

ITSCAM VIGIA+ Product Manual

Revision 2.0



www.pumatronix.com

Pumatronix Equipamentos Eletrônicos Ltda.

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Change History

Date	Revision	Updated content
09/2015	1.0	Initial Version
8/22/2022	2.0	Update of available models; insertion of new product images; general document review

Overview

The continuous increase in population in urban areas implies major challenges in the public management of cities. 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 known as 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 social and economic needs of society. Therefore, the use of Information Technology allows cities to develop economically while increasing the quality of life of their inhabitants by generating efficiency in urban operations.

Examples of these technologies are the Intelligent Transport Systems (ITS), in which Pumatronix products are used, such as the ITSCAM VIGIA+ line. The devices of this line capture images of vehicles for traffic management, inspection, Smart City Applications, mobility systems, and applications that demand capture of images whose minimum distance from the application is greater than 2 meters, using a global shutter image sensor:



Figure 1 - ITSCAM VIGIA+ Line

Handling Risks



This equipment must be powered by a direct current (DC) source with a voltage of 12Vdc or 24Vdc. Do not connect any of the inputs directly to the power grid (AC)!



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



This equipment has a lens set that is sensitive to mechanical impacts such as drops and severe external vibrations.



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



Vision Damage: The built-in illuminator emits thermal and light energy (not visible because it is infrared lighting), so it is not recommended to look directly at the LEDs. It is also not recommended to use any optical instrument to look directly at the LEDs. If malfunctions occur, send the product to Pumatronix Technical Assistance.

Models

ITSCAM VIGIA+ image capture and processing devices are available with the specific technical features that can be identified in the designator in parentheses, indicating the model components.

Available models	Resolution	Estimated range (in meters) *
ITSCAM VIGIA+ (S01L1IT1P)	752x480 px	2 to 4 m (3.3-10mm)
ITSCAM VIGIA+ (S04L1IT1P)	1280x960 px	3 to 9 m (3.3-10mm)
ITSCAM VIGIA+ (S08L6IT1P)	1280x800 px	4 to 11 m (3.2-10mm)
ITSCAM VIGIA+ (S07L1DT2P)	640x480 px	NA**

*License plate characters remain readable in the OCR reading within the distance interval of the estimated range, set according to the lens applied to the model.

**The model with 640x480 px resolution (S07 sensor) is only used in panoramic monitoring, without OCR reading.

Image sensors	Lens *	Built-in Illuminator	Back Lid	Optional
S01: CMOS 752x480px	L1: 3.3-10mm	I: Infrared	T1: Normal back lid	J: Embedded LPR (Brazil or Chile)
S04: CCD 1280x960 px	L6: 3.2-10mm	D: No LEDs on the built-in illuminator	T2: T back lid, coupling connector and 30 cm Ethernet cable (no multi-way cable)	P: PoE Power**
S07: CCD 640x480 px				
S08: CMOS 1280x800 px				

***L1** lens (3.3-10mm) is only valid for **S01**, **S04** and **S07**. **L6** lens is only applicable to the model with the **S08** sensor.

**ITSCAM VIGIA+ devices with S01 and S04 sensors allow 24Vdc or PoE power. Devices with S07 and S08 sensors accept 12Vdc, 24Vdc, or PoE power.

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1. Knowing the Product

The line of ITSCAM VIGIA+ image capture and processing devices was developed for traffic management, inspection, Smart City Applications, mobility systems, and applications that require image capture whose minimum distance from the application is greater than 2 meters.

Models with embedded OCR capture vehicle images, automatically read the characters on the license plate, and send the image and information through data network.

The built-in illuminator allows the identification of vehicles during daytime and nighttime period. In cases where there is insufficient lighting to capture the vehicle license plate legibly, the built-in illuminator is automatically triggered and emits infrared-type light, which is imperceptible to the human eye.

The *Sliding Flap* on the ITSCAM VIGIA+ device housing provides additional protection for the lens in cases where there is a direct incidence of reflections or sunlight, which interfere at the quality of the generated images

The distances applied when installing the device and which allow the identification of the vehicle license plates characters vary according to the model sensor, as specified in the [models table](#).

Lenses and Image Sensors

The ITSCAM VIGIA+ device features an internal motorized lens (with software controllable zoom and focus) and a DC Iris control output that allows you to control the iris electronically if the lens supports it. The lenses used must be compatible with the image sensor sizes used, considering:

Sensor Code	Resolution	Size (in inches)
S01 (CMOS)	752x480 px	1/3"
S04 (CCD)	1280x960 px	
S07 (CCD)	640x480 px	
S08 (CMOS)	1280x800 px	1/4"



Opening the back cover will result in an instant loss of the ITSCAM VIGIA+ Warranty.



The image sensors of the ITSCAM VIGIA+ have high sensitivity to infrared light. See the [sensitivity to light](#) for sensor specifications on compatible wavelength range.

The focal length varies according to the lens used and refers to the distance between the optical center of a lens and the plane of focus, measured in mm (millimeters), with the angle of view being more "open" for smaller values.

Inputs and Outputs

The hardware of the ITSCAM VIGIA+ has a total of 3 input and output ports (IOs): 1 output port, and 2 input ports for the installation of external sensors, which identify the moment of image capture (trigger). In situations where the application of external sensors is not feasible, the ITSCAM VIGIA+ device can be configured to generate trigger events from image analysis, by enabling the software trigger (Virtual Trigger).

Data Transmission over the Network

When ITSCAM VIGIA+ receives an image capture request, either by triggering an external trigger or by software, the flash is synchronized, and the next frame generated will be made available over the network. The captured images are transmitted digitally (in BMP or JPEG format) through the network interface, using the TCP/IP protocol. The transmission time of the images captured by ITSCAM VIGIA+ varies according to the network infrastructure conditions. The transmission capacity of the network to which ITSCAM VIGIA+ is connected may be affected by the following factors:

- Processing capacity of the equipment that receives the data;
- Quality of the network card of the equipment that receives the data;
- Traffic volume of the network to which the ITSCAM VIGIA+ is connected;
- Quality of peripherals connected to the network (hubs, switches, routers, etc.).

The table below shows typical rates of images transmission over the network in JPEG and BMP formats. Upon receiving a request for image capture (via the network or I/O), ITSCAM VIGIA+ prepares the image and stores it in RAM immediately, and transmits it according to network availability.

Table 1 - Typical transmission rates (in frames per second) for images in JPEG and BMP format

Available models	Resolution	JPEG Image Transmission (fps)		BMP Image Transmission (fps)	
		Color	Monochrome	Color	Monochrome
ITSCAM VIGIA+ (S01L1IT1P)	752x480 px	35	35	12	33
ITSCAM VIGIA+ (S04L1IT1P)	1280x960 px	10	10	3	6
ITSCAM VIGIA+ (S08L6IT1P)	1280x800 px	12	12	4	8
ITSCAM VIGIA+ (S07L1DT2P)	640x480 px	40	40	12	30

The internal rate of images capture of ITSCAM VIGIA+ is constant, with the value corresponding to the resolution of the sensor, which has the following speeds ordered by rate:

Table 2 – ITSCAM VIGIA+ acquisition rates

Resolution	Internal acquisition rate
752x480 px	60fps
640x480 px	54fps
1280x960 px	24fps
1280x800 px	20fps

Transmitted Image Format

The image can be transmitted, either in *Photo* or *Video* mode, in BMP or JPEG formats. In both formats, ITSCAM VIGIA+ transmits an image that includes the header of the respective format. In case of JPEG images, within the image are also attached the ITSCAM VIGIA+ settings of capture moment and additional data, such as vehicle license plate in case of embedded OCR.

Additionally, the JPEG image quality can be selected by setting between 1 (worst quality – highest compression) and 100 (best quality – least compression).

Supported Servers

ITSCAM VIGIA+ can communicate with different types of servers, provided they are properly configured. Each server has its features when connecting to ITSCAM VIGIA+:

Server	Interaction with ITSCAM VIGIA+
FTP	Equipment connects via FTP with one of the servers available for sending images
ITSCAMPRO	By configuring the ITSCAM VIGIA+ to communicate with the ITSCAMPRO solution, it is possible to send images and the plates read by the embedded OCR. ITSCAMPRO is an application that concentrates the images and plates sent by ITSCAM VIGIA+, allowing visualization and generation of different types of reports (please consult Pumatronix for more information about the application)
RTSP*	The Real Time Streaming server can receive the images captured by ITSCAM VIGIA+ through the link <code>rtsp://IP_DA_ITSCAM:PORTA/mjpeg</code> . If the default port 554 is specified, the link will be <code>rtsp://IP_DA_ITSCAM/mjpeg</code>
Serial Port	Creates a TCP server on ITSCAM VIGIA+ on the specified ports and causes all messages that travel through the ITSCAM VIGIA+ serial port to be redirected to the port that has been configured in the TCP protocol
Q-protocol	Configures the ITSCAM VIGIA+ to communicate with systems using equipment with support for the Q Protocol, which sends the vehicle passage record

*ITSCAM VIGIA+ implements an MJPEG stream that operates independently from the server it is configured on. This stream can be composed of images not synchronized with the lighting, as well as illuminated images.

2. Additional Documentation

Product	Link	Description
ITSLUX	Product Manual	Manual containing the technical specifications of the ITSLUX illuminator
ITSCAM VIGIA+	Installation & Maintenance Guide	Guide containing the information necessary to carry out the installation and maintenance of ITSCAM VIGIA+
ITSCAM	Integration Manual	Programming and integration manual containing the information necessary for the integration of all ITSCAM lines with an application

3. Generated Information



Figure 2 – Example of an image generated by ITSCAM VIGIA+

The ITSCAM VIGIA+ line is composed of devices for capturing and processing images which are transmitted digitally (in BMP or JPEG format) by the network interface, through the TCP/IP protocol. Each ITSCAM VIGIA+ has an IP address, which allows to remotely reset all its settings. The network interface also allows multiple devices to be accessed by the same machine, without occurring overloading or compromising capture, switching, and synchronization time.

The digital technology of ITSCAM VIGIA+ enhances image quality compared to analog systems. In digital technology, photons are converted to an analog level and then digitized. These digital values corresponding to the pixels of the image and with fewer conversion steps, losses in image quality are reduced.

ITSCAM VIGIA+ line devices use non-interlaced (progressive scan) global shutter image sensors to capture images. This means that all image pixels are captured at the same instant and it is possible to capture images with moving objects. Generally, the real resolution of analog images is 640x240 pixels, while ITSCAM VIGIA+ provides all resolutions shown in the chart. This difference in the number of pixels is sensitive not only to the human eye but also to automatic license plate reading (LPR) algorithms, as illustrated:

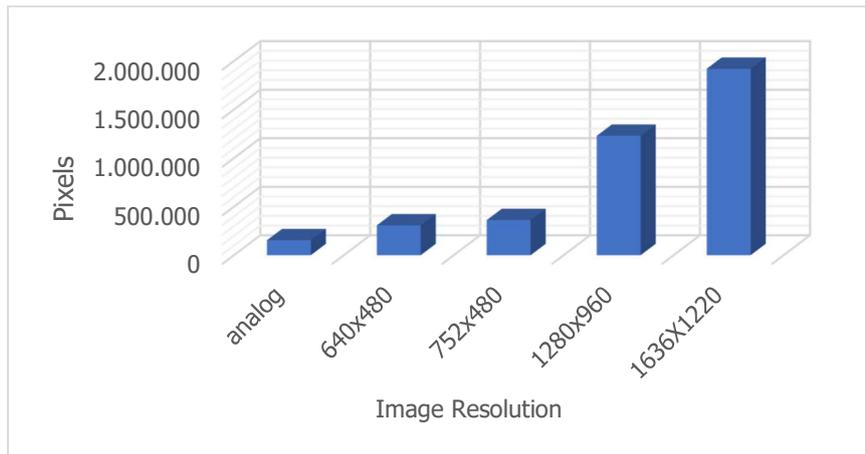


Figure 3 - Comparison between the actual number of pixels of analog and digital images

The larger number of pixels available in the image width also allows a larger image field of view to be achieved with the same zoom used in analog images.

With ITSCAM VIGIA+, the greater number of pixels available in the image width also allows a larger image field of view to be achieved with the same zoom used in analog images. Thus, the loss of information at the edges, such as vehicles between lanes. From firmware version 19 onwards, all ITSCAM VIGIA+ models can generate cropped images and some other resized resolutions, as identified in the table:

Effective Sensor and Pixels	Alternative Resolutions
S01: CMOS 752x480px color	640x480, 480x320, 320x240, 240x180, 160x120
S04: CCD 1280x960px	800x600, 640x480, 480x360, 320x240, 240x180, 160x120
S08: CMOS 1280x800 px	640x480, 480x320, 320x200
S07: CCD 640x480 px	480x320, 320x240 ou 800x600

JPEG Comments

The JPEG format is an image storage format based on information blocks. Blocks start with a tag that is always composed of 0xFF and a second byte. Examples:

- 0xFF 0xD8: Beginning of the image
- 0xFF 0xD9: End of the image
- 0xFF 0xE8: Image information such as data size and formatting
- 0xFF 0xDA: Beginning of the compressed image
- 0xFF 0xFE: Comments in text format

The file is always formatted such that, for example, 0xFFDA only appears once in the file (to indicate the beginning of the image compressed data). Therefore, Pumatronix uses the image comments tag to store generated metadata of each capture. This field (commonly referred to as *Comments* or *Image Comments*) can be found in the image by looking for bytes 0xFF and 0xFE. As comments are placed at the end of the image, it is suggested to search for the marker starting at the end of the file. Then, following JPEG standards, the data is formatted as follows:

Comments tag		Size of comments (counting this field, in Big Endian)		Comments string, ending in 0x00
0xFF	0xFE	LSB	MSB	string [tamanho-2]

As the comments consist of a C string ending '\0', it is possible to use some function like `strcpy`, 2 bytes after the tag to extract it. The string is composed of a sequence of "key=value;" (semicolon separating sets of key and value).

JPEG comment example:

```
DataComp=24/06/202121:14:36;FwV=v19.2.5;FwD=so800x600,LENTE_MOTORIZADA_SENKO,JIDOSHA,JIDOSHA_LIGHT,SENSO
R_BAYER,HW_VIGIA,MEMORIA_EXTENDIDA;FotoColorida=0;Sombra=0;Hdr=0;Gamma=90;TipoShutter=0;ShutterFixo=600;Shu
tterMaximoDay=600;ShutterMaximoNight=600;TipoGanho=0;GanhoFixo=20;GanhoB=0;GanhoC=0;GanhoMaximo=0;ModoTeste
=0;NivelDesejado=20;NivelAutomatico=0;FormatoTrigger=1;QualidadeTrigger=80;NumeroFotosRede=1;NumeroFotosIODay=1;
NumeroFotosIONight=1;DelayFlash=130;ModoFlash=2;ModoFlashAuto=0;flash_out=1;SupervisaoIluminador=0;Revisao=2;Vers
ao=19;TipoSaida=1;Trigger=1;Rotacao=0;TipoGanhoDif=0;ValorGanhoDif=0;TipoGammaDif=0;ValorGammaDif=90;TipoWhiteB
alanceDif=0;ValorWhiteBalanceDif=0;TipoTriggerDif=0;ValorTriggerDif=1;TipoSaturacaoDif=1;ValorSaturacaoDif=6555748;Real
eBorda=0;Modelo=ITSCAM403_VIGIA;Resolucao=800x600;AutoIris=1;DayNightAlgorithm=0;ModoDayNight=1;PorcentagemPri
meiroDisparo=100;PorcentagemSegundoDisparo=100;DelayCapturaDay=0;DelayCapturaNight=0;Sincronismo=0;SincronismoDt
=4;TodasFotosItscamPro=1;JuntaFotosBMP=0;GPS=0;ModoOCR=0;TipoOcrDif=0;ValorOcrDif=0;MaxLowProbChars=0;MinimaPr
obPorCaracter=80;TipoOCR=3;TimeoutOCR=4000;JidoshaLightVersion=3.9.0;JidoshaLightSHA1=1479289519f1cb1944c73aec22
dc0c9a4a8e887b;OcrAngle=0.000000;OcrSlant=0.000000;OcrMinCharHeight=9;OcrMaxCharHeight=60;OcrAvgCharHeight=17;O
crGoodCharProb=80;LimiarPercentNightDay=90;LimiarPercentDayNight=50;LimiarPercentNightDayMotorizada=30;LimiarPercent
DayNightMotorizada=20;TransicaoMotorizadaIO=0;PlacasSerial=0;PlacasSerialIface=2;enableNtpServer=0;ntpServer=http://ntp.
br;triggerStartVeiculoPaddingNoturno=0;triggerStartMotoPaddingNoturno=0;triggerEndPaddingNoturno=0;triggerStartPaddingApro
xDiurno=0;triggerEndPaddingAproxDiurno=0;triggerStartPaddingAfastDiurno=0;triggerEndPaddingAfastDiurno=0;statusFirmwa
reRecebido=0;LimTM=0;RoiTM=0,0,0,0,0,0,0,0;RoiTMMode=0;MapHabilitado=0;MapIp=10.9.0.1;MapPorta=51000;MapIp2=0.0.
0.0;MapPorta2=51001;ocrCountry=1;tipoIluminador=0;usarProtecaoIluminador=0;VmEnable=0;ShutterMaximo=600;NumeroFot
osIO=1;QualidadeReal=80;TSinc=-215699032;TSincDT=-215699032;TempoCaptura=-1931784260;TempoLigado=-
1931784199;ShutterAtual=600;GanhoAtual=20;NivelAtual=0;WhiteBalanceAtual=4210752;SituacaoDayNight=1;FocoIR=0;Horari
o=;Entrada1=0;Entrada2=0;EntradaUsada=0;IndiceFoto=1;IOVigia=255;OCRUsado=0;Contagem=1;Cc0=0.0000;PosC0=0x0,0x
0;Cc1=0.0000;PosC1=0x0,0x0;Cc2=0.0000;PosC2=0x0,0x0;Cc3=0.0000;PosC3=0x0,0x0;Cc4=0.0000;PosC4=0x0,0x0;Cc5=0.00
00;PosC5=0x0,0x0;Cc6=0.0000;PosC6=0x0,0x0;Placa=;CorPlaca=0;CoordPlaca=0x0,0x0;OCRTotalTime=0;OCRRem=0;OCRRem
Ret=0;OCRLoc=0;OCRLocRet=0;OCRRemVersion=0.0.0;OCRRemSHA1=;MeanTM=0;StdTM=0;RoiOCR=0,0,0,0,0,0,0,0;Borda=1
```

JPEG Image Comment	Meaning
Ccx	Reliability of character x
Placa	License plate read
CorPlaca	0: Light plate with dark letters 1: Dark plate with light letters
CoordPlaca	Coordinates of the rectangle that contains the plate identified in the image

Automatic Recognition of Plates

Vehicle license plate location and recognition functionality are possible through an OCR server (MAP or PC) that offers better image analysis processing. The main functionality of this OCR server is to recognize Brazilian and Mercosur license plates from images using a software library. For OCR processing of vehicle license plates from countries other than Brazil, contact Pumatronix Technical Support.

For a better recognition index, it is recommended to adjust the equipment to capture the license plate of the vehicles in the images center and with the height of the letters and numbers of 20 pixels when the resolution is up to 752x480 px and 25 pixels for higher resolutions, of 1280x800 px to 1280x960px.

Whenever an image in JPEG format is requested via the *Photo* command or I/O, ITSCAM VIGIA+ captures the frame, performs license plate recognition, and transmits the image. This functionality is not performed if the request is made by the *Video* command or if the requested image is configured for BMP format.

After capturing image, ITSCAM VIGIA+ seeks to identify objects like a license plate. When locating each of these objects, the recognition algorithm seeks to identify letters and numbers. The result of the identification depends on the minimum reliability of the character. The plate read is inserted within the JPEG stream itself, in the comments field.

Send via RS-232 compatible with Wiegand 26

The ITSCAM VIGIA+ models that have the functionality of locating and recognizing vehicle license plates can communicate with *Wiegand* controllers, very common in parking lots. In this type of communication, a license plate list is used to identify a set of vehicles using only 24 bits. The supported model is *Wiegand 26*, through a serial converter. For this functionality to work correctly, it is necessary to load the [License Plate List](#) into the ITSCAM VIGIA+ memory and carry out the steps to configure the connections.

As in previous versions of ITSCAM VIGIA+, the connection of a user to a serial port, via Serial Server, interrupts all messages exchanged by that serial port, including photo requests with or without label and sending of license plates. Such functionality will be kept so as not to hinder the setting of equipment (which is the purpose of such a feature). The transmission of these messages via serial does not interfere with the reception of messages from other functions (GPS, photo with or without label).

License Plate List File

For the RS-232 port to be used in equipment that supports the *Wiegand 26* protocol, a file must be created containing the information of the plates and their respective identifier. This file containing the list is sent to ITSCAM VIGIA+ and at each new vehicle identification, this list is consulted.

Sending the file with the list can be done using the Web interface, which has a content validator, or by *cgi* command. This file must be *CSV* (separated by a comma, semicolon, or tab (0x09)), containing one plate per line, formatted in two columns: plate (ASCII, 1 to 7 alphanumeric characters) and id (ASCII decimal, between 0 and 16777215). The CSV file standard follows the example:

```
ABC1234,321
```

```
ZZZ4444,456
```

```
XYZ9876,99
```

To forward plates outside the list, the first row of the table must contain the plate: * (just an asterisk) and the id. This value is sent by the equipment whenever an unlisted plate is recognized. When processing the web interface, characters are converted to uppercase. The quotes and spaces are removed before forwarding the list. Other columns and rows with empty columns are ignored. Cases where importing the list using Web Interface will fail:

- The license plate does not have alphanumeric characters;
- Id specified out of range;
- There are invalid characters;
- There are duplicates.

In cases of failure, the interface will point to the incorrect line and will not load. In successful cases, at the end of loading the list, the interface will show the number of lines loaded.

If the list is loaded by POST command to *api/platelistid.cgi*, the file must have only 2 columns, and all values must contain only alphanumeric characters (between 'A' to 'Z' and '0' to '9', except the first line), without spaces and be separated by commas. The rows must be in ascending order, using the plate as a

key. The ASCII character value is used to do this sorting and only 100,000 license plates are supported. The ordering of the list influences the processing speed, as the algorithm uses the binary search method for the plates in the list. In addition, partial plates can be identified by selecting at least one low probability character in the OCR menu, so the search can infer the closest plate in the list.

The verification of the list that is in the equipment can be obtained in the form of a text file, using the *Export List* option. To remove the plates list, use the *Remove List* button on the web interface or upload an empty file.

Vehicle Counter Function

ITSCAM VIGIA+ can be used as a *Vehicle Counter*. This function allows you to select a region of the track to survey the number of vehicles that circulated during a set period.

To obtain optimal performance of this function, ITSCAM VIGIA+ must be installed above the center of the road, so that the traffic direction occurs linearly under the cover of ITSCAM VIGIA+, as exemplified in the figure. In this illustration, ITSCAM VIGIA+ is installed under a footbridge that crosses the highway.

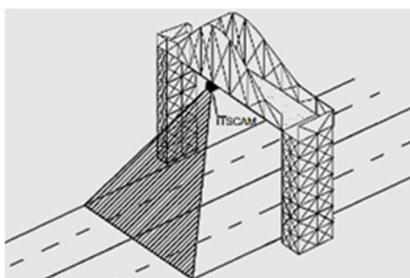


Figure 4 - Installation of ITSCAM VIGIA+ to maximize the results of using the Vehicle Counter function

The *Vehicle Counter* function has its interface (Figure 5), available at www.pumatronix.com, in the *Customer's Area > Technical Support*. The procedure to use counter requires connection to ITSCAM VIGIA+, demarcation of the counting region, and checking or restarting the count:

- 1) Run the application and enter the IP address of the ITSCAM VIGIA+ to be counted and to establish the connection;
- 2) Define an area on the image that must detect the passage of the vehicle and add up the total count value. To determine this counting region, simply select a region of the image with the mouse or enter the coordinates of the area in the image at the top of the screen;
- 3) Once the selection is made, the outline of the region in dark color will mark the selected area;
- 4) The result can be visualized by vehicle size, with a breakdown of vehicle types accounted for as small (motorcycles, small vehicles), medium (medium-sized vehicles), and large (trucks, buses, and the like).



Figure 5 - ITSCAM VIGIA+ Vehicle Counter Interface

4. Mechanical Specifications

- Material: Polycarbonate;
- IP Protection: IP67;
- Fixing:
 - *VIGIA+ Bracket*, using 3 screws 3/16" diameter (not included, as length and type vary according to application);

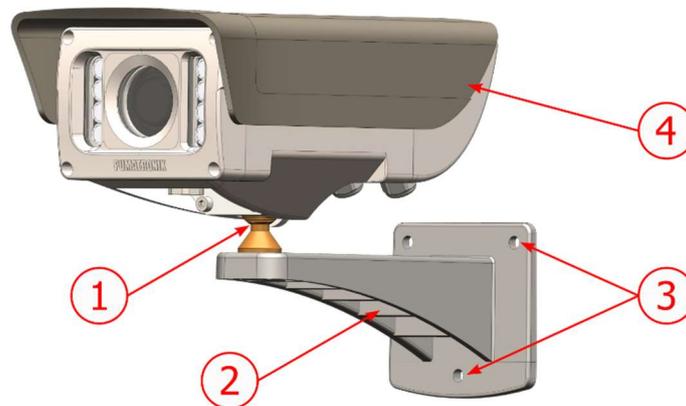


Figure 6 - Fixing the VIGIA+ Bracket: 1) VIGIA+ device tilt adjustment; 2) VIGIA+ Bracket; 3) Fixing points, using 3/16" screws; 4) Sliding Flap, adjusted in the framing

- VIGIA+ Fastener together with the *Support* and 2 M4 Allen 3mm screws allow the equipment to be fixed on the *VIGIA+ Bracket*:

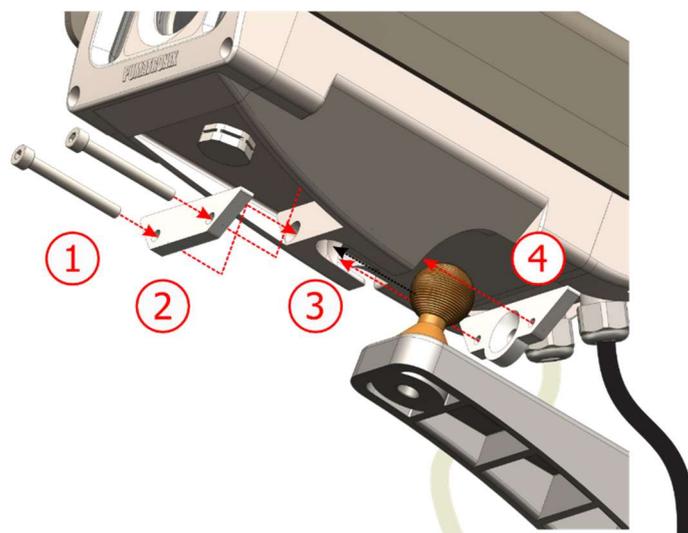


Figure 7 - VIGIA+ Fastener Assembly: 1) M4 Allen 3mm screws (2 units); 2) Support; 3) VIGIA+ cavity; 4) Fastener

- Interfaces:

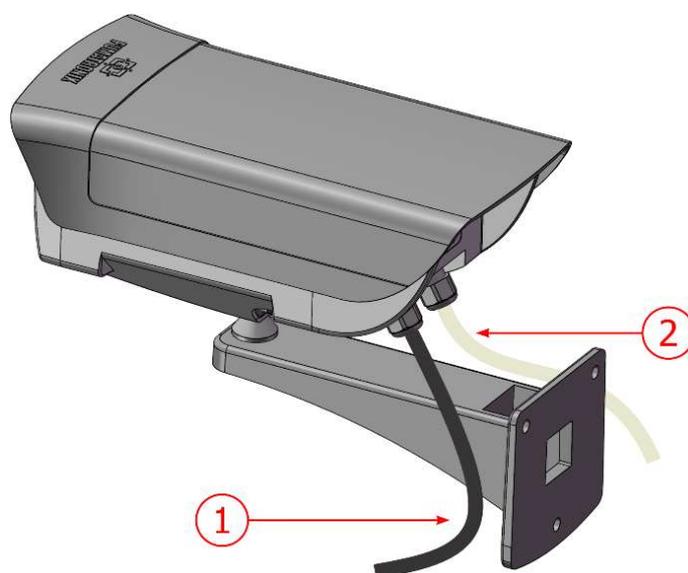
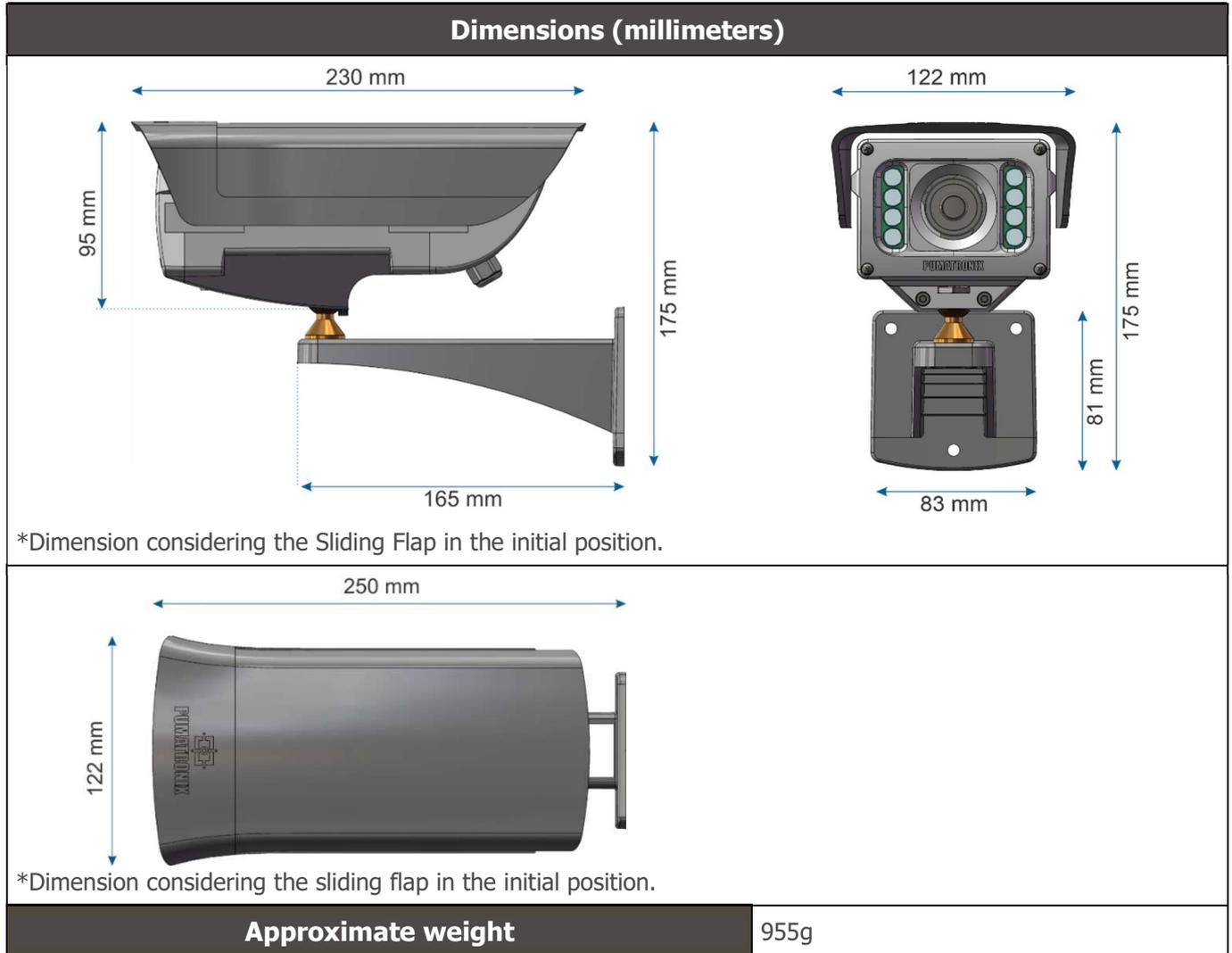


Figure 8 - Connections available on the device: 1) 12-way sleeve; 2) Ethernet

- Temperature: -10 a +60°C;

- Dimensions and Weight:



Opening the back cover will result in an instant loss of the ITSCAM VIGIA+ Warranty.



Sensitivity of Sensors to Light

ITSCAM VIGIA+ has a high sensitivity to infrared light. Below are the Sensitivity X Wavelength graphs for the image sensors of the Monochrome and Day/Night versions, representing approximate values for all current sensor models. Reminding that in the color sensor, 50% of the pixels are green, 25% are red and

25% are blue, according to the Bayer standard. Each color has specific sensitivity, according to the wavelengths. However, in the infrared region, the colors have nearly coincident sensitivity curves.

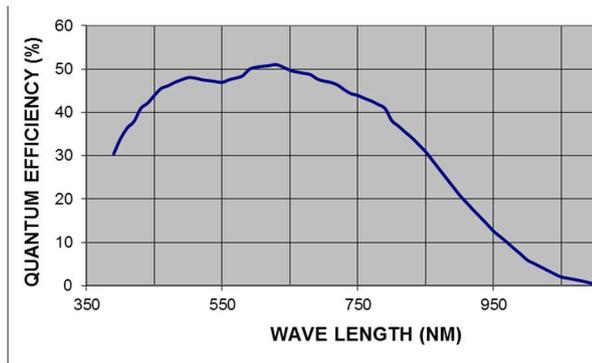


Figure 9 - Monochrome sensor sensitivity

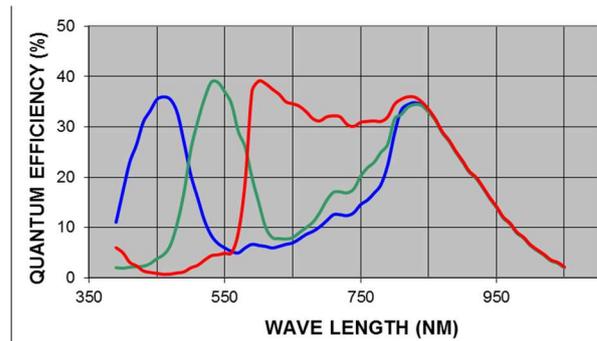


Figure 10 - Red, green, and blue color sensitivity on the color sensor

5. Electrical Specifications

- Power supply: 12 Vdc or 24 Vdc power Source or PoE (Power Over Ethernet) Standard 802.3af
- Maximum power consumption: 10 W
- Reverse polarity protection: 28 V;
- Overvoltage protection (maximum): 28 V;
- Overcurrent protection: 0.5 A;
- Inrush current protection: 1.1 A.

Electrical Connections

The equipment has two cables in its structure, used for the connections: a 1.50m long, 12-way, 6.3mm gauge multi-way cable, which allows connecting the external power supply and accessing the I/O, and the Ethernet cable for external use with an RJ-45 connector, ultraviolet protection, according to the EIA/TIA-568A standard.

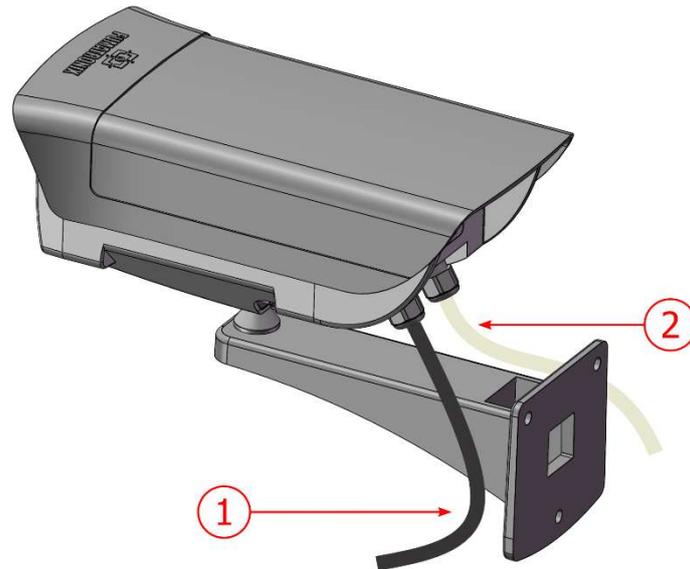


Figure 11 - Cables of the ITSCAM VIGIA+ device housing: 1) Multi-way cable; 2) Ethernet cable

Terminal/Color	Description
1 Red	12Vdc or 24Vdc power supply
2 Brown	Negative (GND)
3 Green	Input 1 + (IN 1+)
4 Blue	Input 1 - (IN 1-)
5 Violet	RX RS232 2
6 White	TX RS232 2
7 Brown + Black	Do not connect
8 Red + Black	Do not connect
9 Gray	Input 2 + (IN 2+)
10 Black	Input 2 - (IN 2-)
11 Orange	Output 1+ (OUT 1+)
12 Yellow	Output 1 - (OUT 1-)



Unused wires must be left floating.



The use of a terminal box to protect electrical and data connections is mandatory.

The input and output signals are optically isolated, and the circuits are laid out in the figure:

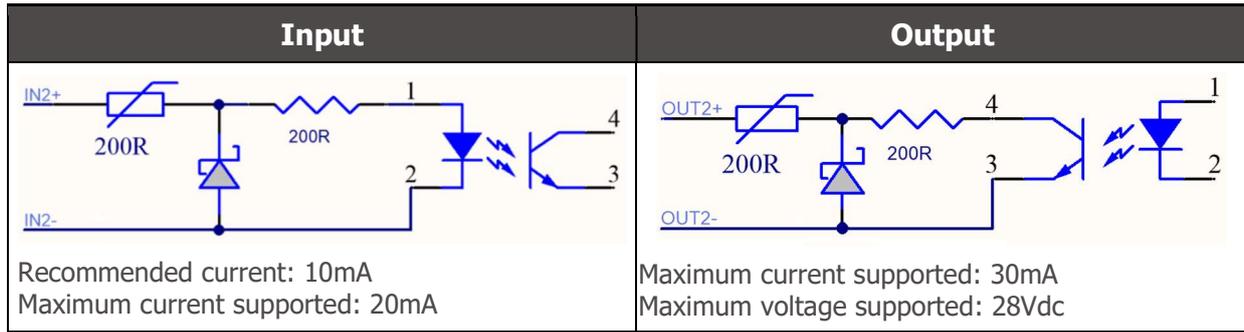


Figure 12 - ITSCAM VIGIA+ isolated input/output signal circuit

The 200-ohm resistors at the input and output are intended to provide basic circuit protection. However, it is up to the user to ensure that the current circulating in both output and input does not exceed **20 mA**. Additional resistors must be inserted to reduce currents above the established limit. The circuit is sized so that the equipment can be connected to 5 Vdc voltage sources without the need for an additional resistor. Voltages higher than 5 Vdc require additional resistors to limit the current:

Source voltage	Additional resistor indicated
12 Vdc	470 ohms
24 Vdc	1000 ohms



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

Selection of Output Signal State

The output port of the ITSCAM VIGIA+ device can be configured to remotely activate equipment via I/O signals, such as barriers, sirens, and monitoring centers. The setting process is done by software, using the equipment's web interface or the communication protocol, available in the Integration Manual of ITSCAM devices.

Flash or Illuminator Shot

When using illuminating devices with ITSCAM VIGIA+, the flash shot output can be synchronized with the sensor exposure for image capture. To maximize the efficiency of these illuminators, this flash shot may occur a few moments before the capture by applying the *Delay* function. This function allows to set a delay in the exposure of the image sensor in relation to the flash shot, to wait until the flash reaches its peak of light emission. As a result, the image is generated with the greatest amount of light provided by the illuminator, as illustrated by the graph of the intensity of the flash over time, after its activation, and the *Delay* in the exposure of the image sensor:

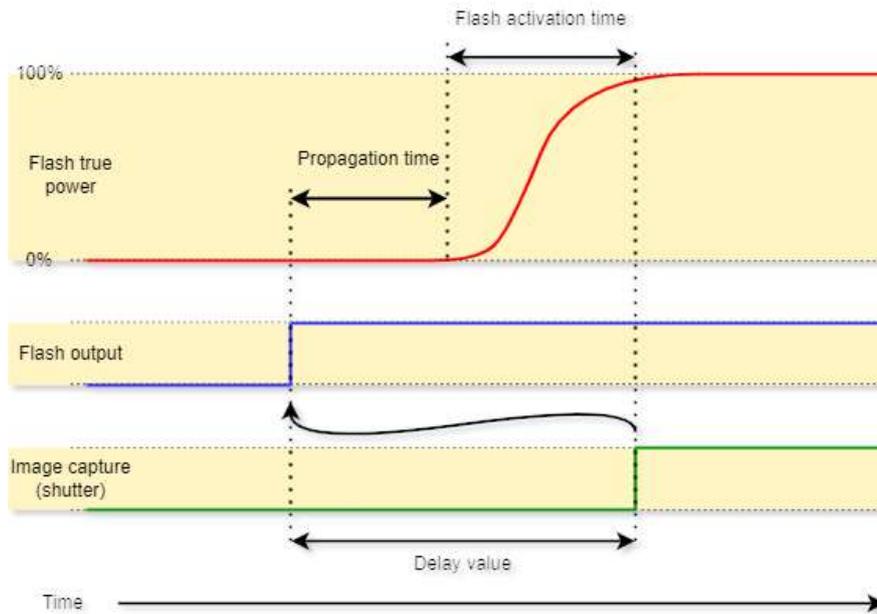


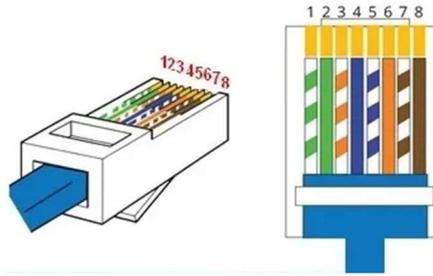
Figure 13 - Moment of Shutter trigger after flash intensification

Each flash model reaches its peak of light emission at a certain time after the shot. For this reason, it is necessary to consult the technical specifications of the equipment for the correct setting of the time that the ITSCAM VIGIA+ device must wait to perform the exposure of image sensor. The available settings for the flash mode and what they operate are described:

Setting	Operation mode
Disabled	Flash is never triggered
Single	Flash is instantly activated when an image is requested
Single with delay	Flash is activated moments before the Shutter exposure, according to the configured time (only for the "Photo" command)
Continuous	Flash is activated on every frame captured internally by the device. This mode is only recommended for illuminators without rest time, such as ITSLUX Video (ITSLUX W6032-V or W6075-V). Indicated for Illuminator testing only, as the Illuminator triggers without any image request
Automatic	Flash is only activated when the environment is dark, in Night mode, avoiding daytime shooting. Generates energy savings for the system
Automatic with delay	Uses the same principle as <i>Automatic</i> flash, but the <i>Delay</i> is used to optimize lighting at the time of capture
Continuous (Night) / OFF (Day)	Flash is triggered on all frames captured internally by the device when the ITSCAM VIGIA+ is operating in <i>Night</i> mode only. In <i>Day</i> mode, the illuminator is not activated

Ethernet Connection

ITSCAM VIGIA+ allows communication with other devices using the TCP/IP protocol over the Ethernet cable. For such connection, the equipment provides a Fast Ethernet port with an RJ45 connector, which follows the ANSI/TIA-568A standard in the connections:



Fast Ethernet connection speed is up to 100 Mbit/s with auto-negotiation, compliant with the IEEE 802.3af standard.

6. Software Specifications

ITSCAM VIGIA+ has a Web interface for evaluating the generated images and making configurations. Accessing the interface requires entering the standard access data:

User	admin
Password	123

The functionalities presented in this manual refer up to firmware 19.3.1, with further information and details specified in the ITSCAM Integration Manual.

Image Capture Architecture

The request for a photo can occur either through the Ethernet interface or from a signal on the input port of the ITSCAM VIGIA+, using, for example, external sensors. The events that can be configured to trigger image capture are:

Setting	Operation mode
1: Disabled	No requests via I/O are made
2: Rising edge	Images are sent when there is a rising edge on the I/O
3: Falling edge	Images are sent when there is a falling edge on the I/O
4: Rising and falling edge	Images are sent when there is a rising edge or falling edge on the I/O
5: Approaching image	The detection of the moment to perform the capture is determined by digital image processing (<i>Virtual Trigger</i>), when the positioning of the ITSCAM VIGIA+ captures the front plate of the vehicle first. Generate captures while detecting an approaching object or vehicle
6: Departure image (fast) 7: Departure image (slow)	In this trigger mode, the detection of the moment to perform the capture is determined by digital image processing. When ITSCAM VIGIA+ detects that an object or vehicle is moving from bottom to top in the image (distancing), images of the vehicle are captured, and OCR is processed (when enabled). This trigger can generate more than one event for each passage depending on the frame and speed of the object in the image.
8: Continuous	Embedded OCR disabled or not available: sends images continuously OCR enabled: capture images continuously, but send only those with recognized plate

Setting	Operation mode
9: Periodic	Captures are sent spaced by the specified time interval, regardless of the external signal of vehicle presence in the I/Os and the image analysis processing (Virtual Trigger), like Low Level, but with an interval specified in minutes. NTP server must be enabled
10: High level	Generates captures at regular intervals while the input 1 signal is at high level considering the <i>Pulse duration</i> specified in milliseconds
11: Low level	Generates captures at regular intervals while the signal of input 1 is at low level considering the <i>Pulse duration</i> specified in milliseconds
12: Rising edge and approaching	Generates a capture when it is detecting by image an object or vehicle approaching and simultaneously there is a <i>Rising Edge</i> on input 1, whichever occurs first
13: Motion Detector	Captures will be sent whenever the <i>Motion Detector</i> identifies variation in the image
14: Start-motion detector	Only a single capture will be sent once the <i>Motion Detector</i> starts to identify variations in the image
15: End-motion Detector	Only a single capture will be sent once the <i>Motion Detector</i> stops identifying variations in the image. Along with region of interest (ROI) positioning, it can detect a vehicle distancing

Virtual Trigger

In situations where the application of external sensors is not feasible, the ITSCAM VIGIA+ device can be configured to generate the trigger events by software from the analysis of the images. The *Virtual Trigger* corresponds to the vehicle detection process using only the statistical analysis of images that determines which images detected by the ITSCAM VIGIA+ device are more likely to contain a vehicle with a license plate.

The events that can be configured to trigger the image capture by *Virtual Trigger* are *Approaching image*, *Departure image*, *Rising edge and approaching* or *Motion Detector*. In these, the images will be processed so that the algorithm can detect the presence of a vehicle and then perform the capture.

Methods of vehicle detection by image are only available on the ITSCAM VIGIA+ model with 752x480 px resolution.

Motion Detector

Virtual Trigger can be activated with *Motion Detector* and consists of optimizing the processing of images without variation in content, necessary in situations where the vehicles flow is low and the images that are captured are not distinct.

The variation parameter is defined by the *Motion Detector Threshold*, which sets the sensitivity to motion between two consecutive images of the ITSCAM VIGIA+. In addition to this sensitivity, a ROI (Region of Interest) can be specified for images where motion will be evaluated, to restrict the search for license plates only in the portion demarcated in the image. It is recommended to use a region of interest to remove sidewalks and regions that are not part of the track. This region corresponds to a polygon with four vertices, which is drawn over the preview image generated by the device.

Multiple Exposures

The *Multiple Exposures* feature of the ITSCAM VIGIA+ is the generation of two to four sequential images per request, by setting the number of *Captures per pulse* through the interface. This functionality can increase the success rate in the automatic identification of license plates and to identify vehicles that were obscured in some way when the first image was taken. The configurations that may vary are:

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

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



Figure 14 - Multiple Exposures in daytime



Figure 15 - Multiple Exposures in nighttime

In both network triggers and I/O triggers, bursts of 2 to 4 images can be captured from a single request. All images in this burst are captured with the illuminator's flash shot. The minimum interval between frames varies according to the frame rate of ITSCAM VIGIA+ models, however, it can be configured:

Table 3 - Time between frames and number of frames per capture

Resolution	Time between frames*	Number of frames per request
640x480px	18,5 ms	1 a 16
752x480 px	16 ms	1 a 4
1280x800 px	50 ms	
1280x960 px	41,6 ms	

*The variation in the time interval between frames occurs due to the longer time required for the equipment to perform internal operations such as OCR, JPEG conversion, and others.

Majority Vote

When OCR is performed in *Multiple Exposures* or using sequential images with *Majority Vote* enabled, the reading results are combined to identify with greater reliability which vehicle license plate is detected, and the photos of the set will present the same OCR result.

The *Majority Vote* is a functionality applied to the results of the automatic reading step on characters from vehicle license plates (OCR). This analytic defines which character sequence best describes the license plate captured in the image. The algorithm compares the reliability of identification of each character, based on a character image in perfect reading conditions. This analysis can be done only on the set of images from *Multiple Exposures* or using sequential images. Just set the *Maximum Number of Different Characters* and *Timeout for plates in the recognized list*. During the passage of the vehicle through the region monitored by ITSCAM VIGIA+, several images of the same vehicle can be captured for processing. However, the option to *Send only the one with better recognition* can be enabled and the other images will be discarded.

After reading the OCR with the information of the best-identified plate, additionally, there is the option of grouping all the photos generated in *Multiple Exposures* in a single jpeg file, enabling the *Mosaic* functionality.

Day or Night Operation Mode

The ITSCAM VIGIA+ device operates in *Day* mode when it captures images with visible light only. Image capture using infrared light occurs only while the equipment is operating in *Night* mode. The transition between these operating modes uses the amount of available lighting in the environment to detect the best operating mode for the current situation.

Switching between *Day* and *Night* modes depends on a component called *Exchanger*. This electronic component has an internal mechanism that performs the positioning of a filter that prevents the passage of infrared light, allowing only the passage of visible light during the day. This filter is located between the light entry and the image sensor.

To maintain the brightness level of the images throughout day and night, ITSCAM VIGIA+ performs a combined adjustment of the *Iris*, *Shutter* (image sensor exposure time), and *Gain* (digital post-processing of captured images). These adjustments are combined to achieve the *Lightness Level* configured in the image. When *Shutter* and *Gain* reach the specified limit values and the ITSCAM VIGIA+ cannot reach the desired *Level*, the operation mode of the equipment must be switched to *Day* or *Night*.

For all firmware versions, 18 and newer, the *Day* and *Night* auto mode feature has had a major change in ITSCAM VIGIA+, which still controls *Iris*, *Shutter*, and *Gain*, but uses two different percentage criteria to switch between modes. After this change, we have two new variables (CGI commands – Common Gateway

Interface) and, applying a more recent firmware version, the default parameters are adopted with the same percentage for both configurations. The suggested setting for these parameters is 50% of the desired *Level* for transitioning to *Night* mode and 90% of the desired *Level* for transitioning to *Day* mode.

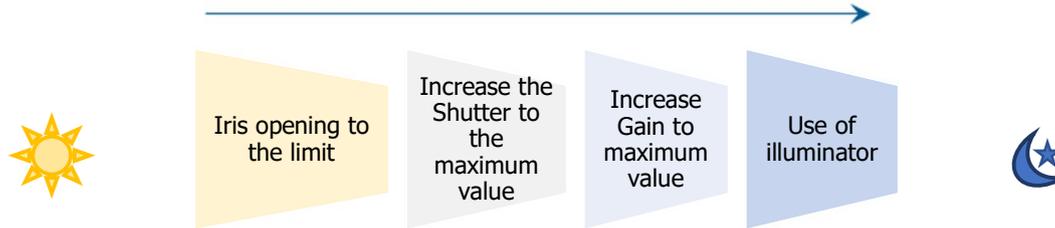


Figure 16 - Sequence of adjustments performed by ITSCAM VIGIA+ in the transition from day to night

This procedure is performed in reverse order for the transition from night to day

Setting	Operation mode
Manual	It always provides images in the specified Day or Night format or according to the input signal.
Automatic	Operating in <i>Day</i> mode: When the <i>Current Level</i> remains below the transition threshold for about 60 seconds, ITSCAM VIGIA+ switches to <i>Night</i> mode. Operating in <i>Night</i> mode: when the <i>Current Level</i> remains above the transition threshold for about 60 seconds, ITSCAM VIGIA+ will operate in <i>Day</i> mode.

7. Licensing

The ITSCAM VIGIA+ license includes the hardware of the image capture and processing device, in addition to the features presented in this manual. New features and bug fixes are made available in new firmware versions by Technical Support via the Pumatronix website.

8. Initial Setting

Installation Prerequisites

Positioning of ITSCAM VIGIA+

To extract the best performance from the ITSCAM VIGIA+, it is recommended that its installation be made parallel to the track and with little horizontal inclination. Concealment of parts of the image by objects such as trees or vehicles from other tracks must be avoided. In situations of reflections such as sunlight, adjust the *Sliding Flap* to the best position that can prevent interference in the quality of the images:

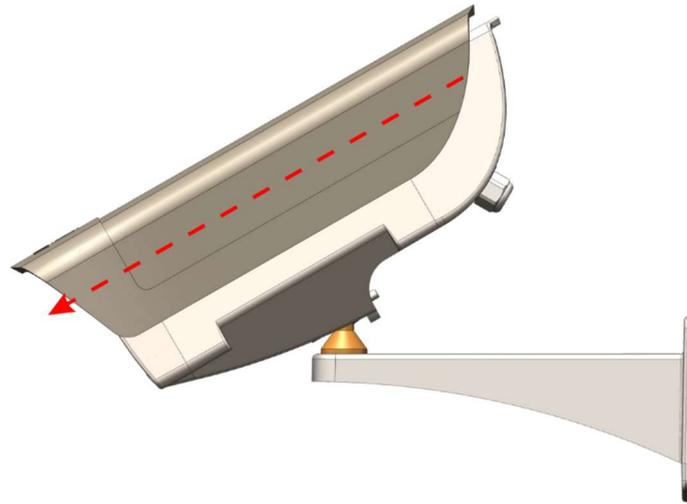


Figure 17 - Illustration of the direction of lens cover extension by the Sliding Flap

The zoom and focus adjustment are intended to produce images where the license plate characters are approximately 20 pixels high. However, the height of the characters can vary from 15 to 30 pixels, and the best recognition rates correspond to the height of 20 pixels.

In traffic enforcement applications, ITSCAM VIGIA+ can be installed on poles or gantries with a maximum height of 1.5 meters, which allows OCR reading. The minimum vertical angle of 15° and the maximum of 45° between the lens center and a line parallel to the ground must be respected, adjusting zoom and focus for the best visibility of the license plate. The distance from ITSCAM VIGIA+ to the vehicles' crossing point varies according to the [lens applied to the model](#).



Illuminator Installation: When using an illuminator with the ITSCAM VIGIA+ device, check the product specifications for the minimum and maximum distance that must be observed from the position of the object intended to be illuminated.

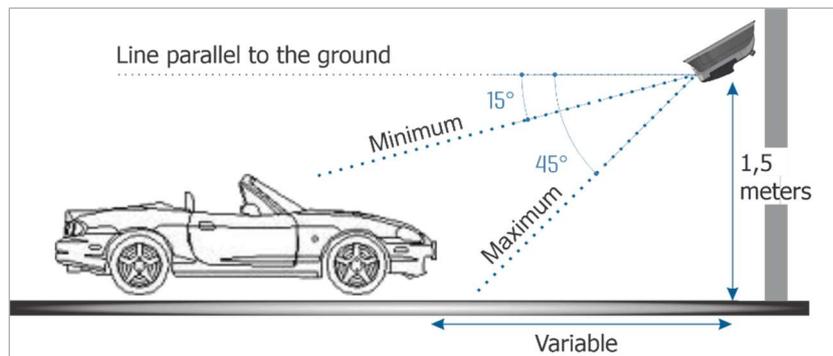


Figure 18 - Side View of the Installation

The captured plate must present a maximum horizontal angle of 30° in relation to the side of the road:

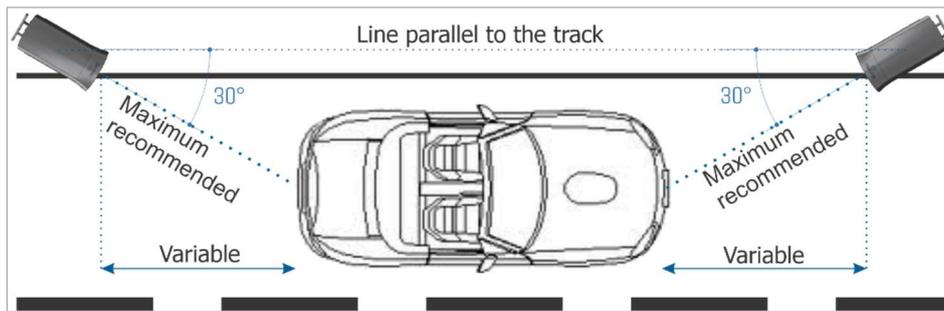


Figure 19 - Top view of the installation

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

Settings for OCR Plate Reading

For ITSCAM VIGIA+ to automatically read vehicle license plates, when starting the equipment, make the following settings:

- 1) Update the ITSCAM VIGIA+ network setting;
- 2) Set the format and quality of the captured images;
- 3) Adjust OCR and MAP processing settings, when available;
- 4) Adjust zoom and focus, which can be done at any time during the configuration process, but it is mandatory. The image parameters indicated for the ITSCAM VIGIA+ are listed in the Integration Manual.

Conditions Required for Installation

After meeting the ITSCAM VIGIA+ positioning prerequisites, check the network setting in which the equipment will be installed and perform the necessary parameterization.



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

Network Interface Parameterization

If the application that uses ITSCAM VIGIA+ presents a network setting different from the equipment's factory default, it is recommended to change the network setting before installing it on the local network. The default network setting of the ITSCAM VIGIA+ is:

Setting	Default Value
IP address	192.168.0.254
Maintenance IP address	192.168.254.254
Network mask	255.255.255.0

The changed network setting is saved in flash memory; however, it is effectively applied after restarting the equipment. When the change is made via web interface, this restart is automatic after the change is confirmed.

ITSCAM VIGIA+ has a recovery IP address (192.168.254.254) for cases in which the user mistakenly changes the IP address and loses connection with the device. Access to this recovery IP address is only available in a point-to-point connection with the equipment.



The ITSCAM VIGIA+ maintenance IP address (192.168.254.254) is disabled when the primary IP address conflicts with it. Therefore, when manually configuring the equipment's network interface (Ethernet), values other than the maintenance IP must be applied, as there will be no way to recover the connection in case of loss of the configured IP address.

The most common situations of conflict between the primary and maintenance IP addresses are:

- Primary IP of ITSCAM VIGIA+ in the range 192.168.254.x and network mask 255.255.255.0;
- Primary IP of ITSCAM VIGIA+ in the range 192.168.x.x and network mask 255.255.0.0;
- Primary IP of ITSCAM VIGIA+ in the range 192.x.x.x and network mask 255.0.0.0;
- Network mask set to 0.0.0.0.

9. First Access

The ITSCAM VIGIA+ web interface can be used to quickly check the status of the equipment and monitor the images in real-time. However, the equipment must be energized, following the [Electrical Specifications](#). An auxiliary device with the Google Chrome browser (version 85 or higher) installed must be used and this device must be on the same data network as the ITSCAM VIGIA+ (with a network setting compatible with that carried out on the ITSCAM VIGIA+).

If a point-to-point connection is used, ITSCAM VIGIA+ can be accessed via the maintenance IP address 192.168.254.254. When entering the IP address of ITSCAM VIGIA+ in the address bar of the auxiliary device's browser, it must be informed:

User	admin
Password	123

10. Care and Maintenance

Some care is required to ensure the performance of the product and extend its service life.



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

Firmware Update

Pumatronix periodically provides updates for ITSCAM VIGIA+ with defect corrections and functionality additions, by contacting Technical Support on the Pumatronix website. The equipment update process requires an auxiliary device to connect to the equipment and can be done by specific update software available from Pumatronix, or 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 VIGIA+ firmware requires some security measures during the procedure, to prevent the file from being corrupted and the ITSCAM VIGIA+ device stop working:

- 1) Keep the ITSCAM VIGIA+ device inactivated during the update process, ensuring that it is not required by any service or other equipment on the network where it is installed;
- 2) Keep the ITSCAM VIGIA+ device always turned on while the update is running, taking the necessary measures to prevent it from being restarted or turned off;
- 3) Request the firmware file by filling out the form available in the Technical Support menu at Pumatronix website:



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

Update of ITSCAM VIGIA+ through Web Interface

- 4) Finalize o procedimento de atualização verificando a versão do firmware indicada na barra superior da página.
- 5) Download the firmware file received by email on the auxiliary device that will be used to connect to the ITSCAM VIGIA+;
- 6) Connect the auxiliary device to the same data network as the ITSCAM VIGIA+;
- 7) Open an auxiliary device browser to access the ITSCAM VIGIA+ web interface;
- 8) Enter the IP address of the ITSCAM VIGIA+ (the default IP address is 192.168.0.254 and point-to-point connections can be made via the address 192.168.254.254);
- 9) Log in with the *login* and *password*;
- 10) Access the menu *Update Firmware*;
- 11) Select the saved firmware file;
- 12) Click *Transfer* and monitor the *Progress of the firmware transfer* until it reaches 100%, ensuring that it is **not** rebooted or disconnected and that it is **not** being requested by any service or other equipment on the network during the transfer. This security is required when performing this procedure to prevent the update from corrupting the firmware and the equipment from crashing;
- 13) Click the *Restart* button while waiting for the equipment to restart to apply the new firmware changes;
- 14) Finish the update procedure by checking the firmware version indicated in the top bar of the page.

Update of ITSCAM VIGIA+ with Pumatronix Software (ITSUPDATE)

- 1) Download the firmware file available on the auxiliary device that will be used to access the ITSCAM VIGIA+ web interface;

- 2) Connect the auxiliary device to the same data network as the ITSCAM VIGIA+;
- 3) Open the ITSUPDATE update software, available for download at www.pumatronix.com;
- 4) Select ITSCAM VIGIA+ under *Equipment Type*;
- 5) Enter the IP address of the ITSCAM VIGIA+ in *Equipment Address*;
- 6) Enter the path to the firmware file in the *Firmware file*;
- 7) Enter the last 4 digits of the file name (shown after the symbol "_" before the *.frw* file extension);
- 8) Click *Transfer* and monitor the *Progress of the firmware transfer* until it reaches 100%, ensuring that it is **not** rebooted or disconnected and that it is **not** being requested by any service or other equipment on the network during the transfer. This security is required when performing this procedure to prevent the update from corrupting the firmware and the equipment from crashing;
- 9) Click *Update* on the web page, waiting for the device's new firmware to be updated and applied;
- 10) Finish the update procedure by checking the firmware version indicated in the top bar of the page.

Preventive Maintenance

The ITSCAM VIGIA+ image capture and processing device must provide artifact-free images. However, if the external surface of the lenses or the protection case shows any dirt, the cleaning procedure must be performed:

- 1) Spray lens cleaning fluid on the lens surface or water on the protection case glass so that excess dirt can be removed from the surface;
- 2) Use a soft, lint-free cloth to remove dirt, moving the cloth in one direction only;
- 3) Use a dry cloth afterward to finish cleaning and do not use force, as this can damage the surface.

11. General Conditions of the Warranty

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

The replacement of defective parts and the performance of services resulting from this Warranty will only be carried out at the Authorized Technical Assistance of Pumatronix 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 accompanied by an Invoice.

Situations in which the Product Loses the Warranty

- 1) Use of software/hardware not compatible with the specifications in the Manual;
- 2) Connection of the product to the power grid outside the standards established in the product manual and installations that present excessive voltage variation;
- 3) Infiltration of liquids from the 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) Use of the product in environments subject to corrosive gases, with excessive humidity and/or dust;

- 6) Show signs of security seals tampering;
- 7) Show signs of opening and modification made by the Client in places 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 transport and packaging of the product by the Client in unsuited conditions;
- 11) Misuse and not in accordance with the Instruction Manual.

Privacy Policy

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

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





www.pumatronix.com

