ITSCAM FF 600
Product Manual

Revision 1.2

PUMATRONIX

www.pumatronix.com

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Change History

Date	Revision	Content updated
20/04/2022	1.0	Initial Version
29/04/2022	1.1	IP Protection update
13/01/2023	1.2	Update of the Connections Board model and specifications; Correction of the Case internal temperature; Update of estimated weight; Update of Electrical Specifications

Overview

Intelligent services that use Information and Communication Technologies (ICTs) become increasingly relevant in helping to monitor, control and make efficient and quick decisions to solve the problems inherent in the large concentration of people, such as mobility and safety in traffic, energy efficiency, public security, supply control, among others.

The concept called Smart Cities is a global trend that classifies the strategic use of infrastructure and services from the application of ICT solutions in urban planning and management, bringing results to the city's social and economic needs. Thus, the use of Information Technology allows cities to develop economically while increasing the inhabitants' quality of life by generating efficiency in urban operations.

Examples of these technologies are Intelligent Transport Systems (ITS), in which Pumatronix products, such as the ITSCAM FF 600 line, are used. This line captures images of vehicles in places whose chosen processing infrastructure is embedded, performing monitoring through automatic reading of their plates and in environments with high volume of traffic, ideal for Free Flow systems.

Figure 1- ITSCAM FF 600

Handling Risks

	**Electric Shock: Handle the ITSCAM FF 600 carefully, as it operates with 127 or 220 Volts (AC) and while installing the external power conductor on the product's *Connection Board*, it must always be executed with the power off to prevent shock risk.**
	**Risk of Infiltration: To prevent liquids inflow, the unused cable gland must remain cordless and closed, with the rubberized protector simulating the installation wire.**
	**Oxidation Risk: The electrical and signal connections, made in the ITSCAM FF 600 bundle and in the data network cable, must be protected in a terminal box or similar structure to avoid the unwanted infiltration of liquids in the bundle and the consequent ITSCAM FF 600 connections oxidation.**
	**Installation Spot: In cases where it is not possible to meet the installation specifications, it is recommended to consult Pumatronix Technical Support.**
ANATEL	**ITSCAM FF 600 contains EC25-AUFA-512-STD and ATWILC3000-MR110UA plates, approval code Anatel 06239-18-07968/0142417-03464.**
	**Loss of Warranty: The absence of an electrical grounding system may cause the ITSCAM FF 600 to burn and the user must correctly ground the product.**
	**Loss of Warranty: Appropriate conductors must be used, with a gauge compatible with the cable gland's, at risk of water infiltrating the product. Likewise, the unused cable gland must remain cordless and closed, with the rubberized protector simulating the installation wire, in order to prevent liquids inflow.**
	**Loss of Warranty: The parts that make up the ITSCAM FF 600 must not be changed, and the user cannot perform any repairs on the product.**

Models

The ITSCAM FF 600 image capture and processing device reads license plates in places with adequate ambient lighting and in situations with low light, it is necessary to separately acquire one illuminator per monitored lane, up to a maximum of two illuminators, such as Pumatronix's ITSLUX or compatible lighting equipment.

Available models	Resolution	Lenses Type	Estimated range (in meters) *
ITSCAM FF 600 (CP1I5)	1636x1220px HDR	Integrated Motorized	10 to 37 meters (13-55mm)

*The estimated range is set according to the selected lens and identifies in which distance range the vehicle license plate characters remain legible in the OCR reading. The motorized lens type cannot be modified, as it is an integral part of the equipment's electronic circuit.

Protective Box	ITSCAM Model Applied
CP1: no heating	**I5**: ITSCAM 600* Capture and Image Processing Device

*For more information about the model and features of the applied image capture and processing device, access the ITSCAM 600 product manual.

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1. Knowing the Product

The ITSCAM FF 600 line of image capture and processing devices was developed for traffic management, surveillance, Smart City Applications, mobility systems, parking lots and applications that require image capture. The 2MP image sensor of the ITSCAM FF 600 enables capturing and processing images up to two lanes. The sensor is combined with a motorized-type lens assembly.

The quality and level of detail of the images captured with ambient and ITSCAM FF 600 artificial lighting come from additional functionalities to the optical set (image sensor with lenses). There is a proprietary HDR (High Dynamic Range) algorithm, to highlight the details of image very dark and very light regions. *Multiple Exposures* can be captured for each photo request made to the equipment. This feature captures and processes more than one sequential image, with capture parameters automatic variation.

ITSCAM FF 600 maintains the images standardization, even when there are significant variations in light conditions. This is possible by switching the image configuration *profiles*. Profile changes are made by the equipment, based on the image level and time.

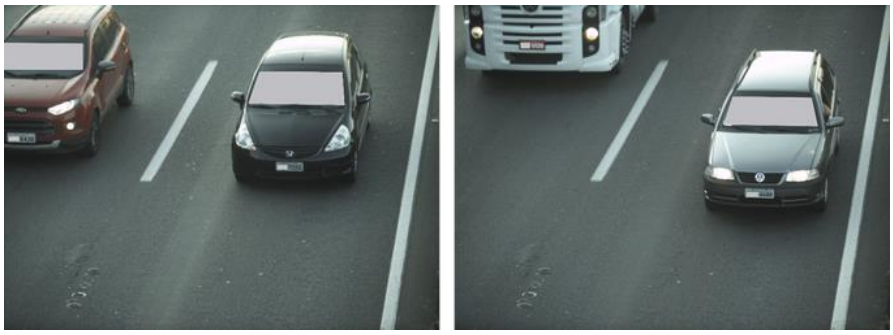


Figure 2 - Examples of daytime images captured with ITSCAM FF 600

Figure 3 - Examples of night-time images captured with ITSCAM FF 600

ITSCAM FF 600 hardware models have 4 input or output ports (IOs), the IO1 and IO2 are dedicated to the control of artificial lighting (flash), which are usually activated automatically in low light situations. IO3 and IO4 are available for the installation of external sensors, such as loops and light barriers, which identify the moment of image capture (*trigger*). However, ITSCAM FF 600 can capture images without external sensors, enabling the trigger by software.

All images captured by ITSCAM FF 600 pass through the Zynq® UltraScale+ EV processor, which scans them for vehicles. Simultaneously with the vehicle detection, the system classifies between motorcycle, car, truck, and bus. This functionality uses the *CLASSIFIER* image processing library. In addition to characterizing the vehicle present in the image, automatic recognition of the vehicle license plate (*OCR*) in

the old Brazilian standard and in the Mercosur standard is available. Refer to Pumatronix Commercial for availability of OCR from other Mercosur countries.

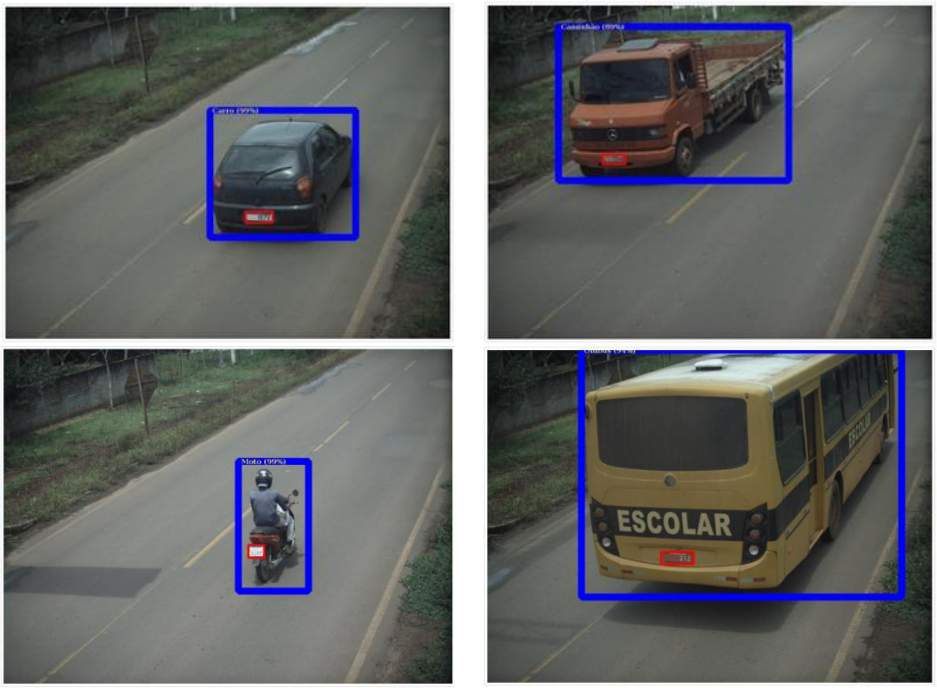


Figure 4 – Classification of vehicle types performed with the Classifier library

ITSCAM FF 600 delivers photos in JPEG format with 1636 x 1220 pixels resolution. Within these files, the comments field is filled with the data referring to each capture, containing the image spot coordinates, the recognized plates, the type of vehicle identified and the equipment instant configurations.

ITSCAM FF 600 line provides 2 Gigabit Ethernet ports on the back panel of the ITSCAM 600 device to facilitate connectivity at monitoring points and allow remote and simultaneous access for multiple users. Accesses can be through the Web Interface of the equipment or applications can connect using the REST API and the File Transfer Protocol (FTP) protocol. Equipment access management is done by specifying the network firewall routes and rules. The commands available through the REST API are detailed in the ITSCAM 600 manual.

The additional connectivity features present in 4G and 3G mobile cellular technologies are available for connection to the equipment, as well as Wi-Fi and IoT M2M communication. The captured images can be georeferenced automatically, via the GPS signal receiving antenna.

2. Further Documentation

Product	Link	Description
ITSCAM 600	Product Manual	ITSCAM 600 Product Manual
ITSCAM 600	Integration Manual	Programming and integration manual containing the necessary information for the integration of ITSCAM 600 with an application.
ITSCAM FF 600	Installation and Maintenance Guide	Guide containing the information necessary to install and mantain ITSCAM FF 600.
ITSLUX	Product Manual	ITSLUX Illuminator Manual
ITSCAMPRO Móvel	Product Manual	ITSCAMPRO Móvel Software Manual

3. Information Generated

The ITSCAM FF 600 line captures images of up to two lanes in JPEG format and automatically provides Brazilian vehicle license plates characters (in the old and Mercosur standard). For releasing recognition of additional country plates, please contact Pumatronix Commercial. The plates read in the images, the type of vehicle captured and information about the equipment setup are stored inside the image files, in the JPEG field for the storage of comments. The images can receive the overlap of a stripe with configurable content, and, for each photo request, sequential captures can be sent with changes in the capture parameters (*Multiple Exposures*).

The images captured by ITSCAM FF 600 can be redirected via wired data network (using the 2 independent Gigabit Ethernet ports), via Wi-Fi network or using 4G and 3G mobile data networks. Using the communication interfaces, the ITSCAM FF 600 images can be automatically sent to FTP or ITSCAMPRO servers. Additionally, equipment operation and captures can be monitored in real time through the ITSCAM 600 Web interface or the ITSCAMPRO Móvel plugin, which presents captures data through the interface in the *Log Report*, detailed in Software Specifications.

4. Mechanical Specifications

- Material: Aluminum and polycarbonate;
- IP protection: IP66;
- Attaching: through the *Pole Support* that comes with the product. Further attaching information can be found in the ITSCAM FF 600 Installation and Maintenance Guide.

Figure 5 - Pole fastener: 1) Pole support; 2) Stainless steel clamp

- Framing adjustment: with movement of the joint at equipment base

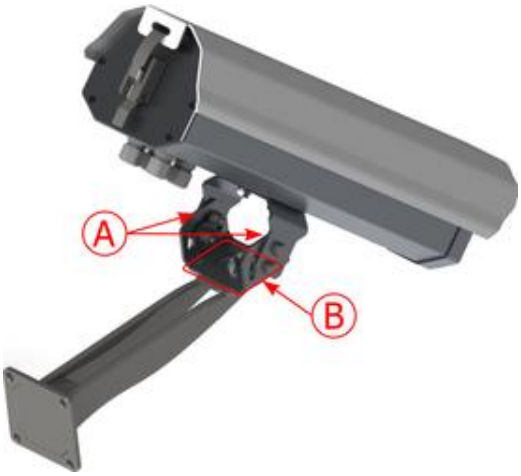
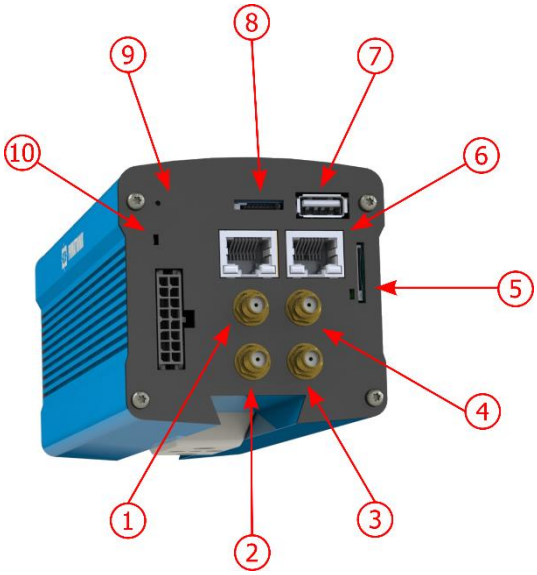


Figure 6 - Possible adjustments to the joint at equipment base: A) Vertical inclination; B) Horizontal rotation

- Interfaces: connectors available for access on the ITSCAM 600 device back panel



	Interface	Mechanical Specification
1	4G/3G/2G Antenna	male SMA connector
2	Wi-Fi b/g/n Antenna	male SMA connector
3	GPS Antenna	male SMA connector
4	MOV Antenna	male SMA connector
5	SIM Card	connector for Micro SIM (15mm x 12mm x 0.76mm)
6	2 Gigabit Ethernet	RJ-45 connector (EIA/TIA-568A standard indicated)
7	USB 2.0 (host)	2.0 (host)
8	SD Card Slot	for microSD 2.0 card
9	Reset Switch	-
10	Status LED	-

- Maximum operating temperature (inside the case): -10° to 65° C (with relative humidity of 5 to 95% and non-condensing)
- Weight: 4.55kg*

*When connecting ITSLUX illuminators, the equipment set total weight can reach 5.15 Kg, depending on the model used. ITSLUX illuminator mechanical specifications can be accessed in the product manual.

- Dimensions:

Front View	Side View
	

	A) Height	B) Width	C) Length
Dimensions in millimeters	245*	140	511

5. Electrical Specifications

- Power: 90 VAC~264 VAC (mandatory grounding at installation site)
- Maximum input current: 1.5 A
- Typical power: 24 W in maximum steady state
- Maximum power: 63 W only at equipment start-up
- Surge protection: IEC 61000-4-5 2 KV
- Protection against electrostatic discharge (DC supply): ±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);
- Fast electrical transient (EFT) protection (DC supply): direct current peak at 10/1000 µs up to 53.3 A ±5% (ISO 7637 and IEC 61000-4-4);
- Inrush current protection: 8 A in 2 seconds (IEC 63129:2020).

Connection Board Interface	Electrical Specifications
4 digital inputs/outputs (IOs)	with bidirectional 3.75 kV insulation programmed by the user (maximum current 50 mA, maximum voltage 28 Vdc and impedance of 10 kΩ)
RS-485/422 Serial Port	Half Duplex port with electrostatic discharge protection of ±8 kV by contact (IEC 61000-4-2) and ±15 kV by air (IEC 61000-4-2)
RS-232 EIA/TIA Serial Port	Port with a maximum transmission rate of 115,200 kbps and protection against electrostatic discharge of ±8 kV by contact (IEC 61000-4-2) and ±15 kV by air (IEC 61000-4-2)

ITSCAM 600 Interface	Electrical Specifications
2 Gigabit Ethernet ports	5 kVAC dielectric insulation, ±30 kV electrostatic discharge protection by contact - Level B (IEC 61000-4-2) and ±30 kV by air (IEC 61000-4-2), EFT for peak direct current at 5/50 ns up to 40 A ± 5% (IEC 61000-4-4) and 4 A surge current protection (tP = 8/20 µs) (IEC 61000-4-5)
Outdoor Storage	protection against electrostatic discharge of ±8 kV by contact (IEC 61000-4-2) and ±15 kV by air (IEC 61000-4-2);
USB 2.0 port (host)	protection against electrostatic discharge of ±8 kV by contact (IEC 61000-4-2) and ±15 kV by air (IEC 61000-4-2).
Wi-Fi	protection against electrostatic discharge ±8 kV by contact (IEC 61000-4-2) and ±15 kV by air (IEC 61000-4-2) and the external high gain antenna (2.45 GHz ISM, U-NII, Wi-Fi, WLAN Whip, 2.4~2.5 GHz 2.8 dBi
4G and 3G	electrostatic discharge protection ±8 kV by contact (IEC 61000-4-2) and ±15 kV by air (IEC 61000-4-2) and high gain straight external antennas (850 MHz, 900 MHz, 1.8 GHz, 1.9 GHz, 2.1 GHz CDMA, DCS, EDGE, GPRS, GSM, HSPA, PCS, UMTS, WCDMA, 824~960 MHz, 1.71~2.17 GHz 1.42 dBi, 1.91 dBi, 2.51 dBi, 3.23 dBi, 2.89 dBi) (Certificates: GCF, FCC, ANATEL, NCC, RCM, CE);
GPS	Qualcomm® IZat ™ Gen8C Lite Multi-constellation Glonass, BeiDou/Compass, Galileo and QZSS, with external active antenna 1.57~1.58 GHz 2 dBic

Interface	Connectivity Specifications
Outdoor Storage	supported microSD 2.0 card up to 128GB
Wi-Fi	iEEE 802.11 standard 2.4 GHz b/g/n bands, with 46 Mbps UDP throughput and 28 Mbps TCP/IP
4G and 3G	LTE-FDD/LTE-TDD/WCDMA/GSM technologies in the bands: LTE FDD: B1/B2/B3/B4/B5/B7/B8/B28; LTE-TDD: B40; WCDMA: B1/B2/B5/B8; GSM/EDGE: Quad-band
2 Gigabit Ethernet ports	10/100/1000 tri-speed
IoT M2M	Supported with 150 Mbps downlink and 50 Mbps uplink rate

Component	Image Processing Specifications
CPU	Quad-core arm™ A53 (1.2 GHz, support ARMv8 and NEON)
RAM Memory	16 Gb LPDDR4 (2100 Mbps and 1050 MHz)
Image sensor	2 MP (1636x1220 px) Global Shutter with proprietary HDR technology and Day/Night mode (generates color or monochrome images)
SD Card Storage	32GB
Watchdog	on hardware with a period of 50 seconds

ITSCAM FF 600 contains EC25-AUFA-512-STD and ATWILC3000-MR110UA plates, approval code Anatel 06239-18-07968/0142417-03464.

Oxidation Risk: The electrical and signal connections, made in the ITSCAM FF 600 bundle and in the data network cable, must be protected in a terminal box or similar structure to avoid the unwanted infiltration of liquids in the bundle and the consequent ITSCAM FF 600 connections oxidation.

Power Connections

Electrical and signal connections are made to the ITSCAM FF 600 Connection Board, and some data connections are available on the ITSCAM 600 device back panel as specified in Mechanical Specifications. Access the Installation and Maintenance Guide for more information and possible connections illustrations.

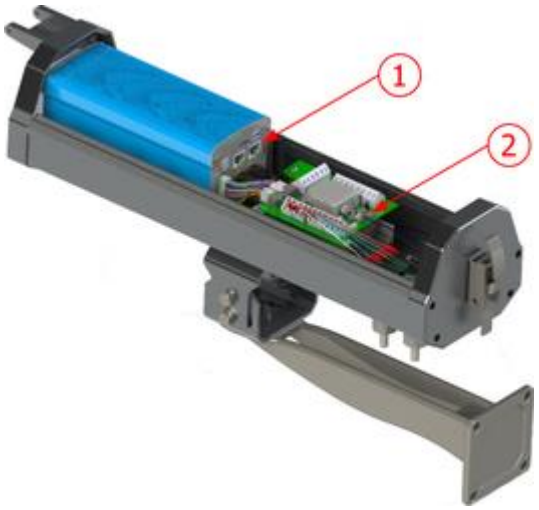
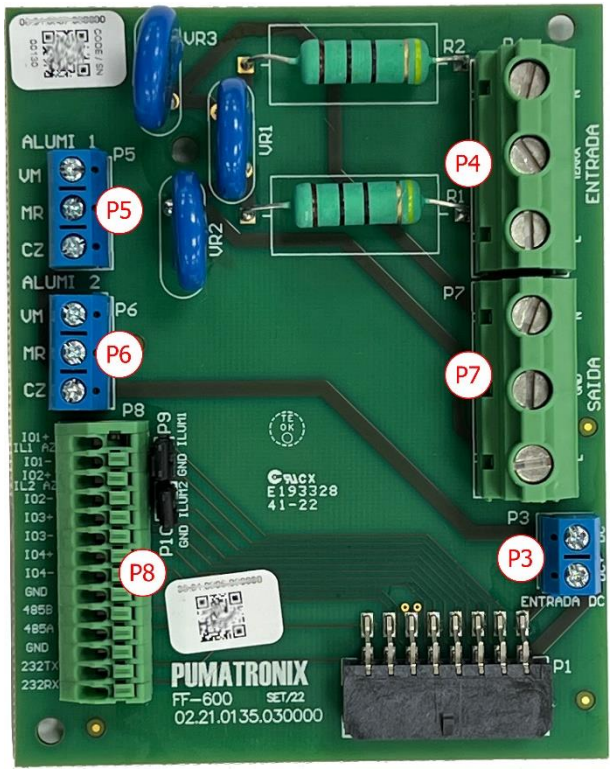


Figure 7 - Available interfaces: 1) ITSCAM 600 device connectors; 2) Connection Board Connectors

- Connectors available on the *Connection Board*:



Connector	Interfaces	Color	Description	Use
P4	**N**	Red or Light Blue *	Neutral	AC power input
	TERRA	Yellow + Green*	Ground	
	L	Red*	Phase	
P7	**N**	White	Neutral	DC Power supply
	GND	Green	Ground	
	L	Blue	Phase	
P3	**DC-**	Brown	24V	PCI power supply
	DC+	Red		
P5	**VM**	Red	Power Supply	Illuminator 1 power supply
	MR	Brown	IN+	
	CZ	Gray	GND	
P6	**VM**	Red	Power Supply	Illuminator 2 power supply
	MR	Brown	IN+	
	CZ	Gray	GND	

Connector	Interfaces	Color	Description	Use
P8	**IO1+**	Blue	Illuminator 1	Connection of input and/or output configurable signals
	IO1-	-	Connect Jumper 9	
	IO2+	Blue	Illuminator 2	
	IO2-	-	Connect Jumper 10	
	IO3+	-	IOs	
	IO3-	-		
	IO4+	-		
	IO4-	-		
	485 GND	-	RS-485	RS-485 protocol connection
	485 B	-		
	485 A	-		
	232 GND	-	RS-232	RS-232 protocol connection
	232 TX	-		
	232 RX	-		

*Colors as indicated in NBR 5410, and user can make available in the installation 110 VAC or 220 VAC.

Trigger in IOs

ITSCAM FF 600 has 4 connections on the Connection Board that can be used as inputs or outputs (IOs), IO1 and IO2 are dedicated to the illuminator drive control and IO3 and IO4 are available for installing external sensors, such as loops and light barriers.

The IOs configuration process is done by software, using the ITSCAM 600 device web interface or the communication protocol. ITSCAM FF 600 ports set as Input can be sensitized by: *Rising Edge*, *Falling Edge*, *High Level* and *Low Level*.

IOs Specification: Maximum supported current of 50 mA and maximum supported voltage of 28 VDC. The circuit rated drive current is 10 mA.

Illuminator Connection

In low light situations at the ITSCAM FF 600 installation spot, it is possible to apply up to two illuminators, connected to the *Connection Board*. Applying illuminators is optional and requires maintaining a minimum distance of 50 centimeters from the image capture device.

Figure 8 - Example of 2 illuminators installation considering the minimum distance to ITSCAM FF 600

IP Protection: To prevent liquids inflow, the unused cable gland must remain cordless, closed and with the rubberized protector simulating the installation wire.

Illuminator Installation: When using an illuminator in conjunction with the ITSCAM FF 600 device, check the product specifications for the minimum and maximum distance that must be observed in relation to the position of the object to be illuminated.

Ethernet Connection

ITSCAM FF 600 enables communication with other devices using the TCP/IP protocol. For such connection, the equipment provides two Gigabit Ethernet ports (RJ-45 connector) on the back of ITSCAM 600 device. It is indicated to use the EIA/TIA-568A standard on the connections.

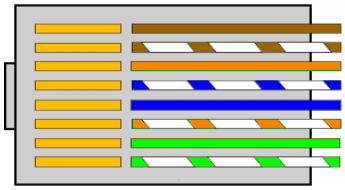


Figure 9 - RJ-45 connector standard EIA/TIA-568ª

ETH2 Ethernet network interface: The ITSCAM FF 600 second network interface is disabled in the standard equipment setup.

Antenna Connection

The images captured by ITSCAM FF 600 may present the geolocation, made available by the GPS integrated with the equipment. The Wi-Fi, 4G and 3G signals can also be amplified using external antenna, with SMA type connector (male connector, i.e., with center pin).

Connectors for Wi-Fi, 4G and 3G antennas signals are available on the back panel of ITSCAM 600 image capture and processing device. The screen printing on the equipment back panel assists in identifying connectors for the antennas:

Figure 10 - SMA connectors for the antennas in the ITSCAM device 600

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

Antennas for 4G and 3G

For 4G/LTE and 3G/GSM (Quad Band) cellular mobile communications, ITSCAM FF 600 has two antennas with the same minimum gain specifications of 2 dBi and the frequency range: 850 MHz, 900 MHz, 1.8 GHz, 1.9 GHz, and 2.1 GHz. If the customer needs to use antennas or signal amplifiers for a longer range, the following are the main specifications that should be considered:

- *Frequency range:* 850 MHz, 900 MHz, 1.8 GHz, 1.9 GHz, 2.1 GHz, 1.71~2.17 GHz;
- Typical signal gain for the respective frequency ranges: 1.42 dBi, 1.91 dBi, 2.51 dBi, 3.23 dBi, 2.89 dBi.

GPS Antenna

The external antenna for capturing the ITSCAM FF 600 GPS signal must have a male SMA connector (with center pin), frequency of 1.57~1.58 GHz and minimum gain of 2 dBic. Check the ITSCAM 600 manual for suggestions for compatible antennas.

Wi-Fi Antenna

The ITSCAM 600 Wi-Fi signal requires an antenna with male SMA type connector (with center pin), 2.4~2.5 GHz frequency and minimum gain of 2 dBi. Check the ITSCAM 600 manual for suggestions for compatible antennas.

6. Software Specifications

The data generated by ITSCAM FF 600 is stored and made available through a plugin that is installed on ITSCAM 600. The plugin used by default for ITSCAM FF 600 is ITSCAMPRO Móvel.

Access to ITSCAM 600

ITSCAM 600 has a web interface for evaluating the images generated and performing configurations such as Network, OCR, Trigger. For accessing the network, it is required to inform:

User	admin
Password	*1234*

Multiple Users

ITSCAM FF 600 allows greater control of access and changes to the equipment, as multiple users can be created and the activity of each one can be tracked in the system logs. Users can present an *Administrator* or *Operator* access profile, which has the characteristic permissions of each profile, detailed in the ITSCAM 600 device manual.

ITSCAMPRO Móvel Plugin Access

The ITSCAMPRO Móvel plugin is installed on ITSCAM FF 600 in the factory process and allows access to the extracted data in the image captures, as a log report. Access can be made through port 9080 by default, indicating the default address for access to plugin 192.168.0.254:9080 and informing the requested data:

User	admin
Password	*admin*

Image Capture Architecture

To meet the applications of Intelligent Transport Systems (ITS), ITSCAM FF 600 has several functionalities associated with image acquisition. These features make up a general architecture and can be disabled in the device setup *Profile*. The image acquisition process begins with the image request (*trigger*). This request can be made through external sensors, connected to one or more ports of ITSCAM FF 600 (IOs set as Inputs). In the ports setups it can be informed that the capture trigger will be made by edge (up, down or both) or level (high and low).

There is an alternative to using external sensors connected to the ITSCAM FF 600 *Connection Board*, which is setting up the Trigger for software activation. In this case, the activation can be in a *Constant* interval of time or when the equipment identifies movement in the image (*Trigger by Motion*). Choosing *Trigger by Motion* enables the Motion Detector functionality. The CLASSIFIER is another feature that improves classifying the vehicles present in the images, it analyzes the images and returns the vehicle type.

After defining the ITSCAM FF 600 image capture flow, the *Multiple Exposures* functionality can be enabled per request. This technology allows setting up two to eight sequential images, with variation in the capture parameters at each request.

Identifying the license plate of the vehicles present in the image can be done by enabling the *OCR* functionality, available for several countries. To increase the reading accuracy, the *Majority Voting* can be enabled.

Motion Detector

The definition of movement between two ITSCAM FF 600 consecutive images depends on the set variation parameter. In addition to this sensitivity, the ROI (Region of Interest of the Image) in which the movement will be evaluated can be specified. This region corresponds to a polygon with four vertices, which is drawn on the image visualization and remains shaded on the visualization. The region definition is displayed after the *Region of Interest* usage option is enabled.

CLASSIFIER

ITSCAM FF 600 can analyze the captured images in real time and evaluate the images content. This analysis aims to distinguish motorcycles, cars, trucks, and buses from images that display only the track. This analysis has a degree of certainty in the classification, considering image samples that were used to generate this analytical. It is important to inform the correct type of installation, as ITSCAM FF 600 can be used to capture two or one lane simultaneously. In the case of two lanes, the Panoramic *Scenario* must be chosen.

Multiple Exposures

The ITSCAM FF 600 *Multiple Exposures* functionality generates two to four sequential images per request, by configuring the Number of captures per pulse via interface. This feature can increase the accuracy rate in the automatic identification of plates and identify vehicles that had some kind of concealment when the first image is captured. The settings that may vary are:

- The Flash intensity, always corresponding to a percentage of the initial trigger. This option is available for the line of ITSLUX illuminators from Pumatronix, designed to deliver the best results with *Multiple Exposures*;
- The image sensor exposure time (*shutter*), generating images varying the amount of light captured;
- Digital post-processing (*Gain*), which allows the images to lighten or darken.

When using *Multiple Exposures* (or photos), the first capture allows the non-reflective plates to be clearly visualized and the second capture will be made with a weak flash, which allows the reflective plates not to be saturated and show a better visualization:

Figure 11 - Multiple Exposures in Daytime

Figure 12 - Multiple Exposures at Night

OCR

ITSCAM FF 600 can recognize license plates from Brazil (in the Brazilian and Mercosur standards), Argentina, Chile, Mexico, Paraguay, Uruguay, and the entire Southern Cone simultaneously. When enabled, recognition is done on all captured images.

OCR also allows you to define an ROI (Region of Interest of the Image), to reduce the processing of image regions where there is no plate to find. Access the ITSCAM 600 device manual for all available OCR settings.

Majority Vote

Majority Vote is a feature applied to automatic license plate character reading (OCR) step results. This analytic defines which string best describes the vehicle plate captured in the image. The algorithm compares the identification *Reliability* of each character, based on the character image in perfect reading conditions. This analysis can be done only on the *Multiple Exposures* image set or using sequential images. For more information on *Majority Vote* settings, please see the ITSCAM 600 device manual.

Setup Profiles Management

ITSCAM FF 600 allows to register up to four sets of ITSCAM 600 device settings, called *Profiles*. These settings correspond to image adjustments, framing (zoom and focus) and the *Transition* conditions between the registered profiles, namely *Day*, *Sunset,* and *Night*. Changing between profiles is automatic when an image *Level* time and value are reached. It is recommended to use one profile for captures with ambient light (daytime) and another for captures with artificial lighting (nighttime).

An example architecture of ITSCAM FF 600 settings profiles is presented in diagram and indicating web interface parameters:

Adjustments to the ITSCAM FF 600 settings profiles define the criteria for *Profile* change. For information on the values used, access the ITSCAM 600 manual.

Suggested Image Setup

Capturing quality images is critical to reaching ITSCAM FF 600 full potential. Therefore, a suggested image setting is presented in the ITSCAM 600 device manual, this setting can be used as a starting point to adjust the equipment for capture with visible light or using artificial infrared lighting.

Log Report

When accessing the ITSCAMPRO Móvel software interface, in the menu *Report* > *Log Report* it is possible to retrieve data from the stored logs, using filter options. The results are presented as a report, based on the application of filter criteria in the search, with the details of each filter in the ITSCAMPRO Móvel manual.

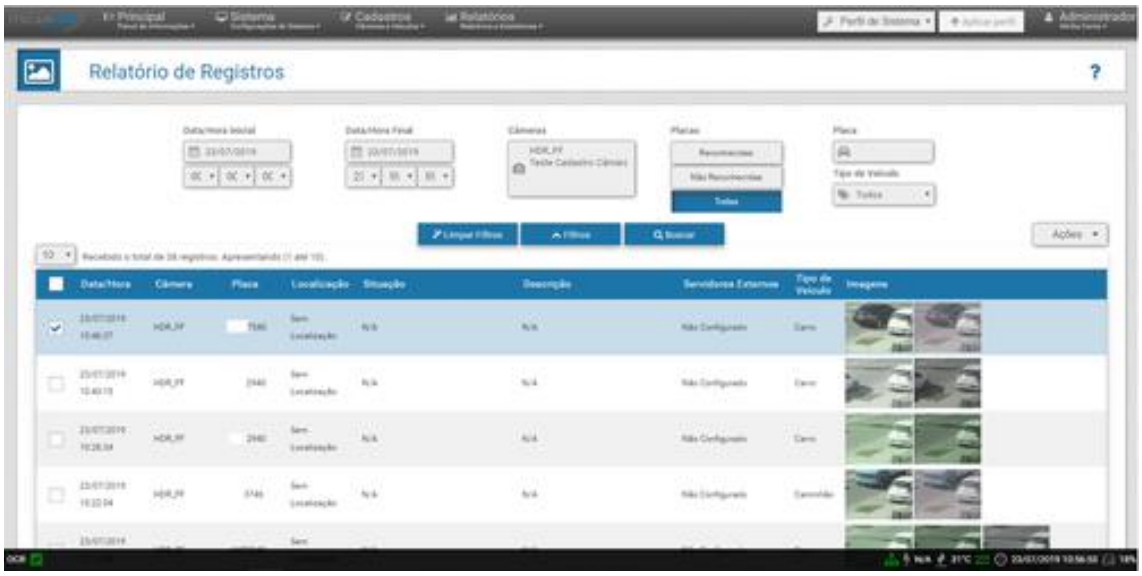


Figure 13 – ITSCAMPRO Móvel Log Report Screen

The *Actions* available for the records files allow: *Exporting selected records* (in CSV format); *Exporting selected records (with images)* in zip format or *Removing selected records*.

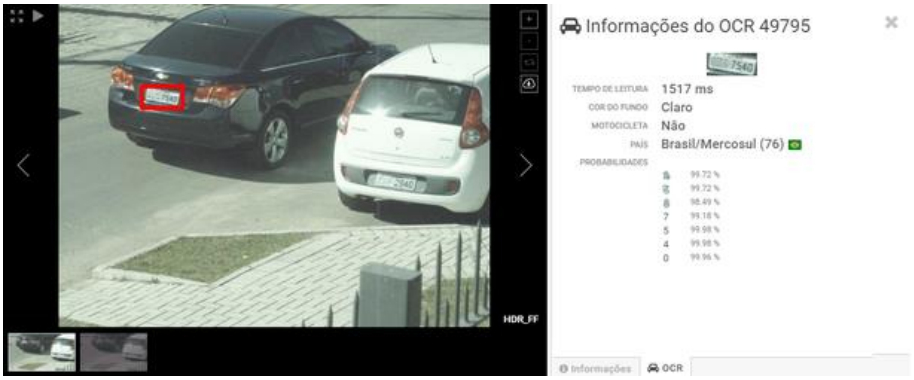
Detailed Registration Information

When accessing the *Log Report* images, the log details are displayed in tabs and contain the data obtained in the capture:

- Sequence of captured images that can be enlarged or viewed in full screen or copied (by clicking on the download button next to them);
- Number of the log generated in ITSCAMPRO Móvel;
- Vehicle license plate read automatically. If the user has permission to change the plate, an edit button is displayed next to it;
- Temporal information of image acquisition (capture date and time);
- Location data (equipment identification and geolocation, when the map is enabled);
- Option to delete the register, if the user has permission;
- Vehicle details (type, country of origin).

Information about the OCR processed for registration can be obtained from the OCR tab and refer to:

- the time spent for recognition;
- the color of the background shown on the plate;
- the type of plate, which may be motorcycle or not;
- the plate's country of origin;
- the OCR probability of success for each identified character.



In the *Send* tab, you can check the status of logs sent to each server enabled in the system:

Receiving Images

ITSCAM FF 600 can send the captured images to vehicle storage and monitoring centers as follow:

Server	Interaction with ITSCAM FF 600
FTP	The FTP server allows receiving the images captured by ITSCAM FF 600

ITSCAMPRO	The ITSCAMPRO type server is used to send images and plate read by the embedded OCR. ITSCAMPRO is an application that concentrates images and plates. Various types of reports can be viewed and generated (see Pumatronix for more information about the application)
WebService REST	Integration of ITSCAMPRO Móvel with systems that use Web Service REST architecture.
PM-PR*	Integration of ITSCAMPRO Móvel with Paraná Military Police system
PM-MG*	Integration of ITSCAMPRO Móvel with Military Police of Minas Gerais PM-MG system
Detecta-SP*	Integration of ITSCAMPRO Móvel with Detecta-SP system
SPIA PRF*	Integration of ITSCAMPRO Móvel with PRF (Federal Highway Police) system

*Integration with PM-PR, PM-MG, Detecta-SP and SPIA-PRF systems depends on license release in ITSCAM FF 600.

7. Licensing

The ITSCAM FF 600 license includes the image capture and processing device hardware, with automatic and embedded recognition of images' vehicles license plate (via OCR) in the old Brazilian and Mercosur standards, besides the functionalities presented in this manual. For releasing recognition of additional country plates, please contact Pumatronix Commercial. New features and bug fixes are available in new firmware versions, provided by Pumatronix Technical Support.

8. Initial Setup

Installation Prerequisites

Equipment Installation Spot

The ITSCAM FF 600 line can be installed in an urban and road environment, and it is possible to adjust the framing to capture one or two track lanes. When installing on the highway, the minimum height limits specified for the location must be respected, as well as the maximum equipment vertical inclination angle of 45°. Vertical inclination larger angles generate significant deformations in the images, which implies a reduction in the plate's automatic recognition:

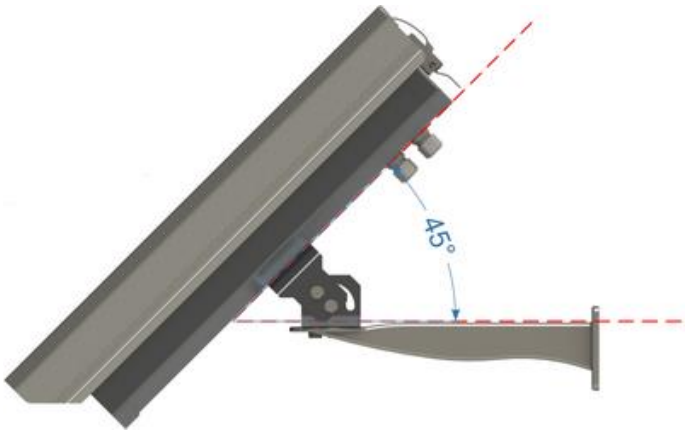
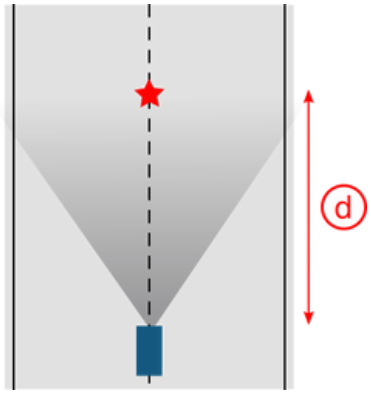


Figure 14 - Maximum angle of inclination of the ITSCAM FF 600 Protective Box

For installing ITSCAM FF 600, the linear distance between the equipment and the image center in the equipment position on the road must be considered. In sequence, the installation diagram for capturing two-lane images indicates the ideal equipment position in relation to the monitored road:

	Positioning on the track center
	
minimum d	10 meters
maximum d	37 meters

ITSCAM FF 600 Installation Suggestion: The suggested information is based on the motorized lenses focal length of Pumatronix's ITSCAM FF 600 line and ITSLUX illuminators. You can install outside the recommended standard, but the vehicle plates automatic recognition indexes may be affected. In case of doubt or installation situation other than those presented, consult Pumatronix Technical Support.

Pay attention to equipment positioning restrictions in vehicle circulation locations if ITSCAM FF 600 is installed on a side structure. When choosing this type of installation, the equipment must be at the nearest safe distance from the road. The equipment height must consider the maximum vertical angle of 45° and the possibility of concealment. Vehicles captured in the furthest lane may be concealed by a large vehicle traveling in the nearest lane.

At the equipment attaching place, there must be:

- Power feeding point according to Electrical Specifications, near the equipment installation point;
- Connectivity with data network near the equipment installation point (based on the chosen modality);
- Pole for attaching the equipment support;
- Availability of an *Auxiliary Setup Device* (for framing conferencing and image adjustments), with the Google Chrome browser (version 85 or higher) installed.

Conditions Required for Installation

To get ITSCAM FF 600 best performance, the installation of the equipment should be done with little horizontal inclination and avoiding the concealment of image parts by objects such as trees or vehicles from other tracks.

Installation Spot: In cases where it is not possible to meet the installation specifications, it is recommended to consult Pumatronix Technical Support.

Network Interface Parameterization

ITSCAM FF 600 has two network interfaces: ETH1 and ETH2. In factory default configuration, the first network interface (ETH1) has the displayed setting, and the second network interface (ETH2) is disabled:

Eth1 Port Setting	Default Value
IP Address	192.168.0.254
Maintenance IP Address	192.168.254.254
Netmask	255.255.255.0

ITSCAM FF 600 connectivity: Check in the Wi-Fi Network Configuration how to configure the Wi-Fi, 4G and 3G network interfaces, since they are disabled in the equipment's factory settings standard.

In situations where ITSCAM FF 600 network setting is distinct from the standard, it is indicated to change the settings before installing the equipment in the place. The changed network setting is saved in a flash memory; however, it is effectively applied after restarting the equipment. When the change is made by the Web interface, the restart is automatic, after confirming the change.

ITSCAM FF 600 has a recovery IP address (192.168.254.254), for cases where the user mistakenly changes the IP address and loses connection to the device. Access to this recovery IP address is only available in a peer-to-peer connection with the equipment when connected to the ETH1 port.

The ITSCAM FF 600 (192.168.254.254) maintenance IP address is used to recover connection in extraordinary situations of loss of primary IP. For this reason, when manually configuring the equipment's network interface (Ethernet or Wi-fi), it must be applied values that differ from maintenance IP.

The most common conflict situations between the primary IP address and the maintenance one are:

- ITSCAM FF 600 primary IP in 192.168.254.x range and 255.255.255.0 netmask;
- ITSCAM FF 600 primary IP in 192.168.x.x range and 255.255.0.0 netmask;
- ITSCAM FF 600 primary IP in 192.x.x.x range and 255.0.0.0 netmask;
- Netmask set to 0.0.0.0.

Wi-Fi Network Configuration

ITSCAM FF 600 connectivity: Wi-Fi, 4G and 3G network interfaces are disabled in the standard equipment factory settings.

1) Access the device's web interface with data recorded in the parameterization of network interface;
2) Access the *Equipment* > *Network* menu on the *Wi-Fi* tab;
3) Select the *Station (STA)* Operating Mode to connect to an existing Wi-Fi network;
4) Click in the *SSID* field and the nearby Wi-Fi networks available for connection are listed for selection;
5) Select the *Authentication* Protocol to use: *Open (no authentication)*, *WEP* or *WPA/WPA2 PSK*;

6) Enter the password for access to the selected Wi-Fi network;
7) Click the *Apply* button at the top of the page when validating the entered data.

Select *Access Point (AP)* Operating Mode only when you want the device to be used as an access point to an available Wi-Fi network:

1) Enter the Identification Data (*SSID*), *Country*, *Channel*, and *Authentication* Protocol that will be applied to the distribution of the Wi-Fi connection;
2) Enter the *IP Address* and *Subnet Mask* for the DHCP Server by determining the address range for the appliances that connect to the Access point.

Use an IP address for the DHCP server that is different from the one applied to access the ITSCAM FF 600 device for the purpose of avoiding conflicts and malfunction of the data network.

3G or 4G Cellular Configuration

Some mobile Internet operators require manual configuration of network data:

1) access the device's web interface with the data recorded in the parameterization of the network interface;
2) Access the *Equipment* > *Network* menu on the *Mobile* tab;
3) Click *Enabled* and the configuration fields are visible;
4) Enter the data when customized or for the *Claro* operator manually:
    a. APN: claro.com.br;
    b. User: claro;
    c. Password: claro;
5) Click *Apply* to save the network settings.

9. First Access to ITSCAM 600 Device

The web interface of ITSCAM 600 device can be used to quickly check the equipment status and to monitor images in real time. However, the equipment must be energized, following the Electrical Specifications. An *Auxiliary Setup Equipment* (for framing conferencing and image adjustments) must be used with the Google Chrome browser (version 85 or higher) installed.

In addition, the *Auxiliary Setup Equipment* must be on the same data network as ITSCAM FF 600 (with a compatible network setting). If a point-to-point connection is used, ITSCAM FF 600 can be accessed through the maintenance IP address *192.168.254.254*. When typing the ITSCAM FF 600 IP address in the browser address bar of the *Auxiliary Setup Equipment*, you must inform:

User	**admin**
Password	*1234*

10. First Access to the ITSCAMPRO Móvel Plugin

The ITSCAMPRO Móvel plugin web interface is used to extract the data captured by ITSCAM FF 600. The ITSCAMPRO Móvel must be accessed from an *Auxiliary Setup Equipment*, connected to the same data network as the ITSCAM FF 600 device, by the address for external access or by devices that have the Android/iOS application installed.

The default address for accessing the plugin is 192.168.0.254:9080. If a point-to-point connection is used, ITSCAM FF 600 can be accessed by the maintenance IP address *192.168.254.254:9080*, through ETH1.

Use the Google Chrome browser (version 85 or higher) to access the system, typing the IP address provided in the navigation bar and then the user credentials. However, in the first access, it is indicated to create other users and restrict the *administrator* account use. To access for the first time, use the default factory data on the login screen:

User	**admin**
Password	*admin*

11. Care and Maintenance

Some steps are necessary to ensure the product performance and extend its shelf life.

Product Risks: There are some risks from using the product, these are presented in the Handling Risks section.

Firmware Upgrading

Pumatronix periodically provides an update to ITSCAM FF 600 with defect corrections and functionality inclusions, please contact Technical Support on the Pumatronix website. The equipment upgrade process

requires an *Auxiliary Setup Equipment* to connect to the equipment and can be done directly through its web interface using one of the installed web browsers:

- Internet Explorer 11 or higher;
- Google Chrome version 38 or higher;
- Firefox version 21 or higher;
- Opera 25 or higher;
- Safari 8 or higher.

Updating the ITSCAM FF 600 firmware requires some security measures during the procedure to prevent the file from getting corrupted and the ITSCAM FF 600 device from not working:

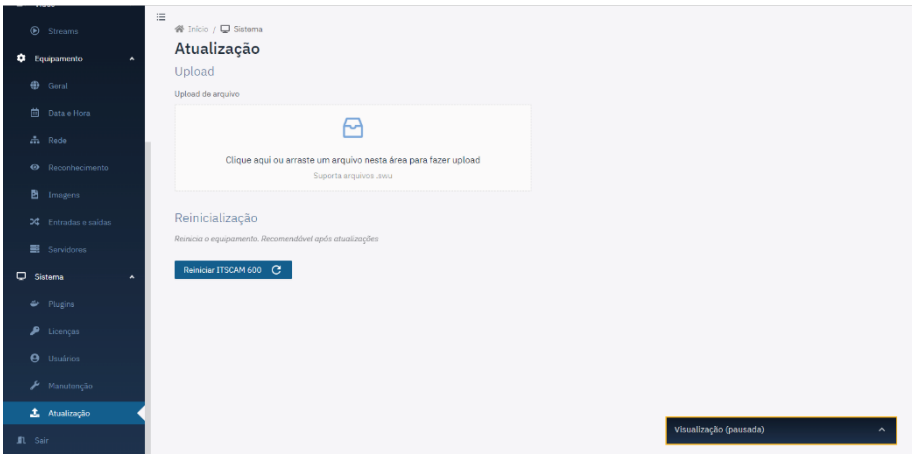
1) Keep the ITSCAM FF 600 device inactive during the upgrade process, ensuring that it is not requested by any service or other equipment on the network in which it is installed;
2) Keep the ITSCAM FF 600 device always on during the update, taking the necessary measures to prevent it from being restarted or disconnected;

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

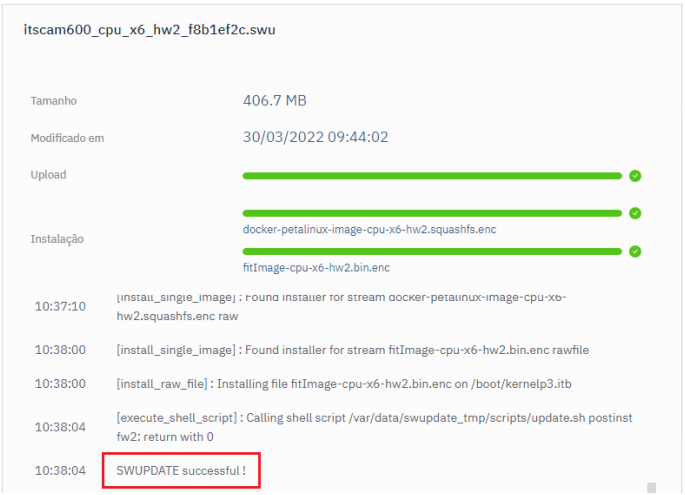
If you have any questions, please contact Technical Support at suporte@pumatronix.com.

ITSCAM FF 600 Update via Web Interface

1) Download the firmware file received by email (which starts with the name itscam600 and has the extension .swu) on the *Auxiliary Setup Equipment* that will be used to connect to the ITSCAM FF 600;
2) Connect the Auxiliary Setup Equipment to the same data network as ITSCAM FF 600;
3) Open the Auxiliary Setup Equipment browser;
4) Enter the ITSCAM FF 600 IP address (the default IP address is 192.168.0.254 and point-to-point connections can be made by the address 192.168.254.254);
5) Log in with the login and password;
6) Access the menu: *System* > *Updating* the ITSCAM FF 600 web interface



7) Select or drag the firmware file (the update starts automatically and occurs in three steps, which are signaled by the progress bar);
8) Keep track of the *Upload* reaching 100%, and following the *Installation*, making sure that the device is **not** restarted or turned off and that it is **not** being requested by any service or other equipment on the network during the process. This security is required when performing this procedure to prevent the update from corrupting the firmware and the equipment from crashing;
9) Check the *SWUPDATE successful!* message that indicates that the installation is complete.



10) Click on the ITSCAM 600 Restart button;
11) Wait for the equipment to restart so that the new firmware changes are applied;
12) Finish the update procedure by checking the firmware version indicated in the page top bar.

(Restricted Procedure) Recovery of ITSCAM FF 600 by Factory Reset

Loss of Information: All files, images and settings stored in ITSCAM FF 600 are lost while performing the Recovery procedure.

Restoration of the ITSCAMPRO Móvel plugin: Performing the ITSCAM FF 600 factory recovery process, causes the ITSCAMPRO Móvel plugin to stop. To restore the plugin's operation, it is necessary to trigger the support to release the plugin and update the licenses.

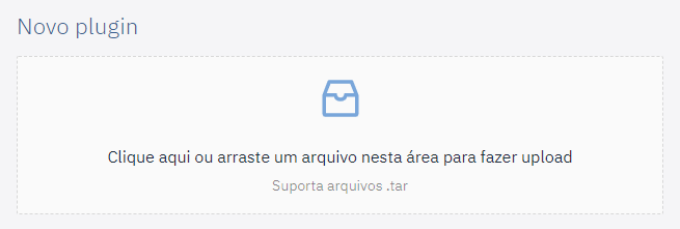
The ITSCAM FF 600 recovery procedure requires an SD card with a minimum capacity of 4 GB and that can be formatted.

1) Download the ITSCAM FF 600 recovery file (file with .tar extension) (please contact Pumatronix Technical Support for access to the file)
2) Format the SD card using FAT32
3) Unzip the recovery file on the formatted SD card
4) Disconnect ITSCAM FF 600 from power
5) Insert SD card into ITSCAM FF 600 (at ITSCAM 600 back panel)
6) Keep the *RESET* button pressed
7) Energize ITSCAM FF 600
8) Release the *RESET* button once the status led turns green
9) Verify the status LED blinking red, which indicates that the recovery process is undergoing
10) Verify the status LED blinking green, which indicates the recovery is done
11) Power off the board
12) Remove the SD card from the card slot and power it on again

ITSCAMPRO Móvel Plugin Update

ITSCAM FF 600 has integrated into the SD card the ITSCAMPRO Móvel software plugin, which provides the user with a user-friendly interface and simple operation. Upgrading to the latest version allows you to take advantage of updates and new features. The plugin update process occurs following the steps:

1) Download the firmware file received by email (which starts with the name *itscampromovel* and has the extension *.tar*) on the *Auxiliary Setup Equipment* that will be used to connect to the ITSCAM FF 600;
2) Connect the *Auxiliary Setup Equipment* to the same data network as ITSCAM FF 600;
3) Open the *Auxiliary Setup Equipment* browser;
4) Enter the ITSCAM FF 600 IP address (the default IP address is 192.168.0.254 and point-to-point connections can be made by the address 192.168.254.254);
5) Access the menu *System* > ITSCAM FF 600 Web Interface *Plugins*;
6) Select the *Stop* function for the current plugin at the page bottom;
7) Click *Remove* the current plugin;
8) Start the process of installing the plugin's new version by inserting the respective file in the area



9) Create the redirect ports as described:
    a. - 80 (private) → 9080 (public)
    b. - 2000 → 2000
    c. - 2005 → 2005
    d. - 10000 → 10000
10) Click on *Install;*
11) Please wait while the entire shipping and installation process is completed. Depending on the network situation, it may take up to 15 minutes for the entire process to be completed;
12) Force the initialization of the plugin by clicking on the *Start* button;
13) Check after this first startup that the plugin is automatically booted when accessing the ITSCAM 600 device system.

Preventative Maintenance

The ITSCAM FF 600 image capture and processing device shall provide images without artifacts. However, if the lenses or the protective box outer surface has any dirt, it must be cleaned;

14) Spray liquid for cleaning lenses on the surface of the lenses or water on the glass of the protective box, so that it is possible to remove excess dirt adhered to the surface:
15) Use a soft cloth that does not loosen fibers to remove dirt, moving the cloth in only one direction;
16) Wipe a dry cloth afterwards to finish cleaning and do not use force, as it is possible to damage the surface.

Figure 15 - ITSCAM FF 600 protection glass

12. Warranty General Conditions

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

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

This Warranty will only be valid if the product is accompanied by a *Maintenance Form*, duly completed and without erasures, and an Invoice.

Situations where the Product Lose Warranty

1) Using software/hardware not compatible with the Manual's specifications;
2) Connecting the product to the power grid outside the standards established in the product manual and installations that present excessive voltage variation;
3) Liquids infiltration while opening/closing of the product;
4) Damage caused by natural agents (electric discharge, flood, sea air, excessive exposure to climatic variations, among other factors) or excessive exposure to heat (beyond the limits established in the Manual);
5) Using the product in environments subject to corrosive gases, excessive humidity and/or dust;
6) Showing signs of tampering with security seals;
7) Showing signs of opening and modification made by the Customer in points of the product not authorized by Pumatronix;
8) Damage caused by accidents/falls/vandalism;
9) Display tampered and/or removed serial number;
10) Damage resulting from the Customer transporting and packaging the product in conditions incompatible with it;
11) Misuse and use not compliant with the Instruction Manual.

Privacy Policy

In accordance with the Brazilian General Data Protection Law (LGPD) - Law No. 13.709, of August 14, 2018, this product has programmable functions for capturing and processing images that may infringe the LGPD when used, together with other equipment, to capture personal data.

Pumatronix is not responsible for the captured images purposes, use and treatment, and the product's user or purchaser solely decides how to control the information and operate the product.