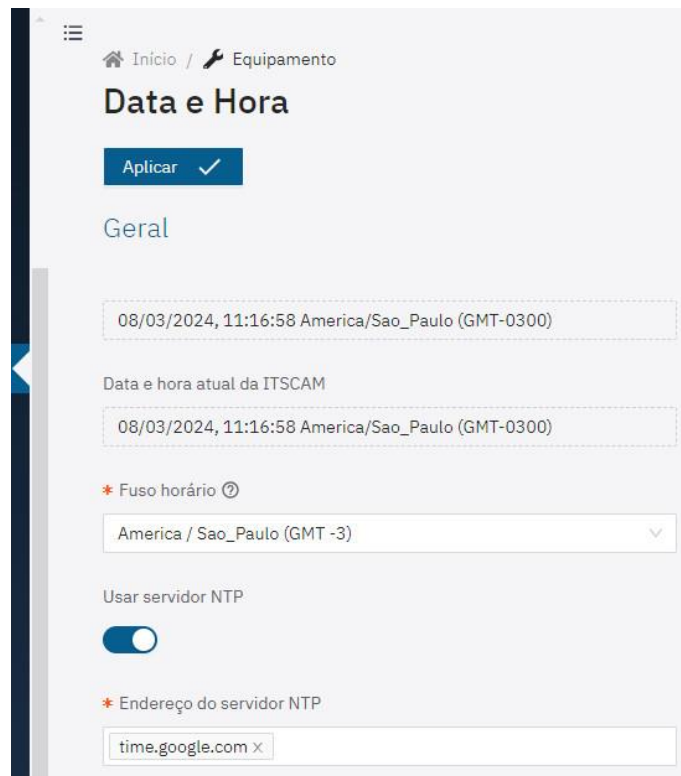


Figure 12 – Equipment > Date and Time menu screen

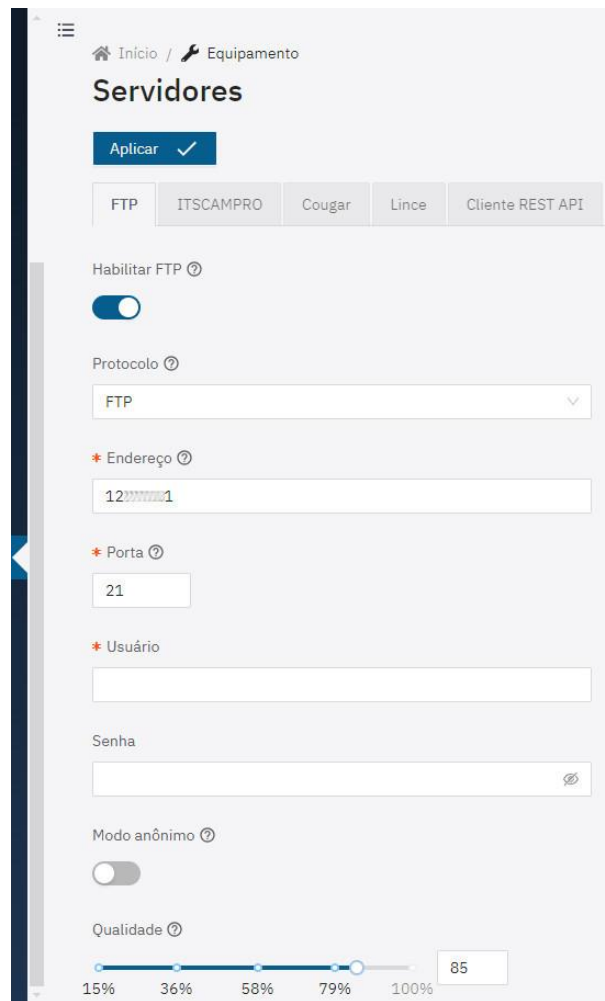
Servers

The devices can automatically send the images to an FTP server or to ITSCAMPRO, for example.

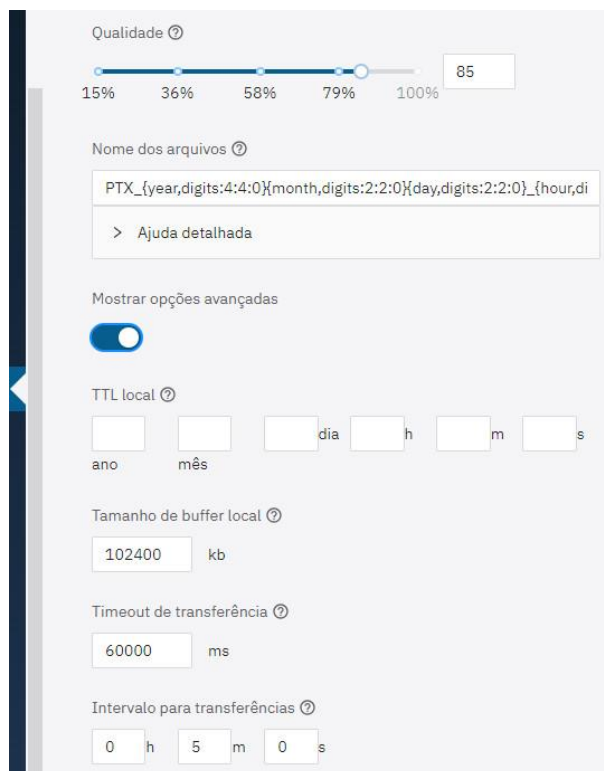
- 1) Go to the *Equipment > Servers* menu;
- 2) Select the tab corresponding to the server to be configured: FTP, ITSCAMPRO, Cougar, Lince or REST API Client;
- 3) Check [Maintenance](#) for the steps to restore the system to factory defaults, should any errors occur while configuring the servers.

FTP servers

- 1) Enable the FTP server by clicking *Enable FTP*;
- 2) Select the Protocol to be used from the options:
 - a. *FTP*: Basic file transfer protocol;
 - b. *FTPS*: SSL/TLS secure file transfer protocol;
 - c. *SFTP*: SSH file transfer protocol.
- 3) Fill in the *IP Address* and *access Port*;
- 4) Define a *User* and *Password*;
- 5) Enable *Anonymous Mode* when not using username and password;



- 6) Adjust the quality of the JPEG image when saving via FTP by selecting it in the *Quality* field;
- 7) Change the code in *File names* to customize the name of the file with information from the capture. To ensure that the name is in the correct format, a validation mechanism has been implemented that indicates if any field is filled in incorrectly. To consult, expand the *Detailed help* option;
- 8) Enable the *Show advanced options* option and check/adjust the storage options that the FTP upload service will use:
 - a. Local *TTL*: If it is not possible to connect, the device will temporarily keep the images for the specified time;
 - b. Local buffer size: If it is not possible to connect, the device will keep the images temporarily, limited by the size specified;
 - c. Transfer timeout: time limit for an individual FTP transfer;
 - d. Interval for transfers: After uploading all the images, the device disconnects from the FTP server and only reconnects after the specified time;
- 9) Click *Apply* after checking the data entered.



Qualidade ⓘ

15% 36% 58% 79% 100% 85

Nome dos arquivos ⓘ

PTX_{year,digits:4;4:0}{month,digits:2;2:0}{day,digits:2;2:0}_{hour,di

> Ajuda detalhada

Mostrar opções avançadas

TTL local ⓘ

ano mês dia h m s

Tamanho de buffer local ⓘ

102400 kb

Timeout de transferência ⓘ

60000 ms

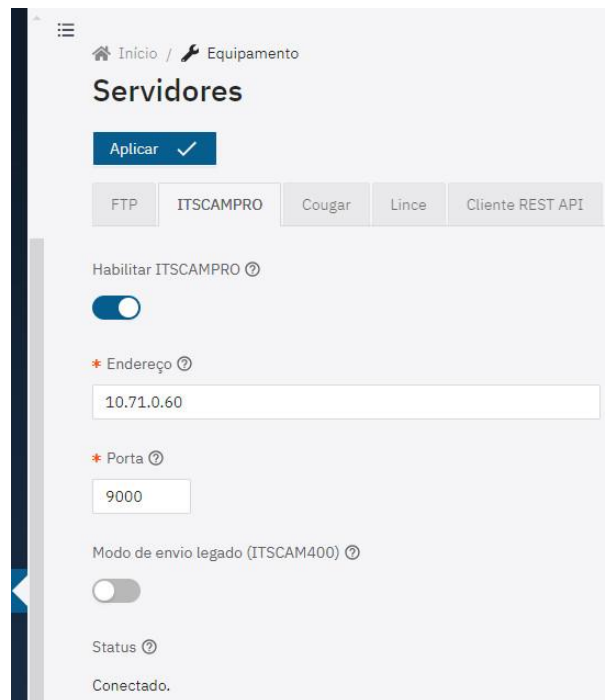
Intervalo para transferências ⓘ

0 h 5 m 0 s

ITSCAMPRO Server

Devices can be enabled to send captures to an external ITSCAMPRO server:

- 1) Select the *Enable* ITSCAMPRO option on the ITSCAMPRO tab;
- 2) Fill in the *IP Address* of the ITSCAMPRO server, which must be a domain name or a valid IPv4 address;
- 3) Enter the access *Port*, between 1 and 65535;



- 4) Select *Legacy Send Mode (ITSCAM 400)* when the P0 protocol is to be used for sending data. This mode is compatible with ITSCAM400 and should only be used on legacy systems;
- 5) Click *Apply* to validate the data entered;
- 6) Check in *Status* that the server is *Connected*.

Cougar Server

- 1) In the Cougar tab, select the *Enable* authentication option;

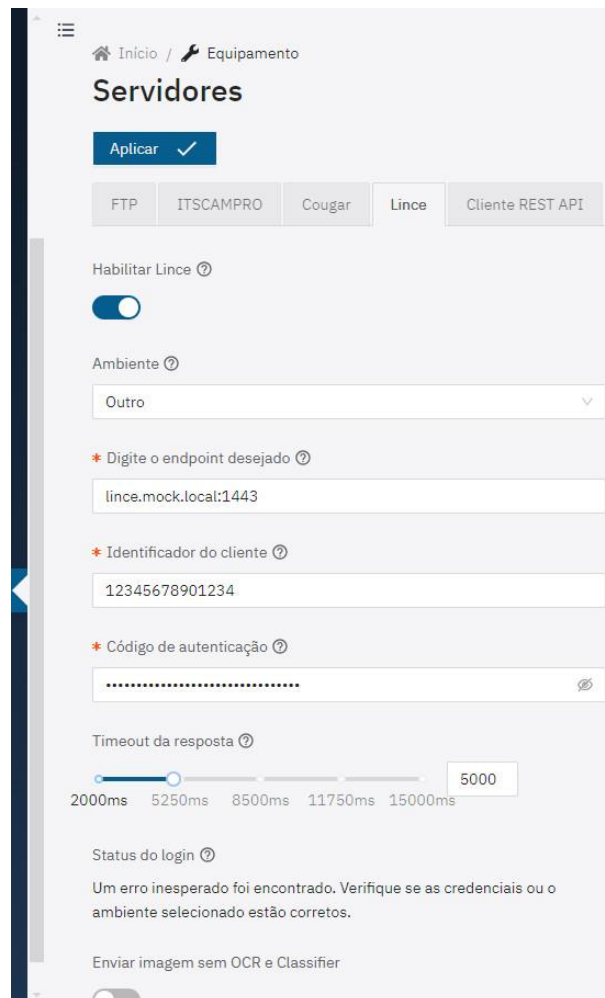


- 2) Set a *Password* to authenticate with Cougar, using up to 64 characters, as *Cougar* can configure multiple aspects of the device;
- 3) Click *Apply* after checking the data entered.

Lince server

- 1) In the *Lince* tab, select the *Enable Lince* option;
- 2) Select the server operating *Environment* from the options: *Development*, *Homologation*, *Production* or *Other*;

- 3) Enter the desired endpoint by entering the desired URL for sending the captures via the Lince server. Example: lince.app.br or lince.app.br:1443;
- 4) Enter a *Client Identifier* for the Lince server;
- 5) Enter an *Authentication Code* for the Lince server;
- 6) Set the Lince server *Response Timeout* between 2,000 and 15,000 milliseconds;
- 7) Check the *Login status* of the last login attempt to send records;
- 8) Select the *Send image without OCR* and *Classifier* option so that images without recognition are also sent;
- 9) Click *Apply* after checking the data entered.

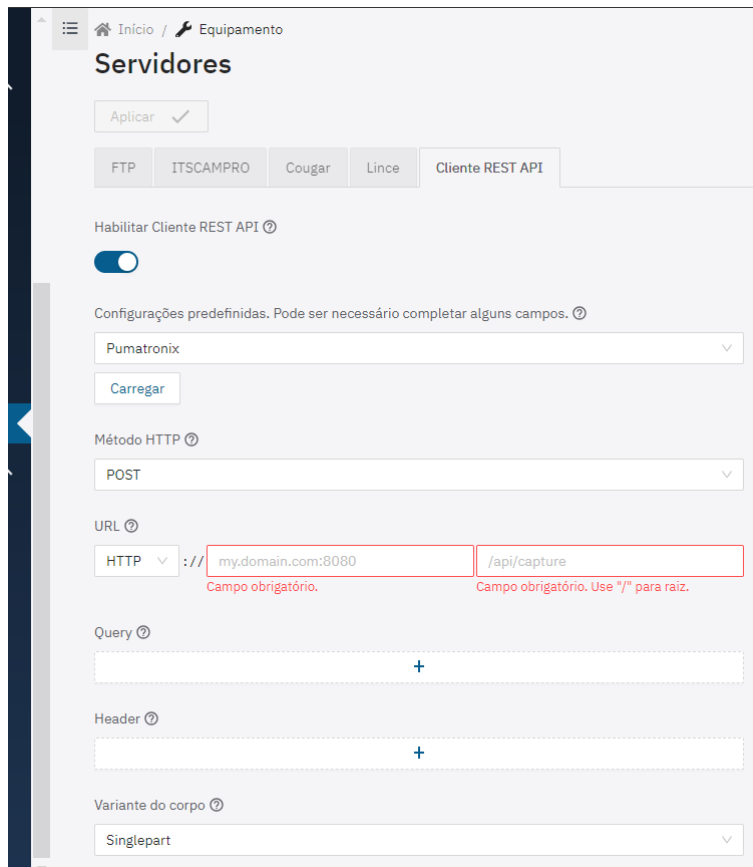


REST API Client Server

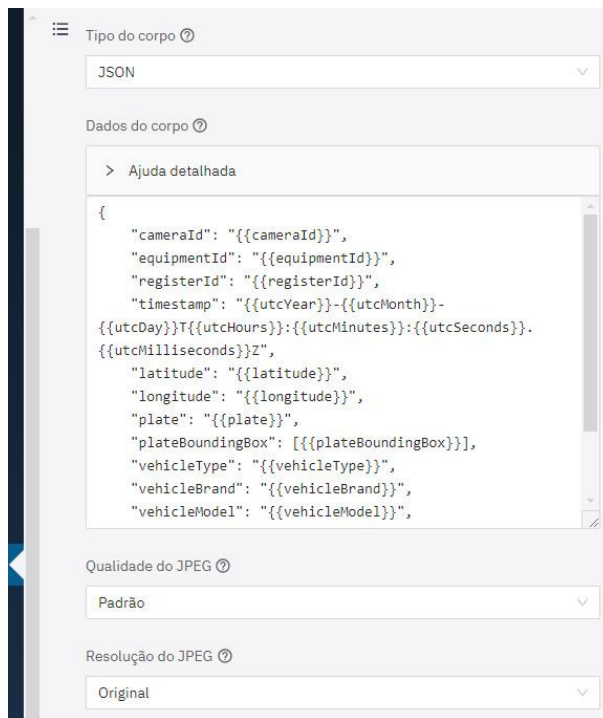
The devices support sending captures to a generic HTTP server, resizing the image and retrying sending.

- 1) In the *REST API Client* tab, select the *Enable REST API Client* option, which allows sending captures to a generic HTTP server;
 - a. Under *Predefined settings*, select a preset to apply a pre-configuration to certain fields by clicking on the *Load* button;
- 2) Select the *HTTP Method* of the custom request from GET, POST and PUT;
- 3) Enter the URL for the custom request, indicating the schema, host and path filled in separately;
- 4) Enter the *Query* parameters for the custom request by clicking +;

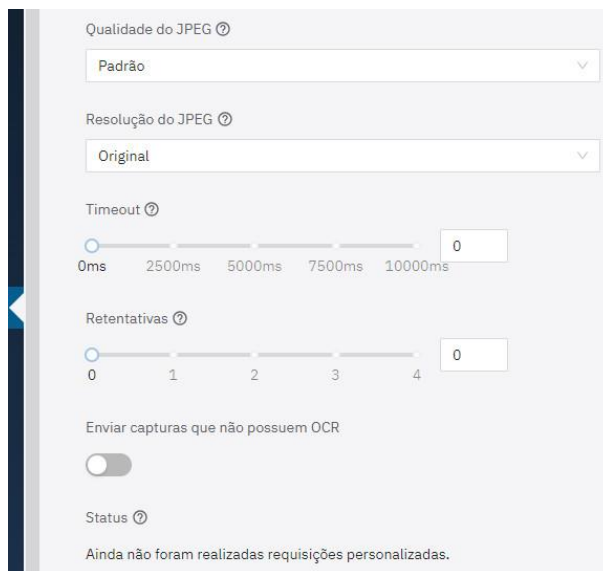
- 5) Enter additional headers for the custom request in *Header* by clicking + and entering name and value;
- 6) Select the *Custom body* request variant between *Singlepart* and *Multipart*;



- 7) Select the custom request *Body Type* (Content-Type header is added automatically) from the *JSON*, *JPEG* and *Form (URL encoding)* options;
- 8) Check and edit the custom request *Body Data* (Content-Length header is added automatically) by replacing the variables with variable names surrounded by double braces, considering the variables available in the detailed help;
- 9) Select the *JPEG Quality* that is sent in the body between *Standard* or between 5% and 95%;
- 10) Select the *JPEG Resolution* that is sent in the body, bearing in mind that an image ratio different from the original will cause stretching when resizing (if this is a problem, it will be required to select an image crop with the same ratio);



- 11) Enter in *Timeout* the time interval, in milliseconds, in which the custom request is canceled if there is no response from the server;
- 12) Indicate the number of *Retries* that are performed on the personalized request again in the event of a failure. Note that variable substitution errors do not count as failures;
- 13) Select whether the device should *Send No-OCR captures*, considering that captures in which there is no recognition of license plate characters will be sent;
- 14) Check *Status* for information about the last custom request made by the REST API Client.

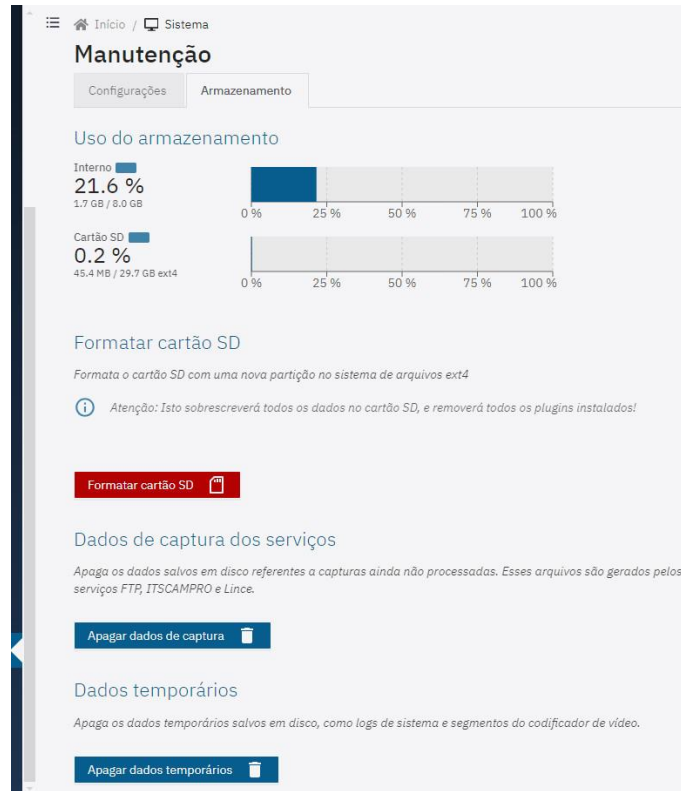


Plugins

Importing plugins directly via the web interface and configuring more than one port with external mapping is possible for ITSCAM 600, ITSCAM 600 FHD, VTR600 devices. The VTR600 is factory-installed with the ITSCAMPRO Mobile plugin.

The import of plugins requires that an *ext4* formatted SD card be inserted in the capture device. To format an inserted card:

- 1) In the *System > Maintenance* menu, go to the *Storage* tab:
- 2) Check *Storage Usage* to see if there are any files saved on the SD card;
- 3) Only click *Format SD card* if it is certain that the plugin files can be overwritten and replaced;



If the SD card is not present, the device will display the following error message:



Figure 13 – Error message displayed if SD card is not present

Proceed with the installation of plugins after formatting the SD card, following the steps:

- 1) Go to *System > Plugins*;



- 2) Click or drag a *.tar* file into the *New Plugin* area;

- 3) Enter the *Name of the plugin* that describes its use;
- 4) Configure the plugin's *Environment variables* by clicking on *Add environment variable*;
- 5) Click *Add port mapping* when an internal container port needs to be exposed on the device, according to the plugin in use;
- 6) Click *Install* after checking the data entered.

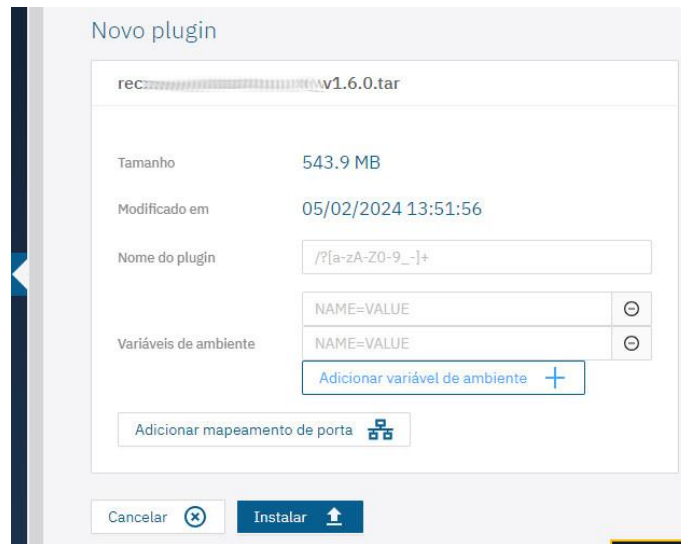


Image Profiles

The *Daytime* and *Nighttime* image capture configuration profiles are the factory defaults. The settings applied to each parameter of an image profile can be accessed via the *Image > Profiles* menu:

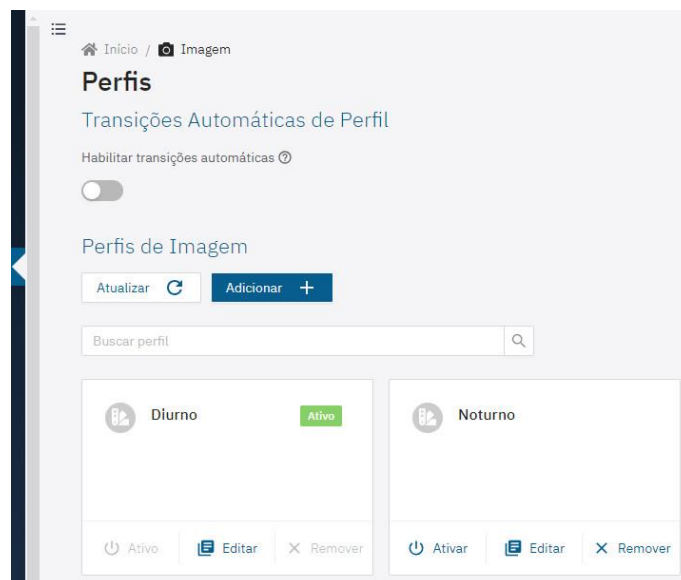


Figure 14 – Image Menu Screen > Profiles

- 1) Enable the option *Enable automatic transitions* to change between profiles automatically according to internal settings and lighting conditions for optimum image quality in any situation;
 - a. Use one profile for captures with ambient light (daytime) and another for captures with artificial lighting (nighttime), as recommended, and it is possible to register up to four *Image Profiles*, each with its own set of settings;
 - b. Select the *Level Smoothing* to be applied when switching between profiles;

- i. *None*: Level changes are made instantly when profiles are changed;
- ii. *Simple*: level change is performed using a smoothing time during the profile change;
- iii. Set the *Time for level smoothing* in the automatic transition between profiles, in milliseconds;



The existing settings for an image *Profile* are available in tabs and are saved automatically. The initial tab labeled *General* contains the *Identification* and *Text Overlay* settings on the image:

- 1) Click Add+ under *Image Profiles* to create new image profiles (it is recommended to configure existing profiles before creating new ones);
- 2) Or click on the *Edit* button for the profile to be configured;
- 3) Identify the Profile by assigning a *Name* and adding a *Description*;
- 4) Enable the *Photos caption* option to apply a text overlay to all generated photos;
- 5) Enter a String of up to 1024 characters in the *Photos caption text* field. Go to the *Detailed help* field to check the values that can be entered as captions.

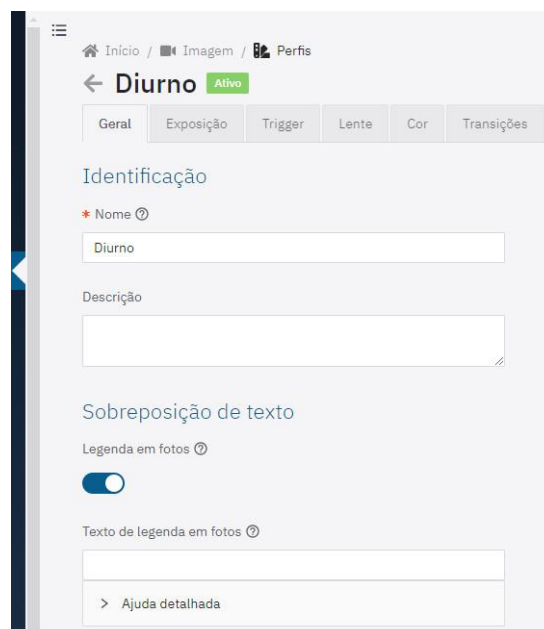


Figure 15 – Image Menu Screen > Profiles

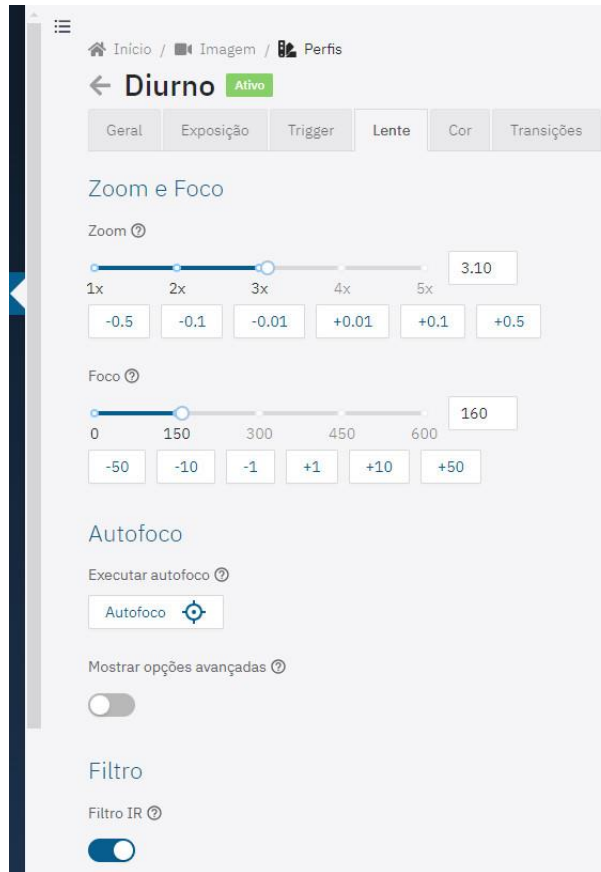
Lens

The *Lens* tab contains the *Zoom* and *Focus*, *Autofocus* and *Filter* settings.

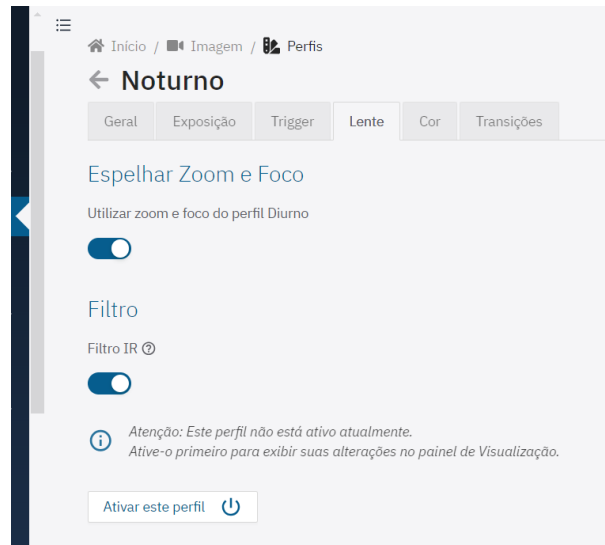


Keep the *Automatic Iris* option (available on LM models) disabled during the focus adjustment process, to obtain better results during the image setting process (available on the *Exposure* tab).

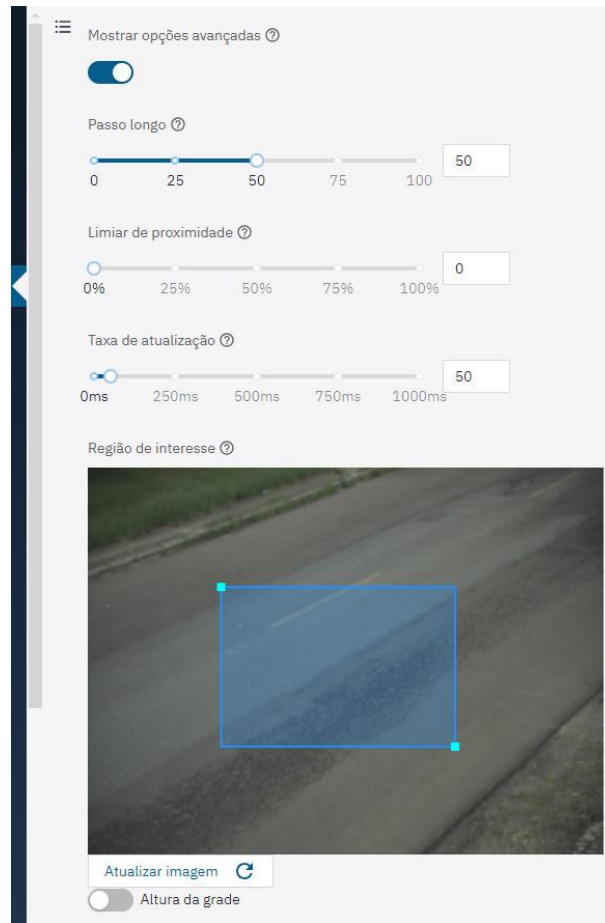
- 1) Select the *Lens* tab;



- 2) Check the *Zoom* and *Focus* settings in real time using the [Pop-up Preview window](#);
- 3) Select the *Zoom* rate value, gradually increasing the available buttons until finding the ideal value;
- 4) Select the distance of the *Focus* lens, gradually increasing the available buttons until finding the ideal value;
 - a. Copy the *Zoom and Focus* settings from the first profile configured, via the *Mirror Zoom and Focus* option, enabling the *Use zoom and focus option for the Day profile*, available on the *Lens* tab of the other profiles (the profile name is displayed as configured: *Use zoom and focus for profile [profile name]*);



- 5) Adjust the automatic focus by clicking on *Autofocus* (only available on models with a motorized lens), which modifies the focus position until finding the point of greatest image contrast. The button remains active while the algorithm is running and resets when it finishes. To stop the process, simply deactivate by clicking again on the button. It is suggested to place objects with notable edges at the place of use to help the algorithm;
- 6) Click *Show advanced options* to display the advanced *Autofocus* settings, only in the event of an algorithm malfunction;
 - a. *Long pitch*: if the image is not in focus to begin with, the algorithm first runs through the entire focus range, with this value as the increment. Reduce this value if the focus range is too thin;
 - b. *Proximity threshold*: the minimum contrast for the image to be considered in focus;
 - c. *Refresh rate*: the time it takes for the focus to be correctly applied to the image;
 - d. *Region of interest*: defines the region in which *Autofocus* will be executed, by default only the central region of the image is considered and can be edited by dragging the vertices of the default rectangle.



The advanced *Autofocus* options should only be adjusted if the algorithm is malfunctioning.

- 7) Enable the *IR Filter* during the daytime to protect the image sensor and because infrared light can distort the colors of the image. When using infrared lighting devices, keep the *IR Filter* disabled, ensuring that the image is formed on the sensor;
- 8) Adjust the positioning of the device based on the images displayed in *Live View*. The suggested framing for two lanes in the image is to show the ends of the lane, as shown in the examples:



Figure 16 – Example of an image with the suggested framing generated during the daytime



Figure 17 – Example of an image with the suggested framing generated during the nighttime

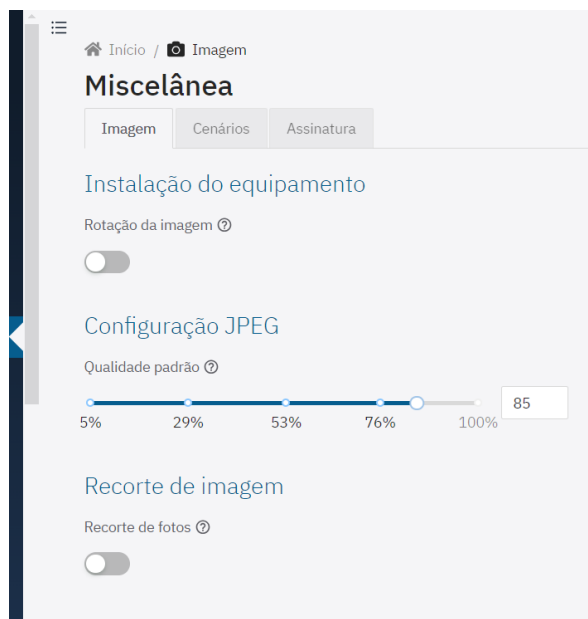


The Zoom and Focus adjustment corresponds to the Image Profile: Zoom and focus adjustment must be performed on all Profiles enabled on the device.

Image Framing

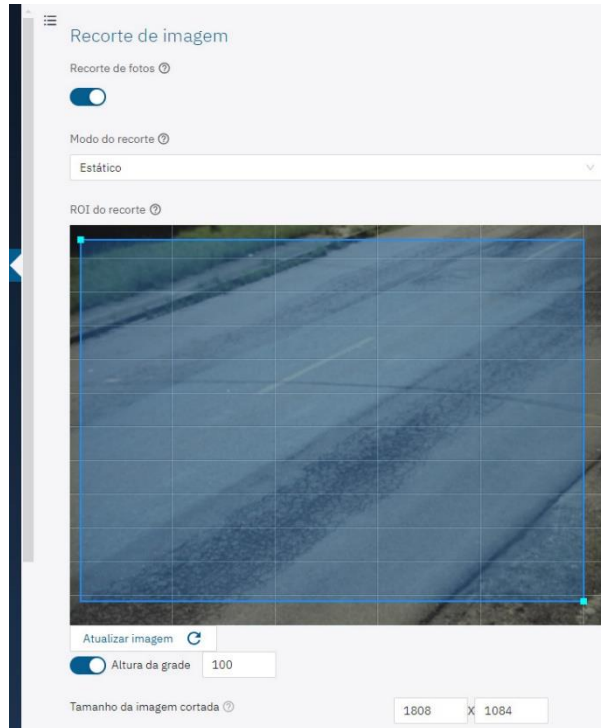
When the device is attached using a suction cup to the windshield of a vehicle or when it is attached to the roof, the image of the device will be upside down in the view, which can be corrected in *Image rotation*:

- 1) Go to the *Image > Miscellaneous* menu and the settings will be saved automatically;
- 2) Go to the *Image* tab and enable the *Image rotation* option when installed upside down;
- 3) Set the *Default Quality* value at which the JPEG will be generated;



- 4) Enable the *Image crop* option and images will only be generated of the portion of the ROI delimited over the preview image. This option does not affect streams and live image viewing and is intended to improve the conversion time to JPEG;

- a. Select the *Crop Mode* between the options *Static* (cropping used to imitate a model with lower resolution) or *OCR* (cropping uses the ROI as the default position and if a license plate is recognized, keeps the vehicle centered, adjusting the position and maintaining the same size);
- b. Display the license plate size reference by clicking on *Grid height* and specifying the value in pixels, following the [template shown in OCR](#);
- c. Check that the *Size of the cropped image* is the final desired size;



- 5) Click on the *Scenarios* tab to configure two-lane surveillance, defining two different scenarios in the image generated by the capture device, simulating the operation of two different capture devices;
 - a. Enter a text at the top of the image, up to 1024 characters, for *Scenario 1*, by clicking on the *Caption text in photos* field. Go to the *Detailed help* field to check the values that can be entered as captions;



- b. Select the Size of the cropped image for Scenario 1 from the available size options;
- c. Display the license plate size reference by clicking on *Grid height* and specifying the value in pixels, following the template shown in OCR;
- d. Check that the caption and the size of the crop are properly set by clicking on the *Preview crop with overlay text*;



- e. Repeat the steps above, defining the specifications for *Scenario 2*;
- 6) Click on the *Signature* tab and select *Enable digital signature* on images and *Concatenation mode* to join the signature to the generated JPEG file;
- 7) Copy the public key text, and/or save it in a file for future verification, referring to the private equivalent that was saved or generated;



- 8) Click or drag a file into the *Embedded Signature Check* to check whether an image with a signature in JPEG comments is valid and has been signed by the device itself.

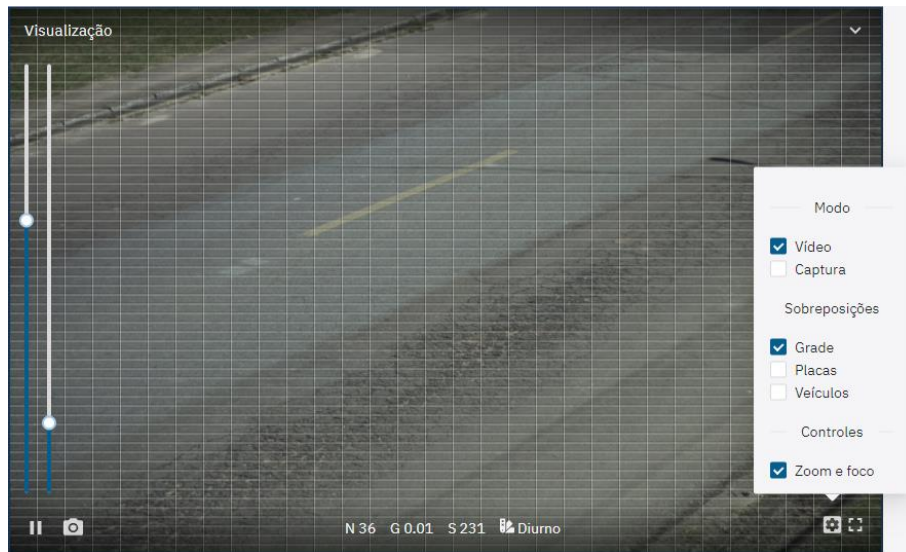
Live Viewing

The web interface has a live image viewer, available in a pop-up window that can be moved to any place on the interface screen, or expanded to occupy the entire window.



Figure 18 – Pop-up live view window: 1) Pause live view; 2) Take photo; 3) Level, Gain, Shutter and Photo Profile values active; 4) View settings; 5) Full screen; 6) Minimize window

- 1) Click *Pause live view* (1) to pause the live video and the last captured image remains fixed;
- 2) Click on the *Take photo* (2) button to download an instant JPEG file generated from the image being captured by the device;
- 3) View, at the bottom of the pop-up window, the *Level, Gain and Shutter* values that are being applied to the device and the *Image Profile* that is active;
- 4) Click on the option *Display settings* (4) button to access the image display options in the pop-up window:
 - a. *Video*: displays the image being taken in real time by the device;
 - b. *Capture*: displays the last image captured in the configured parameters;
 - c. *Grid*: displays a grid over the image;
 - d. *License plates*: displays a recognition area about license plates (as shown in the image);
 - e. *Vehicles*: displays a recognition area about vehicles (as shown in the image);
 - f. *Zoom and focus*: displays two bars on the side of the pop-up window, which allows the adjust of the image Zoom and Focus.

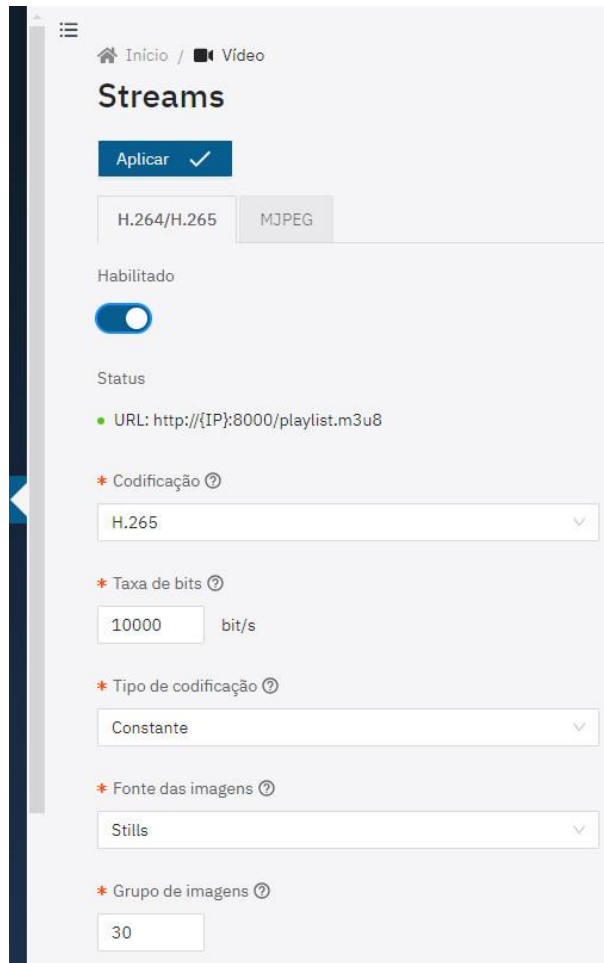


- 5) Click on the *Full Screen* option (5) to expand the view and make interface full screen.

Streams

The devices offer the option to follow live images captured by the device outside the web interface, integrated into a DVR or video monitoring system by setting it in the *Video > Streams* menu. The ITSCAM 450 and ITSCAM 450+ devices only allow *MJPEG* streaming.

- 1) Access the settings in the *H.264/H.265* tab by clicking on *Enabled*;
- 2) Choose between the H.264 or H.265 *encoding* options;
- 3) Set the Data transfer *Bit rate* for the stream in bit/s;
- 4) Select the *Encoding type* from the options:
 - a. *Constant*: the value remains the same throughout the duration of the video;
 - b. *Variable*: the value decreases in parts that need less information and increases in sections that need a greater amount of data.
- 5) Select the *Profile* that defines the compression standard (only available for H.264 coding) from the options: *High*, *Main* or *Baseline*;
- 6) Select the *Image Source* for the flow from the options:
 - a. *Preview*: using continuous image;
 - b. *Stills*: using image captures (or high trigger rate);
- 7) Enter a number of frames from an *Image Group* block. This block is used as a reference for the stream encoding process;

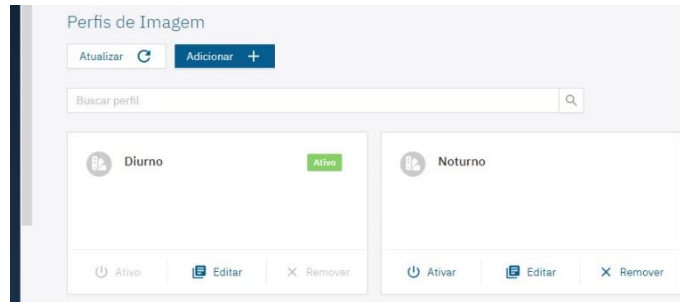


- 8) Access the stream configuration options in the *MJPEG* tab;
- 9) Adjust the quality of the images sent by the stream in the *Quality* field;
- 10) Set the *Maximum frame rate* of images sent by the stream;
- 11) Click *Apply* after confirming the settings entered.

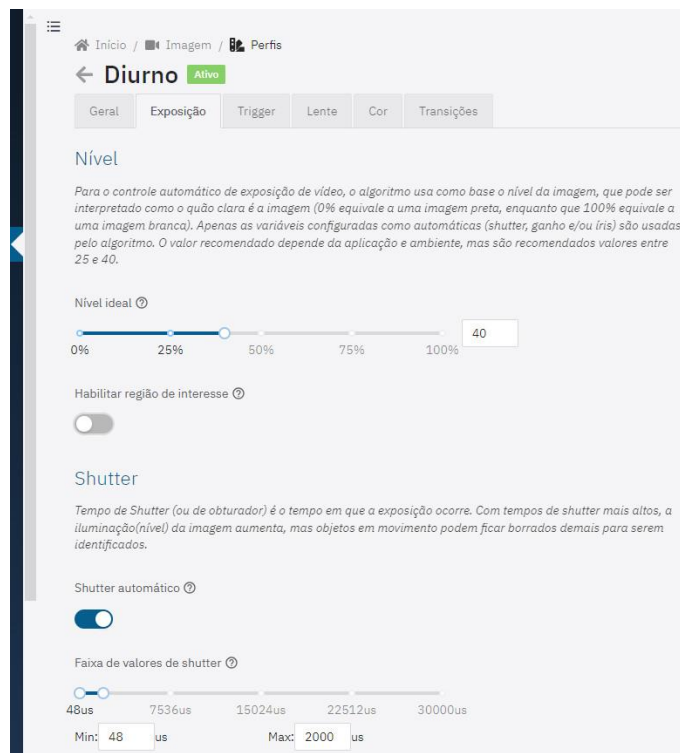


Exposure

- 1) Find the profile to set-up in the *Image > Profiles* menu and click *Edit*;



- 2) Select the *Exposure* tab and on this screen, the settings are automatically saved;
- 3) Select the target value for the level of image brightness that the device should try to achieve using the variables configured as automatic (shutter, gain and/or iris) in *Optimal level*, considering that 0% is equivalent to a black image, while 100% is equivalent to a white image, with values between 25 and 40 being recommended, depending on the environment;
- 4) Select the *Enable region of interest* option and define which region of the image should be considered for level calculation, especially in scenarios with regions that could hinder the level algorithm (e.g. lamps that are too bright, flashing or regions that are too dark);
- 5) Enable the *Automatic shutter* or select the value for the *Fixed shutter* in microseconds;
- 6) Select the automatic *Range of shutter values* that can be applied by the *Optimal Level* algorithm, in microseconds;



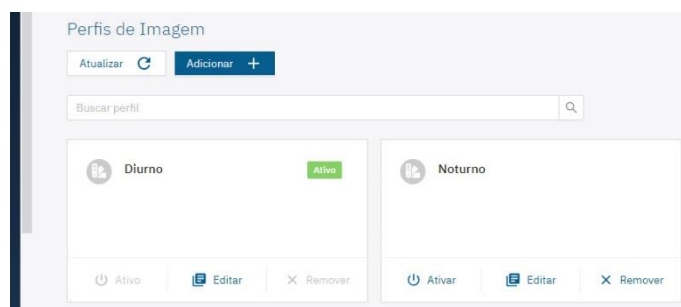
- 7) Enable *Gain* by clicking on the *Automatic Gain* option, in which the equipment will adjust the *Gain* (within the limits set by the user) to keep the image at the optimal level. When this option is deactivated, the *Gain* to be applied is a fixed value also defined by the user;
- 8) Select the *Range of gain values* that can be applied by the automatic level algorithm, in decibels;
- 9) Enable the option of *Automatic iris* (available for LM models):



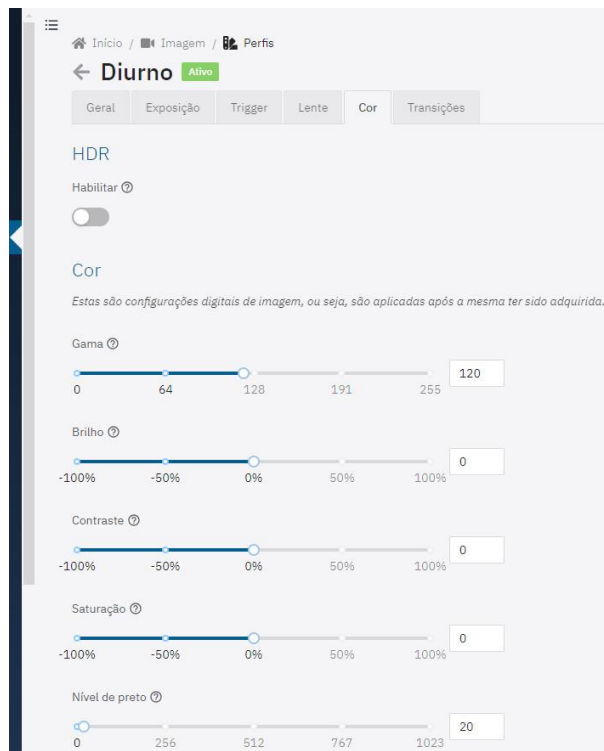
Color

It is not recommended to change the color settings, with the exception of the *Gamma* option.

- 1) Find the profile to set-up in the *Image > Profiles* menu and click *Edit*;



- 2) Select the *Color* tab and on this screen, the settings are automatically saved;
- 3) Set the *Gamma* value, which adjusts the lighting of the image by increasing the gain to darker places than lighter ones;
- 4) Enable the *Auto White Balance* option and the *Red*, *Green* and *Blue* balance in the image will be adjusted automatically.

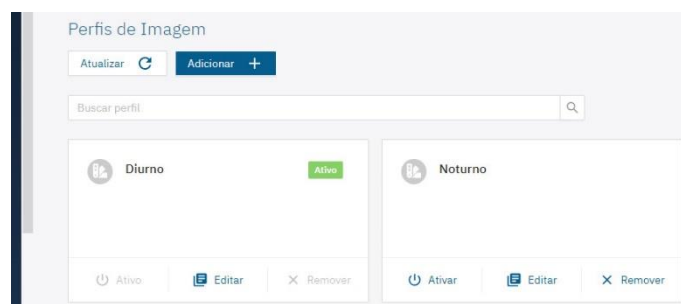


The Brightness, Contrast, Saturation and Black Level values are factory-set to the ideal values in normal image lighting conditions and adjustments are restricted in cases of poor quality images generated. Please contact Technical Support for guidance on these color settings.

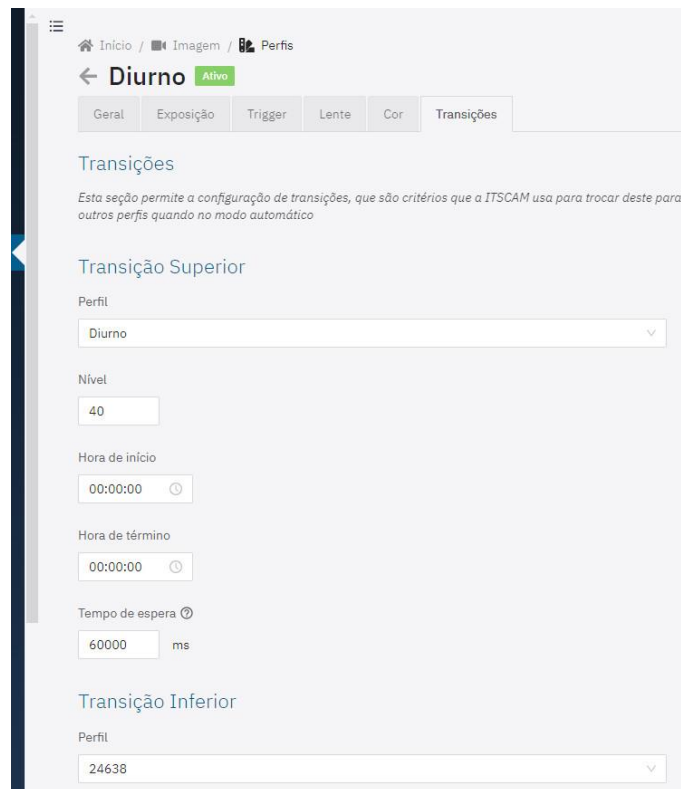
Transitions between Image Profiles

When the *Enable automatic transitions* between image [Profiles](#) option is selected, the *Level* values and times applied are used as the basis for the transition.

- 1) Find the profile to set-up in the *Image > Profiles* menu and click *Edit*;



- 2) Select the *Transitions* tab and on this screen, the settings are automatically saved;



- 3) Set the *Upper Transition* options for the profile being edited:
 - a. Select which *Profile* the upper transition occurs;
 - b. Set the *Level* value at which the upper transition should occur;
 - c. Set a *Start time* and/or an *End time* for the upper transition;
 - d. Set the *Timeout* for the upper transition so that the device does not oscillate unnecessarily between profiles by entering a value between 10,000 milliseconds (10s) and 100,000 milliseconds (100s);
- 4) Set the *Lower Transition* options for the profile being edited:
 - a. Select which *Profile* the lower transition occurs;
 - b. Set the *Level* value at which the lower transition should occur;
 - c. Set a *Start time* and/or an *End time* for the lower transition;
 - d. Set the *Timeout* for the lower transition so that the device does not oscillate unnecessarily between profiles by entering a value between 10,000 milliseconds (10s) and 100,000 milliseconds (100s).

Suggested Image Configuration for Profiles

Capturing quality images is key to getting the full potential out of the ITSCAM 600, ITSCAM 600 FHD, VTR600, ITSCAM 450 and ITSCAM 450+ capture devices. For this reason, a suggested image configuration is presented in the Visible Light (Daytime Profile) and Infrared Light (Nighttime Profile) situations, which can be used as a starting point for adjusting the equipment.

Images taken at nighttime and/or with the aid of artificial infrared lighting (Nighttime Profile) require image settings that highlight the details of vehicles and license plate characters, and the suggested image setting can be used as a starting point for adjusting the equipment and checking that the lighting device is activated.

Parameter	Suggested value in Daytime Profile (Visible Light)	Suggested value in Nighttime Profile (Infrared Light)
Optimal level	40%	
Region of Interest	Disabled	
Automatic Shutter	Enabled	
Minimum Shutter	66µs	
Maximum Shutter	1000µs	500µs
Automatic Gain	Enabled	
Minimum Gain	1dB	
Maximum Gain	30dB	
Automatic iris (on LM models)	Enabled	
Multiple Exposures (Trigger*)	Disabled	
HDR**	Disabled	
Gamma	130	25
Gloss	0%	
Contrast	0%	
Saturation	0%	-100%
Black level	20	
Automatic white balance	Enabled	
Enable automatic transitions***	Checked	
Profile (Upper Transition)	Daytime	
Level (Upper Transition)	40	30
Timeout****	60,000ms	1,000ms
Profile (Lower Transition)	Nighttime	
Level (Lower Transition)	20	10
Timeout****	60,000ms	1,000ms

The captures generated by ITSCAM are determined by the *Event* configured and within the specified *Minimum interval* between triggers.

**Only devices with the S6 sensor have this functionality.

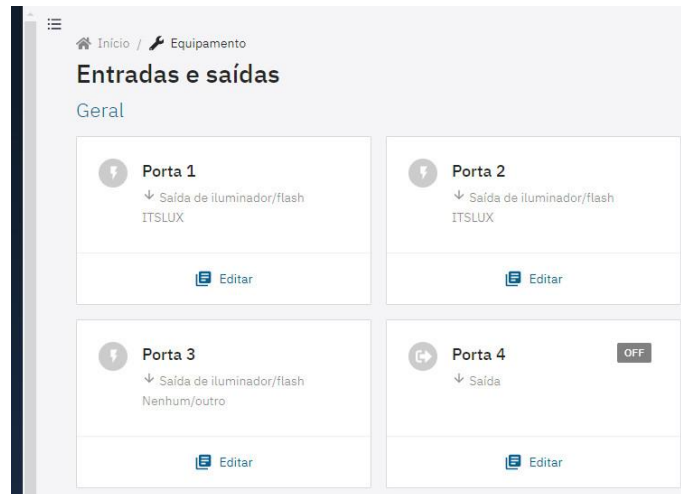
***The settings shown for the automatic transition between profiles must be made in the *Transitions* tab of the corresponding profile.

****It is advisable to set the *Timeout* close to 1 minute (by entering a value of 60,000ms in the interface) so that the device does not oscillate unnecessarily between configuration profiles.

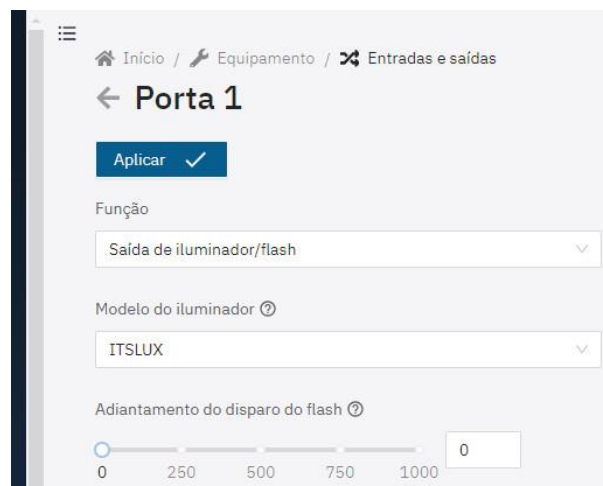
Inputs and Outputs

The ITSCAM 600, ITSCAM 600 FHD and VTR600 devices have 4 ports that must be configured by software as inputs or outputs (IOs), with IO1 and IO2 dedicated to controlling the lighting device's trigger and IO3 and IO4 available for the installation of external sensors, such as loops and light barriers, which identify the moment of image capture (trigger). To set-up the use of each IO port:

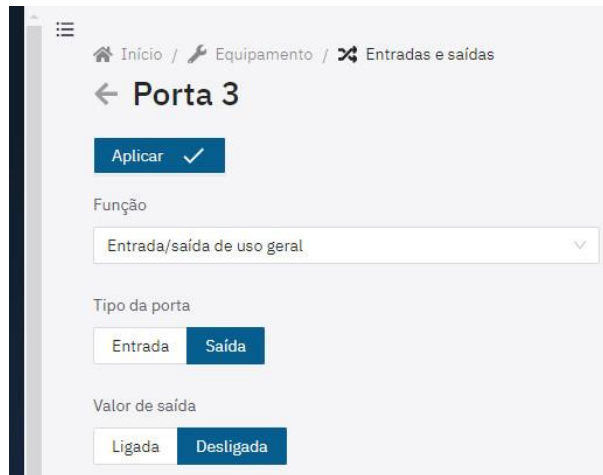
- 1) Access the settings in the menu *Equipment > Inputs and outputs*;
- 2) Locate the *Port* to be configured;
- 3) Click on the corresponding *Edit* button;



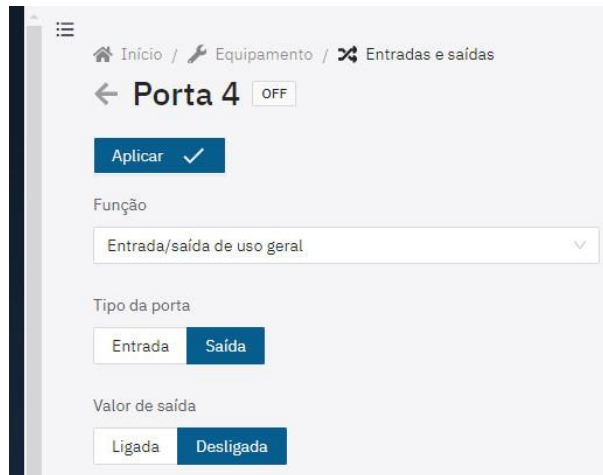
- 4) Select the *Function as Lighting device/flash* output when the IO port is used to flash the lighting device (preferably ports 1 and 2):
 - a. Select the lighting device model: ITSLUX, WHITELUX, WHITELUX (video) or, if the lighting device is from another manufacturer, None/other;
 - b. Set the *Flash Trigger Delay* value to align the image capture with the flash at its peak light output on equipment that has a trigger delay.



- 5) Select the *Function as a General-purpose input/output* when receiving a loop signal or light barrier (preferably ports 3 and 4):
 - a. Select the *Port Type* as *Input* (example: when receiving a loop signal or light barrier);



- b. Select the *Port Type* as *Output* (example: when triggering gates or alarms);
 - i. Select *Output value* as *On* to activate the output signal;
 - ii. Select *Output value* as *Off* to deactivate the output signal;
- 6) Apply the port settings by clicking *Apply*.



ITSCAM 450 and ITSCAM 450+ Inputs and Outputs

The ITSCAM 450 and ITSCAM 450+ devices have 2 Inputs and 2 Outputs, which are available to control the lighting device triggering or to install external sensors, such as loops and light barriers, which identify when the images are captured (trigger). To configure the outputs, access the menu *Equipment > Inputs and outputs*.

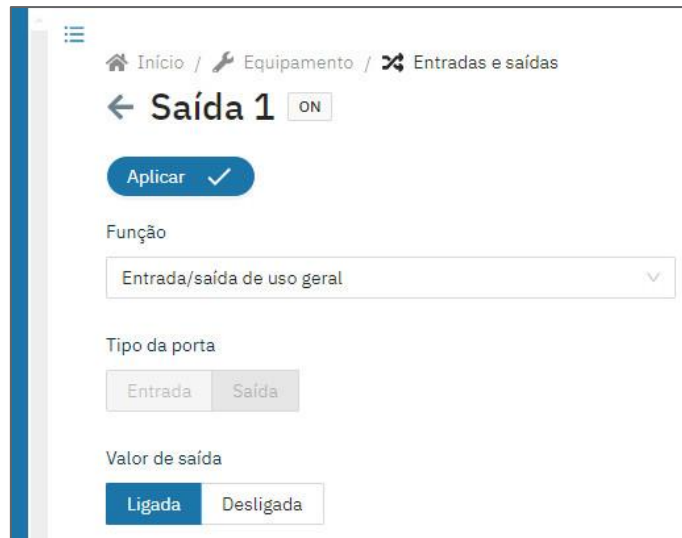
- 1) Locate the *Port* to be configured and click the *Edit* button;



- 2) Select the *Function* as *Lighting device/flash* output when the output port is used to trigger the lighting device flash;
 - a. Select the *Lighting device model* as *ITSLUX* and, if the lighting device is from another manufacturer, *None/other*;
 - b. Set the *Flash Trigger Delay* value to align the image capture with the flash at its peak light output on equipment that has a trigger delay.



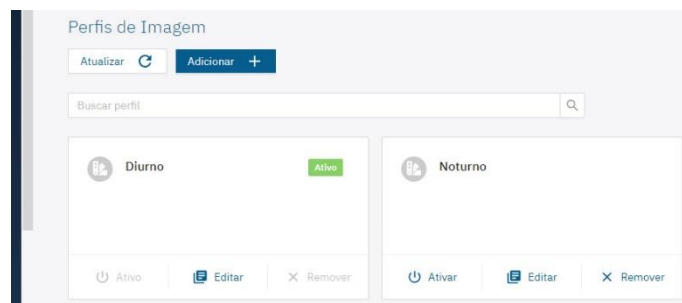
3) Select the *Function* as *General-purpose input/output* when used, for example, to activate a gate;



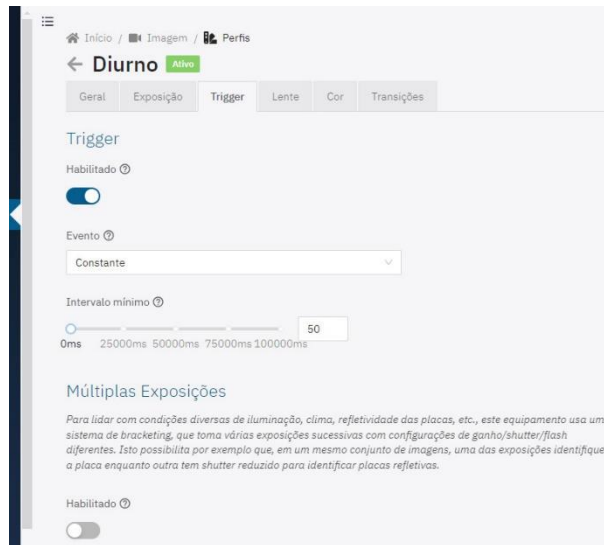
- a. Select *Output value* as *On* to activate the output signal;
 - b. Select *Output value* as *Off* to deactivate the output signal;
- 4) Apply the port settings by clicking on *Apply*.

Trigger

1) Find the profile to set-up in the *Image > Profiles* menu and click *Edit*;



- 2) Select the *Trigger* tab and on this screen, the settings are automatically saved;

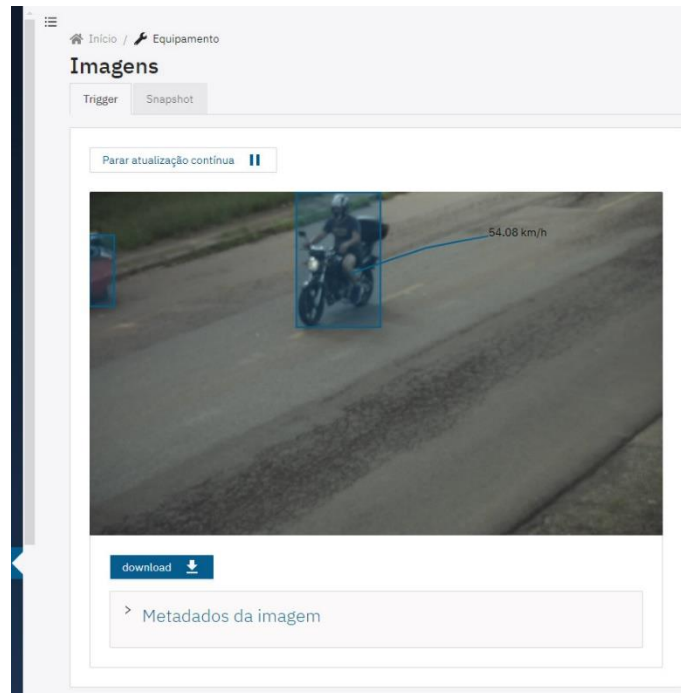


- 3) Select the *Enabled* option to configure image capture according to the configured *Event*
- 4) Select *Event* as *Constant* to generate a continuous stream of image captures at the highest rate the device can handle;
- 5) Select signal input *Event* from the options:
- Rising edge*: generates an image capture when the signal is activated;
 - Falling edge*: generates an image capture when the signal is deactivated;
 - Rising and falling edge*: generates an image capture when the signal is activated or deactivated;
 - High level*: generates image captures continuously as long as the signal level is high;
 - Low level*: generates image captures continuously as long as the signal level is low;
 - Select the input *Port* of the signal used for the trigger, configured in [Inputs and Outputs](#);
- 6) Select the *Event* as *Motion* to activate the *Motion Detector* functionality, which generates image captures without the need for external sensors, while motion is being detected:
- Set the *Minimum interval* for separation between triggers, in milliseconds;
 - Set the *Threshold* value (from 0 to 100) required to activate the *Motion Detector*;
 - Select *Enable region of interest* to delimit the area of the image that should be considered in the motion calculation.

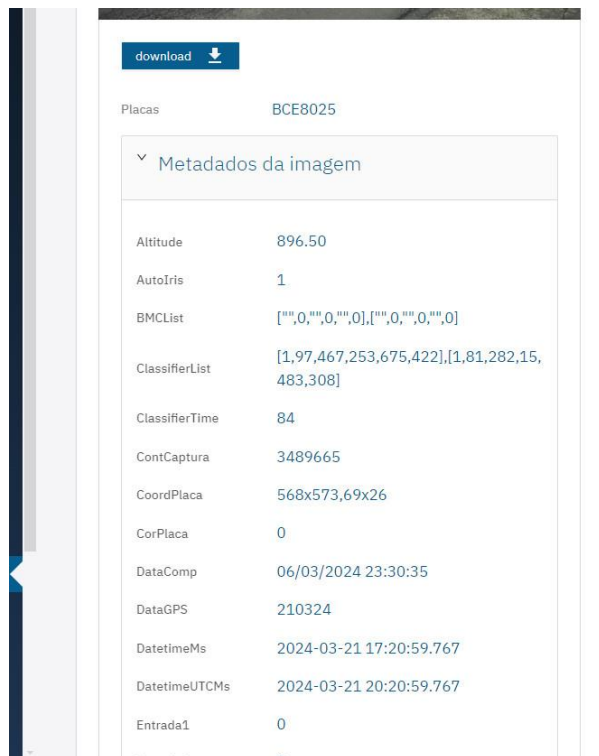
Checking the Images Generated

It is possible to manually generate a capture and view it, in order to check the local lighting, daytime or nighttime, by accessing the *Equipment > Images* menu:

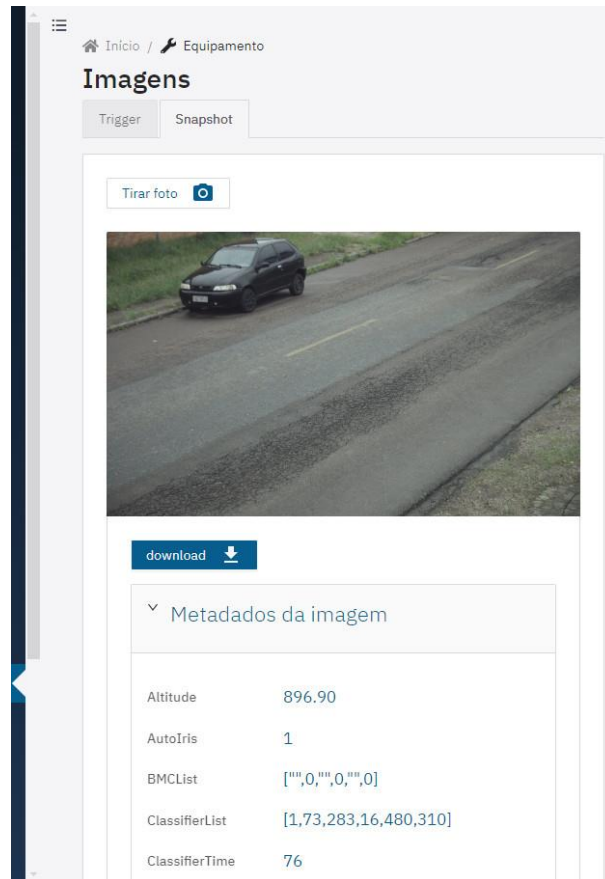
- Select the *Trigger* tab and the last capture made is displayed, waiting for the last capture to be updated when necessary;



- a. Click on *download* to download an instant JPEG image of the capture made by the device;
- b. Click on *Image metadata* to view the metadata of the generated image;



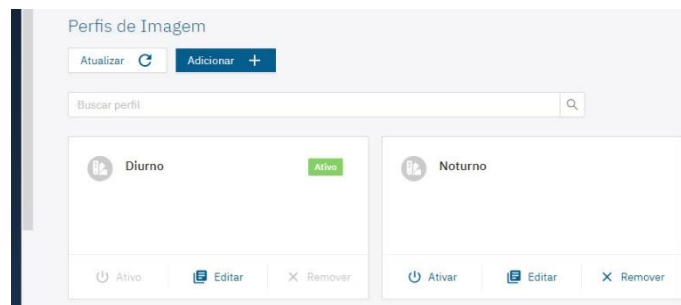
- 2) Go to the *Snapshot* tab to access the current settings applied to the image;
 - a. Click on *Take photo* and the generated image will be displayed;
 - b. View by clicking on the *Metadata of the generated image* field;



- 3) Make the necessary adjustments using the information from the current image settings.

Multiple Exposures

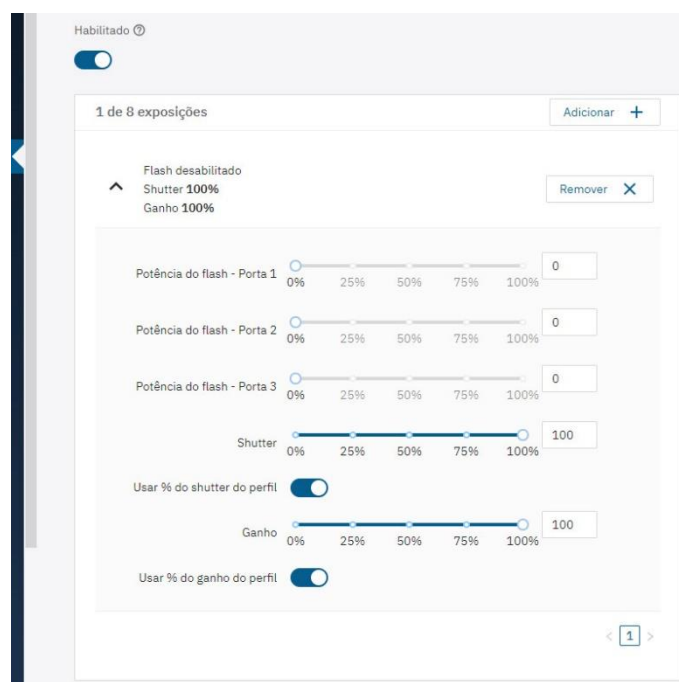
- 1) Find the profile to set-up in the Image > Profiles menu and click *Edit*;



- 2) Select the *Trigger* tab and on this screen, the settings are automatically saved;
- 3) Enable Multiple Exposures by clicking *Enabled* to take multiple shots simultaneously with different flash, shutter and gain settings. If disabled, only one exposure is taken per trigger, without flash and with shutter and video gain;
- 4) Click on *Add+* to create an exhibition (up to 8 per profile);



5) Select the exposure to display its settings;



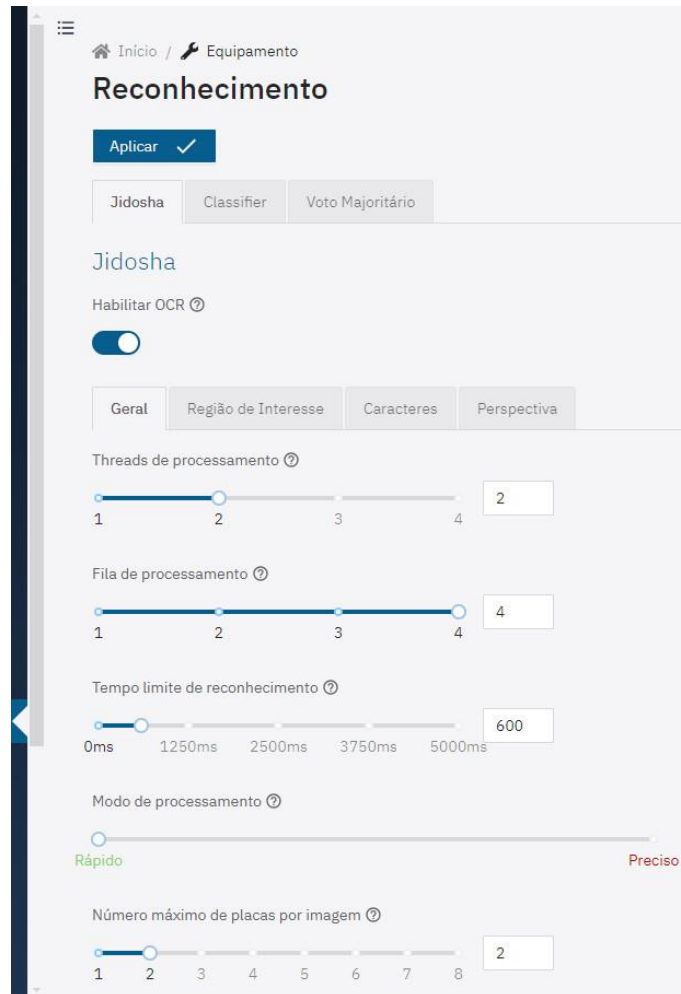
- 6) Select the *Flash power*, always corresponding to a percentage of the initial shot (this option is available for the Pumatronix ITSLUX range of lighting devices);
- 7) Select the *Shutter* percentage (exposure time of the image sensor), generating images with a variation in the amount of light captured;
- 8) Select the *Gain* percentage (digital post-processing), which allows to lighten or darken the images.

Recognition (OCR Reading)

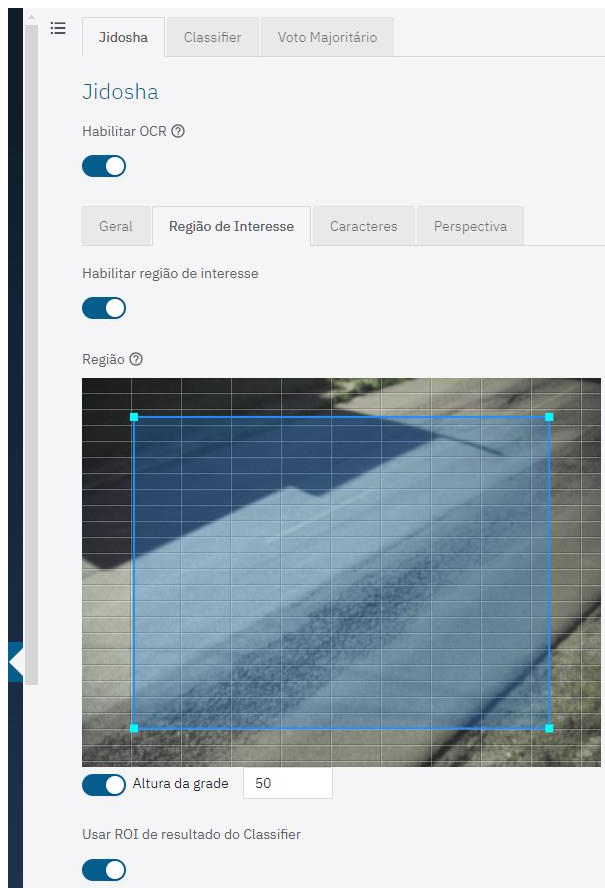
The images captured can provide automatic recognition of the license plate of the vehicles in the images (OCR) and the type of vehicle identified (*Classifier*). In this way, JPEG images are delivered with the comments field of the file containing the license plates identified, the type of vehicle identified (motorcycle, car, truck and bus) and the instantaneous settings of the equipment.

- 1) Go to the *Equipment > Recognition* menu;
- 2) Select the *Jidosha* tab and click *Enable OCR*;
- 3) Access the setting options in the *General* tab:

- a. Set the number of *Processing threads* that will be used to process the OCR;
- b. Set the maximum size of the OCR *Processing Queue* (smaller values reduce latency while larger values reduce frame loss in high flow situations);
- c. Set the *Recognition Timeout* (images without a license plate or with hidden characters cause the algorithm to continue searching for the license plate until the specified time is reached);
- d. Set the OCR *Processing Mode* to faster or more precise;
- e. Set the *Maximum number of plates per image*, determining the maximum number of plates that can be read in the same image;



- f. Select the *Type of plate* of the vehicles that should be searched for by the algorithm in the images, considering the pattern of license plate letters and numbers, which are different for vehicles and motorcycles (in frontal installations, motorcycle license plates are not captured);
 - g. Select the *Country of the plate* of the vehicles in the images. For OCR processing of license plates from countries other than Brazil, please contact Pumatronix technical support. ITSCAM with embedded OCR performs the processing for Brazilian license plates only.
- 4) Select the *Region of Interest* tab and click *Enable region of interest*:
- a. Enable the *Grid Height* option, located just below the image;



- b. Set 10 for the *Grid height* (in pixels)
 - i. Note the size of the license plate characters in the region of the image marked as 1 in the example, i.e. when the vehicles are in the most distant region to the capture device. The characters should be approximately the grid's height. If they are very different, it is necessary to review the zoom settings;



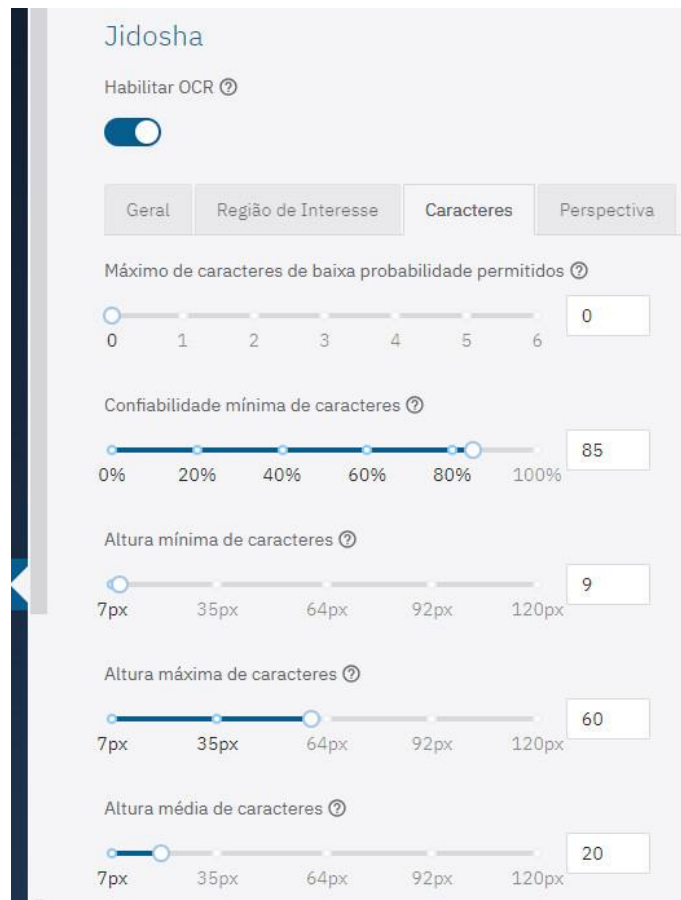
- c. Set 40 for the *Grid height* (in pixels);
 - i. Note the size of the license plate characters in the region of the image marked as 3 in the example, i.e. when the vehicles are in the region closest to the capture device. The characters should be approximately the grid's height. If they are very different, it is necessary to review the zoom settings;

- d. Set 25 for the *Grid height* (in pixels);
 - i. Note the size of the license plate characters in the region of the image marked as 2 in the example, i.e. when the vehicles are in the central region of the image. The characters should be approximately the grid's height. If they are very different, it is necessary to review the zoom settings;





OCR in Region of Interest: OCR is performed only within the drawn region, which is slightly shaded in the image.


- 5) Select the adjustment options in the *Characters* tab:





Jidosha


Habilitar OCR 

Máximo de caracteres de baixa probabilidade permitidos 

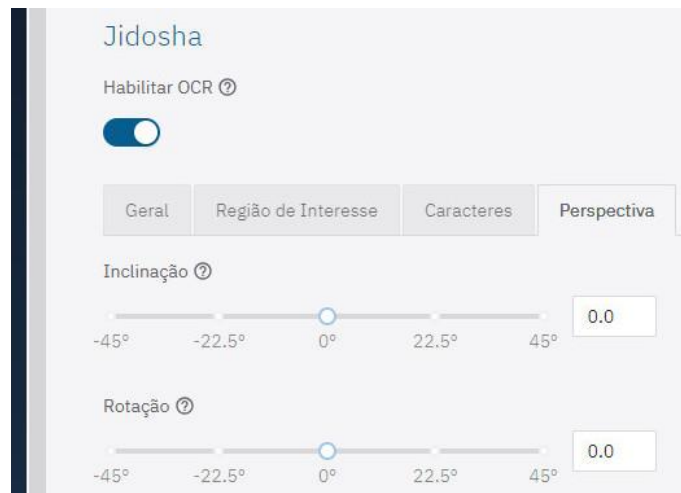
Confiabilidade mínima de caracteres 

Altura mínima de caracteres 

Altura máxima de caracteres 

Altura média de caracteres 

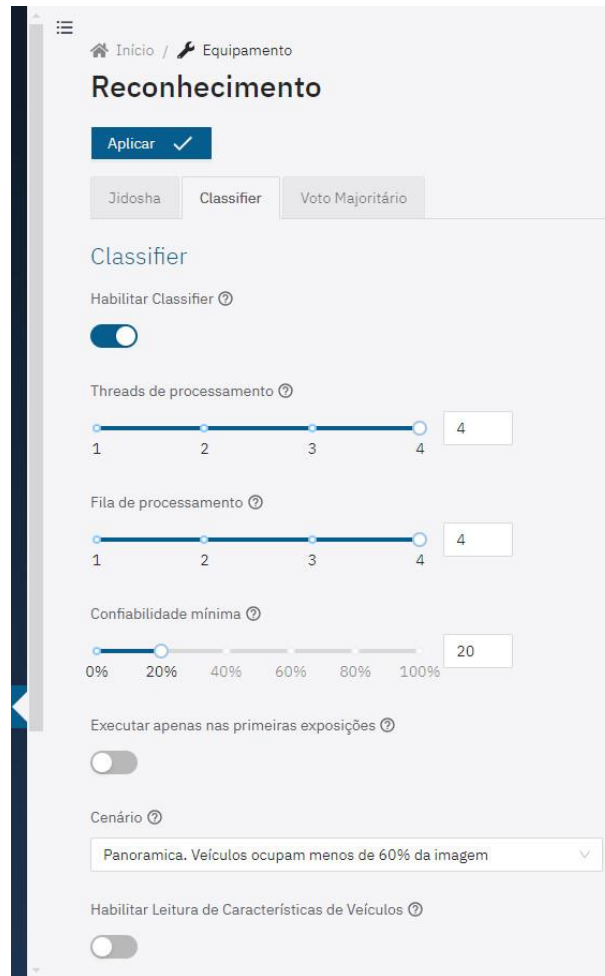
- a. Set the *Maximum number of low probability characters allowed* and characters that are identified with reliability lower than the minimum value set are represented by the '?' character;
- b. Define the *Minimum Character Reliability* with the minimum OCR reliability percentage, which considers the degree of similarity between the letter identified in the processing and a letter in perfect capture conditions. It is recommended to maintain the factory standard of 85% minimum reliability;
- c. Set the *Minimum character height* as 9;
- d. Set the *Maximum character height* as 60;
- e. Set the *Average character height* as 20;
- 6) Access the setting options in the *Perspective* tab



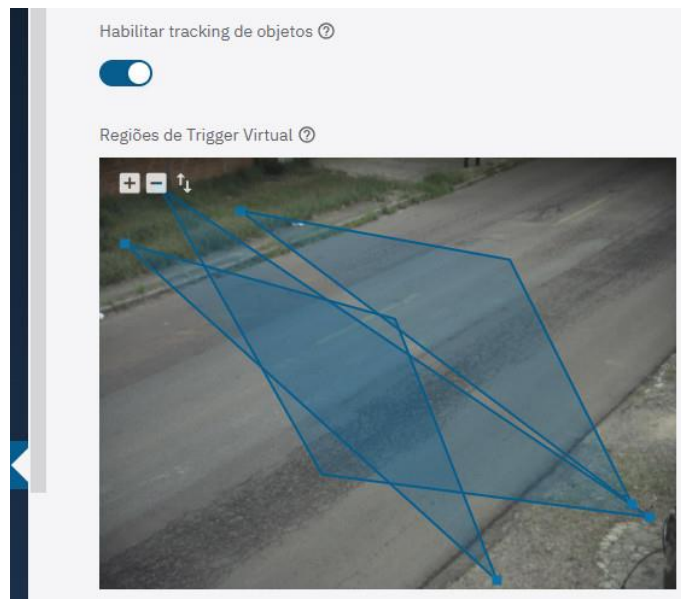
- a. Adjust the *Tilt* angle of the plates as they appear in the image, removing the 'italics' effect, in order to improve OCR efficiency:
 - i. Take a photo of a plate in the desired position, using the functionality in *Equipment>Images>Snapshot*, and adjust the tilt value until the characters on the plate are aligned with the vertical axis of the grid;
 - b. Adjust the *Rotation* angle of the plates as shown in the image to improve OCR efficiency:
 - i. Take a photo of a plate in the desired position, using the functionality in *Equipment>Images>Snapshot*, and adjust the rotation value until the characters on the plate are aligned with the horizontal axis of the grid;
- 7) Click *Apply* to validate the entered information.

Classifier

- 1) Go to the *Equipment > Recognition* menu;
- 2) Select the Classifier tab and click *Enable Classifier* for the device to analyze the captured images in real time and evaluate the content present in the images. This analysis aims to distinguish motorcycles, cars, trucks and buses from images that show only the road;
 - a. Set the number of *Processing threads*;
 - b. Set the size of the image *Processing queue*;
 - c. Set the *Minimum reliability* (for identifying/classifying the vehicles in the images);
 - d. Enable the option to *Run only on the first exposures* and the *Classifier* recognition will be processed only on the first exposure, when the *Multiple Exposures* option is enabled, which changes the lighting on the first exposure, enough to distinguish the vehicle and the other exposures have adequate lighting for license plate recognition;
- 3) Select the *Scenario*:
 - a. *Panorama* for capturing up to two lanes;
 - b. *Close-up* for a single lane;
- 4) Select *Enable Reading of Vehicle Characteristics* to have *Classifier* process the reading of vehicle characteristics such as brand, model and color. This option can increase processing time;

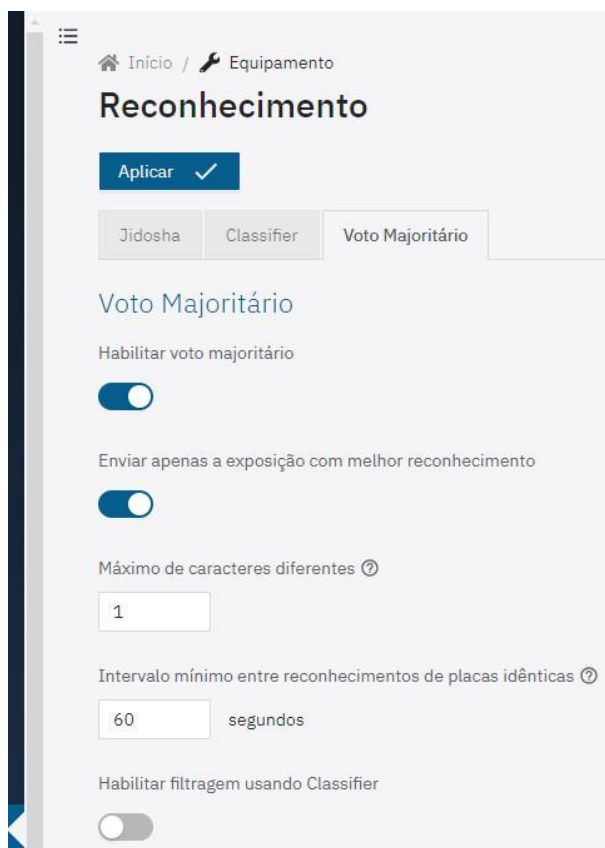


- 5) Select the *Enable object tracking* option to generate a high-precision *virtual loop* (virtual trigger):
- 6) Create the *Virtual Trigger Regions* which are made up of 3 pieces of information: 2 points (indicating a line) and a direction (represented by the third point of the triangle), indicating that vehicles crossing the line defined by the two points and following the direction indicated by the triangle generate the capture of an image, characterizing the *Virtual Loop* (virtual trigger):
 - a. + (Add region): Add a new region. This configuration is limited to a maximum of 4 regions;
 - b. - (Remove region): Remove selected region. This action can also be performed using the 'delete' key on the keyboard;
 - c. ↕ (Rotate region): Changes the direction of the selected region. This function allows the creation of separate loop points for each lane and indicates the direction of vehicle flow in order to generate a precise virtual loop, based on the class of the objects;



Majority Vote

- 1) In the *Majority Vote* tab, access the adjustment options by clicking on *Enable majority vote* when the *Multiple Exposures* feature is enabled and with the aim of the plate resulting from the OCR reading considering the most reliable detection for each character;



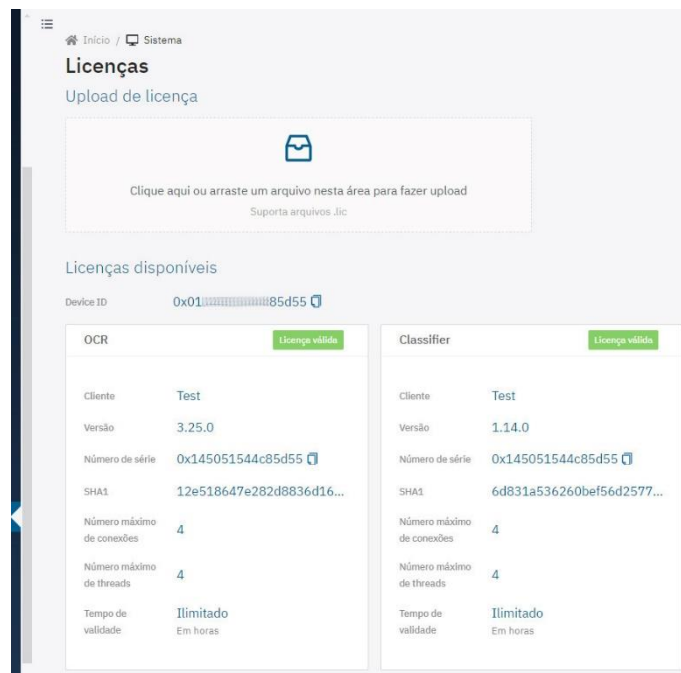
- 2) Enable the option *Send only the exposure with the best recognition* so that only the image with the best recognition index is sent;
- 3) Set the *Maximum number of different characters* tolerated to consider two license plates as being the same;

- 4) Set a time, in seconds, for the *Minimum interval between recognizing identical license plates*;
- 5) Select *Enable filtering using Classifier* which allows the use of the *Classifier* recognition and only images with a vehicle are generated;
- 6) Click *Apply* to validate the entered information.

Licenses

Analytics licenses can be updated directly via the web interface, either for automatic recognition of the license plate of the vehicles in the images (OCR) or for recognition of the type of vehicle identified (*Classifier*).

- 1) Go to the *System > Licenses* menu to update the licenses;



- 2) Click or drag the file in *.lic* format to the *License Upload* area, provided by Support or Commercial departments, when available;
- 3) Click on *Apply*;
- 4) Confirm on the reboot prompt if it is possible to reboot the system after applying the license:

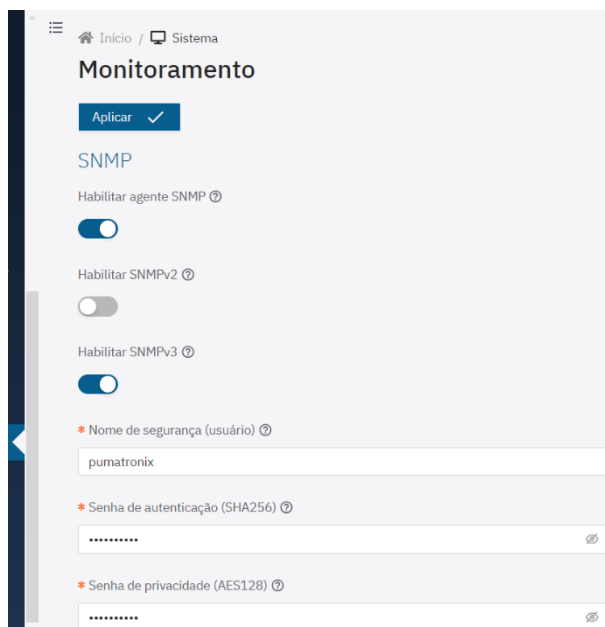


- 5) Wait for the file to load completely.

Monitoring

The capture device can be monitored remotely using the *SNMP* protocol, configured directly via the web interface.

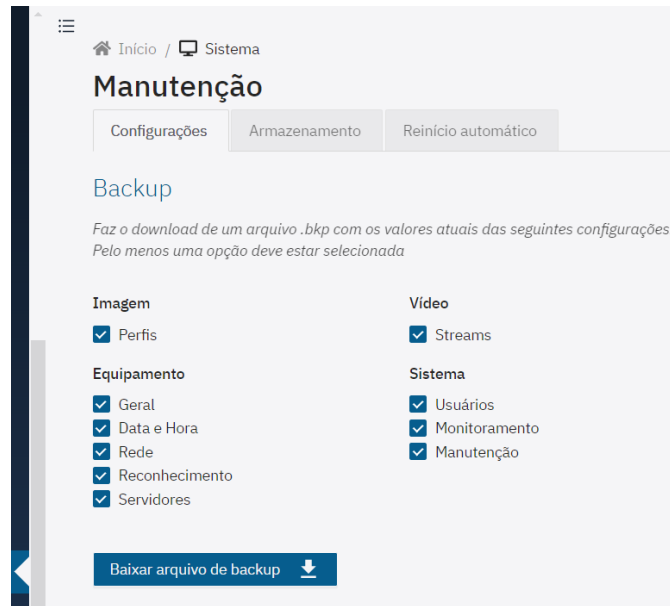
- 1) Go to the System > Monitoring menu;
 - a. Select the Enable SNMP agent option to enable the integrated SNMP agent;
 - b. The Enable SNMPv2 option enables version 2 of the SNMP protocol. As SNMPv2 is insecure by default, SNMPv3 should be used when possible.
 - c. The Enable SNMPv3 option enables version 3 of the SNMP protocol.
- 2) Set a Security name (user) (this field is mandatory);
- 3) Set an Authentication Password with the authentication protocol is SHA256 (this field is mandatory);
- 4) Set a Privacy Password with the privacy protocol is AES128 (this field is mandatory);
- 5) Click on *Apply* after confirming the data entered;



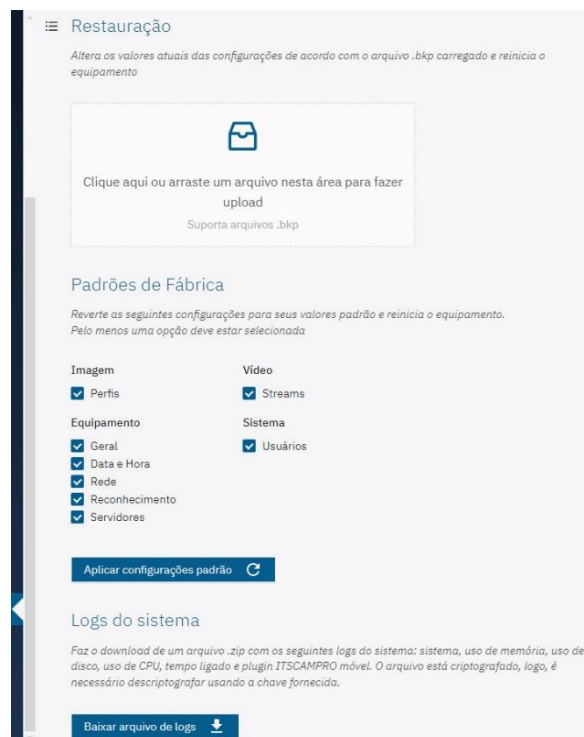
Maintenance

The *Backup*, *Restore*, *Factory Defaults* and *Automatic Reboot* maintenance options are available via the *System > Maintenance* menu.

- 1) Locate the *Backup* field to save a backup file of the settings, which can be restored on the device itself or to import the configuration to other devices;
 - a. Select the settings that will be saved in the backup file;
 - b. Click on *Download backup file*;

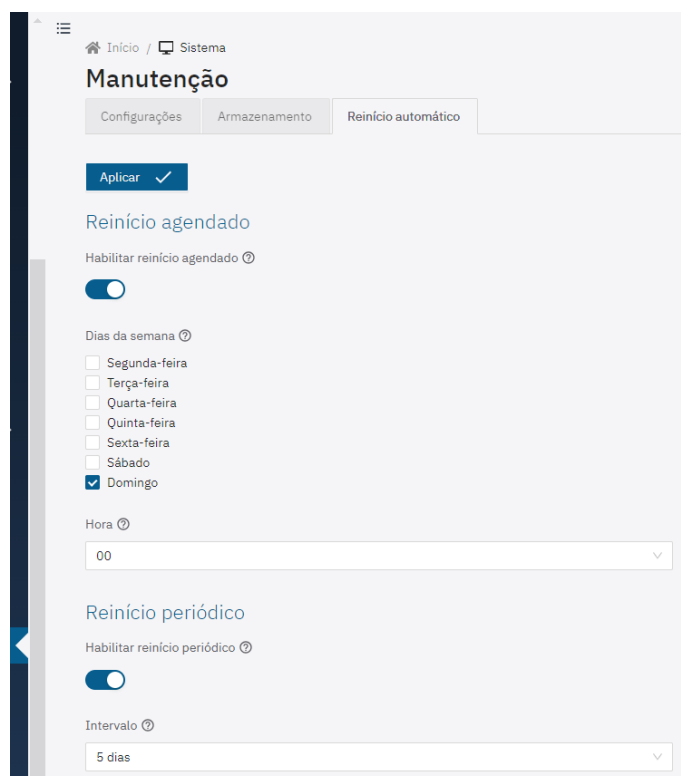


- 2) Locate the *Restore* field to use a backup, in which case the current settings will be overwritten by the information saved in the file;
 - a. Click or drag a file in *.bkp* format;
 - b. Wait for the file to load and for the device to reboot;
- 3) Locate the *Factory Defaults* field to restore the factory settings in the event of a device malfunction or incorrect settings;
 - a. Select the settings that will be reset to the factory default;
 - b. Click on *Apply default settings*;
 - c. Wait for the device to reboot;



- 4) Locate the *System Logs* field to download a *.zip* file with the main system logs: system, memory usage, disk usage, CPU usage, connected time and the ITSCAMPRO mobile plugin. The file is encrypted, so it must be decrypted using the key provided:

- a. Click on *Download log file*;
 - b. Unzip the zipped file;
 - c. Access the text files, locating the data from each log separately.
- 5) Program the *Automatic Reboot* of the device on a scheduled day and time or periodically for improved system:
- a. Select *Enable scheduled reboot* to restart the system at the specified days and times;
 - i. Choose one or more *Weekdays* for the system restart;
 - ii. Set a time for rebooting the system;
 - b. Select *Enable periodic reboot* to restart the system whenever it is on for longer than the specified interval;
 - i. Set a range between the available options.



3. API REST

The capture devices have a API REST to access the images and settings of the equipment. This API follows the *OpenAPI* format and can be accessed via port 8081 (http://IP_ITSCAM_600:8081/).

The settings are available in end-point form and can be accessed via http://IP_ITSCAM_600:8081/v2/camera/profiles/0/schema. This functionality is only accessible if the firewall is disabled and its use should be limited to the development environment.

Color Settings

Parameter	Minimum	Maximum
blacklevel	0	1023
brightness	-100	100
contrast	-100	100
gamma	0	255
saturation	-100	100

Exposure Settings

Gain		
Parameter	Minimum	Maximum
automatic	false	true
fixedValue	1	3600
maxValue	1	3600
minValue	1	3600

Iris		
Parameter	Minimum	Maximum
automatic	false	true
fixedValue	1	1000

Level		
Parameter	Minimum	Maximum
roi	false	true
roi: x0, x1, x2, x3	0	1632
roi: y0, y1, y2, y3	0	1220
target value	0	100

Shutter		
Parameter	Minimum	Maximum
automatic	false	true
fixedValue	53	64000
maxValue	53	64000
minValue	53	64000

Lens Settings

Parameter	Minimum	Maximum
exchanger	false	true
focus	0	600
zoom	0	2330

Movement Filter (*MovFilter*) Settings

Parameter	Minimum	Maximum
enabled	false	true
onlyCheck	false	true
roi	false	true
roi: x0, x1, x2, x3	0	1632
roi: y0, y1, y2, y3	0	1220
threshold	0	100

Multiple Exposures (*multipleExposures*) Settings

Parameter	Minimum	Maximum
enabled	false	true

Transitions Settings

Parameter	Minimum	Maximum
enabled	false	true
lower - endTime	0	20
lower - holdTime	100	100000

Parameter	Minimum	Maximum
lower - level	0	10
lower - profile	0	2147483647
lower - startTime	0	20
upper - endTime	0	20
upper - holdTime	100	100000
upper - level	0	10
upper - profile	0	2147483647
upper - startTime	0	20

Trigger Settings

Parameter	Minimum	Maximum
enabled	false	true
event	0	99
minimumInterval	0	100000
port	1	4
roi	false	true
roi: x0, x1, x2, x3	0	1632
roi: y0, y1, y2, y3	0	1220
threshold	0	100

White Balance (*Whitebalance*) Settings

Parameter	Minimum	Maximum
automatic	false	true
red	0	800
green	0	800
blue	0	800

4. COUGAR Communication Protocol (Socket)

The Cougar protocol is an integration interface based on TCP socket connections and the main functionalities made available through this API are: device control and configurations; receiving images and metadata from vehicle ticket records. The protocol has the following features:

- Modular implementation
 - All messages will share a common header, making it easier to implement the low-level interpreter;
 - Use of the JSON format, allowing all the fields in some settings to be filled in automatically;
 - Implementation of metadata and extra functionalities in the same command, without interfering with operation;
- Asynchronous messages
 - Metadata can be sent without interfering with settings communication;
 - Facilitates the creation of GUIs or other services with a high rate of simultaneous events;
- Connection customization
 - Information is only sent when requested, reducing bandwidth consumption;
 - Image metadata can be sent separately, making it possible to receive only metadata, only the image or both;
 - Complete metadata is sent during JPEG processing, improving event timing and bandwidth usage;
 - Allows the connection to use other binary JSON formats to reduce the amount of data transmitted;
 - More secure connections by requiring a password.

Connection and Messages

Cougar is implemented using TCP port 60.000. By default, the server will not send any data until it is configured to send it or as a response to a request, except for the server shutdown indication.

All data sent is encapsulated in a message and every message contains a header and a body. Data is formatted with the most significant byte (MSB) first, also called Network Byte Order. The message structure is:

Cabeçalho												Corpo							
Byte Inicial	Tamanho (32bits)				Operação (16bits)		ID (32bits)				CRC (16bits)			Corpo				CRC corpo (16bits)	
(102) 0x66	MSB			LSB	MSB	LSB	MSB			LSB	MSB	LSB	0	1	...	Tamanho-1	MSB	LSB	

- Initial byte
 - 8 bits;
 - Fixed value of 102 (0x66);
- Body size
 - 32 bits with no signal;
 - Contains the size of the message body (without CRC);
- Operation
 - 16 bits with no signal;
 - Describes operation performed or type of message in the body;
- ID
 - 32 bits with no signal;
 - "Unique" transaction identifier (possible reuse of IDs with count scrolling);

- Responses to requests have the same ID as the request.
- Incremental value, with an increment of 2;
- The client must start counting at 0. Server starts counting at 1;
- CRC
 - 16 bits with no signal;
 - XMODEM format (polynomial: 0x1021, initial value: 0x0000, residue: 0x0000);
 - Refer to the CRC16 XMODEM calculation example.
 - Calculation for sending done from the initial byte to the ID (11 bytes);
 - Enables checking by running the algorithm only once on the entire header (13 bytes);
 - The header's CRC will always return 0.
- Body (optional)
 - Size described in bytes in the header;
- Body CRC (if there is a body)
 - 16 bits with no signal;
 - XMODEM format (polynomial: 0x1021, initial value: 0x0000, residue: 0x0000);
 - Calculation made only for the body.

General definitions

Important details of the device's implementation:

- The device has 4 "dry I/Os" (usually called GPIOs), which can be set to:
 - Input of image capture signals (Trigger);
 - Output for activating equipment (gates, signaling, etc.);
 - Flash drive output;
- The device has 2 serial interfaces that can be set up as RS-232 or RS-485 (usually RS-232 on serial 1 and RS-485 on serial 2).
- Captured images can be separated into 3 categories:
 - Preview:
 - When there are no settings, the images are Preview;
 - Main source of video streams;
 - No flash trigger;
 - No OCR processing or vehicle detection;
 - Used for motion detection and image brightness adjustment;
 - *Snapshot*:
 - Request made by the client (Cougar, WEB or Pumatronix Protocol);
 - Multiple exposures (1 to 8): Flash, shutter and gain can be customized in the request;
 - Processing pipeline where OCR and other analyses are carried out;
 - The image is never filtered (there is always a response to the client);
 - *Trigger*:
 - Request made automatically (via rising/falling edge of signal, motion detection, etc.);
 - Multiple exposures (1 to 8): Flash, shutter and gain customized in advance via REST/WEB or Cougar;
 - Processing pipeline where OCR and other analyses are carried out;
 - Image can be filtered if set not to forward images without vehicles (majority vote);
- The equipment can take between 1 and 8 exposures from a single event, each with its own shutter and gain, which in turn can be set by the user or depend on the current value, and each can trigger up to 4 independent flashlights with power control.

Operations

Type	Name	Value	Comments
General	NACK	1 (0x0001)	Message failure / keep-alive
Events	SHUTDOWN	256 (0x0100)	Equipment/connection disconnecting
	EVT_TRIGGER	257 (0x0101)	Trigger metadata
	JPEG_TRIGGER	258 (0x0102)	Trigger image
	EVT_SNAPSHOT	259 (0x0103)	Snapshot metadata
	JPEG_SNAPSHOT	260 (0x0104)	Snapshot image
	EVT_PREVIEW	261 (0x0105)	Preview metadata
	JPEG_PREVIEW	262 (0x0106)	Preview image
	EVT_PIPE_START	263 (0x0107)	Pipeline image input
	EVT_GPIO	264 (0x0108)	Changing GPIO inputs
	EVT_SERIAL	265 (0x0109)	Data received on serial
Requests	SET_OPT_STR	512 (0x0200)	Section setup
	SET_CALLBACKS	513 (0x0201)	Callback setup (events)
	SET_JPEG_CFGS	514 (0x0202)	JPEG conversion settings
	TRIGGER_SNAPSHOT	515 (0x0203)	Request Snapshot
	GET_LASTFRAME	516 (0x0204)	Request last frame (Preview)
	AUTHENTICATE	517 (0x0205)	Client authentication
	SET_SERIAL_CFGS	518 (0x0206)	Serial interfaces setting
	SEND_SERIAL_DATA	519 (0x0207)	Sending data via serial interfaces
	SET_EQUIP_CFGS	520 (0x0208)	General equipment settings

The body of all messages has one of the following formats:

- None: (empty body [0 bytes])
 - Used for NACK as a check-alive (to check more quickly if the connection to the server has dropped);
- Binary: Body contains only data in binary format (i.e.: JPEG image)
 - Used for GET_LASTFRAME;
- JSON: Body contains data only in JSON format or one of the binary variants, set using SET_OPT_STR;
 - Used for all other requests and events without a JPEG image (i.e.: EVT_SNAPSHOT);
- Mixed: Body contains, in order:
 - Metadata size in 32 bits (4 bytes);
 - MSB first, as well as for the header.
 - Metadata in JSON format (or variant);
 - Data in binary format, occupying the rest of the space specified by the header;
 - Used in image events (i.e.: JPEG_SNAPSHOT);

Descriptions of JSON fields come with the data type in square brackets, along with the default value or an example. For example:

- "field" [*string*, "value"]: Field explanation.

For most fields, the response contains all the fields that can be set for a given request. Therefore, to read the current settings, send an empty request.

NACK

NACK is sent by the server in response to a command when:

- Response to the NACK command (sent by the client)
 - As the TCP connection often assumes that the server is still operational, using a check-alive can check whether the server has shut down more quickly.
- Invalid operation or not implemented by the server;
- Unauthenticated client (if the option is enabled);
- The required operand is not present or is incorrectly formatted;
- Internal failure;

A NACK is not sent when:

- Message header is malformed, with invalid header or body CRC;
- Non-critical operation fails or is incorrectly formatted
 - i.e.: when trying to set the "trigger" field in the SET_CALLBACKS command to 1, the operation fails because it expects a Boolean value (true or false), but does not generate errors. It is necessary to check the command response to determine whether the operation was successful.

The body of the response is a JSON with a "reason" field that describes the error encountered for debugging purposes, unless it is a response to the NACK command itself (in which case the body is empty).

SHUTDOWN

Event sent when the server is shutting down (for example, if the device is rebooting). Sent without arguments and does not need to be set to be sent.

SET_OPT_STR

SET_OPT_STR sets options related to the client section/connection. For security reasons, this is the only setting that only works with the plain JSON format (e.g.: {"string": "value"}). The settings for this option are:

- "json" [*string*, "plain"]: how all other messages are sent. That could be:
 - "plain": Common JSON (ascii string);
 - "bson": Binary JSON (BSON);
 - "cbor": Concise Binary Object Representation (CBOR);
 - "messagepack": MessagePack;
 - "ubjson": Universal Binary JSON;
- "respondCfgPath" [*bool*, *false*]: When set, the SET_EQUIP_CFGS operation returns the path that was sent to the request (more details in the operation).

AUTHENTICATE

If the server is set up as such, the client will need to send a password for authentication. This option is highly recommended for any operating system, as Cougar has access to most of the device's settings. The parameter used in the request (which can be omitted if the status is only to be checked) is:

- "pass" [*string*]: Password for client access.

This command does not return NACK. The answer will always contain:

- "auth" [*bool*]: True if access to other messages is enabled;
- "msg" [*string*]: Message related to the status of the operation. It could indicate, for example:
 - If authentication is not required;
 - If it's already authenticated;
 - If authentication was successful;
 - If the field is poorly formed;
 - If the password is incorrect;

The only commands that work without requiring authentication are NACK (check-alive), SET_OPT_STR (to configure JSON mode) and AUTHENTICATE.

SET_CALLBACKS

SET_CALLBACKS sets which events are sent to the client. The fields are:

- "pipeline" [*bool, false*]: Enables EVT_PIPE_START events;
- "trigger" [*bool, false*]: Enables EVT_TRIGGER events;
- "snapshot" [*bool, false*]: Enables EVT_SNAPSHOT events;
- "preview" [*bool, false*]: Enables EVT_PREVIEW events;
- "gpio" [*bool, false*]: Enables EVT_GPIO events;
- "triggerjpeg" [*bool, false*]: Enables JPEG_TRIGGER events;
- "snapshotjpeg" [*bool, false*]: Enables JPEG_SNAPSHOT events;
- "previewjpeg" [*bool, false*]: Enables JPEG_PREVIEW events;
- "serial1" [*bool, false*]: Enables EVT_SERIAL events for serial 1;
- "serial2" [*bool, false*]: Enables EVT_SERIAL events for serial 2;

SET_JPEG_CFGS

SET_JPEG_CFGS sets the minimum quality and timing for generating JPEGs. The default quality is configurable via the REST/WEB interface. The fields are:

- "trigger"
 - "quality" [*int, configurable*]: Quality of images generated from Trigger.
- "snapshot"
 - "quality" [*int, configurable*]: Quality of images generated from Snapshot.
- "preview"
 - "quality" [*int, configurable*]: Quality of images generated from Preview;
 - "mindt" [*int, 100*]: Minimum time (in milliseconds) between Preview images, to reduce the maximum frame rate.

EVT_PIPE_START

Event sent when a frame enters the photo pipeline (Trigger and Snapshot). Used to facilitate the timing of taking photos with an external server. Only the simplest metadata is sent:

- "framecount" [*uint64*]: Unique image value, implemented using a counter that increments with all images taken (Snapshots, Triggers and/or Previews), reset to zero at server startup
- "rid" [*uint64*]: Snapshot sync value. Implemented so that the client can correlate the request made (which returns the same value) with the image taken
- "multexp"
 - "len" [*int*]: Number of exposures in the multiple exposure group;
 - "pos" [*int*]: Position of the image in multiple exposures, starting with 0.

EVT_TRIGGER, EVT_SNAPSHOT, and EVT_PREVIEW

All these events are sent when the images have finished being processed internally and are delivered to the Server. The moment these events are sent, the JPEG conversion of the image also begins, if enabled. For Trigger and Snapshot images it is possible to correlate EVT_PIPE_START events using "framecount". The metadata for all of them is similar, with the exception of the lack of "rid", "jidasha" and "classifier" data for Preview images. The fields are:

- "framecount" [*uint64*]: Unique image value, implemented using a counter that increments with all images taken (Snapshots, Triggers and/or Previews), reset to zero at server startup;
- "rid" [*uint64*]: Snapshot sync value. Implemented so that the client can correlate the request made (which returns the same value) with the image taken;
- "ogSize"
 - "w" [*int*]: Original image width, in pixels;
 - "h" [*int*]: Original image height, in pixels;
- "size"
 - "w" [*int*]: Image width. Different from the original if the image has been cropped, in pixels;
 - "h" [*int*]: Image height. Different from the original if the image has been cropped, in pixels;
- "multExp"
 - "len" [*int*]: Number of exposures in the multiple exposure group;
 - "pos" [*int*]: Position of the image in multiple exposures, starting with 0;
- "shutter" [*int*]: Shutter exposure in microseconds
- "gain" [*int*]: Analog exposure gain in millibels (100x decibels)
- "stats"
 - "level" [*int*]: Image level, with a value from 0 to 1000;
 - "meanr" [*int*]: Average value of the color Red, with a value from 0 to 255;
 - "meang" [*int*]: Average value of the color Green, with a value from 0 to 255;
 - "meanb" [*int*]: Average value of the color Blue, with a value from 0 to 255;
 - "stddev" [*int*]: Standard deviation squared, with a value from 0 to 65535;
- "time"
 - "setup" [*uint64*]: Monotonic exposure scheduling time, in microseconds;
 - "exp" [*uint64*]: Monotonic exposure time, in microseconds;
 - "dma" [*uint64*]: Monotonic entry time of the exposure into the pipeline, in microseconds;
 - "now" [*uint64*]: Internal monotonic time of this message, in microseconds;
- "date"
 - "year" [*int*]: Year the image was taken;
 - "month" [*int*]: Month the image was taken;
 - "day" [*int*]: Day the image was taken;

- "hour" [int]: Time the picture was taken;
- "min" [int]: Minute the image was taken;
- "sec" [int]: Second the image was taken;
- "msec" [int]: Millisecond from when the image was taken (taken at the same moment as the "time.dma" field);
- "crop"
 - "x" [int]: Horizontal position of the start of the image crop, in pixels;
 - "y" [int]: Vertical position of the start of the image crop, in pixels;
- "jidoshu"
 - List / Vector
 - "plate" [string]: Identified plate;
 - "probs" [float list]: Probabilities of each character identified. Same size as the identified plate. Values from 0.0 to 1.0;
 - "pos"
 - "x" [int]: Horizontal position of the plate, in pixels;
 - "y" [int]: Vertical position of the plate, in pixels;
 - "w" [int]: Plate width, in pixels;
 - "h" [int]: Plate height, in pixels;
 - "color" [int]: Plate color, 0 for white and 1 for red;
 - "moto" [int]: Value 1 for when the identified license plate has the Motorcycle format, 0 otherwise;
 - "country" [int]: OCR country code, using ISO 3166-1;
- "classifier"
 - List / Vector
 - "type" [int]: Type of vehicle identified, based on the Classifier interface:
 - 0: Unknown;
 - 1: Car;
 - 2: Motorcycle;
 - 3: Truck;
 - 4: Bus;
 - "prob" [float]: Identification probability, from 0.0 to 1.0
 - "pos"
 - "x" [int]: Horizontal position of the vehicle, in pixels;
 - "y" [int]: Vertical position of the vehicle, in pixels;
 - "w" [int]: Vehicle width, in pixels;
 - "h" [int]: Vehicle height, in pixels.

JPEG_TRIGGER, JPEG_SNAPSHOT, and JPEG_PREVIEW

All of these events load the converted JPEG image along with some metadata relating to the capture, so that the events can be correlated (using the Mixed formatting described above). The quality of the conversion is set via the "quality" fields of SET_JPEG_CFGS. For the JPEG_PREVIEW event, only the "framecount" and "quality" fields are filled in. For the others, the fields are:

- "framecount" [uint64]: Unique image value, implemented using a counter that increments with all images taken (Snapshots, Triggers and/or Previews), reset to zero at server startup;
- "quality" [int]: JPEG conversion quality, in percent;
- "rid" [uint64]: Snapshot sync value. Implemented so that the client can correlate the request made (which returns the same value) with the image taken;
- "multExp"
 - "len" [int]: Number of exposures in the multiple exposure group;

- "pos" [int]: Position of the image in multiple exposures, starting with 0.

TRIGGER_SNAPSHOT

This operation queues a Snapshot request. By default, when called without any parameters, it uses the default parameters configured for the Trigger in the WEB/REST interface. Multiple exposure settings should be formatted as follows:

- "multexp"
 - List / Vector (between 1 and 8 items)
 - "shutter" (only one of the options, 100% of the current shutter if not populated)
 - "percent" [int, 100]: Percentage of the current shutter;
 - "value" [int]: Shutter in microseconds;
 - "gain" (only one of the options, 100% of the current gain if not populated)
 - "percent" [int, 100]: Percentage of the current gain;
 - "value" [float]: Gain in decibels;
 - "flash"
 - "1" [int, 0]: Flash percentage at output 1;
 - "2" [int, 0]: Flash percentage at output 2;
 - "3" [int, 0]: Flash percentage at output 3;
 - "4" [int, 0]: Flash percentage at output 4.

The "shutter" and "gain" fields expect only one of the available options. If both are filled in, the percentage will always be used. In addition, in order for the flash to work properly, the outputs used as flash must be pre-configured.

The request response only contains the "rid" (64-bit integer field), which is a unique identifier value for the request, serving to correlate requests with the resulting images/processing/metadata.

GET_LASTFRAME

This operation uses the last Preview exposure to generate a JPEG. The only input parameter is:

- "quality" [int, 80]: JPEG conversion quality

The response to this command fills the body entirely with the converted image or returns NACK if there is a problem. For continuous use (video or preview) we recommend using the JPEG_PREVIEW event to generate the images.

EVT_GPIO

This event is sent when there is a change in the status of the device's "dry" inputs (GPIO).

The data sent is:

- "framecount" [uint64]: Frame in which the event occurred, useful for correlating with exposures;
- "rising" [int]: Combination of all inputs where the logic level ranged from 0 to 1;
- "falling" [int]: Combination of all inputs where the logic level ranged from 1 to 0;
- "state" [int]: Final state of inputs.

To shorten the messages, the data from all the inputs is placed in the same integer variable, setting the bit with the corresponding offset. For example, if input 3 changes state from 0 to 1 and input 1 is high, the corresponding event (in "plain" mode) would be:

```
{"framecount":1234, "rising":4, "falling":0, "state":5}
```

Therefore, setting the bit corresponding to input 3 would be equivalent to $1 \ll (3-1) \Rightarrow 4$ (" \ll " being the shift-left operation) and the combination of bits 1 and 3 would be $(1 \ll (3-1)) | (1 \ll (1-1)) \Rightarrow 5$ (" $|$ " being the bit-by-bit OR operation).

SET_SERIAL_CFGS

SET_SERIAL_CFGS sets the serial interfaces. They can be used by more than one client and reconfiguration using different parameters can lead to data loss. It is recommended (especially for RS485 connections) that all devices on the same bus use the same settings. The available settings are:

- "serial1"
 - "baud" [*int*, 115200]: Interface speed in bits per second (baud);
 - "bits" [*int*, 8]: Number of bits in each frame. Valid values are between 5 and 8;
 - "stop" [*int*, 1]: Number of stop-bits. Valid values are 1 or 2;
 - "parity" [*string*, "n"]: Parity of each frame. Valid values are:
 - "n": No generation or checking;
 - "o": Odd parity;
 - "e": Even parity.
- "serial2"
 - Same parameters as "serial1".

EVT_SERIAL

Event generated when data is received via the serial interface. As there is more than one interface, the message format is mixed. In the metadata, it is sent:

- "pipe" [*string*]: Data source ("serial1" or "serial2")

In the rest of the message (binary format), the received data is sent. Between 1 and 2048 bytes of raw data can be sent in each message. Due to internal timings and other factors, messages being received may be sent in fragments smaller than the maximum size.

SEND_SERIAL_DATA

This operation sends data to the specified interface. The required fields are:

- "pipe" [*string*]: Target interface ("serial1" or "serial2");
- "ascii" [*string*]: Data in ASCII format (no special characters/bytes) or;
- "base64" [*string*]: Data in base64 format or;
- "hex" [*string*]: Data in hexadecimal format (2 characters per byte, 0-9;A-F).

Only one of the data fields is used (using primarily "ascii", then "base64" and then "hex" if multiple are sent). It is recommended to send only the most convenient format.

If everything goes as expected, the command will return:

- "len" [*int*]: Number of frames (usually bytes) sent.

SET_EQUIP_CFGS

SET_EQUIP_CFGS is the main interface for controlling equipment settings on the Cougar. To approximate the formatting of the REST interface, it controls the image-taking settings, making it equivalent to REST endpoints:

- /camera/misc/readonly/volatile → "equip.volatile";
- /camera/misc/readonly/constants → "equip.miscRO";
- /camera/misc → "equip.misc";
- /camera/autofocus → "equip.autofocus";
- /camera/profiles/:id (except creating and deleting profiles) → "equip.profiles";
- /camera/profiles → "equip.currProfile";
- /camera/transitioner → "equip.transitioner";
- /camera/ios → "equip.io".

It also controls the Services endpoints:

- /camera/services/stream → "h264" and "mjpeg";
- /camera/services/ocr → "ocr";
- /camera/services/classifier → "classifier";
- /camera/services/analytics → "analytics";
- /camera/services/ftp → "ftp";
- /camera/services/itscampro → "itscampro";
- /camera/services/licenses → "license".

The (optional) input parameters for this command are:

- "path" [*string*, ""]: Root path to consider for the data;
- "data" [*object/value*, {}]: Data to be written to the settings.

All the settings mentioned above are available in a complete settings tree. Therefore, like all the other Cougar settings, it is possible to configure the elements sparsely, configuring only what it is need. This means that, from a writing point of view, the following options are equivalent:

- 1) {"path": "analytics.voting.roi1.x0", "data": 123}
- 2) {"path": "", "data": {"analytics": {"voting": {"roi1": {"x0": 123}}}}
- 3) {"path": "analytics.voting", "data": {"roi1": {"x0": 123}}}

Due to the sheer volume of configurations, when using an empty path in a conventional case, around 800 elements are answered. This unnecessarily increases the consumption of processing and network resources and is therefore not recommended for continuous use. For the examples above, the answers are:

- 1) 123;
- 2) all settings (~800 elements);
- 3) only majority voting settings (~25 elements).

Due to the volume of configurations, it is recommended to use the REST interface documentation as a reference for the parameters of this command.

APIs available

Since the protocol is open, it is possible to implement its own version of the client, especially if the application does not use one of the languages in which they have been implemented, or if the version made available does not meet the requirements of the rest of the application (e.g. python 2 vs. 3, C++ 98 vs. 11

vs. 17 vs. 20). Pumatronix provides clients in C++ and Python, for code reference only (contact technical support to obtain them).

General Recommendations

Configurations can be changed partially/sparsely, without the need to read, modify and write a fixed structure. This way, even if new fields are added, client behavior remains consistent.

For the SET_EQUIP_CFGS operation, the path closest to the settings to be adjusted should be entered, so that the return from the operation is as small as possible. It is recommended to get all the settings ("path":"") only when necessary (for example: when initializing the client logic).

To implement the protocol independently, it is highly recommended to use a multi-threaded environment to handle message reception and interpretation in a separate thread, to reduce latency between data reception. If necessary, it is possible to use a *threadpool* to make interpretation faster in multi-core environments.

All messages are asynchronous, meaning that during the processing of a command (waiting between sending and receiving) other messages (events, images or even commands from other threads) can be received.

CRC16 XMODEM calculation example

```
// Example implementation of the CRC16 XMODEM algorithm. This example uses a
// "CRC tab" to precalculate coefficients and optimize performance.
// It is possible to define the tab as a "magic" value constant.
// It uses variables defined in <stdint.h> that can be overridden
// for the system equivalent. They usually are:
// - uint8_t -> unsigned char
// - uint16_t -> unsigned short int
uint16_t crcXMODEM(const uint8_t *c, int numBytes, uint16_t currCrc = 0) {
    static uint16_t crcTab[256];
    static bool init = 0;
    if(!init){
        init = true;
        for (int i=0; i<256; i++) {
            uint16_t short_c = i<<8;
            uint16_t crc = 0;
            for (int j=0; j<8; j++) {
                if ( ((crc ^ short_c) & 0x8000) != 0 ) {
                    crc <<= 1;
                    crc ^= 0x1021;
                } else {
                    crc <<= 1;
                }
                short_c <<= 1;
            }
        }
    }
}
```

```

    crcTab[i] = crc;
  }
}
for (int i = 0; i < numBytes; i++) {
    currCrc = (currCrc << 8) ^ crcTab[((currCrc >> 8) ^ c[i])];
}
return currCrc;
}

```

5. Open Source Pumatronix Communication Protocol (Socket)

Communication with the devices is via the Ethernet interface, using the Pumatronix UDP and TCP/IP communication protocols. The port used to communicate with the external device is **50000**. Therefore, the application developed to communicate with the device must be configured to send commands using this port in the TCP and UDP protocols.

The UDP protocol is only used to identify devices connected to the network, as it allows *broadcast-type* packets to be sent, which are received by all devices. This allows the image capture device to send its ID when it receives this packet. All other commands use the TCP protocol, which establishes a point-to-point connection between the control device and the image capture device. Receiving and changing settings is secured by transmitting a *CRC* code. However, most of the responses sent by the equipment do not have a *CRC*.

The Pumatronix Protocol supports connections that have been developed based on the Dynamic Library (dll) and the C++ class for Linux. A *Development Kit (SDK)* is available at www.pumatronix.com with the files needed to develop the application, to download it, go to *Customer Area > Technical Support*.

Commands			
VIDEO	REQ_DATA	SETA_TIPO_SHUT	REQ_POSICAO_ZOOM
VIDEO_CONTINUO	REQ_ENTRADA	SETA_SHUT	REQ_POSICAO_FOCO
FOTO	REQ_GAMMA	SETA_SHUT_MAX	
FOTO_INFO_ADIC	REQ_GANHO_VISIVEL	SETA_TIPO_GANHO	
REQ_CONF_IMAGEM	REQ_TEMPO_LIGADO	SETA_GANHO	
REQ_CONF_GER	REQ_MOV_LENTE	SETA_GANHO_MAX	
SETA_DEFAULT	REQ_FOCO_IR	SETA_NIVEL_IMG	
REQ_CONF_REDE	REQ_IO_VIGIA	SETA_ZOOM	
REQ_SITUACAO_DAY_NIGHT	REQ_DIR_IO_VIGIA	SETA_FOCO	
REQ_ROTACAO	SETA_ROTACAO	SETA_POSICAO_ZOOM	
REQ_LENTE_AUTO_IRIS	SETA_LENTE_AUTO_IRIS	SETA_POSICAO_FOCO	

Commands			
REQ_MODALO_DAY_NIGHT	SETA_MODALO_DAY_NIGHT	SETA_IO_VIGIA	
REQ_SATURACAO	SETA_SATURACAO	SETA_DIR_IO_VIGIA	
REQ_WHITE_BALANCE	SETA_WHITE_BALANCE	SETA_GAMMA	
REQ_FOTO_COLORIDA	SETA_FOTO_COLORIDA	REQ_WB_ATUAL	
REQ_HORA	SETA_SAIDA	SETA_ZOOM_FOCO	



www.pumatronix.com

