PUMATRONIX

VTR 600

HIGH PRECISION AND EFFECTIVENESS FOR LAW ENFORCEMENT VEHICLE INSPECTIONS

Product

Pumatronix Equipamentos Eletrônicos Ltda.

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Revision History

Date	Revision	Updated Content
07/10/2024	1.2.0	SD Card Storage Update; Vehicle License Plate Recognition Update
07/26/2024	1.3.0	Network Interface Update; IP Protection Update; GPS Information Update
01/31/2025	1.4.0	Maximum Capture Speed Adjustment; Addition of New IP Protection; Storage Specifications; System Alerts Description Update; Android App Version Indication (SAD-709)
02/13/2025	1.4.1	Change Control Update (SAD-717)
03/17/2025	1.4.2	VTR 600 image update (SAD-770)

Overview

In a landscape where crime demands swift and effective responses, Pumatronix stands out with the VTR 600, an innovative solution that merges the Internet of Things (IoT) and Artificial Intelligence to revolutionize law enforcement operations, redefining crime prevention and enhancing public safety. Designed for public security applications such as electronic roadblocks, police operations, and fiscal inspections, the VTR 600 is a cutting-edge tool for modern law enforcement.

The VTR 600 reads license plates of moving vehicles, enabling the immediate identification of vehicles with circulation restrictions, stolen or robbed vehicles, or those linked to criminal activities. Upon detection, instant alerts are transmitted to tablets, mobile devices, and in-vehicle multimedia systems. Its advanced connectivity, featuring Gigabit network interfaces, GPS, Wi-Fi, and 4G, ensures seamless communication in any operational scenario. Additionally, its integration with public security systems fosters effective collaboration between authorities, strengthening crime-fighting operations and contributing to safer, higher-quality urban environments.

Figure 1 – VTR 600

As a state-of-the-art device, the VTR 600 is designed to ensure total security and integrity of captured data. Equipped with Digital Signature technology, it guarantees that the information received by the end user can be validated. Any attempt to alter or manipulate data is immediately detected, providing absolute confidence in the information authenticity.

Furthermore, the VTR 600 employs data encryption as an additional layer of protection, securing access to the device and the transmission of data to servers. This ensures that only authorized recipients can access images, preventing unauthorized individuals from intercepting or viewing sensitive information and maintaining data privacy and confidentiality at all times.

The VTR 600 offers a powerful image capture and processing engine, along with the flexibility to integrate custom software, enabling adaptation to specific project needs. Equipped with a 2.3 MP global shutter sensor and a 6mm fixed lens, the VTR 600 delivers detailed vehicle classification, including type, make, model, and color. Its ability to capture images at relative speeds of up to 160 km/h, both day and night, with hardware-synchronized flash, ensures precise license plate recognition, even in challenging conditions.

The VTR 600's video capture technology includes a video encoder supporting H.264, H.265, and MJPEG formats. Additionally, it features an open platform that enables direct video capture and processing on the device, eliminating the need for external computers or routers. Designed for external vehicle installation, the VTR 600 is built to withstand various weather conditions. Its durable metal housing ensures excellent heat dissipation, while allowing simultaneous processing of up to three lanes and vehicles parked in parallel or at an angle. With hardware-synchronized flash and low power consumption, the VTR 600 guarantees superior performance across multiple applications. The Region of Interest (ROI) feature further enhances motion detection capabilities, allowing users to define specific areas of interest for improved accuracy.

With nationwide technical support and installation services by specialized technicians, the Pumatronix VTR 600 is the ultimate solution for real-time vehicle license plate recognition. Contact with sales representatives is recommended in order to learn more about how this technology can enhance operations and improve security in several environments.

Handling Risks

	**The VTR 600 is designed to operate on 12V DC and can be connected directly to a vehicle's battery or cigarette lighter socket. Do not connect any of its inputs directly to the AC power grid!**
	**This equipment may include lenses, which are sensitive to mechanical impacts such as drops and extreme vibrations.**
	**Installation Location: If it is not possible to meet the installation specifications, it is recommended to consult Pumatronix Technical Support.**

Models

Available Models	Resolution	Lens Type	Estimated Range* (meters)
VTR 600 (S09L9IN1W1AJ)	1920x1200px	Fixed 6 mm	3 to 15m

* The estimated range is defined according to the lens specifications and indicates the distance at which vehicle license plate characters remain legible for OCR reading.

Image Sensors	Lens	Integrated Illumination	Network Interfaces	Antennas	Optional Features
S09: CMOS 1920x1200px	**L9**: Fixed 6 mm	**I**: Infrared	**N1**: 1 Network Interface	**W1**: External Antennas	**A**: Digital Signature (TPM1.0) **J**: Embedded LPR

Digital Signature Functionality: The VTR 600 ensures high security with Digital Signature and Data Encryption, guaranteeing the integrity and confidentiality of the captured information. For more details, please contact Technical Support.

Table of Contents

1. Getting to Know the Product

The VTR 600 line of image capture and processing devices is designed for real-time vehicle license plate recognition, enabling the identification of vehicles with circulation restrictions, stolen or robbed vehicles, or those suspected of involvement in criminal activities when integrated into security systems. Equipped with a 2.3 MP image sensor, the VTR 600 can capture and process images from up to three traffic lanes ahead (left, center, and right), as well as vehicles parked in parallel or diagonally on both the left and right sides. This sensor is paired with a 6mm fixed lens for high-quality imaging.

The image quality and level of detail in both natural and artificial lighting from the VTR 600 result from additional functionalities integrated into the optical system (image sensor with lenses) and a 16-LED illuminator. Multiple Exposures can be captured for each photo request made to the device. This feature captures and processes more than one sequential image, with automatic parameter adjustments for optimized capture.

All images captured by the VTR 600 are processed through a Quad-Core processor with a neural network accelerator, which scans them for vehicles. The identification extends to distinguishing motorcycles, cars, trucks, and buses, as well as recognizing vehicle characteristics such as make, model, and color. This function is called Classifier, which can be performed with high precision, detecting vehicles even in cases where the license plate is missing or when character visibility is low. Alongside vehicle identification in the Classifier, it is possible to define regions that operate the Virtual Loop in the image (Virtual Trigger Regions). In addition to vehicle characterization within the image, automatic character recognition (OCR) of license plates is available, supporting both the old Brazilian format and the Mercosur standard (OCR). For information on the availability of OCR recognition for other Mercosur countries, please contact Pumatronix's commercial team.

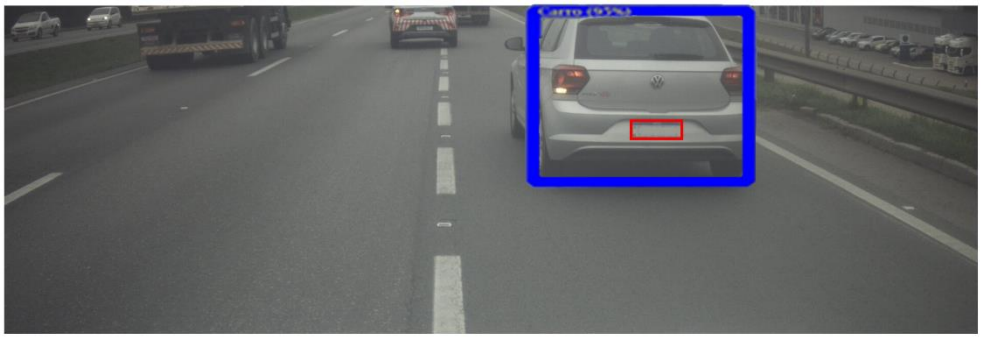


Figure 2 - Live Image Visualization with Classifier Enabled

The VTR 600 captures JPEG images with a resolution of 1920 x 1200 pixels. Within these image files, the comment field is automatically populated with data related to each capture, including GPS coordinates, recognized license plates, identified vehicle type, and the equipment's instant configuration settings.

To enhance connectivity in monitoring points, the VTR 600 features a Gigabit Ethernet port, allowing remote and simultaneous access for multiple users. Users can connect through the device's Web Interface or via applications using the REST API, FTP (File Transfer Protocol), the ITSCAMPRO server, or the Lince® platform. Access management is performed by defining network firewall rules or specifying *routes*. The available REST API commands are detailed in the VTR 600 Integration Manual.

The VTR 600 also offers advanced connectivity features. It supports 4G cellular connectivity, as well as Wi-Fi and IoT M2M communication. Additionally, the built-in GPS module enables image capture with georeferencing, ensuring accurate location tracking of monitored vehicles.

2. Additional Documentation

Product	Link	Description
Docker	https://docs.docker.com	Documentation with usage instructions for Docker.
Docker Engine API	https://docs.docker.com/engine/api/	API documentation for interacting with the Docker daemon.
VTR 600	Installation and Maintenance Guide	Guide containing the necessary information for installing and maintaining the VTR 600.
	Integration Manual	Programming and Integration Manual containing the necessary information for integrating the VTR 600 with an application.
ITSCAMPRO Mobile	Product Manual	Manual for the ITSCAMPRO Mobile software.

3. Generated Information

The VTR 600 captures images of up to three lanes and parked vehicles (both parallel and diagonal) in JPEG format and automatically extracts license plate characters from Brazilian plates (both the old standard and Mercosur format). The recognized plates, captured vehicle type, and equipment configuration details are stored within the JPEG file's comment field. The JPEG file quality is adjustable, and images can include a customizable overlay caption for each *profile*. For each photo request, sequential captures can be taken with different capture parameters (*Multiple Exposures*). The captured images can be viewed through the interface on the Snapshot and Trigger screens, which present the user with the image metadata, such as vehicle type (Car, Motorcycle, Bus, or Truck), make, model, and color identified by the *Classifier*, and license plates identified by OCR Recognition.

The redirection of images captured by the VTR 600 can be performed via wired data networks (using the Gigabit Ethernet port), Wi-Fi networks, or 4G mobile data networks. Using communication interfaces, images from the VTR 600 can be automatically sent through the device's Web Interface, or applications can connect using the REST API Client, FTP (File Transfer Protocol), ITSCAMPRO server, LINCE server, and APIs that enable integration with security agency systems such as PM-PR, PRF (SPIA), PM-MG (Helios), Detecta-SP, and Córtex.

Additionally, real-time monitoring of the device's operation and image captures can be performed via the Web Interface or the ITSCAMPRO Mobile plugin, which presents capture data in a Log Report format, detailed in Software Specifications. The video feed from captured images is available in MJPEG, H.264, or H.265 formats with adjustable quality, as well as a floating live-view window, which can be moved or minimized. This window can optionally display only the captured images, with the ability to adjust zoom and focus for the current profile.

Current Status Information is available on the home screen, displaying the device data, such as Device ID (or Serial Number), installed versions, CPU performance status, memory and storage usage, and GPS status.

4. Mechanical Specifications

- Material: Aluminum and polycarbonate;
- IP Protection: IP67 and IP69K;
- Mounting: Fixed base installation on the vehicle roof using magnets and *a 60cm Security Steel Cable*, which must be attached to the vehicle rack for increased stability;

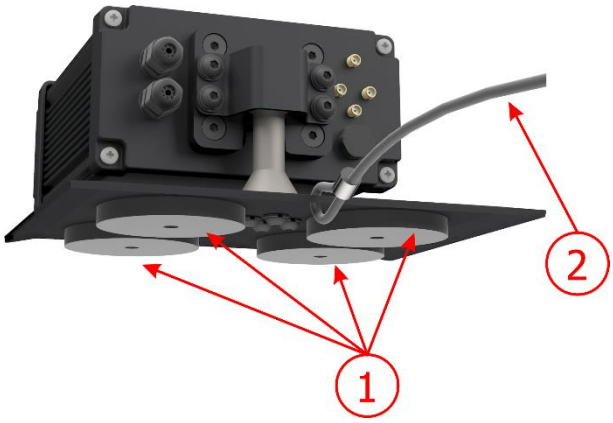


Figure 3 – VTR 600 Mounting: 1) Base Magnets, 2) Security Steel Cable

The *Security Steel Cable* must remain securely attached to the vehicle rack as an additional safety measure for securing the VTR 600 to the roof. Additionally, it enhances stability for accurate image capture alignment. Periodically check that the cable is properly fastened to the vehicle rack.

- Interfaces: The VTR 600 features connectors available on the rear panel:

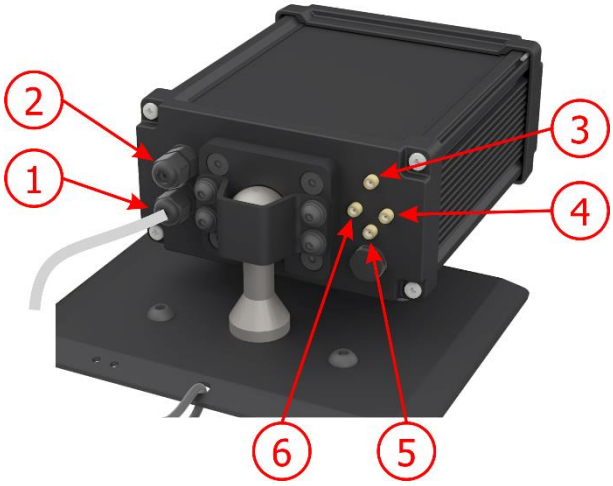


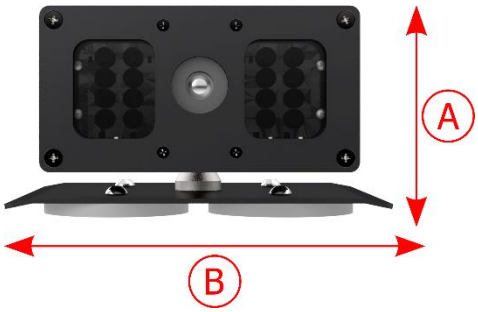
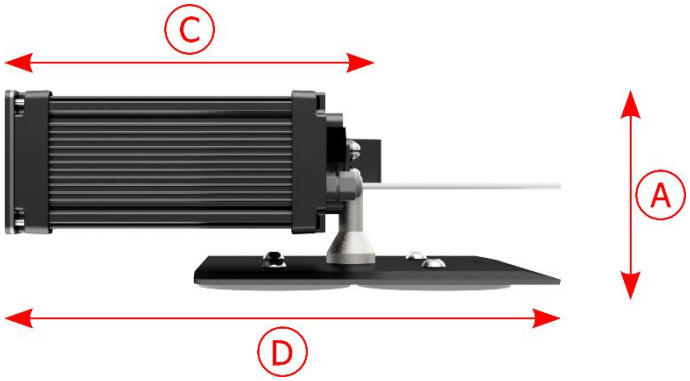
Figure 4 - Available Interfaces on the VTR 600

	Interface	Especificações
1	Cable Harness	Power connector, I/O ports
2	Gigabit Ethernet	RJ-45 connector (EIA/TIA-568A standard recommended)
3	4G Antenna	Male SMA connector
4	MOV Antenna	
5	GPS Antenna	
6	Wi-Fi Antenna	

- Temperature Range: -10 to 65º C with 5% to 95% relative humidity, non-condensing;
- Weight:

Model	Weight
VTR 600 (S09L9IN1W1AJ)	3500g

- Dimensions:

Front View	Side View
	

	A) Height	B) Width	C) Device length	D) Total Length (device + base)
Dimensions in millimeters	112	156	216	300

5. Electrical Specifications

- Power Supply: 9~14.4 VDC (Nominal 12V);
- Maximum Input Current: 2 A (with trigger), 0.7 A (without trigger);
- Typical Power Consumption: 24 W (with trigger), 8 W (without trigger);
- Maximum Power Consumption: 30 W (with trigger), 10 W (without trigger);
- Reverse Polarity Protection: 45 V with a 2 µs fast response to reverse polarity (ISO 7637-2);
- Overvoltage Protection (max.): 28 V in 10/1000 µs (IEC 61000-4-5:2014);
- Electrostatic Discharge Protection (DC power): ±30 kV by contact – Level B (IEC 61000-4-2/AEC Q100-002) and ±30 kV by air (IEC 61000-4-2/AEC Q100-002);
- Electrical Fast Transient (EFT) Protection (DC power): Direct peak current in 10/1000 µs up to 53.3 A ±5% (ISO 7637 and IEC 61000-4-4);
- Inrush Current Protection: 8 A for 2 seconds (IEC 63129:2020).

VTR 600 Interfaces	Electrical Specifications
2 bidirectional ports (input/output)	Digital, 3.75 kV isolation, bidirectional, and individually programmable by users (max current 50 mA, max voltage 28 VDC, 10 kΩ impedance)
1 Gigabit Ethernet port	5 kVAC dielectric isolation, ±30 kV electrostatic discharge protection by contact (Level B - IEC 61000-4-2), ±30 kV by air (IEC 61000-4-2), EFT protection for direct peak current in 5/50 ns up to 40 A ±5% (IEC 61000-4-4), and surge current protection of 4 A (tP = 8/20 µs) (IEC 61000-4-5)
Wi-Fi	Electrostatic discharge protection: ±8 kV by contact (IEC 61000-4-2) and ±15 kV by air (IEC 61000-4-2). External high-gain antenna (2.45 GHz ISM, U-NII, Wi-Fi, WLAN Whip, 2.4~2.5 GHz, 2.8 dBi)

VTR 600 Interfaces	Electrical Specifications
4G	Electrostatic discharge protection: ±8 kV by contact (IEC 61000-4-2) and ±15 kV by air (IEC 61000-4-2). External high-gain straight antennas (850 MHz, 900 MHz, 1.8 GHz, 1.9 GHz, 2.1 GHz – CDMA, DCS, EDGE, GPRS, GSM, HSPA, PCS, UMTS, WCDMA, 824960 MHz, 1.712.17 GHz, 1.42 dBi, 1.91 dBi, 2.51 dBi, 3.23 dBi, 2.89 dBi). Certified by GCF, FCC, ANATEL, NCC, RCM, CE
GPS	Qualcomm® IZat™ Gen8C Lite, supports multi-constellation systems (Glonass, BeiDou/Compass, Galileo, and QZSS). Includes active external antenna (1.57~1.58 GHz, 2 dBic).

Interface	Connectivity Specifications
1 Gigabit Ethernet port	10/100/1000 tri-speed
Wi-Fi	IEEE 802.11 standard (b/g/n 2.4 GHz), with UDP transfer rate of 46 Mbps and TCP/IP transfer rate of 28 Mbps
4G	Supports LTE-FDD/LTE-TDD technologies on the following bands: LTE-FDD: B1/B2/B3/B4/B5/B7/B8/B28 LTE-TDD: B40
IoT M2M	Supported, with downlink rate of 150 Mbps and uplink rate of 50 Mbps
e-SIM	Enables mobile network communication via e-SIM
GPS	The embedded GPS module allows image capture with georeferencing accuracy of up to 20 meters radius

Component	Image Processing Specifications
CPU	Quad-core ARM™ A53 (1.2 GHz, suporte ARMv8 e NEON)
RAM Memory	16 GB LPDDR4 (2100 Mbps and 1050 MHz)
Image Sensor	2.3 MP Global Shutter (1920x1200 px), with Day/Night mode (captures color images during the day and monochrome at night) Physical Sensor Size: 1/2.6” Frame Rate External | Internal: 30fps Shutter Speed Minimum: 48 µs; Maximum: 30,000 µs (30 milliseconds)
Internal storage	Up to 4 GB available (total of 16 GB) Storage for event logging, local access, and transmission buffering in case of connection loss with the platform
SD Card Storage	32 GB or 128 GB Event storage on an SD card for local access or transmission buffering in case of connection loss with the platform
Watchdog	Hardware-based, with a 50-second cycle

Electrical Connections

Figure 5 – VTR 600 Power and Signal Connector (6-wire cable)

Pin	Color	Description
1	Brown	VIN-
2	Red	VIN+
3	Green	IO3+
4	Yellow	IO3-
5	Gray	IO4+
6	Blue	IO4-

The VTR 600 is powered through the connection of a 6-wire cable to a power source within the vehicle's infrastructure. It can be powered by the vehicle battery or via a plug connected to the cigarette lighter. In each case, the installation is customized according to the vehicle model:

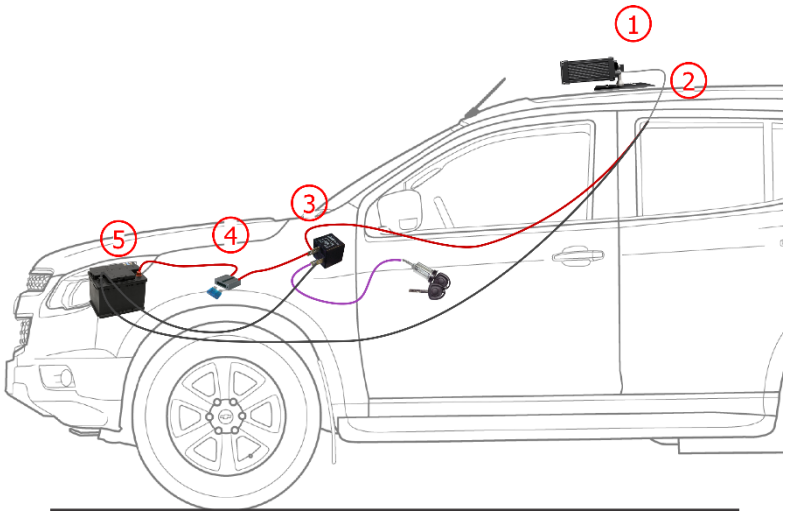


Figure 6 - Installation Model Using the Vehicle Battery for Power Supply: 1) VTR 600 mounted on the vehicle roof, 2) 6-wire cable (12V DC), 3) Auxiliary relay connected to the vehicle ignition switch, 4) Fuse, 5) Vehicle battery

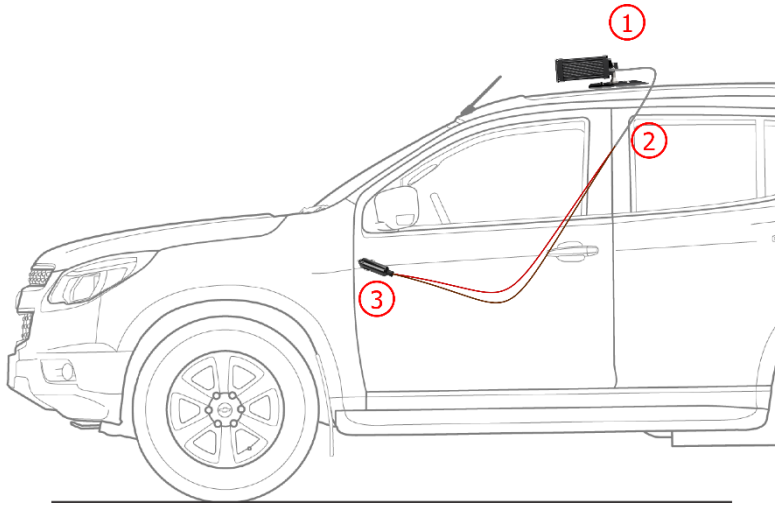


Figure 7 - Installation Model Using the Cigarette Lighter for Power Supply: 1) VTR 600 mounted on the vehicle roof, 2) 6-wire cable (12V DC), 3) Plug connected to the vehicle's cigarette lighter

Ethernet Connection

The VTR 600 enables communication with other devices using the TCP/IP protocol. To establish this connection, the device is equipped with a Gigabit Ethernet port (RJ-45 connector). It is recommended to follow the EIA/TIA-568A standard for connections.

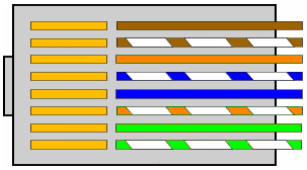


Figure 8 - RJ-45 Connector Following EIA/TIA-568A Standard

Antenna Connection

The images captured by the VTR 600 can include geolocation data provided by the integrated GPS. Wi-Fi and 4G signals can be amplified using an external antenna with an SMA-type connector (male connector with a central pin).

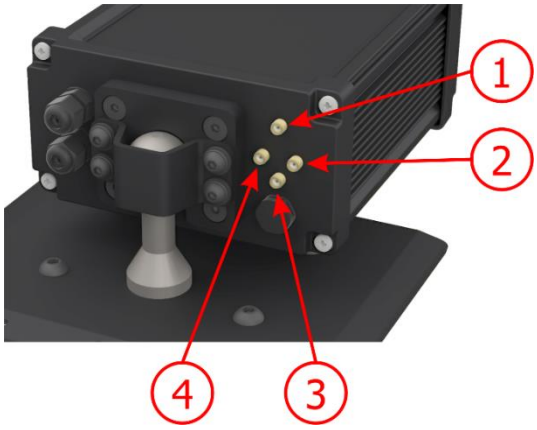


Figure 9 – Antenna Connection Points on the VTR 600*

1	4G Antenna
2	MOV Antenna
3	GPS Antenna
4	Wi-Fi Antenna

* Antennas are provided for connection. In non-standard installation locations where the antenna may not function effectively, please contact Pumatronix Support.

4G Technology Specification: For using the VTR 600 in other countries, consult Pumatronix Technical Support.

6. Software Specifications

The data generated by the VTR 600 is stored and made available through a plugin installed on the device. The default plugin for the VTR 600 is ITSCAMPRO Mobile.

Accessing the VTR 600

The VTR 600 Web Interface can be used for quickly checking the device's status and the captured images. However, the device must be powered according to the Electrical Specifications. To verify framing and adjust image settings, an *Auxiliary Configuration Device* should be used, with Google Chrome (version 85 or later) installed.

Additionally, the *Auxiliary Configuration* Device must be on the same data network as the VTR 600 (with a compatible network configuration). If using a point-to-point connection, access to the VTR 600 can be made through its maintenance IP address: *192.168.254.254*. When entering the VTR 600 IP address in the browser's address bar on the *Auxiliary Configuration* Device, the following should be provided:

User	*admin*
Password	*1234*

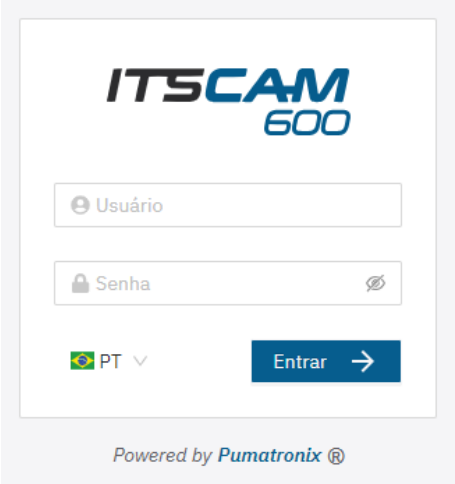


Figure 10 - VTR 600 Access Screen

Multiple Users

The VTR 600 offers enhanced access control and modification capabilities. By creating multiple users with simultaneous remote access, each user's activity can be tracked in the system logs. Users are assigned either *Administrator* or *Operator* access profiles, each with specific permissions, as detailed in the VTR 600 Integration Manual.

Accessing the ITSCAMPRO Mobile Plugin

The ITSCAMPRO Mobile Plugin is pre-installed on the VTR 600 during manufacturing and allows access to extracted image capture data in the form of a *Log Report*. This plugin must be accessed using an *Auxiliary Configuration* Device connected to the same data network as the VTR 600. Access is available via an external address or through devices with the Android/iOS application installed (available on Google Play, compatible with Android® 8.0 or later).

Default plugin access address: 192.168.0.254:9080. If a point-to-point connection is used, access to the VTR 600 can be made through the maintenance IP address 192.168.254.254:9080 via ETH1.

To access the system, Google Chrome (version 85 or later) must be used. Enter the provided IP address in the browser's address bar and then input the user credentials. However, on the first login, it is recommended to create additional users and restrict the use of the administrator account. For initial access, use the default factory credentials on the login screen:

User	*admin*
Password	*admin*

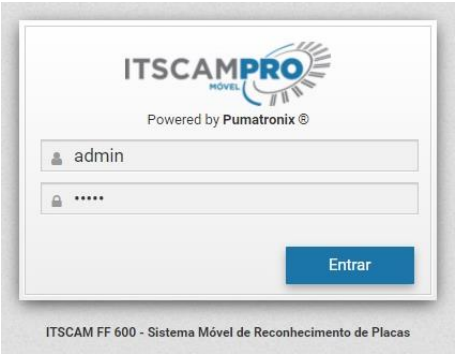


Figure 11 - ITSCAMPRO Mobile Software Access Screen

System Alerts

Users who have notifications enabled in the ITSCAMPRO Mobile interface can receive an audible alert when a restricted license plate is detected. The detection of a restricted license plate occurs when the system is integrated with a security system configured within ITSCAMPRO Mobile. This notification/alert can be enabled or disabled through the device's interface.

Registers Report

When accessing the ITSCAMPRO Mobile software interface, users can retrieve stored log data through the *Reports > Registers Report* menu by applying filter options. The results are displayed in a report format, based on the applied filter criteria, which are detailed in the ITSCAMPRO Mobile software manual.

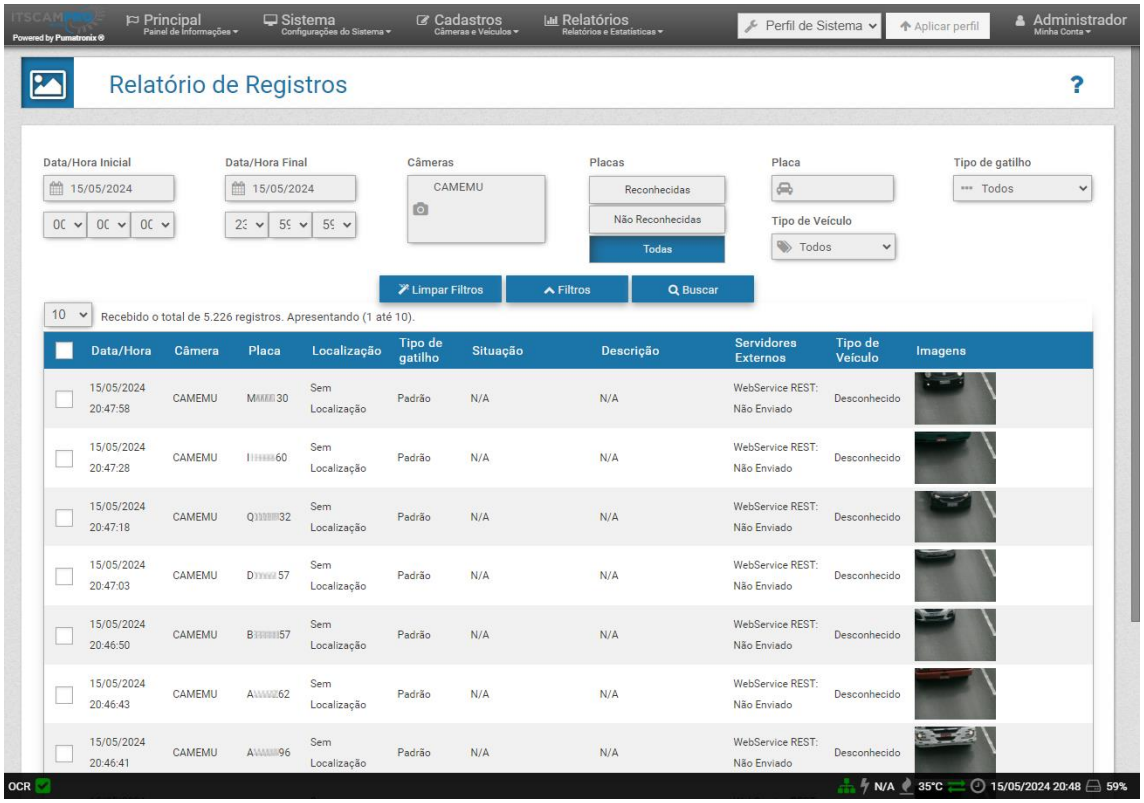


Figure 12 - ITSCAMPRO Mobile Registers Report Screen

The available actions for records are *Export selected records* (in CSV format), *Export selected records* with images (in ZIP format), or *Delete selected records*.

Detailed Record Information

When accessing images in the *Register Report*, the record details are displayed in tabs and contain the data obtained during capture:

- Sequence of captured images, which can be enlarged, viewed in full screen, or copied (by clicking the download button next to them);
- Record number generated in ITSCAMPRO Mobile;
- Automatically read vehicle license plate. If the user has permission to modify the license plate, an edit button is displayed next to it;
- Timestamp of image acquisition (date and time of capture);
- Spatial information (device identification and geographical location, when the map is enabled);
- Option to delete the record, if the user has the necessary permissions;
- Vehicle details (category).

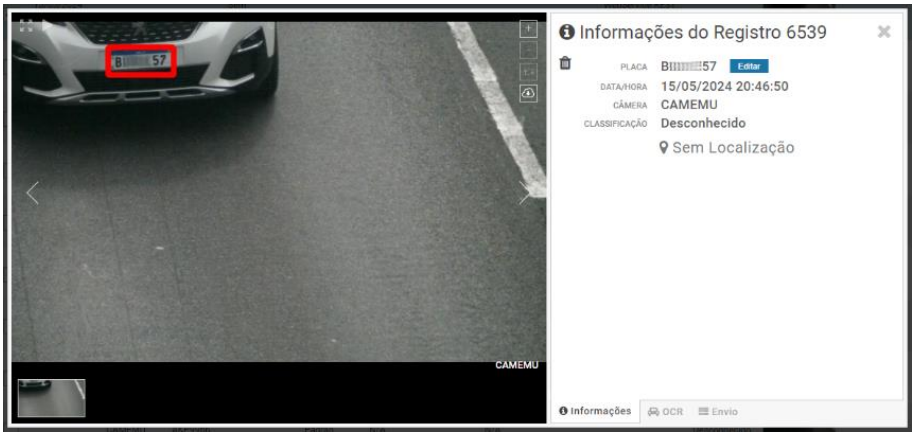


Figure 13 - Record Information Screen (Initial Tab)

The information about the OCR processing for the record can be found in the *OCR* tab and includes:

- Time spent on the recognition process;
- License plate's background color;
- Type of plate (whether it belongs to a motorcycle or not);
- Country of origin of plate;
- OCR accuracy probability for each identified character.

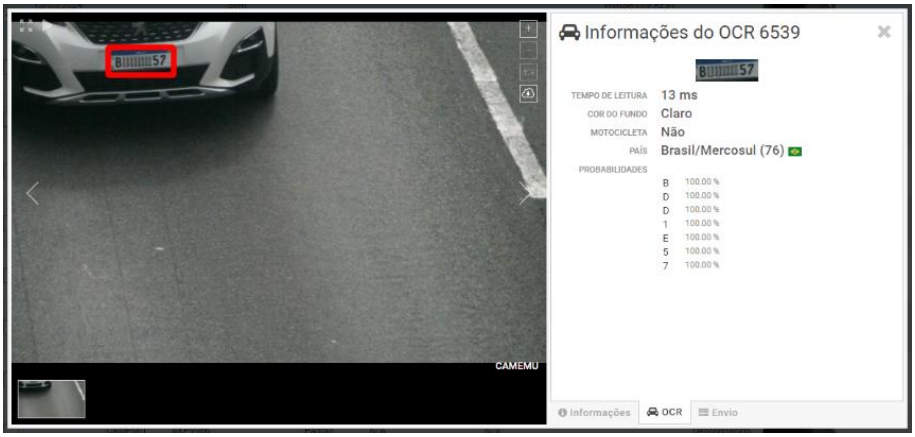


Figure 14 - Record Information Screen (OCR Tab)

In the *Send* tab, it is possible to check the status of record transmissions for each server enabled in the system:

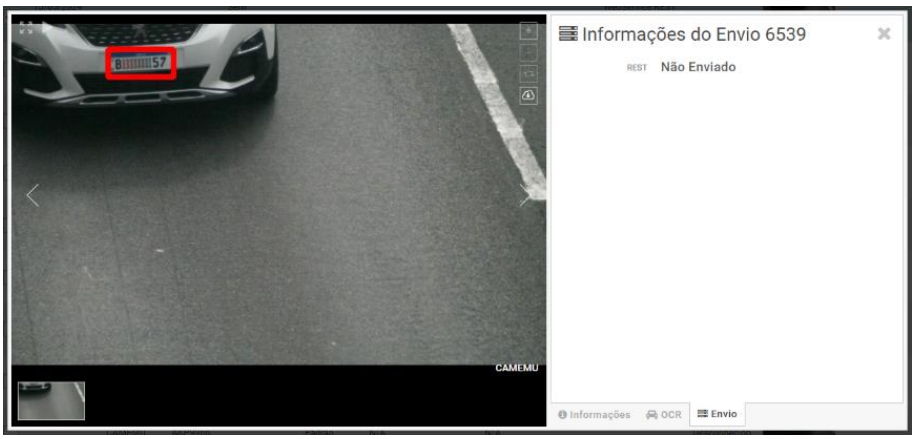


Figure 15 - Record Information Screen (Send Tab)

Image Capture Architecture

To meet the requirements of Intelligent Transportation Systems (ITS) applications, the VTR 600 includes several functionalities related to image acquisition. These functionalities are part of a general architecture and can be disabled by accessing the device's configuration *Profiles*. The image acquisition process begins with the image request method (*Trigger*). This request can be made by configuring the trigger to capture an image via software activation. The triggering method can be set to a *Constant* Time Interval or to activate when the device detects movement in the image (motion-triggered capture) by enabling the *Motion Detector* functionality.

Once the image capture flow for the VTR 600 is defined, the *Multiple Exposure* per Request functionality can be enabled. This technology allows configuring two to eight sequential images, with variations in capture parameters for each request.

The license plate identification of vehicles in the image can be performed by enabling OCR processing, which supports plate recognition for various countries. To improve reading accuracy, the *Majority Voting* functionality can be enabled.

The functionality that enables a more comprehensive recognition of vehicles in images is the *Classifier*, responsible for identifying the type of vehicle detected in the image, as well as brand, model, and color characteristics.

Motion Detector

The definition of motion between two consecutive images of VTR 600 depends on the configured variation parameter, which considers a time interval between triggers for the Motion Detector and a variation threshold required for activation. Additionally, it allows specifying a Region of Interest, defining in which portion of the image the motion will be evaluated. This corresponds to a polygon with four vertices, drawn over the visualization image.

Classifier

The VTR 600 is capable of analyzing captured images in real-time and evaluating their content. This analysis aims to distinguish motorcycles, cars, trucks, and buses from images that display only the roadway. The *Classifier*'s analysis has a classification confidence level, based on image samples used to generate this analytical function. It is important to specify the correct installation type, as the VTR 600 can capture up to three lanes simultaneously. For two or more lanes, the *Panoramic* scenario should be selected. The VTR 600 can also be used to capture vehicles parked parallel and diagonally to the left and right.

Enabling the Object Tracking option in the *Classifier* allows defining regions that operate the *Virtual Loop (Virtual Trigger Regions*) by configuring the direction in which vehicles travel in each lane, with support for up to four loops.

When *Vehicle Characteristics Reading* is enabled, the Classifier processes the reading of vehicle characteristics such as brand, model, and color, along with other enabled options, which may increase processing time.

Multiple Exposures

The VTR 600 *Multiple Exposures* functionality generates two to eight sequential images per capture request. This functionality can increase the accuracy rate in automatic license plate identification and help identify vehicles that were partially obscured at the first image capture time. The configurable settings include:

- *Flash* intensity, always corresponding to a percentage of the initial trigger;
- Sensor exposure time (*Shutter*), generating images with variations in captured light levels;
- Digital post-processing (*Gain*), which allows brightening or darkening images.

Thus, varying adjustments of Gain, Shutter, and Flash in each exposure allow, for example, the first capture to clearly display non-reflective plates, while in the second capture, by adjusting the weaker flash, reflective plates can be better visualized by preventing overexposure in the image.

OCR

VTR 600 can recognize vehicle license plates from Brazil (both Brazilian and Mercosur standards), Argentina, Chile, Mexico, Paraguay, Uruguay, and the entire Southern Cone simultaneously. When enabled, recognition is performed on all captured images. Depending on the vehicle flow and the processing demand on the VTR 600, the number *of processing threads can be adjusted.* It is important to set a *Processing Time Limit* to discard images where the plate could not be read. The effort spent on plate identification can be defined in the *Processing Mode*.

The OCR allows defining a *ROI* (Region of Interest) within the image to reduce processing in areas where plate recognition is unnecessary. Refer to the VTR 600 Integration Manual for all available OCR settings.

Majority Vote

The Majority Vote is a functionality applied to the results of the automatic character reading stage of vehicle license plates (OCR) and/or the *Classifier*. This analytical process determines which sequence of characters best represents the vehicle plate captured in the image. The algorithm compares the Identification *Confidence* of each character, based on a perfectly readable character image. This analysis can be performed only within the set of Multiple Exposures images or using sequential images. Simply configure

the parameters for *Maximum Number of Different Characters* and *Minimum Interval Between Recognitions of Identical Plates.* During a vehicle's passage through the VTR 600 monitored area, multiple images of the same vehicle may be captured for processing. However, an option can be enabled to *Send Only the Best Recognized Exposure*, while discarding all other images.

Automatic Transition Between Image Profiles

The VTR 600 allows up to four equipment configuration sets, referred to as *Profiles*. These configurations include image adjustments, framing (zoom and focus), and transition conditions between registered profiles. Profile switching is automatic when a specific time or image brightness *level* is reached, ensuring optimal image quality in any lighting condition. It is recommended to use one profile for ambient light captures (daytime) and another for artificial lighting captures (nighttime). Refer to the Integration Manual and Product Manual for technical details on these technologies.

Available Integrations

The VTR 600 can send captured images to vehicle monitoring and storage centers using the following methods:

Server	Integration with the VTR 600
FTP	The FTP server allows receiving images captured by the VTR 600
ITSCAMPRO	The ITSCAMPRO server is used to send images and license plates read by the embedded OCR. ITSCAMPRO is an application that centralizes images and plate data. Various types of reports can be viewed and generated (contact Pumatronix for more information about the application).
Lince	The Lince server is Pumatronix's cloud-based SaaS platform, ideal for managing large volumes of devices and implementing electronic perimeter monitoring via images.
WebService REST	Integration of ITSCAMPRO Mobile with systems using REST Web Service architecture.
PM-PR*	Integration of ITSCAMPRO Mobile with the Paraná Military Police system
PM-MG*	Integration of ITSCAMPRO Mobile with the Minas Gerais Military Police (PM-MG) system
Detecta-SP*	Integration of ITSCAMPRO Mobile with the Detecta-SP system
SPIA PRF*	Integration of ITSCAMPRO Mobile with the Federal Highway Police (PRF) system

*The integration with PM-PR, PM-MG, Detecta-SP, and SPIA-PRF systems is specifically for use in Brazil and depends on license activation in the VTR 600.

Information Security

The Digital Signature and Data Encryption mechanisms ensure the security of all information generated by the VTR 600. The *Digital Signature* technology guarantees that the information received by the end user can be validated, and any attempt to alter or manipulate the data will be promptly detected. Data Encryption ensures that only authorized recipients can access the images, preventing unauthorized individuals from intercepting or viewing the information.

Digital Signature

To sign the images, the VTR 600 employs asymmetric encryption via software, which allows for either automatic key generation or the use of a provided signature key in PEM or P12 format.

When the VTR 600 converts the captured image to JPEG format, a hash of the image is computed using the SHA-256 algorithm. This hash is then signed using RSA encryption with a 1024, 2048, or 4096-bit key. The final image, which is transmitted over the network, includes the following fields:

- Sign: RSA signature of the hash;
- ExpoenteRSA: Exponent used in the signature calculation;
- ModuloRSA: Module used for signature verification;
- Sha256: SHA-256 hash of the image.

For high security, the exponent used is always 65537.

These data fields are attached, in text format, to the JPEG image's comment field, defined in the "FF FE" marker as per the ISO/IEC 10918 specification. To verify the Digital Signature, follow these steps:

1) Remove the text fields corresponding to Sign, ExpoenteRSA, ModuloRSA, and Sha256 from the comment field.
2) Calculate the image hash with the text specified in "a" removed.
3) Extract the hash from the signature (Sign field) considering the exponent (ExpoenteRSA) and the module (ModuloRSA).
4) Compare the hash obtained in "b" with the hash obtained in "c." If the hashes match in both cases, the image is authentic. Otherwise, the image has been tampered with.

Encryption

Encryption is a security mechanism that can be configured for device access and data transmission to servers through secure protocols such as *HTTPS*, *FTPS*, and *SFTP*, ensuring data security by applying *TLS/SSL* encryption. This technology guarantees that only authorized recipients can access the images, maintaining the confidentiality of all data generated by the VTR 600.

Plugin Installation

The VTR 600's processing capacity and infrastructure enable the execution of embedded applications within the device's virtualized environment. The virtualization technology used is *Docker*, which allows third-party applications to run in an isolated environment using *containers.*

The plugin added to the interface will be available using an SD Card formatted with *ext4*, connected to the VTR 600, which serves as storage for the data generated by the plugin.

Access to the plugin uses a specific port for each type. Plugin installation requires the corresponding license and a *.tar* file, which must be installed in the system through the interface:

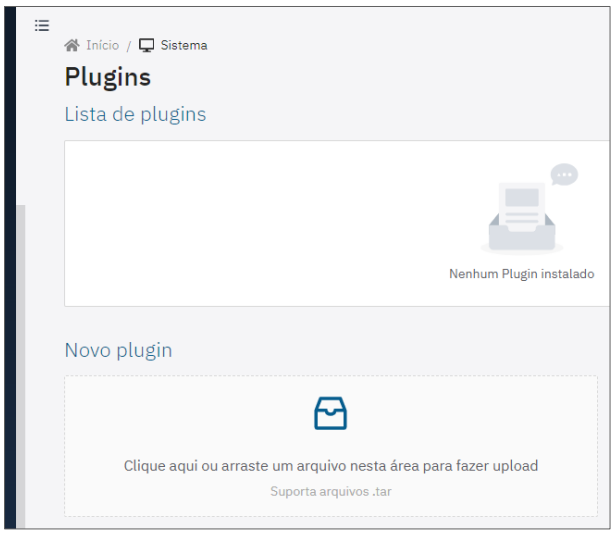


Figure 16 – VTR 600 Web Interface for Plugin Installation

7. Licensing

The VTR 600 license covers the image capture and processing device hardware, including automatic and embedded license plate recognition (OCR) for vehicles present in the images, supporting both the old Brazilian standard and the Mercosur standard. Additionally, it includes the functionalities described in this manual. New features and bug fixes are made available through firmware updates, which are provided by Pumatronix Technical Support.

8. Initial Configuration

Installation Prerequisites

The monitoring site conditions prior to installation are essential for the proper equipment.

Equipment Installation Location

The VTR 600 can be installed on the roof of any vehicle, with adjustable framing to capture up to three lanes and parked vehicles positioned parallelly or diagonally to the right and left. During installation, the necessary image framing must be considered, setting the vehicle's hood as the lower boundary and the sky as the upper boundary, as shown in the illustration:

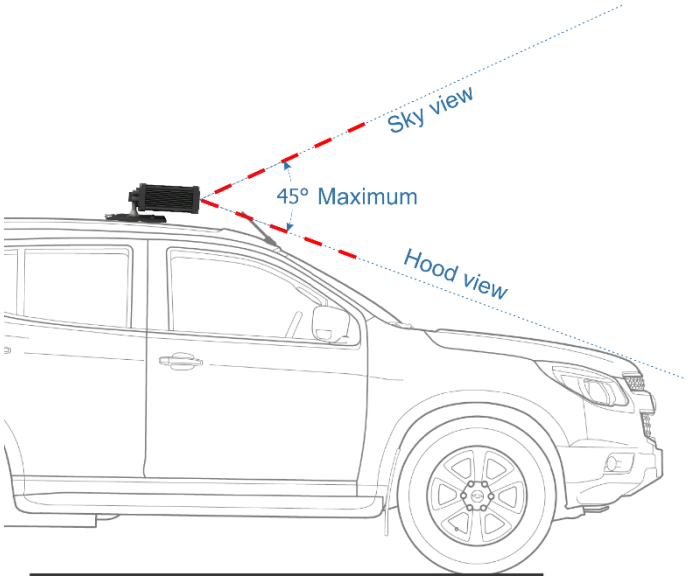


Figure 17 – Illustration of the ideal angle and framing limits

The installation must respect the maximum vertical tilt angle of 45º. Thus, if a greater angle is applied, the images will show significant distortions, which results in a reduced automatic recognition rate of vehicle license plates captured in the images.

Required Infrastructure

- Power source in the vehicle (battery or cigarette lighter socket);
- Connectivity with a data network near the equipment (based on the chosen mode);
- Security cable attached to the vehicle rack;
- Availability of an *Auxiliary Configuration* Device (to check framing and image adjustments), with Google Chrome (version 85 or later) installed.

Necessary Conditions for Installation

Refer to the Installation and Maintenance Guide for instructions on making the necessary connections.

Installation Location: If it is not possible to meet the installation specifications, it is recommended to consult Pumatronix Technical Support.

Network Interface Parameterization

Ethernet Port Configuration	Default Value
IP Address	192.168.0.254
Maintenance IP Address	192.168.254.254
Network Mask	255.255.255.0

Refer to the Wi-Fi Network Configuration guide for instructions on configuring the Wi-Fi and 4G network interfaces, as they are disabled by default in the factory settings of the equipment.

In cases where the VTR 600 network configuration differs from the default settings, it is recommended to modify the settings before physically installing the equipment on-site. The modified network configuration is saved in the flash memory, but it is only applied after the device restarts. When the configuration is changed through the Web Interface, the restart occurs automatically after the confirmation of all changes.

The VTR 600 has a recovery IP address (*192.168.254.254*) for situations where the user mistakenly changes the IP address and loses connection to the device. This recovery IP is only available for point-to-point connections with the equipment when connected via the Ethernet port.

The maintenance IP address (192.168.254.254) is deactivated when the primary IP address conflicts with it. Therefore, when manually configuring the network interface (Ethernet), the IP address should be set to a value different from the maintenance IP, as there will be no way to recover the connection in exceptional cases of primary IP loss.

Common situations of primary and maintenance IP address conflicts:

- Primary IP of VTR 600 in the 192.168.254.x range with a 255.255.255.0 subnet mask
- Primary IP of VTR 600 in the 192.168.x.x range with a 255.255.0.0 subnet mask
- Primary IP of VTR 600 in the 192.x.x.x range with a 255.0.0.0 subnet mask
- Subnet mask set to 0.0.0.0

Wi-Fi Network Configuration

VTR 600 Connectivity: The Wi-Fi and 4G network interfaces are disabled by default in the equipment factory settings.

1) Access the device's web interface using the credentials set in the network interface configuration.
2) Go to the menu Equipment > Network, in the Wi-Fi tab.
3) Select the Station (STA) mode to connect to an existing Wi-Fi network.
4) Click on the SSID field, and the available nearby Wi-Fi networks will be listed for selection.
5) Select the Authentication Protocol to be used: Open (no authentication), WEP, or WPA/WPA2 PSK.
6) Enter the password to access the selected Wi-Fi network.
7) Click the Apply button at the top of the page to confirm the entered data.

Select *Access Point (AP)* Mode only when the device is needed to act as a Wi-Fi network access point:

8) Enter the Identification Data (*SSID*), *Country*, *Channel*, and *Authentication Protocol* that will be applied to the Wi-Fi connection distribution.
9) Enter the *IP Address* and *Subnet Mask* of the *DHCP Server*, specifying the address range for devices that connect to the *Access Point*.

Use a DHCP server IP address that is different from the one applied for accessing the VTR 600 device and different from the maintenance IP to avoid conflicts and network malfunctions.

4G Mobile Network Configuration

Some mobile internet providers require manual configuration of network settings:

1) Access the device's web interface using the credentials set in the network interface configuration.
2) Navigate to the menu *Equipment* > *Network*, in the *Mobile* tab.
3) Click *Enable*, and the configuration fields will become visible.
4) Enter the custom settings whenever necessary to configure the carrier information. By default, the information is:
5) APN: http://[carrier name].com.br
    a. Username: [carrier name]
    b. Password: [carrier name]
6) Click *Apply* to save the network settings.

9. Precautions and Maintenance

Certain precautions are necessary to ensure product performance and extend its lifespan.

Product Risks: The use of the product presents risks, which are detailed in the Handling Risks section.

Firmware Update

Pumatronix periodically* releases updates for the VTR 600, including bug fixes and new functionalities. Updates can be obtained by contacting Technical Support through the Pumatronix website. The firmware update process requires an *Auxiliary Configuration Device* to connect to the equipment and can be performed directly through its Web Interface using one of these web browsers:

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

The VTR 600 firmware update requires specific safety measures to prevent file corruption and malfunction of devices:

1) Keep the VTR 600 device inactive during the update process, ensuring that it is not accessed by any service or other equipment on the network where it is installed;
2) Keep the VTR 600 powered on throughout the update process, taking necessary precautions to prevent it from restarting or shutting down;

Request the firmware file by filling out the form available in the *Technical Support* menu on the Pumatronix website:

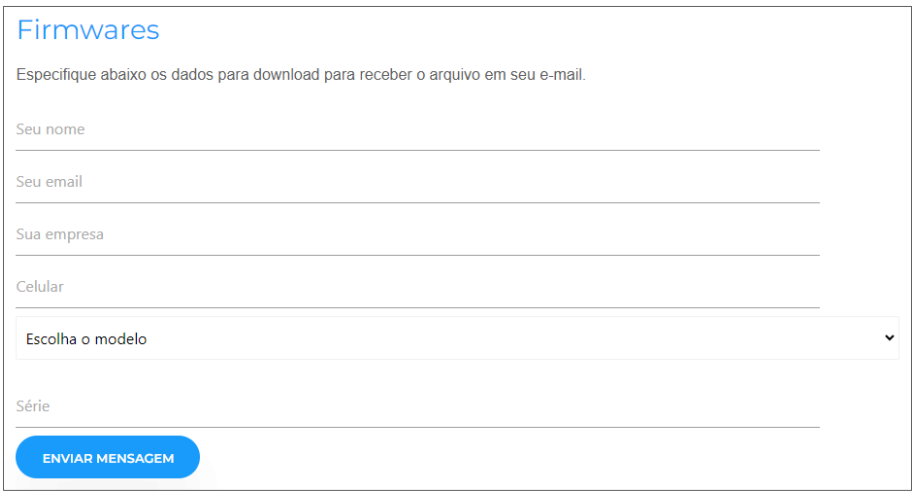


Figure 18 – Online Firmware Request Form

For any questions, contact Technical Support via email at suporte@pumatronix.com or WhatsApp +55 (41) 9203-8327.

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

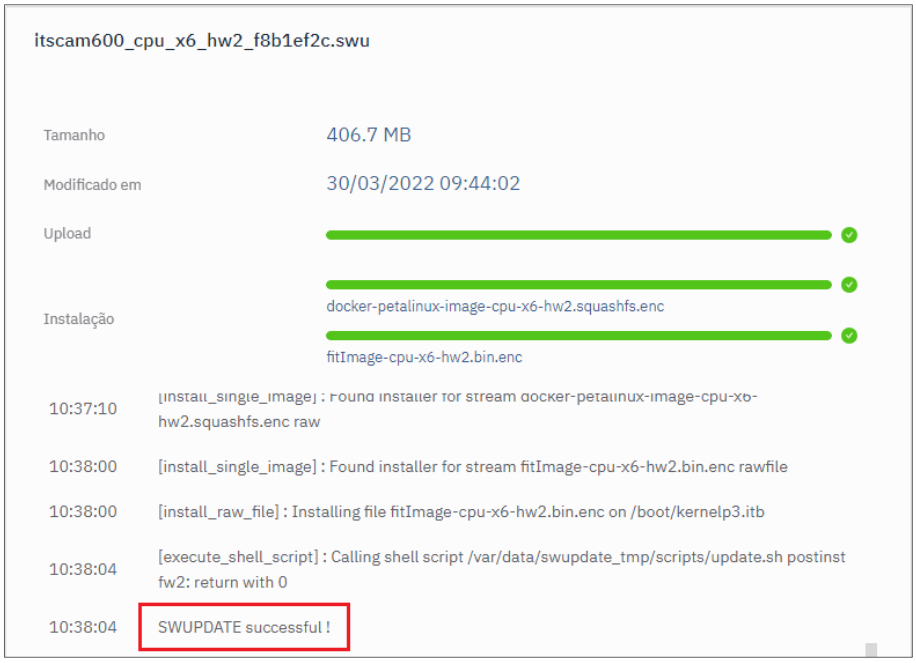
Updating the VTR 600 Firmware via Web Interface

1) Download the firmware file received by email (file name starts with VTR 600 and has the .swu extension) on the Auxiliary Configuration Device that will be used to connect to the VTR 600;
2) Connect the Auxiliary Configuration Device to the same data network as the VTR 600;
3) Open the web browser on the Auxiliary Configuration Device;
4) Enter the IP address of VTR 600 (default IP is 192.168.0.254, and point-to-point connections can be made using 192.168.254.254);
5) Enter the username and password;
6) Navigate to System > Update in the VTR 600 Web Interface

7) Select or drag the firmware file (the update starts automatically and proceeds in three stages, indicated by the progress bar);
8) Monitor the *upload* until it reaches 100%, followed by the *installation process,* ensuring that the device is **not** restarted or powered off and is **not** being accessed by any service or other

equipment on the network during the process. This precaution is necessary to prevent firmware corruption and device malfunction;

9) Verify the message: "*SWUPDATE successful!*", which confirms that the installation is complete



10) Click the "*Restart VTR 600*" button;
11) Wait for the device to restart, allowing the new firmware changes to be applied;
12) Complete the update process by verifying the firmware version displayed in the top bar of the page.

Updating the ITSCAMPRO Mobile Plugin

A VTR 600 possui integrado no cartão SD o plugin do software ITSCAMPRO Móvel, que fornece para o usuário uma interface amigável e de simples operação. Atualizar para a versão mais atual permite usufruir das atualizações e novas funcionalidades. O processo de atualização do plugin ocorre seguindo os passos:

1) Download the plugin file received by email (named *itscampromovel* with a *.tar* extension) on the *Auxiliary Configuration* Device used to connect to the VTR 600;
2) Connect the *Auxiliary Configuration Device* to the same data network as the VTR 600;
3) Open the web browser on the *Auxiliary Configuration Device;*
4) Enter the IP address of VTR 600 (default IP is 192.168.0.254, and point-to-point connections can be made using 192.168.254.254);
5) Go to the *System* > *Plugins* menu in the VTR 600 Web Interface;
6) Select the *Stop* function for the current plugin at the bottom of the page;
7) Click on *Remove* to uninstall the current plugin;
8) Start the installation process for the new plugin version by inserting the .tar file in the designated area;

9) Open Sistema_Plugins3.jpg

   - 80(private) → 9080(public);
   - 2000 → 2000;
   - 2005 → 2005;
   - 10000 → 10000;

10) Click on *Install;*
11) Wait for the entire upload and installation process to be completed. Depending on the network conditions, it may take up to 15 minutes for the process to finish;
12) Force the plugin initialization by clicking the *Start button;*
13) Verify after this first initialization that the plugin starts automatically when accessing the VTR 600 system.

Updating Analytical Licenses

The licenses for the *Classifier* and OCR image analytics libraries can be updated directly through the web interface. Upon receiving the *.lic* file provided by Technical Support, access the *System* > *Licenses* menu in the interface and drag the file to the designated area:

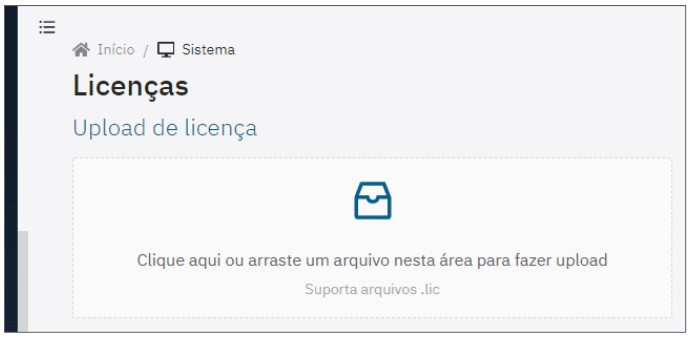


Figure 19 – VTR 600 Web Interface for License Update

Preventive Maintenance

The VTR 600 image capture and processing device must provide artifact-free images. However, if the outer lenses surface or the protective case accumulates dirt, follow the cleaning procedure:

1) Spray lens cleaning liquid on the lens surface or water on the protective case glass to loosen any dirt stuck to the surface;
2) Use a soft, lint-free cloth to remove the dirt, wiping in only one direction;
3) Wipe with a dry cloth to complete the cleaning. Do not apply force, as it may damage the surface.

10. General Warranty Conditions

Pumatronix guarantees the product against any material or manufacturing defects for a period of 1 year from the invoice issuance date, provided that, in the judgment of authorized technicians, the defect occurs under normal usage conditions.

The replacement of defective parts and the performance of warranty services will only be carried out at a Pumatronix Authorized Service Center or a third party expressly designated by Pumatronix, where the product must be delivered for repair.

This warranty is only valid if the product is accompanied by a duly completed and unaltered *Maintenance Form* along with the Invoice.

Situations in Which the Product Loses Warranty

1) Use of software/hardware that is not compatible with the specifications in the Manual.
2) Connecting the product to an electrical network that does not comply with the standards established in the product manual or installations with excessive voltage fluctuations.
3) Liquid infiltration resulting from the product opening/closing .
4) Damage caused by natural agents (lightning strikes, floods, salt spray, excessive exposure to climatic variations, among others) or excessive heat exposure (beyond the limits established in the Manual).
5) Use of the product in environments with corrosive gases, excessive humidity, and/or dust.
6) Signs of tampering with security seals.
7) Signs of unauthorized opening or modification of the product by the Customer in areas not authorized by Pumatronix.
8) Damage caused by accidents, falls, or vandalism.
9) Altered and/or removed serial number.
10) Damage resulting from the product transportation and packaging by the Customer in inappropriate conditions.
11) Misuse or operation not in accordance with the Instruction Manual.

11. Privacy Policy

In compliance with the General Data Protection Law (LGPD) - Law No. 13.709, dated August 14, 2018, this product has programmable functions for image capture and processing, which may violate the LGPD when used in combination with other equipment to collect personal data.

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

Pumatronix is not responsible for the purposes, use, or processing of captured images, as the control of information and the product operation are the sole the product's user or purchaser responsibility.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