

TC400GC TrafficCam

Installation and Operation Manual

Includes Web Interface Set-up, Trouble-Shooting, and Support

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Revision: -

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HISTORY OF REVISIONS

REVISION No.	DATE	DESCRIPTION
-	MAR 2018	Initial Release

IMPORTANT NOTES

DISPOSAL

The TC400GC TrafficCam is designed to have a long service life and contains state-of-the-art technology. As with all electronic products, future technological developments can create a need/desire to replace/upgrade equipment. When the time comes to replace, upgrade, or dispose your Viion TC400GC TrafficCam, please dispose of the camera and its hardware properly at a certified electronics recycling/disposal center.

CELLULAR/WIRELESS

The TC400GS TrafficCam is a cellular transmitting/receiving device. Cellular communications may be enabled if cellular wireless data transmission capability is desired and available in the installation area. It is the customer's responsibility to provide a cellular SIM card to enable the wireless data transmission option. Further, the customer must ensure this equipment is compliant and compatible with the mobile carrier in the planned installation area prior to purchase.

The TC400GC TrafficCam supports the following GSM band frequencies providing worldwide cellular coverage:

HSPA 850, 900, 1700, 1900, 2100 MHz

WARRANTEE

Viion Systems Inc. ("Viion") warrants the TC400GC TrafficCam to be free of defects in materials or workmanship under normal use for three (3) years from the original date of purchase. If a defect is discovered during the applicable warranty period, Viion will repair or replace, at its option, the product or the defective part. This warrantee extends only to the original purchaser of the Viion product.

This warrantee does not extend to repairs, adjustments, or replacements of a Viion product or part that results from misuse, negligence, alteration, modification, tampering, vandalism, or improper installation/maintenance of the product.

This warrantee does not extend to repairs, adjustments, or replacements of a Viion product or part that results from any damage resulting from extreme weather conditions such as lightning strikes, strong storms and hurricanes.

Due to the nature of computer vision technology employed by the TC400GC TrafficCam, there are factors which could influence the accuracy of vehicle speed estimation and/or license plate reading. Factors such as multiple license plate issues (character sizes, font, color, back ground, reflectivity, etc..), and environmental factors such as rain, snow, fog as well as dirty or damaged license plates may limit the accuracy of the device.

ORDERING INFORMATION

To receive additional copies of this publication, order Document number **DM-TC400GC Rev -**, TrafficCam TC400GC Installation and Operation Manual.

To order additional or replacement components for your Viion TrafficCam TC400GC system contact:

sales@Viionsystems.com

NOTES

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1 INTRODUCTION

1.1 ABOUT THIS MANUAL

This manual describes the installation and operation of the TC400GC TrafficCam. It is intended for use by persons suitably qualified and experienced in the installation, operation and maintenance of sensitive electronic equipment in regulated environments such as roadways, railways, airports, etc.

It is the responsibility of the customer, contractor, and installer to ensure all applicable usage, regulatory, environmental, and safety requirements for the system and installation area are met.

1.2 SAFETY CONSIDERATIONS

WARNING – DO NOT LOOK DIRECTLY INTO THE LED ARRAY LOCATED AT THE FRONT OF THE CAMERA. PROLONGED CLOSE PROXIMITY EXPOSURE TO HIGH INTENSITY NEAR INFRARED LIGHT MAY PRESENT A RISK OF PERMANENT DAMAGE TO THE EYE(S) OR BLINDNESS.

While installing the TC400GC TrafficCam, the customer/contractor must consider and take the appropriate safety precautions while working alone and/or at heights as applicable to the installation. Further, the customer/contractor must take appropriate safety precautions while working on or around roadways, airports/aircraft, railways, etc. as applicable to the installation.

DO NOT attempt to install any electronic equipment on or around tall metal structures during weather events where there is a risk of a lightning strike.

DO NOT install any electronic equipment in wet weather and always take appropriate precautions to avoid electric shock.

DO NOT operate the TC400GC TrafficCam in areas where blasting is in progress, where explosive or flammable materials may be present, or near any electronic equipment which may be susceptible to radio frequency interference. In such areas, the TC400GC TrafficCam should be completely disconnected from all power sources and communications cables to avoid potentially hazardous conditions.

If your camera is mounted magnetically to the body/roof of a vehicle – **DO NOT OPERATE THE CAMERA** unless the vehicle is stationary. The camera must be removed before moving the vehicle.

1.3 QUICK START GUIDE

The TC400GC TrafficCam is a monitoring device that is easy to install and configure and can be deployed in a few minutes using a standard web browser and Viion's Web Interface. This section provides a brief overview of a typical installation for experienced contractors and estimating purposes. For detailed product information, installation instructions, and set-up information refer to the relevant sections later in this manual.

1.3.1 Connect the Camera

Connect the camera to a 110VAC power supply using the supplied power adapter. Connect the camera to a Local Area Network (LAN) with a DHCP server using the supplied Ethernet cable. Wait for a blue or green flashing LED on the front of the camera.

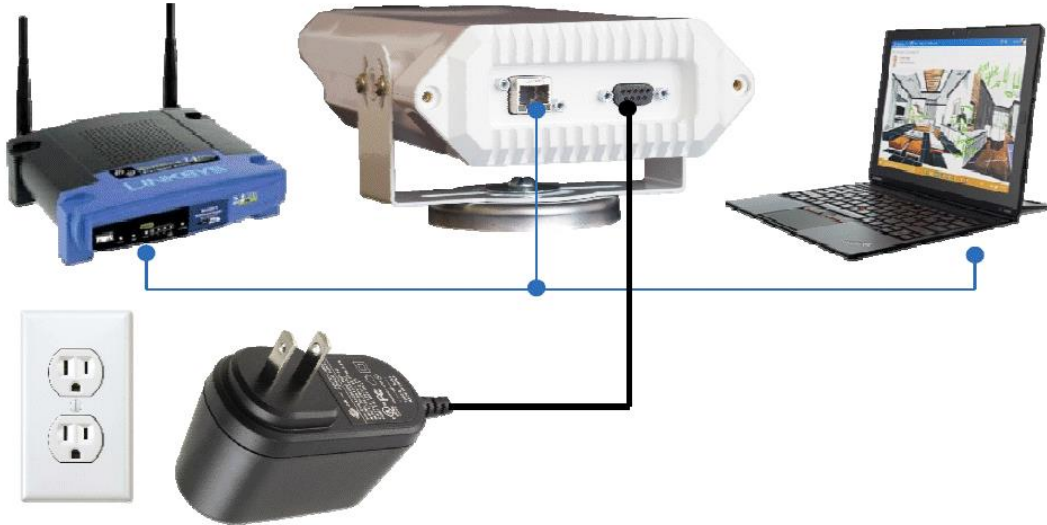


Figure 1: Quick start TrafficCam setup. The TrafficCam may powered from a 110 VAC to 12 VDC adapter, and is connected to a laptop where the web interface can be run.

1.3.2 Network Interface

Open Windows Explorer and locate the Viion TrafficCam under “Network” (make sure network discovery is enabled) Hit F5 to refresh devices if the icon does not appear.

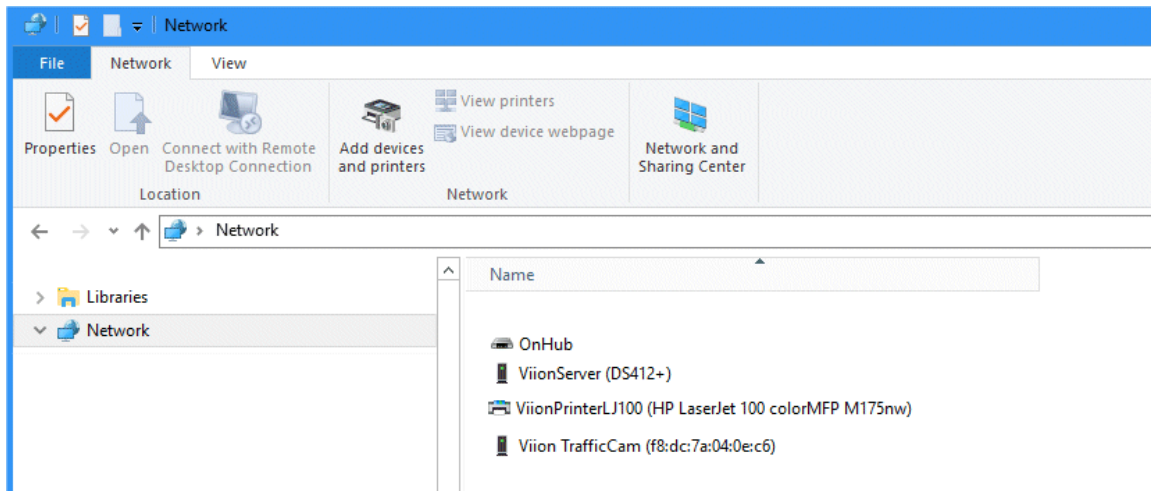


Figure 2: Viion TrafficCam listed under Network when using Microsoft Windows Explorer.

1.3.3 Application

Double click on the Viion TrafficCam icon to open the web page. Click “Play IR” to see video. Turn on overlayEnabled under Event Setup to see license plate information.



Figure 3: Live Feed within Web Interface

1.3.4 Calibration

For on-street calibration, aim across the lanes at approximately 20 degrees. Turn on “showLanePaths” under Event Setup and ensure passing plates are between 8 and 20 m. Adjust the tilt (up and down) such that both lanes are visible in the right and left side of the field of view.

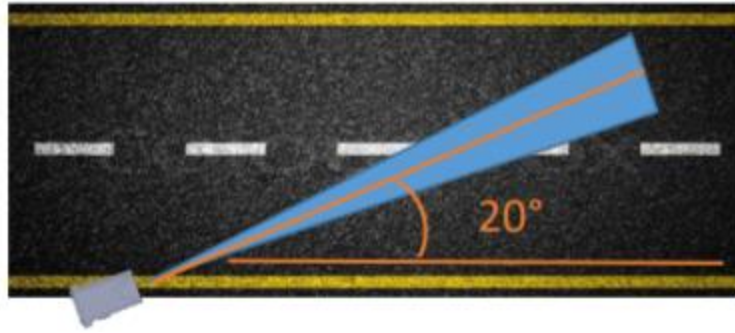







Figure 4: Typical side-mounted viewing angle.

1.3.5 Status LED – Legend

Status LED Color	Status Description
 Solid White 0-15 Sec	Power On – Normal First Status
 Solid Purple 15-45 Sec	System Start-up – Normal Second Status
 Flashing Green > 45 Sec	Connected to Internet
 Flashing Blue > 45 Sec	Not Connected to Internet
 Flashing Red > 45 Sec	Hardware or Software Fault

1.4 PRODUCT INTRODUCTION – CONTENTS AND DESCRIPTION

The TC400GC TrafficCam uses powerful on-board analytics to measure and record traffic-based data. The design includes a compact, rugged, fully integrated traffic monitoring camera that can generate high quality images suitable for automatic license plate recognition and speed estimation.

On-board hardware includes a Quad-Core ARM CPU, dual video sensors, near infrared illuminator, GPS, Wi-Fi, Ethernet and cellular communication interfaces sealed inside an IP67 rated enclosure.

1.4.1 Unpacking the Equipment

Carefully unpack the equipment. Visually inspect the package contents for any evidence of shipping damage. Retain all shipping containers and packaging materials in case re-shipment is necessary.

Begin by opening the box from the top, taking care not to cut deeply into the package as doing so could damage the camera inside. Carefully remove the camera. Depending on the ordered options, other items may also be included in the box including a RJ-45 Cable Sealing Boot, DB9 Connector Sealing Plug, and printed copy of this manual.

Inspect all items for damage sustained during shipping. Confirm all components are included in the box as listed in Section 1.4.2 below. If any items are damaged or missing, contact your sales associate immediately.

1.4.2 Package Contents

The TC400GC TrafficCam system package includes the following components:

Item	Quantity
TC400GC TrafficCam w/ Pan/Tilt Mounting Bracket	1
RJ-45 Cable Sealing Boot	1
DB9 Connector Sealing Plug	1
RJ-45 Sealing Plug	1
TC400GC TrafficCam Installation and Operation Manual	1

If an evaluation version or custom application TC400GC TrafficCam was ordered, additional signal and/or power cables may be included in the package. Refer to your purchase order to confirm all ordered components are included in the shipping package.

Note if cables were ordered with your TC400GC TrafficCam, the cables will be packed on the bottom of the box. **DO NOT** use a sharp object to cut open the box from the bottom as this could damage the cables.

1.5 PRODUCT FEATURES/APPLICATIONS

1.5.1 Design

The TC400GC TrafficCam is designed to capture and transmit vehicle images, video, and license plate information for up to two (2) lanes of traffic. Performance will be influenced by viewing range, viewing angle constraints, illumination and weather conditions.

1.5.2 Overview - Nomenclature

External Features

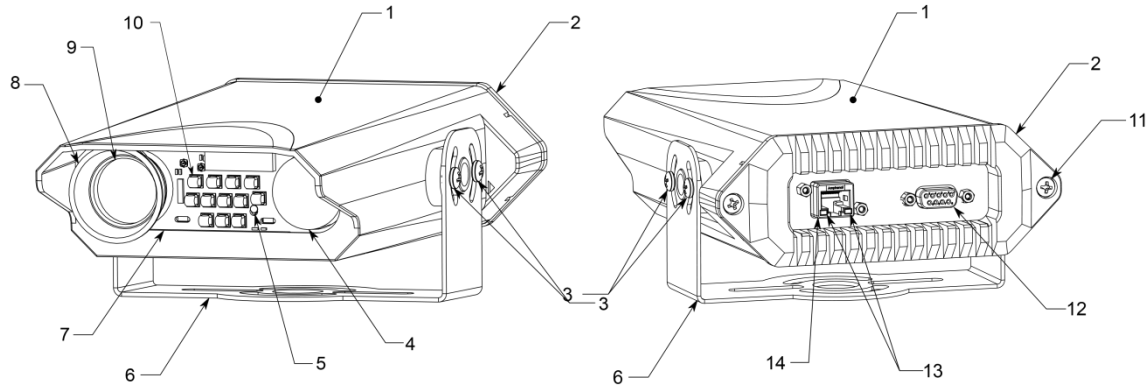
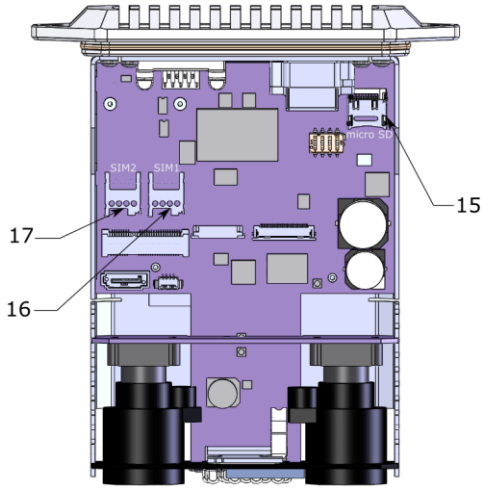


Figure 5: TrafficCam External Features.

Item	Description – External Features	Quantity
1	Enclosure Body	1
2	End Cap	1
3	Tilt Lock Screws	4
4	Color Overview Lens	1
5	Status LED	1
6	Pan/Tilt Base Plate	1
7	Window	1
8	Near-Infrared Lens Hood	1
9	Near-Infrared Lens	1
10	Near-Infrared Illuminator	12
11	Securing Screws – End Cap	2
12	DB9 Power/Signal Port	1
13	Ethernet Status (Link/Activity) Lights	2
14	Ethernet Connector	1

Internal Features



Item	Description – Internal Features	Quantity
15	SD Card Slot	1
16	SIM Card Slot 1	1
17	SIM Card Slot 2	1

Figure 6: TrafficCam internal Features

1.5.3 Processor

Each unit contains a Quad-Core ARM processor which runs proprietary software which implements image and video capture, communications, and video analytics including detecting and reading licence plates, and estimating vehicle speed.

1.5.4 Sensors

There are two (2) 1280x960 resolution optical sensors within each TC400GC TrafficCam:

Color Overview Sensor (Item 4) – Video playback appears in color. This sensor is normally used to collect overview images and video.

Near Infrared Sensor (Item 9) – Video playback appears black and white. This sensor is normally used for all license plate recognition and speed estimation applications.

1.5.5 Near Infrared Illuminator

There is a 12x near infrared LED array (Item 10) included in each TC400GC TrafficCam. The near infrared illuminator is always on when the camera is powered on, and is used to illuminate objects passing in front of the camera for the near infrared sensor (item 9) to capture. The near infrared illuminator appears a dim red color to the eye as the light emitted is at the edge of the visible spectrum.

WARNING – Although the red light emitted from the illuminator appears dim, the illuminator emits powerful non-visible light which can damage the eyes if prolonged close proximity exposure is allowed. See complete safety considerations listed in Section 1.2.

1.5.6 Serial No. and MAC Address

Each TC400GC TrafficCam has a unique Serial Number and MAC address shown on a label located on the bottom face of the camera as shown in Figure 7.

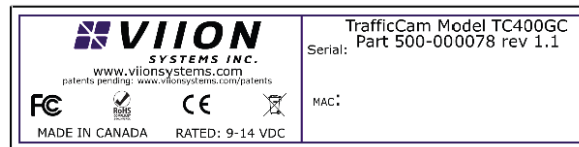


Figure 7: A tag located on the underside of unit contains a serial number and Mac address.

1.6 ACCESSORIES/REQUIREMENTS NOT SUPPLIED

The TC400GC TrafficCam is intended for use with standard electronic cabling and equipment. The following items (not supplied) are required for typical installations:

- RJ 45 Cables
- Power supply cable with DB9 termination (see Appendix C – Cable Specification)
- SIM Card
- Pole or wall mount bracket
- Zip ties/cable clamps

1.7 SPECIAL TOOLS REQUIRED

The following tools are required to install the TC400GC TrafficCam:

- 3/8" Standard Box Wrench. A3/8" Ratcheting Wrench is ideal however a standard box wrench will suffice. Standard sockets are not compatible with the geometry of the camera mounting structures.
- #2 Phillips Screw Driver
- Medium Flathead Screw Driver
- RJ45 Connector crimp tool

1.8 LICENSE REQUIREMENTS/AGREEMENTS

The software running on the camera includes BSD LGPL and Apache open source software licenses:

https://en.wikipedia.org/wiki/BSD_licenses

https://en.wikipedia.org/wiki/GNU_Lesser_General_Public_License

https://en.wikipedia.org/wiki/Apache_License

2 INSTALLATION (*HARDWARE*)

This section describes the installation of the TC400GC TrafficCam including mounting, aiming, and electrical connections. A post installation check list is included in Section 2.9

2.1 SAFETY CONSIDERATIONS

WARNING – DO NOT LOOK DIRECTLY INTO THE LED ARRAY LOCATED AT THE FRONT OF THE CAMERA. PROLONGED CLOSE PROXIMITY EXPOSURE TO HIGH INTENSITY NEAR INFRARED LIGHT MAY PRESENT A RISK OF PERMANENT DAMAGE TO THE EYE(S) OR BLINDNESS.

While installing the TC400GC TrafficCam take appropriate safety precautions while working alone and/or at heights as applicable to the installation. Further take appropriate safety precautions while working on or around roadways, airports/aircraft, railways, etc. as applicable to the installation.

DO NOT attempt to install any electronic equipment on or around tall metal structures during weather events where there is a risk of a lightning strike.

DO NOT install any electronic equipment in wet weather and always take appropriate precautions to avoid electric shock.

2.2 PRE-INSTALLATION INFORMATION

Always follow good electrical installation practices and carry out the installation using a suitable qualified and experienced contractor familiar with the applicable building codes and regulations in your area. Follow the installation procedure in this section as it is presented for a successful installation. Read the entire section before beginning the installation. Perform the post-installation check before closing out the work area.

2.3 INSTALLATION OVERVIEW

A successful installation should begin with careful planning; including determination of the best camera mounting location considering viewing angle and periodic maintenance access. Once the mounting location has been determined, prepare the mounting bracket and electrical cabling for installation. It may be easier to rough in the cabling and secure to the mounting frame before installing the mounting frame to the mounting structure.

2.3.1 Operating Conditions

The TC400GC TrafficCam is designed to function within certain environmental/installation parameters. Failure to meet the recommended operating conditions may result in reduced performance and/or

reduced operational lifetime of the product. For effective operation, the product must be installed and operated according to the conditions below:

Item	Value / Description	Units
Nearest vehicle detection distance ¹	5	m
Furthest vehicle detection distance ¹	20	m
Operating temperature – POE	-40 to +50	°C
Operating temperature – 12V	-40 to + 60	°C
Storage temperature	-45 to + 85	°C
Maximum shock stress, non-repetitive	4	G
Wind Speed	80 Max	Km/h
Required License plate type ¹	Dark characters, retro-reflective background	
Cleanliness requirement ¹	License plates must be substantially free from dirt, visible, and in good condition with high contrast between character and background.	

2.4 INSTALLATION CONSIDERATIONS

The TC400GC TrafficCam is designed to mount to an exterior pole, overhead frame, or similar structure adjacent to or over a roadway. The standard product package does not include camera mounting provisions or brackets. Viion offers several mounting brackets for purchase separately as shown in Section 2.5.

Avoid installing the TC400GC TrafficCam near high voltage equipment.

Viion does not recommend mounting the camera to non-rigid structures such as trees. Slight movements in the mounting structure can reduce the cameras performance, ability to collect license plate data, and capture the correct area of the road way.

Consider environmental factors in the planned installation area such as heavy rain, snow and fog which can impede the cameras vision. Also consider trees and branches near or in front of the camera as they can grow or sway in the wind which may damage the camera or block the cameras view of the road.

Ensure there is free air movement around the camera, do not install the camera inside a close-fitting enclosure as air must be allowed to flow around the camera for cooling requirements. The cameras End Cap, see Para 1.5.2 (Item 2), also functions as a heat sink for the electronic equipment inside the camera. If the camera must be mounted inside an enclosure, consider including a forced air ventilation component to keep the camera well ventilated and cooled. See Section 2.3.1 for operating temperature ranges.

NOTE – Dusty areas contributing to dirty or damaged license plates may limit the accuracy of speed measurements.

¹ For applications where license plate reading or speed estimation is performed.

NOTE – Some jurisdictions may require an additional restraining device (ie strap) to ensure the TrafficCam cannot not fall onto the roadway or into traffic. It is the responsibility of the installer to ensure compliance with local safety requirements and codes.

2.5 EQUIPMENT MOUNTING

Viion offers a variety of mounting brackets for use with the TC400GC TrafficCam to suit different applications such as wall or pole mounting. There is also a magnetic mount option available for temporary/mobile applications.

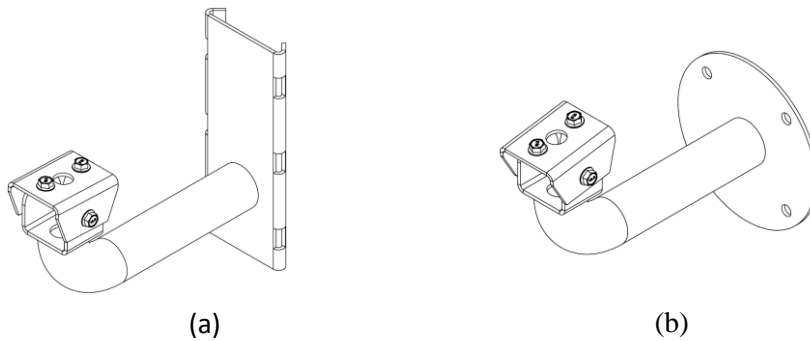


Figure 8: Mounting bracket options. (a) Pole-mount, and (b) wall-mount.

Once the applicable mounting bracket has been selected and installed on the mounting structure, attach the camera Pan/Tilt Base Plate, (see Figure 5, Item 6), to the mounting bracket using the supplied fasteners.

Note – Always follow proper safety procedures best practices while installing electrical equipment. The Installer should consider the hazards associated with working alone, at heights, working around traffic, railways, aircraft, etc. Always take precautions to avoid the risks of lightning strikes and electrical shock while installing the camera and mounting brackets.

Safety Reminder – DO NOT LOOK DIRECTLY INTO THE LED ARRAY LOCATED AT THE FRONT OF THE CAMERA. See Section 1.2 for a complete list of safety considerations.

2.6 ELECTRICAL CONNECTIONS

The standard TC400GC TrafficCam installation kit does not include installation cabling – all Ethernet and power cabling is the responsibility of the customer/contractor to provide for the installation. Various Ethernet and power cables are available separately from Viion and may be provided for some TC400GC TrafficCam evaluation versions and temporary installations.

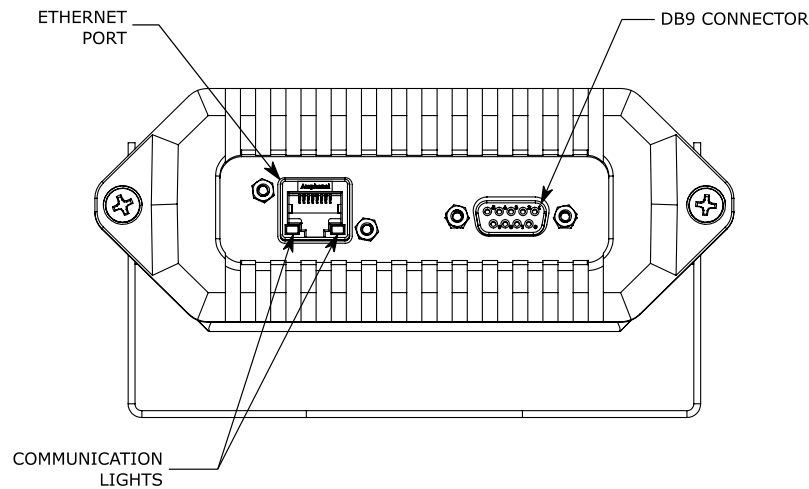


Figure 9: Electrical Connections.

For non-POE installations where installers are providing their own power cabling please refer to Appendix C – Cable Specification.

2.6.1 Wireless 3G

The Viion TrafficCam supports worldwide 3G cellular connectivity provide through the use of a standard SIM card. There are two (2) MicroSIM card ports available. Install the customer supplied SIM card into SIM1 (Item 16) as shown in Figure 6. The back plate of the unit is removed by unscrewing the two rear Phillips screws. Carefully slide the camera frame out of the housing, and you will see the locations for installing SIM cards as outlined in Figure 6.

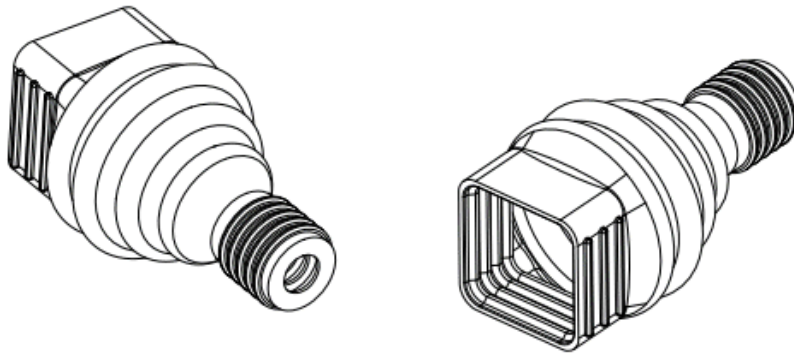
2.6.2 Power

The TC400GC TrafficCam is powered through either the DB9 connector or via Power-Over-Ethernet (POE).

DB9 Connector – Connect the DB9 power connector to the plug show in Figure 9 above. Ensure the DB9 connector is properly secured to the camera, the 2x securing screws are tight, and the seal is properly seated on the camera surface. Power is supplied through this cable, and wiring details are given in Appendix C – Cable Specification.

Power-Over-Ethernet – The TrafficCam can be powered using POE 802.3af (13W). Install the supplied RJ-45 connector sealing boot over the RJ-45 Ethernet connector and connect to the Ethernet plug show in Figure 6 above. Note that a standard POE supply is required at the other end of the cable.

Note – A **SEALED** DB9 connector and/or the supplied Ethernet sealing boot **MUST** be used for all installations (see below). THE CAMERA WARRANTY is void if the correct connector seals are not used.



AMPHENOL PART NO.	COLOUR
MRJ-258E-11BP	TRANSPARENT
MRJ-258E-12BP	BLACK

Figure 10: Amphenol boot required to seal Ethernet cable at rear connector when used.

In some cases one or both of the rear connectors will not be required. It is recommended that the sealing plugs supplied with each camera be used to protect exposed un-used connectors from the elements. Both types of sealing plugs are provided with TrafficCam units, and examples are shown below.



Figure 11: Seals used to protect connectors at the rear of TrafficCam - (a) for DB9, and (b) for RJ45.

2.6.3 Communication

Install the supplied Ethernet connector sealing boot over the Ethernet connector and connect to the Ethernet plug shown in Figure 6 above. By default, the TrafficCam is configured to automatically have an IP address assigned on networks that have Dynamic Host Configuration Protocol (DHCP) services. If the network does not have a DHCP server, then the unit should be configured to use a fixed IP address that can be assigned through the Networking section of the Web Interface (see section 3.5). In most installations, it will be important that the TrafficCam be able to contact Internet-based servers. Once a device is configured correctly, connection to the Internet is indicated by a green flashing status LED (see Table 1 below).

Secure all cables to the mounting bracket and mounting structure as required using zip ties, cable clamps, or similar materials to ensure cables remain firmly in place.

Once the TC400GC TrafficCam is connected to Power and a LAN, the Status LED located on the front of the camera (Section 1.5.2, item 5) will illuminate. See Table below for Status LED Color and meaning.






Status LED Color		Status Description
	Solid White 0-15 Sec	Power On – Normal First Status
	Solid Purple 15-45 Sec	System Start-up – Normal Second Status
	Flashing Green	Camera operational Connected to Internet
	Flashing Blue	Camera operational – Not Connected to Internet
	Flashing Red > 45 Sec	Hardware or Software Fault

Table 1: Color legend for status LED located at the front of the TrafficCam.

2.7 CAMERA AIMING

Once the camera is installed on the mounting structure and the power and communication cables are connected aim the camera across the roadway at approximately 20 degrees as shown in Figure 12 and tighten the fasteners attaching the camera Pan/Tilt Base Plate, Item 6 in Section 1.5.2, to the mounting bracket.

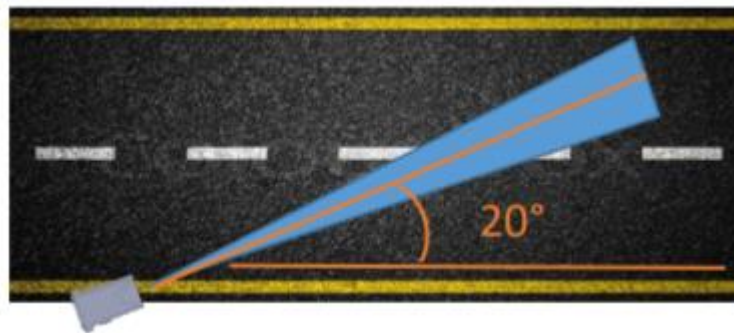


Figure 12: Camera aiming for a typical road-side mounted configuration.

Refer to Section 3.8 for Camera Set-Up using the Web Application, and tilt the camera up and down to make final camera aiming adjustments such that the roadway video/image appears approximately as shown in Figure 13:



Figure 13: Lane path feedback using the web Interface.

Lines indicate the paths of vehicles in lanes 1(blue) and 2 (green). The numbers at the end of each line indicate the distances as estimated to each of the last passing vehicles. Overlay must be enabled to access this feature.

The lane paths are used to select the correct camera aiming. In a two-lane configuration (as shown above), there should be two sets of paths – one green (lane 2) and one blue (lane 1). The numbers at the end of each line indicate the distances to the vehicles that were passing in these lanes. For a correct alignment, the smallest values should be around 8-10 m, and the largest values should be between 18-22m.

Once the camera is correctly aimed, tighten the 2x Phillips Tilt Locking Screws on each side of the camera – see Item 3 in Section 1.5.2.

2.8 USING WEB INTERFACE – SYSTEM CONFIGURATION

The power and communication connections described in the preceding sections must be connected prior to proceeding with the following network installation.

2.8.1 Device Detection

Begin the Device Detection by launching Windows Explore and expand the Network link under MyDesktop:

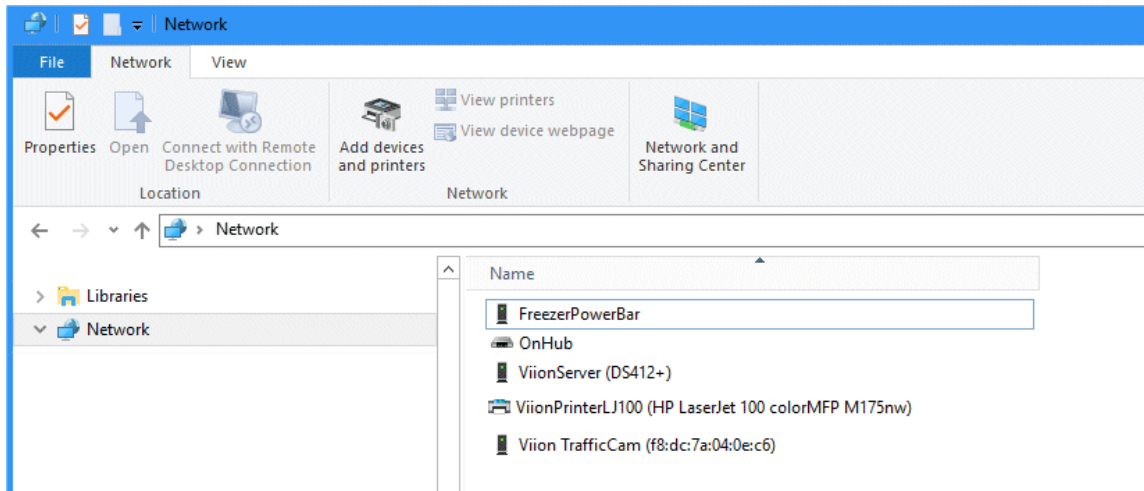


Figure 14: Detecting a Viion TrafficCam in Microsoft Windows explorer under Network.

Double click on the Viion TrafficCam link.

Note – Some networks may occasionally lose visibility of the Viion TrafficCam. If the icon below is not in the network list, disconnect your computer from the network and re-connect.

Note: TrafficCam appearing in Windows Explorer under Network depends upon having *AutoDiscovery* enabled on the local Microsoft Windows system.

A network privacy notification may appear the first time connecting to the Web Interface. At the first screen, click ADVANCED and then click Proceed to... at the bottom of the page.

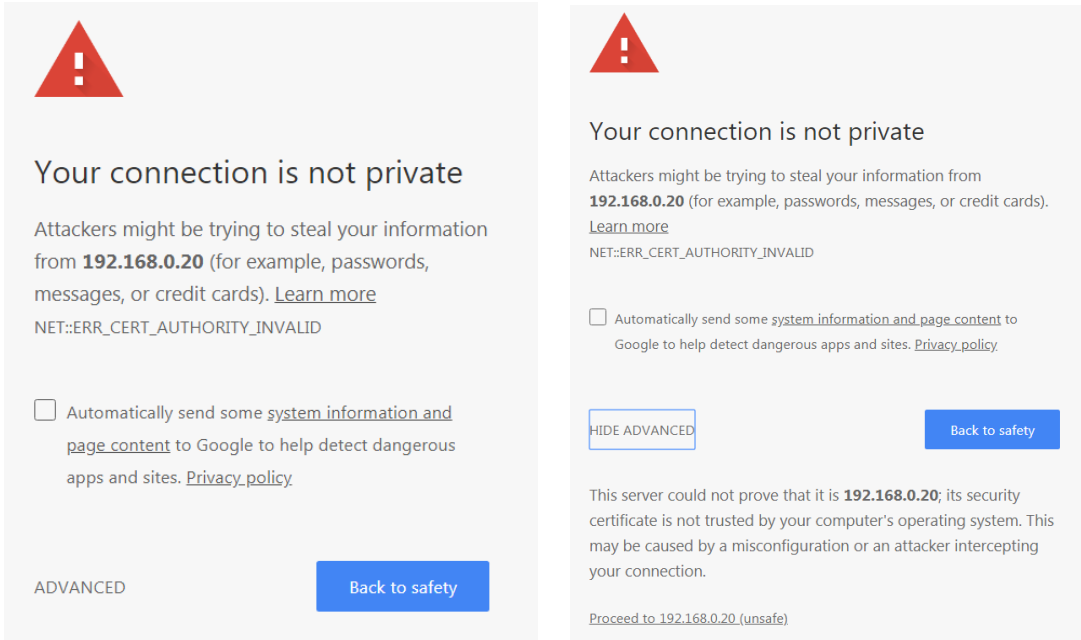


Figure 15: Connection warning messages when you first connect to a TrafficCam web interface.

An internet browser displaying the Viion Web Interface will launch:

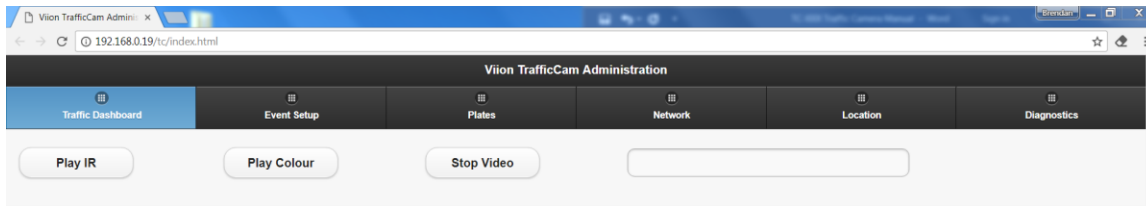


Figure 16: Web Interface screen.

NOTE - **Google Chrome** is the recommended internet browser for use with the Viion Web Interface. If Chrome is not set as the default web browser, copy the URL (in a form similar to <https://192.168.X.XX/index.html>) from the browser, launch Chrome, paste the URL into the Chrome, and press enter to display the Viion Web Interface in the Chrome Browser.

NOTE – for quick access to your Viion TrafficCam it is recommended the user adds this web interface URL to the favorites within the Chrome web browser, or copy the URL for easy reference later.

Confirm the cameras sensors are functioning by clicking on the Play IR button and the Play Color button. Note the different display characteristics using each sensor. For more detailed information about each camera sensor, refer to section 1.5.4 Sensors.

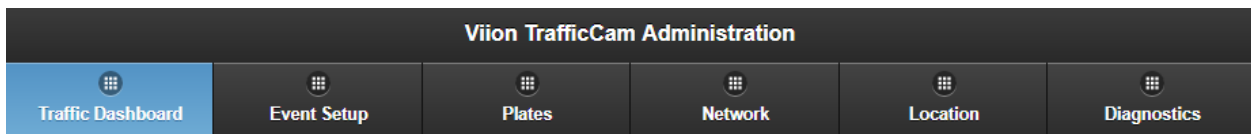
2.9 POST-INSTALLATION CHECK

- **Mounting Check** – Ensure the camera is correctly aimed and all mounting fasteners are correctly installed and tight.
- **Wiring Installation Check** – Verify all cables are properly secured and connector fasteners are tight. Confirm DB9 and/or Ethernet connector sealing boots are properly installed
- **Camera Check** – Confirm the window glass is clean and clear, and equipment is free of defects.
- **Communications Check** – Confirm the Ethernet link lights (where appropriate) on the back of the camera (Figure 5 item 13) are flashing and the Status LED on the front of the camera is flashing Green (or Blue).
- **Electromagnetic Interference Check** – Ensure there are no sources of electromagnetic interference in the installation area such as high voltage power lines, power sub-stations, energised railway tracks, etc.
- **Line of Sight Check** – Ensure there are no objects such as trees or branches which could obstruct the camera line of sight
- **Web Interface Check** - Confirm the Web Interface launches properly and both Play IR and Play Color video are functioning correctly.

3 WEB INTERFACE

3.1 WEB INTERFACE OVERVIEW

The TrafficCam, and the data which the TrafficCam transmits, is configured using the six tabs shown in the figure below.

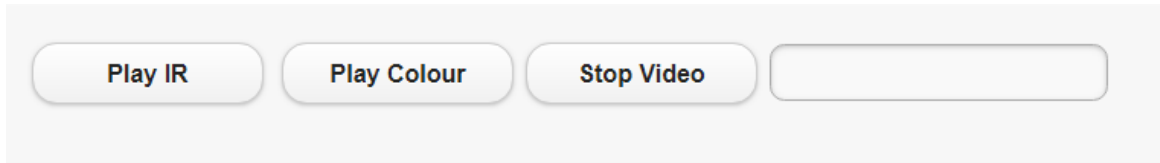


Each tab is explained in detail in the following sections.

Note - When entering data or changing button values, it is advisable to press the “TAB” key following each change. This will ensure that the values are correctly sent to the device.

3.2 TRAFFIC DASHBOARD

The **Traffic Dashboard** tab provides the user interface for each of the TC400GC TrafficCam’s sensors. At the top of the Traffic Dashboard tab, the user can toggle between the Infrared sensor, see item 9 in Section 1.5.2, (**Play IR**) and the Color sensor, see item 4 in Section 1.5.2, (**Play Color**) by clicking the respective buttons.



To stop displaying video on either sensor, press the **Stop Video** button. See Section 3.8.1 for more detailed information related to camera sensors and use.

3.2.1 Traffic Dashboard

At the bottom of the **Traffic Dashboard** tab, there is a summary of detected traffic data is displayed. These fields are only relevant in applications where vehicle speeds are being recorded based on license plate detection, or where license plate reading is employed.

Viion TrafficCam Administration

Traffic Dashboard	Event Setup	Plates	Network	Location	Diagnostics
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TrafficDashboard

vehiclesPerHour:

violatingVehiclesPerHour:

maximumSpeedInLastHour:

averageBlurLastHour:

fracInvalidSpeedsLastHour:

3.2.1.1 vehiclesPerHour

This field displays the number of detected vehicles that passed in front of the camera (in both lanes) in the last one-hour period.

3.2.1.2 *violatingVehiclesPerHour*

This field displays the number of vehicles that passed in front of the camera where the estimated vehicle speed was detected to be above the user specified speed limit (in both lanes). See Section 3.3.1 for instructions on setting the violating speed limit parameter.

3.2.1.3 *maximumSpeedInLastHour*

This field displays the highest measured vehicle speed to pass in front of the camera in the last hour.

3.2.1.4 *averageBlurLastHour*

This field is used to indicate the average image quality in the last hour and may be used to indicate the quality of the cameras image focus and the sharpness of the license plate reading. The higher the Average Blur, the lower the- quality/sharpness of the license plate image.

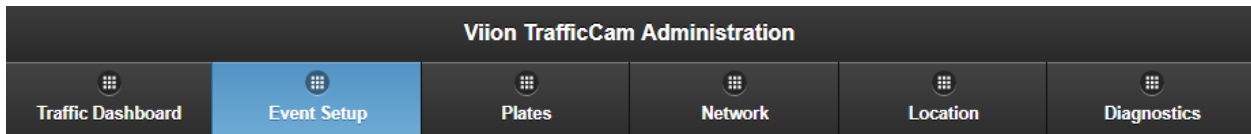
3.2.1.5 *fracInvalidSpeedsLastHour*

This field displays the proportion of vehicles where the vehicle speed was measured and the calculated speed error was above the user specified error threshold. See Section XX for instructions on setting the error threshold.

For example, if the Speed Limit is set to 70, and the allowable speed error is set to 5, each vehicle with a calculated error estimate above 5 is recorded as an invalid speed. The total number of invalid speeds is compared to the total number of vehicles to give a proportion of invalid speeds per hour.

3.3 EVENT SETUP

The **Event Setup** tab provides the user interface to configure the camera for use in specific applications with parameters grouped into the following sections.



SpeedEventSettings – These settings adjust and select options for information displayed in the image overlay and shown in the video and image files. These options also configure trigger data packets.

LocalStorageSettings – These settings are used to store data locally on the camera (default is off).

Note – a customer supplied SD card is required to store data. Please contact Viion if a local storage option is required.

ColorVideoSettings – These settings adjust the white balance on the color video sensor. There are no user configurable settings in this section.

CaptureBrightnessSettings – These settings are used to Control the brightness of the IR sensor. There are no user configurable settings in this section.

TriggerInterfaceSettings – These settings are used to configure the TrafficCam so that it may be triggered remotely by an external device. Example applications include wrong-way driver detection and other triggered vehicle presence recording.

Refer to the sub-sections below for details and descriptions of each field under each section above. It is recommended the user only adjusts the fields explained below within the **Event Setup** tab. For advanced support beyond the fields explained below, please contact Viion.

3.3.1 Speed Event Settings

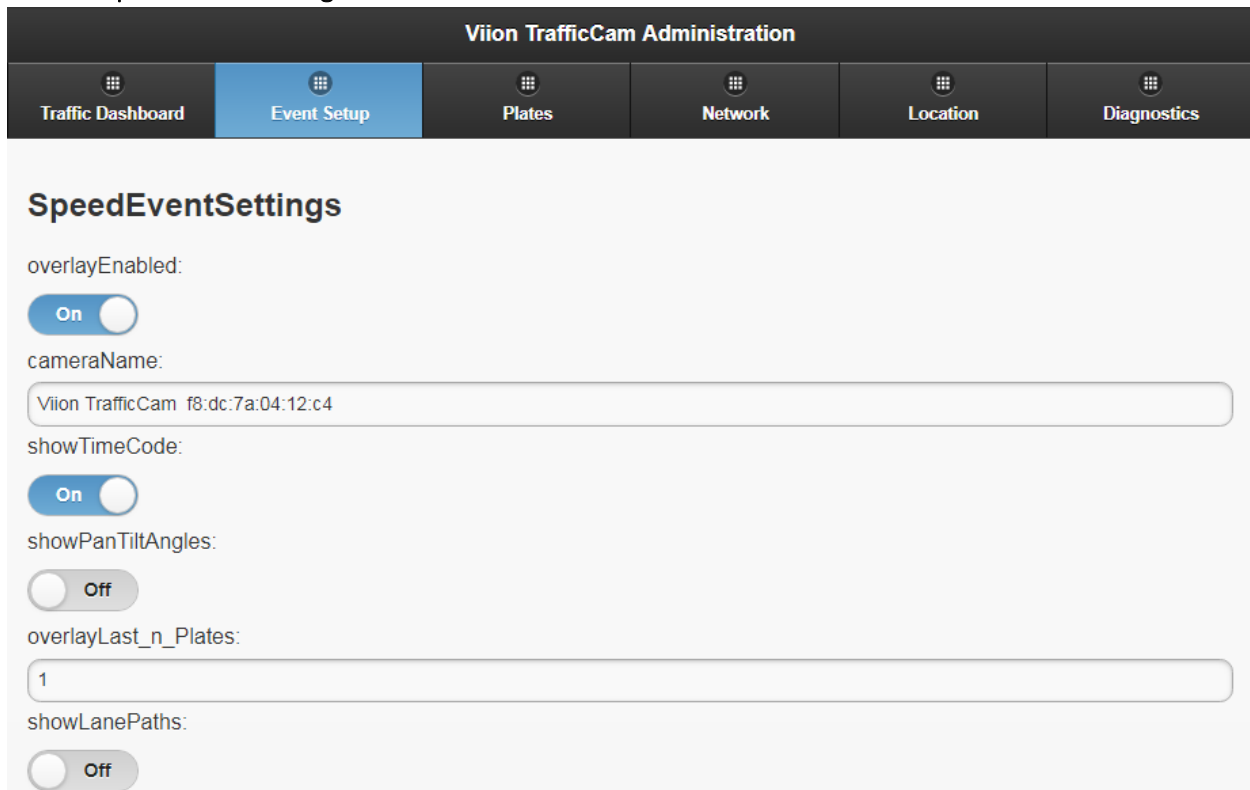


Figure 17: SpeedEventSettings showing only the first 6 settings.

3.3.1.1 overlayEnabled

Toggles text/information overlay on the image/video display see Section 3.8.2, Figure 19 for example of text overlay (shown in green). This feature is important when setting up and aiming a TrafficCam in order to display lane paths (see 3.3.1.6) and to validate that plates are getting captured. Default is off.

3.3.1.2 cameraName

This field is used to set the Camera Name as it will appear in the video overlay. Typically, the camera name should be indicative of the camera location or intersection where it is installed to easily differentiate cameras installed in multiple locations and areas. The default Camera Name is set as Traffic Cam followed by the MAC Address, see Section 1.5.6 for MAC Address.

3.3.1.3 showTimeCode

Toggles Time Code on the image/video display when overlay is enabled (see Figure 19). Default is on.

3.3.1.4 *showPanTiltAngles*

Toggles Pan and Tilt angle overlay on the image/video when overlay is enabled. Default is off.

3.3.1.5 *overlayLast_n_Plates*

Sets the number of license plates displayed in the lower right-hand corner of the video/image display when overlay is enabled. Each time a vehicle passes, this list is updated with the latest plate appearing at the top of the list. The value entered represents the largest number of plates which can be displayed. Default is 0.

3.3.1.6 *showLanePaths*

Toggles display of lane paths in the video/image display when overlay is enabled. Lane paths are shown as straight green lines indicating the trajectory of license plate images moving across the camera's field of view. Digits are displayed at each end of the lanes paths indicating the license plate distance from the camera at each line end-point in meters (see Figure 13). Default is off.

3.3.1.7 *GenerateAndUploadSimulatedTDP (Trigger Data Packet)*

Press this button to create a single Trigger Data Packet (for details see Appendix D – Trigger Data Packets). This feature is useful for testing communications between a TrafficCam and a customer-configured server where trigger data packets are to be received. The simulated TriggerDataPacket will contain the same data that a regular trigger data packet would contain following a speed enforcement violation, and once created it is sent to the uploadURL (see 3.3.1.10 below).

3.3.1.8 *writelrVideoFile*

When set to true, this option will store a video segment from the IR camera along with the other data that is stored in a Trigger Data Packet.

Note – Default is set to off (still images only) as video segments require much more storage capacity than still images.

3.3.1.9 *writeColorVideoFile*

When set to true, this option will store a video segment from the color camera along with the other data that is stored in a Trigger Data Packet.

Note – Default is set to off (still images only) as video segments require much more storage capacity than still images.

Note – both IR and Color video files may be created concurrently, however doing so requires significant storage capacity.

3.3.1.10 *uploadURL*

Enter the URL/web address where the camera Trigger Data Packets may be sent to. Each time a trigger data packet is created, the camera will send the data to this URL/web address.

3.3.1.11 *speedThreshold*

This represents the speed limit value in km/h. When a vehicle is measured with an estimated speed above this value, a TriggerDataPacket will be generated and sent to the URL as listed in Section 3.3.1.10.

3.3.1.12 speedErrorThreshold

Each time a vehicle speed is estimated, there is an associated computed error that reflects the quality of the estimate. For example if a vehicle speed is estimated to be 20 km/h with an error of 10 km/h,, the actual speed of the vehicle could have been as low at 10 km/h or as high as 30 km/h. This may or may not be acceptable given a particular application. The speedThreshold allows you to select a maximum error value. In the previous example, if the speedErrorThreshold value was 5 km/h, and the computed estimate error was still 10 km/h, the speed estimate would be rejected, and no Trigger Data Packet would be generated even if the estimated speed was above the speedThreshold.

3.3.2 Local Storage Settings

The screenshot shows the 'Viion TrafficCam Administration' web interface. The top navigation bar includes 'Traffic Dashboard', 'Event Setup' (highlighted), 'Plates', 'Network', 'Location', and 'Diagnostics'. The main content area is titled 'LocalStorageSettings' and contains the following fields:

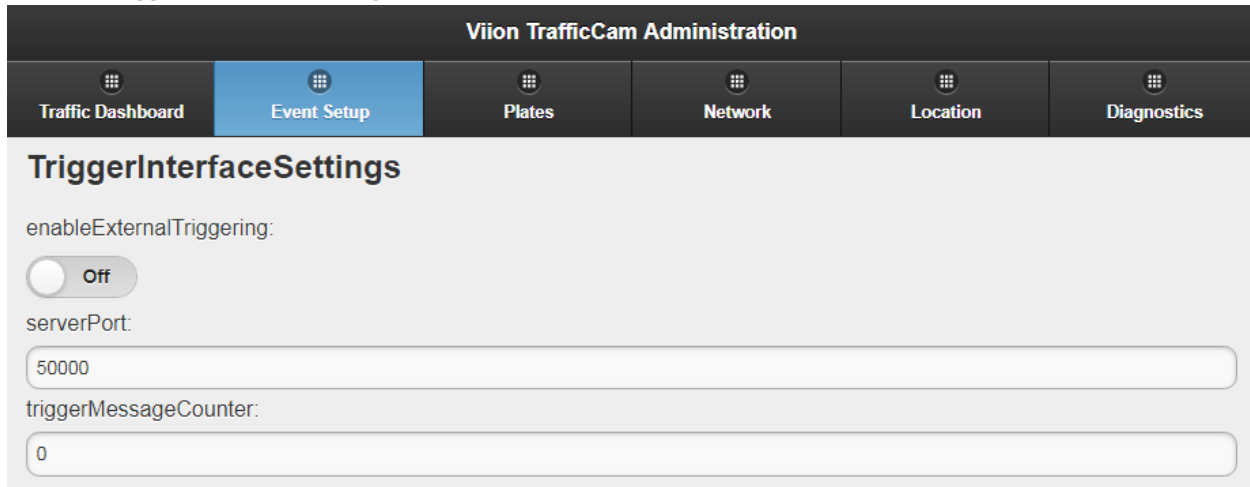
- localStorageEnabled:** A toggle switch currently set to 'Off'.
- localStorageDevice:** A dropdown menu with a downward arrow.
- totalFilesOnDisk:** A text input field containing '0'.
- diskCapacity_MB:** A text input field containing '0'.
- freeSpace_MB:** A text input field containing '0'.
- maxDaysToKeepRecords:** A text input field containing '30'.

At the bottom of the settings area is a button labeled 'Download Data'.

3.3.2.1 localStorageEnabled

Toggles an option to store data using an on-board customer supplied SD card. Default is off. Please contact Viion if you require local storage options.

3.3.3 Trigger Interface Settings



If an external triggering device is employed, it communicates with the TrafficCam via Ethernet. The TrafficCam runs a TCP server that listens for requests on a specified port. The following settings are configurable.

3.3.3.1 *enableExternalTriggering*

Toggle on/off to enable external triggering. Default is Off.

3.3.3.2 *serverPort*

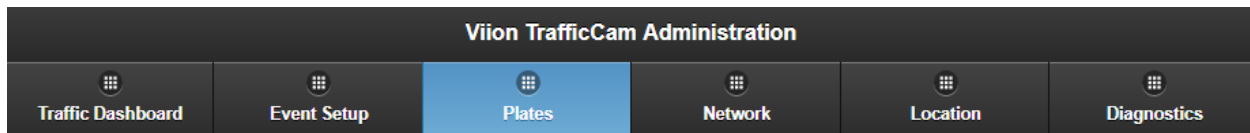
This parameter lists the port that the TCP server listens for messages on. Default is 50000.

3.3.3.3 *triggerMessageCounter*

Displays a read-only counter that represents the number of received messages. This value is used when monitoring system health since there are regular heartbeat messages that are sent from external clients. When a client is connected, the counter values should increment several times over a 20 second period.

3.4 PLATES

The **Plates** tab provides the user interface to configure the camera’s license plate recording parameters and data. The **Plates** tab is broken into the following sections:









ViionOCRSettings – These settings toggle and configure Object Character Recognition (OCR) parameters.

PlateTrackerSettings – These settings are used to set-up license plate character tracking between frames for single point speed estimation.

PlateFinderSettings – These parameters are set by Viion to set and adjust the license plate character recognition parameters. Do not adjust these settings.

3.4.1 ViionOCRSettings

Viion TrafficCam Administration

 Traffic Dashboard	 Event Setup	 Plates	 Network	 Location	 Diagnostics
---	---	--	---	--	---

ViionOCRSettings

minPlateHistorySize:

postReadsURL:

postPlateSubImages:

 On

ViionOCRSettings are used to configure Object Character Recognition (OCR) parameters which are used in Automated License Plate Reading (ALPR) applications. The user configurable settings are outlined below.

3.4.1.1 postReadsURL

Each time a vehicle passes in front of the camera its license plate is read. These reads may be recorded by sending them to a server whose address is specified through the postReadsURL. Each plate read string is sent in a small .xml data packet which also includes date/time information and the TrafficCam identity and location. Default is empty which disables the functionality. For details on how to receive plateRead data, please refer to the Viion *Technical Specification: TrafficCam Interface Protocols*.

Note – When this option is selected, all license plate reads are sent to the postReadsURL, regardless if there was a triggered event (for examples see Sections 4.2 and 4.4).

3.4.1.2 postPlateSubImages

If this option is set to On, each time a plate read is posted to the postReadsURL, a small image of the plate is also sent along with the .xml data. Default is off.

Note - The remainder of fields listed under ViionOCRSettings are used in settings where more complex interactions between the TrafficCam and a server are required. For further information please contact Viion.

3.4.2 PlateTrackerSettings

Viion TrafficCam Administration

Traffic Dashboard
Event Setup
Plates
Network
Location
Diagnostics

PlateTrackerSettings

trackOnlyVehiclePlates: Off

logTrackerVehicleClassDebugData: Off

issueTdpAllMotorcycles: Off

lensFocalLengthMM:

plateCharHeightMM:

motorcyclePlateCharHeightMM:

Most of the settings in PlateTrackerSettings are not meant to be altered except when instructed by Viion staff. The following parameters are exceptions:

3.4.2.1 *plateCharHeightMM*

For speed estimation applications, this value defines the physical height of license plate characters in millimeters. An example is shown below in Figure 18.

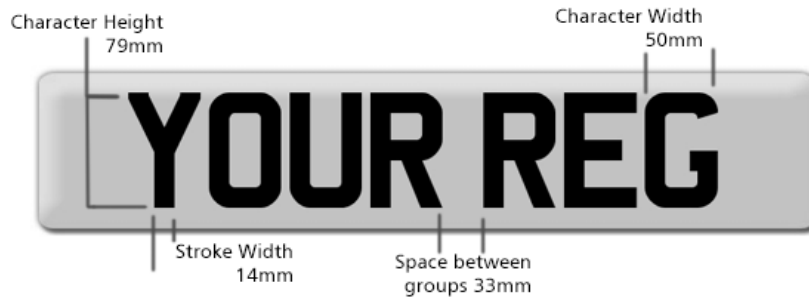


Figure 18: License plate example showing a character height of 79mm.

3.4.2.2 *motorcyclePlateCharHeightMM*

If this value is set to a positive number, the system will attempt to discriminate between motorcycles and other vehicles using a deep-learning classifier. If a motorcycle is detected, the motorcyclePlateCharHeight value is used to compute the vehicle speed (as opposed to the plateCharHeight value that is used for all non-motorcycle vehicles).

3.4.2.3 *minVehicleSpeedKPH*

This setting is used to specify the maximum speed that will be detected for vehicles **moving towards** the camera. Vehicles moving towards the camera are assigned a **negative speed**, so this value is always negative or 0. The default value is -160 kph – meaning that the system will detect speeds for vehicles moving towards it so long as the speed is below 160 kph. If you don't wish to estimate speeds for vehicles moving towards the camera, then set this value to 0.

3.4.2.4 *maxVehicleSpeedKPH*

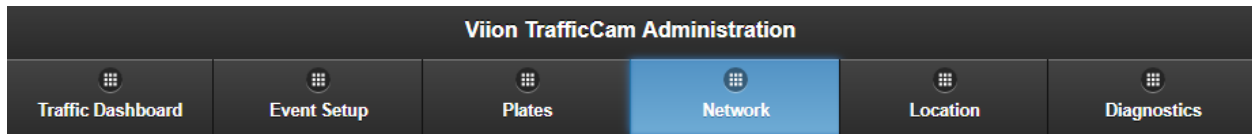
This setting is used to specify the maximum speed that will be detected by the system for vehicles moving away from the camera. The default value is 160 kph. If you don't wish to estimate speeds for vehicles moving away from the camera, then set this value to 0.

3.4.2.5 *PlateFinderSettings*

There are no settings in this section that should be adjusted by the customer unless directed to do so by Viion staff.

3.5 NETWORK

The **Network** tab provides the user interface to configure the camera's network settings. The **Network** tab is divided into the following sections:



Security – These settings are used to encrypt Trigger Data Packets (see Appendix D – Trigger Data Packets), and to select a password to restrict access to the web interface (see Section 5).

EthernetSettings – These settings are used to configure communications with the TrafficCam via Ethernet.

Wireless3GSettings – These settings are used to configure communications with the TrafficCam via wireless 3G (cellular).

Modbus – These settings are used when the TrafficCam is connected to other devices that use the Modbus communications protocol.

MQTT – These settings are used when the TrafficCam is configured to send data to a message broker so that traffic statistics can be broadly shared on a network with other devices.

3.5.1 Security

Viion TrafficCam Administration

Traffic Dashboard
Event Setup
Plates
Network
Location
Diagnostics

Security

GenerateKeyPairAndPostPrivateKey

publicKey:

privateKeySubmissionURL:

enablePassword:

Off

Password:

Confirm Password:

Change Password

These settings allow a user to encrypt Trigger Data Packets (see Appendix D – Trigger Data Packets). Encryption employs a private and public key pair, and these may either be generated on a TrafficCam, or the public key may be entered manually in the field provided. The customer needs to have access to the private key to decrypt Trigger Data Packets.

3.5.1.1 *GenerateKeyPairAndPostPrivateKey*

Press this button to send the decryption key to the URL and to generate the public key (used to encrypt the data on the TrafficCam). The generated public key will then be displayed in the publicKey field.

3.5.1.2 *publicKey*







This field displays the public key following generation of the decryption key as above. You may also enter a valid public key into this field manually. If the field becomes blank it indicates an invalid public key has been entered into the field and encryption will not take place.

3.5.1.3 *PrivateKey SubmissionURL*

If a public-private key pair is generated on the device, enter the URL where the TDP decryption key (private key) is to be sent.

3.5.2 Ethernet Settings

Viion TrafficCam Administration

 Traffic Dashboard	 Event Setup	 Plates	 Network	 Location	 Diagnostics
---	---	--	---	--	---

EthernetSettings

useDHCP:

On

IPAddress:

SubnetMask:

DefaultGateway:

overrideDNS:

On

3.5.2.1 UseDHCP

When set to on, this option will allow a TrafficCam to be automatically assigned an IP address when on a network where there is a Dynamic Host Configuration Protocol (DHCP) server. Default is on. If the option is set to off, then the IP address and other details below need to be carefully set manually.

3.5.2.2 IpAddress

The manually selected IP address

3.5.2.3 Subnetmask

The manually selected subnet mask

3.5.2.4 DefaultGateway

The manually selected default gateway that will be used to access the Internet.

3.5.2.5 overrideDNS

When set to on, this will allow the user to select a Domain Name Server (DNS) that is different from the default available on the local network. Default is off. The override DNS values are entered in the following fields: DNSServer1, DNSServer2, DNSTimeout, and DNS Retries.

3.5.2.6 Refresh Ethernet Settings from File

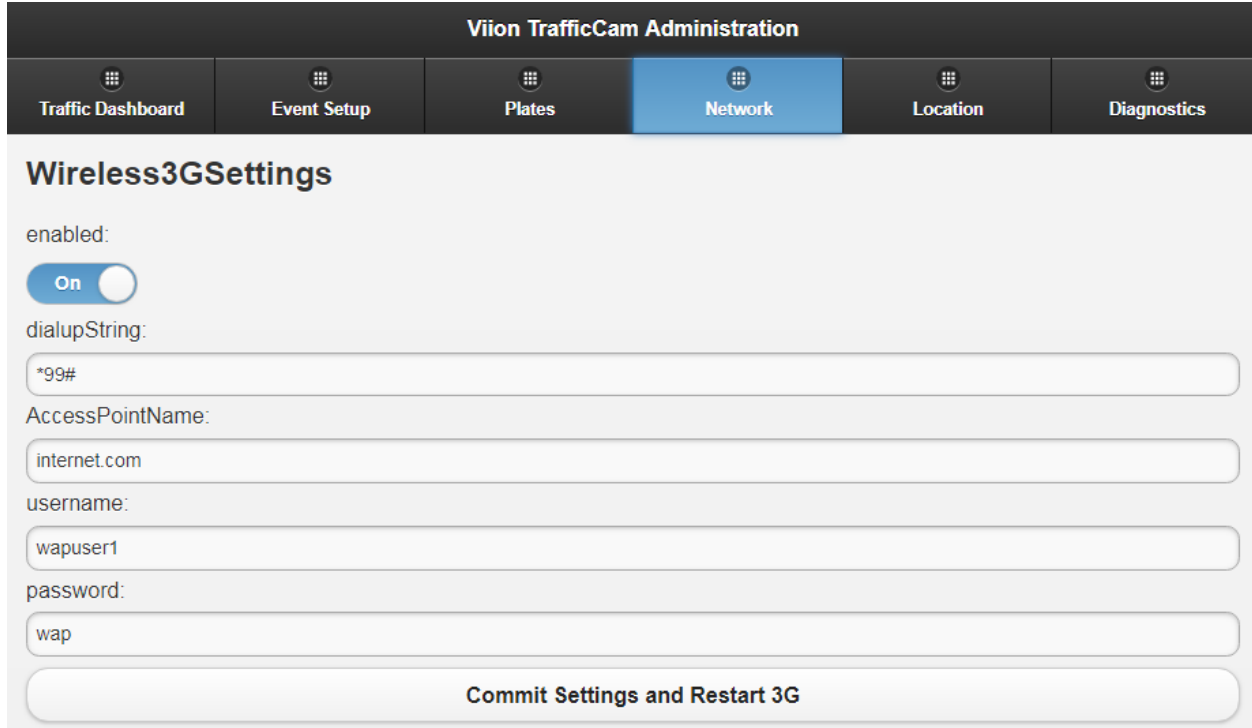
This button allows you to read the current Ethernet configuration values directly from the Linux filesystem.

3.5.2.7 Commit Settings and Restart

Any time that Ethernet settings are changed it is necessary to press this button once you have carefully validated that all changes are correct.

Note - if an error is made in manually specifying a fixed IP address or subnet mask, it may not be possible to re-connect to the device once the new settings have been committed.

3.5.3 Wireless 3G Settings



Viion TrafficCam Administration

Traffic Dashboard Event Setup Plates **Network** Location Diagnostics

Wireless3GSettings

enabled:
 On

dialupString:

AccessPointName:

username:

password:

Commit Settings and Restart 3G

3.5.3.1 *enabled*

Used to enable/disable 3G (cell) functionality. Default in On

3.5.3.2 *dialupString*

This value is a standard string that is used with most carriers. The default value *99# should not be altered.

3.5.3.3 *AccessPointName*

Each cellular provider will have a different Access Point Name (APN) along with a set of login rules which allow devices to communicate on the cell network. Enter the appropriate APN value provided by your cell provider in this field.

3.5.3.4 *Username and password*

These values are provided by the cell provider and are associated with the APN.

3.5.3.5 *Commit Settings and Restart 3G*

Once you have carefully validated that the correct 3G APN and login values have been entered, press this button to re-configure the device based on your entered values.

3.5.4 Modbus

Viion TrafficCam Administration

Traffic Dashboard	Event Setup	Plates	Network	Location	Diagnostics
--------------------------	--------------------	---------------	----------------	-----------------	--------------------

Modbus

serialPortName:

deviceType:

MQTTSubTopicName:

pollingInterval_s:

slaveAddress:

lastMessage:

Modbus support is a recently introduced feature. For more details contact Viion Systems.

3.5.5 MQTT

Viion TrafficCam Administration

Traffic Dashboard	Event Setup	Plates	Network	Location	Diagnostics
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MQTT

MQTTEnabled:

Off

brokerAddress:

brokerPort:

clientID:

topic:

MQQTusername:






MQQTpassword:

MQTT support is a recently introduced feature. For more details contact Viion Systems.

3.6 LOCATION

The **Location** tab provides the user interface to configure the camera's geographic **Position Settings**.

Viion TrafficCam Administration

 Traffic Dashboard	 Event Setup	 Plates	 Network	 Location	 Diagnostics
--	--	---	--	---	--

PositionSettings

automaticLocationUsingGPS:

On

latitude_deg:

48.480492

longitude_deg:

-123.407602

cameraTiltAngle_deg:

90.000000

roadGradeAngle_deg:

0.000000

magneticHeading_deg:

-17.525568

fixType:

Marginal location: GPS fix available

3.6.1 PositionSettings

These settings control or reflect the current geographical position of the device. In some instances when a device is installed in allocation where there is poor GPS reception (underground for example), it may be necessary to disable the automatic GPS position updating, and assign a position manually.

3.6.1.1 *automaticLocationUsingGPS*

If this is enabled, the on-board GPS receiver will set the latitude and longitude values for the device. If disabled, the user may instead manually specify the latitude and longitude values (see below).

3.6.1.2 *latitude_deg*

This represents the current latitude of the device in degrees and fractions of a degree. If automaticLocationUsingGPS is disabled, the device latitude may be entered here.

3.6.1.3 *longitude_deg*

This represents the current longitude of the device in degrees and fractions of a degree. If automaticLocationUsingGPS is disabled, the device longitude may be entered here.

3.6.1.4 *cameraTiltAngle_deg*

This is a read-only value that reflects the current tilt of the device relative to the horizontal. It is updated using an on-board accelerometer.

3.6.1.5 *roadGradeAngle_deg*

This setting is not currently used

3.6.1.6 *magneticHeading_deg*

This setting is not currently used

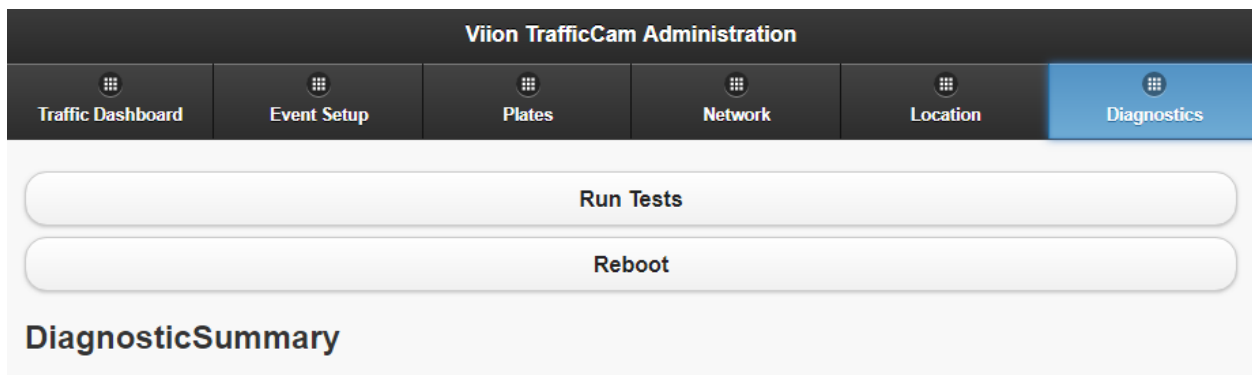
3.6.1.7 *fixType*

This value reflects the quality of fix obtained by the GPS receiver. Currently supported fixType values include:

- "No fix" – No current GPS fix
- "Locked; correct location" – have a valid GPS fix
- "none" – have not received any data from the GPS unit

3.7 DIAGNOSTICS

The **Diagnostics** tab provides the user interface to check the cameras operating parameters and connectivity is functioning correctly. Values are periodically updated, or may be instantaneously updated by pressing the Run Tests button.



3.7.1 Run tests

Press this button to perform a self-diagnostic. Results of the test are displayed in the DiagnosticSummary fields below.

3.7.2 Reboot

Press this button to reboot the camera operating system. It is not recommended that you use this button.

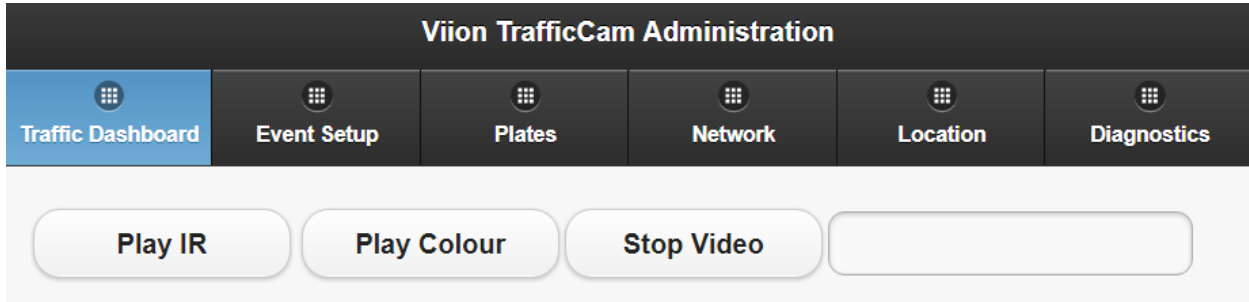
3.7.3 DiagnosticSummary

This is a list of read-only parameters that reflect the current state and overall health of the unit. Parameters shown in green are functioning normally. Parameters in red are outside normal operating range and may require additional attention. Note that if a SIM card has not been installed in a TrafficCam, the Wireless 3GStatus and cellularStatus values will appear in red since there is no available 3G connection. The same is true for the ethernetStatus values (if there is no physical Ethernet connection to the TrafficCam), or the GPSStatus (if the device is installed out of GPS reception range).

3.8 CAMERA SET-UP

3.8.1 Previewing Video

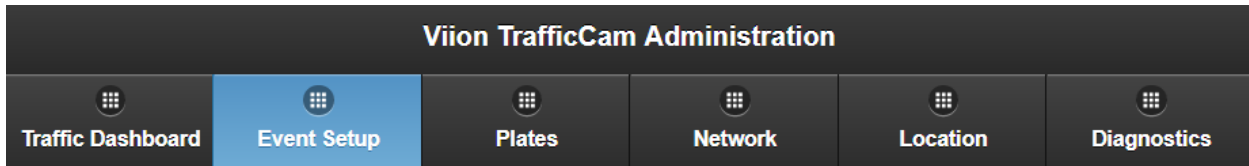
Video may be previewed using either the Near Infrared sensor (**Play IR**) or the Color sensor (**Play Color**) by selecting the **Traffic Dashboard tab** (default) within the Web Interface and pressing the respective buttons:



To stop video playback, press the **Stop Video** button. The field to the right of the Stop Video button is used to display the current received frame rate (in frames per second fps).

3.8.2 Enabling Overlay

The **overlayEnabled** button IS located on the **Event Setup Tab** and is very useful when aiming a camera or evaluating its performance visually. When enabled, it will display various diagnostics on the IR feed (there is no overlay for the color feed).



SpeedEventSettings

overlayEnabled:



Referring to Figure 19 below, the default overlay settings include the camera name with MAC address (**Viion TrafficCam f8:dc:7a:04:12:c4**), date (**2018-Mar-05**), time (**19:31:14.37**), last vehicle speed in **km/h**, and number of plates that have been read.

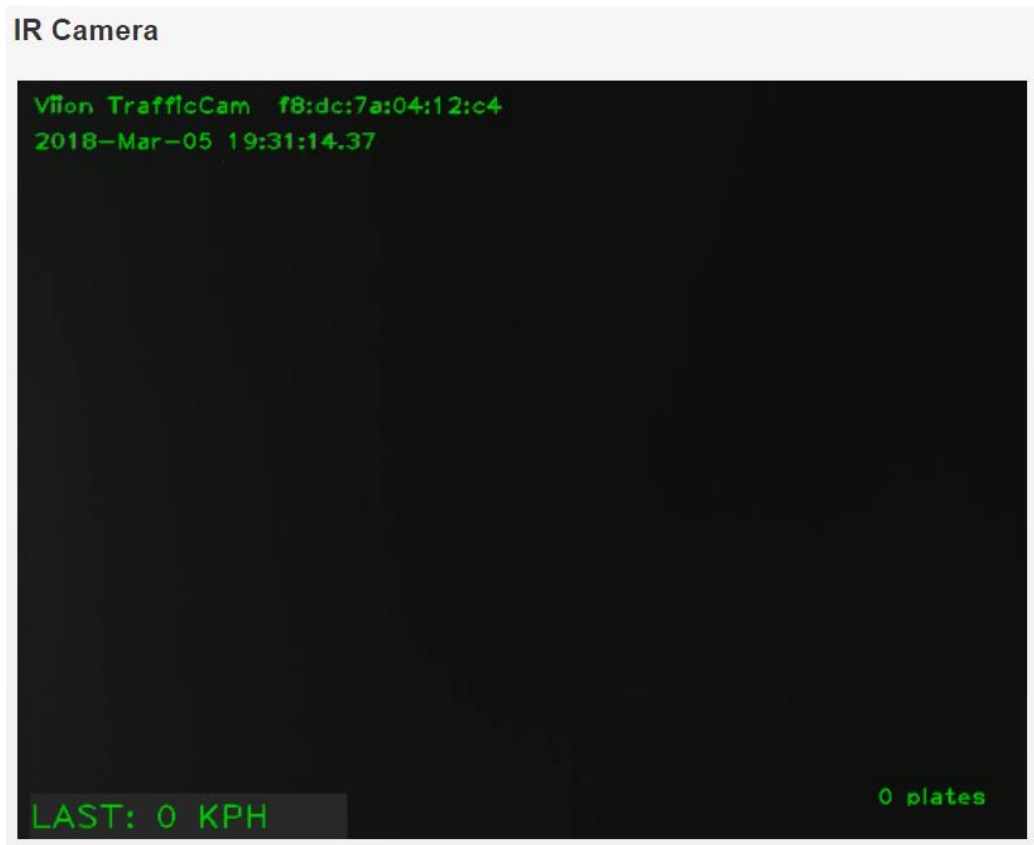


Figure 19: Overlay data shown in green on IR video feed.

The TrafficCam Mac address is displayed along with the current date/time. At the lower part of the screen the speed of the last passing vehicle is shown (lower-left) along with the number of read plates (lower-right).

Once overlayEnabled is set to On, each of these options are enabled or disabled through the following settings (see section 3.3.1):

- cameraName
- showTimeCode
- showPanTiltAngles
- overlayLast_n_Plates
- showLanePaths

4 APPLICATION EXAMPLES

The following examples demonstrate some of the typical applications where a TrafficCam may be deployed. In each case some of the key parameters that are used in configuring the device are mentioned.

4.1 AUTOMATED LICENSE PLATE (NUMBER PLATE) RECOGNITION ALPR (ANPR) AND TRAFFIC MONITORING

ANPR is used to read the license plates of all vehicles passing in front of the camera. The system can be configured to send each read to a customer specified URL.

4.1.1 Overview

All ALPR functionality is controlled through the ViionOCR settings page of the web interface (see section 3.4). The two main control parameters are as follows:

postReadsURL – this is the URL where plate read data gets posted

postPlateSubImages – when true, this option will include a plate sub image along with each read posted to the postReadsURL

4.1.2 Typical applications

Hotlist applications – each time a plate is read, it is matched on a customer’s server against a list of wanted vehicles. When a match is found, an alarm is raised. Examples include amber alerts, and stolen and scofflaw vehicle detection

White-list applications – each time a plate is read it is matched against a list of valid users. If a match is detected, some action is taken. Examples include access control to gated communities or parking facilities.

Tolling – each time a plate is read it may be used to generate a bill that gets sent to the vehicle owner, or it may be matched against other records (such as transponder identification) that comes from a passing vehicle.

4.2 POINT SPEED MEASUREMENT

Point speed measurement is done using a single TrafficCam, and it may be used to implement speed enforcement functionality or for traffic data collection. The TrafficCam is able to estimate vehicle speeds based on knowing the height of license plate characters in a given jurisdictions. This functionality is only practical to use when the majority of license plates have the same character height (see Section 3.4.2). In some locales, motorcycles have plate characters that are typically smaller than for other vehicles. The system has the ability to also estimate speeds for motorcycles (see Section 3.4.2.2). When a violation is detected a Trigger Data Packet (see Appendix D – Trigger Data Packets) is created and sent to a customer-specified URL.

The following settings are used in point speed measurement applications. Refer to sections 3.3.1 and 3.4.2 for a detailed description of each setting.

Web Interface Tab	Group	Setting name	Description
Event Setup	SpeedEventSettings	uploadURL	3.3.1.10
Event Setup	SpeedEventSettings	speedThreshold	3.3.1.11
Event Setup	SpeedEventSettings	speedErrorThreshold	3.3.1.12
Plates	PlateTrackerSettings	plateCharHeightMM	3.4.2.1
Plates	PlateTrackerSettings	motorcyclePlateCharHeightMM	3.4.2.2
Plates	PlateTrackerSettings	minVehicleSpeedKPH	3.4.2.3
Plates	PlateTrackerSettings	maxVehicleSpeedKPH	3.4.2.4

speedEventSettings

- uploadURL
- speedThreshold
- speedErrorThreshold
- PlateTrackerSettings
- plateCharHeightMM
- motorcyclePlateCharHeightMM

4.3 JOURNEY TIME, ORIGIN-DESTINATION, AND AVERAGE SPEED MEASUREMENT USING ANPR

By deploying two or more TrafficCams along a roadway, it is possible to track vehicles as they pass each of the cameras based on matching license plate reads. In the simplest case, two cameras (camera A and camera B) are installed on the same section of road and the spacing between cameras is known. As a vehicle passes camera A its plate is read, and sometime later as it pass camera B its plates is again read. For cameras A and B plate reads are sent to a common server using the methods described above in Section 4.1.

The customer provides logic on the server that matches reads from cameras A and B, and given the distance between the cameras is able to compute the average speed that the vehicle was travelling at between these two points. In some jurisdictions (for example the UK), it is legal to issue speed infractions based on such information. This type of enforcement is referred to as *Average Speed* or *Interval Enforcement*. Similar functionality may also be used in non-enforcement settings when conducting traffic studies to examine the flow of traffic between a given origin and destination - so-called **origin-destination (OD)** studies – or when examining the time, it takes for vehicles to travel from one location to another –referred to as **journey time measurements**.

4.3.1 Overview

Each deployed unit is configured to send plate reads to a common server at a URL as outlined above in Section 4.1. The units may also be configured to send license plate sub-images along with reads.

In the case of enforcement, additional image data is often required that may contain full resolution overview images of the vehicle from both the IR and color channels. Since it is not typically economical to send all full-resolution data along with each plate read, there is a mechanism which allows image data to be retrieved from both cameras A and B after the fact when it is required. More details and configuration examples can be obtained by contacting Viion directly.

4.4 TRIGGERED DATA ACQUISITION

TrafficCams may be configured to generate Trigger Data Packets based on an external trigger. There are a variety of instances where this functionality may be required. One common application is for wrong-way driver detection. In these systems, one or more TrafficCam units are deployed along with Viion's WWD580 unit and a radar detection unit. Based on data from the radar unit, the WWD580 unit detects when a vehicle is driving the wrong-way along a section of road. The unit then sends messages to the TrafficCam units that results the recording of a video clip that starts some time before the detection event, and lasts until sometime after the event. Details for configuring the WWD580 are given in the WWD580 User manual (**DM-WWD580**). Once triggered, each TrafficCam will generate a Trigger Data Packet that gets sent to the customer URL as outlined above (see Section 3.3.1).

4.4.1 *Wrong-Way Driver configuration*

One important triggering mode for the TrafficCam is the detection of wrong way driving events. A Detailed system description is provided in the user manual for the Viion Wrong Way driver module (WWD580 – see DM-WWD580). The following diagram shows the main system components deployed as part of a WWD system which includes WWD580 module, a radar unit, two confirmation cameras, and a Traffic Management Center Workstation.

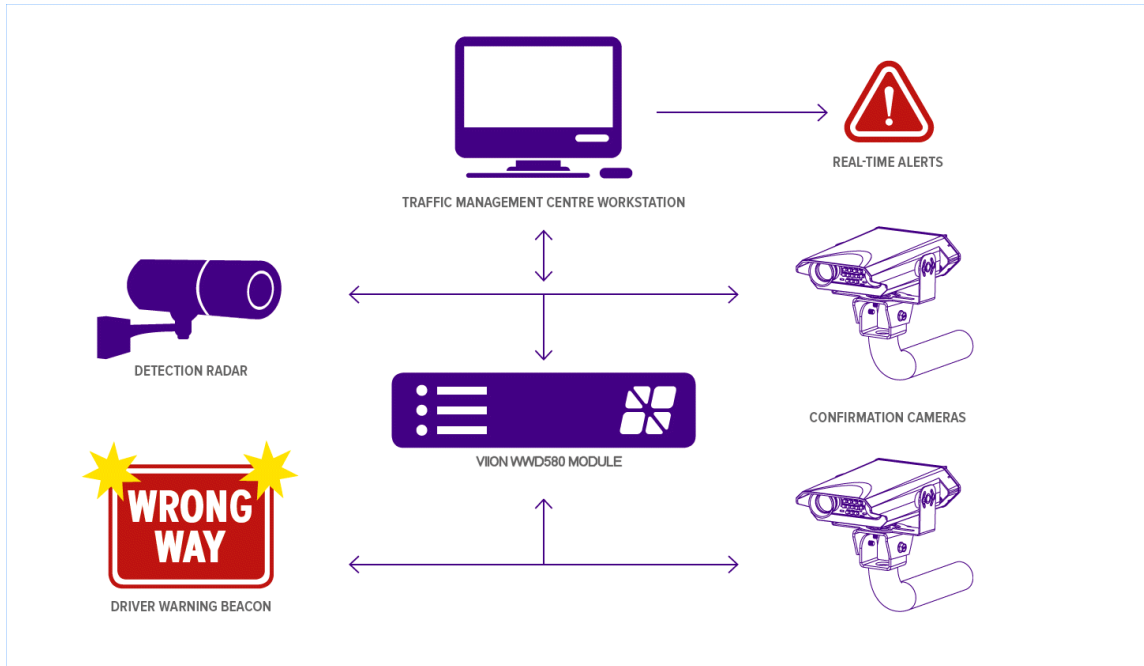


Figure 20: Wrong way driver system components.

The following settings require set-up to enable a TrafficCam for wrong-way driver applications. Refer to section 3.3.1 for a detailed description of each setting.

Web Interface Tab	Group	Setting name	Value
Event Setup	SpeedEventSettings	writeColorVideoFile	On
Event Setup	SpeedEventSettings	videoLength_frames	600
Event Setup	SpeedEventSettings	videoPreroll_frames	300
Event Setup	SpeedEventSettings	uploadURL	See notes below
Event Setup	SpeedEventSettings	speedThreshold	500
Event Setup	SpeedEventSettings	pollWebDirector	On
Event Setup	SpeedEventSettings	pollingURL	See notes below
Event Setup	TriggerInterfaceSettings	enableExternalTriggering	On

Notes:

videoLength_frames specifies the total number of frames that will be captured for each WWD event. The maximum value is 600 corresponding to a video clip approximately 30 sec. in duration.

videoPreroll_frames specifies the number of frames that will be captured from before the triggering event. By selecting videoPreroll_frames = 300 with videoLength_frames = 600, the WWD event will be recorded approximately close to the middle of the video file (between playback seconds 12 and 15).

uploadURL – this is the URL where all recorded wrong way driver event data gets pushed. In most cases it will be an address of a workstation in the TMC where Viion’s Central WWD Application is running.

speedThreshold – this value is used when the camera is configured for speed enforcement. By selecting value of 500 the camera will not be detecting speed violations.

pollingURL – this is the URL where the Viion Central WWD Application is installed. All cameras and WWD580 units should be configured to push diagnostic data to this location.

Refer to **DM-WWD580** for more information on system configuration wrong-way driver applications.

It may be necessary to modify the `videoLength_frames` and `videoPreroll_frames` values in a particular setting. For example if the TrafficCam is directed towards the front of an approaching wrong way driver, the video capture may be biased towards capturing more information before the trigger event. This would mean increasing the value of `videoPreroll_frames`. For cameras viewing the rear of a wrong way driving vehicle sometime after the trigger event has been raised, it may be appropriate to bias the capture so that more video is recorded after the event (by reducing the value of `videoPreroll_frames`)

5 PRIVACY PROTECTION, SECURITY AND ENCRYPTION

5.1 VIION VEHICLE RECORD ENCRYPTION FORMAT

Trigger data Packets may be protected using a built-in asymmetric (public key, private key) encryption. If this option is selected, when packets are created they are encrypted using a public key that is provided through the web interface (see Security section 3.5.1). On the receiving side, the customer is required to have access to the private key in order to decrypt the Trigger Data Packet.

Details and code examples for decrypting encrypted Trigger Data Packets may be obtained from Viion.

5.2 CHARACTER MASKING

For license plate reading applications, it may be required that one or more characters is masked for privacy reasons. To enable this feature, in the web interface, go to `ViionOCRSettings` under the Plates Tab (see Section 3.4). The setting `obfuscateCharOrdinal` will cause the functionality to be enabled when set to a positive value.

The index of the character to be masked starts at position 0. For example - to mask the first character, set the value to 0, and to mask the third character, set the value to 2.

6 CALIBRATION

6.1 FOCAL LENGTH CALIBRATION PROCEDURE

The system is factory calibrated. However, if there is an indication that the camera is out of calibration, then the camera may be re-calibrated. The details for performing a camera calibration are given in the Viion TrafficCam Assembly Guide.

6.2 SPEED MEASUREMENT TEST PROCEDURE

When a TrafficCam is deployed for speed estimation applications, it is important to validate the accuracy of speed measurements. This may be done in the field after a camera unit has been installed and correctly aimed (see section 2.7). The test requires that a driver passes the camera a number of times at a variety of speeds within the range that will be measured at that location. We recommend that a minimum of 5 to 10 passes be performed. For each pass the *actual* speed of the vehicle should be recorded. We strongly recommend that the actual vehicle speed not be measured using the vehicles' speedometer. There are a variety of factors that influence the accuracy of speedometers and which can lead to significant errors. A better alternative is to use a GPS-based system that is designed to provide accurate speed estimates in real time. We recommend devices similar to the AIM Solo (<https://www.aimtechnologies.com/car/aim-solo-gps-lap-timer/>) or equivalent.

Before performing the tests, the speedThreshold value (see section 3.3.1) should be set low enough that a Trigger data Packet will be generated on each of the trial passes. Having performed a number of passes with known speeds at known times, these values are then compared against those stored in the uploaded Trigger Data Packets.

6.3 OVER-THE-AIR (OTA) FIRMWARE UPDATING

From time to time Viion may need to update the camera to deal with stuff like bugs. This can be done over the internet through either the 3G wireless or Ethernet connection. Viion may contact the supplier to schedule the update or the supplier may contact Viion to arrange/ confirm if updates are available for their products.

7 LIST OF ACRONYMS

ANPR – Automated License Plate Reading

ALPR – Automated Number Plate Reading

DHCP - Dynamic Host Configuration Protocol

DNS – Domain Name System

GPS – Global Positioning System

GSM – Protocols for second generation digital cellular networks

HSPA - High Speed Packet Access

KPH – Kilometers Per Hour

LAN – Local Area Network

LED – Light Emitting Diode

OCR – Optical Character Recognition

OTA – Over the Air

POE – Power Over Ethernet

TDP – Trigger Data Packet

URL - Uniform Resource Locator

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10 APPENDIX A – TROUBLESHOOTING

10.1 TROUBLESHOOTING

TrafficCam units are factory calibrated and thoroughly tested to minimize the chance of any in-field issues. The most common issues are due to failures in connectivity, power supply, or result from incorrect configuration. The following summarizes some common issues along with some suggested actions. In the event that you can't resolve the issue, we recommend you contact your local integrator or Viion to get further support.

Symptom	Corrective Action
Front status indicator LED is never illuminated	Validate 12VDC power supply and voltage levels. Also check to see if the IR Illuminators (see Figure 5, item 10) are glowing red. If they are not then it would also indicate a power supply issue.
Front status LED is flashing blue but the unit has an installed SIM card.	<p>Validate that the cell provider supports the frequencies used in the TrafficCam 3G modem (see Section 2.6.1) and that you have the correct APN and login information as provided by the carrier (see Section 3.5.3). It is important that you validate that these settings are entered correctly in the Web Interface, and that you have pressed the "Commit Settings and Restart 3G" button at the bottom of the Wireless3GSettings section.</p> <p>Check that the SIM card is activated</p> <p>Check that there is a clear signal path to local cell antennas. On the Diagnostics tab in the Web Interface, the value cellularSignalStrength_dBm represents the local cell signal strength. If this value is lower than -110 it would indicate that the signal is too weak. There may be metal or other objects nearby that could be compromising the signal strength.</p>
Front status LED is flashing blue but the unit has an active Ethernet connection and should be able to see the Internet.	<p>Validate that the link lights on the rear of the unit are flashing periodically (see Figure 5, item 13). If they are not flashing it would indicate either a damaged Ethernet cable, or that the device connected at the other end is not operating correctly.</p> <p>If there is a valid electrical connection, validate that the Internet can be accessed from another device connected to the network.</p>
Trigger Data Packets are not getting received on server	<p>It is important that the uploadURL (see Section 3.3.1.10) be set correctly and that the unit is connected to the appropriate network. Using the Web Interface, under Event Setup, there is a button labelled "GenerateAndUploadSimulatedTDP". By pressing this button you will generate a single simulated TDP which will be</p>

	send to the uploadURL. This tool allows you to rapidly evaluate if there are issues on the receiving side.
Diagnostic or Plate Read data not getting received on the server	As for the previous item, it is important to carefully review all relevant settings and also validate that the TrafficCam has communication with the server. This can be done using the “GenerateAndUploadSimulatedTDP” button as outlined above to validate the connection.
Neither blue nor green flashing status LED	After a TrafficCam has been powered for more than 5 minutes, the front status LED should be flashing either green or blue. If other behaviors are observed consult Table 1 for more information.

If a TrafficCam unit is not behaving as expected, power cycling the unit may also be a simple way to correct the issue. Following a power cycle, if you are still unable to get the desired operation, you should contact a local Viion representative.

11 APPENDIX B – PERIODIC MAINTENANCE

11.1 MAINTENANCE PROCEDURES

- Cleaning the front glass **once a year** is recommended. In coastal, dusty, or high-pollution areas, more frequent cleaning may be required.
- A periodic visual inspection is also recommended. This should include:
 - Visual inspection of cables, connectors, waterproof boots, and sealing surfaces.
 - Check mounting fasteners are tight
 - Flashing lights
 - Lens is clear, free of moisture evidence or debris
 - Damage to bracket or camera body, cracked case, bent bracket etc.

WARNING – DO NOT LOOK DIRECTLY INTO THE LED ARRAY LOCATED AT THE FRONT OF THE CAMERA. PROLONGED CLOSE PROXIMITY EXPOSURE TO HIGH INTENSITY NEAR INFRARED LIGHT MAY PRESENT A RISK OF PERMANENT DAMAGE TO THE EYE(S) OR BLINDNESS.

12 APPENDIX C – CABLE SPECIFICATION

The following diagram shows connection details for a TrafficCam power/signal cable which is used in non-POE installation settings.

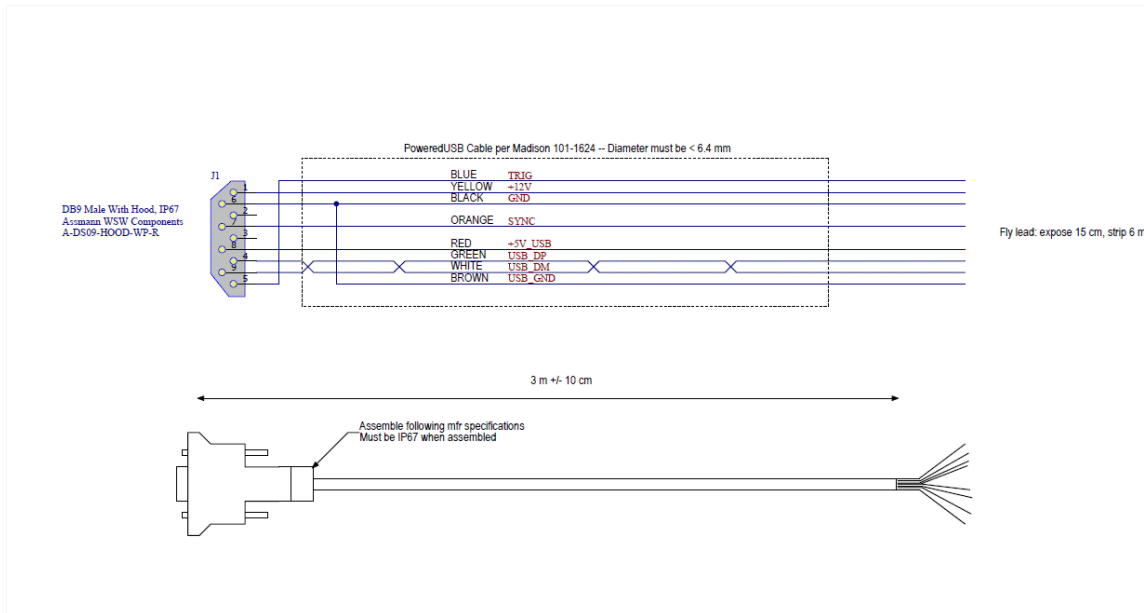


Figure 21: Specification for TrafficCam Power/Signal cable

13 APPENDIX D – TRIGGER DATA PACKETS

The TrafficCam is often configured to upload Trigger Data Packets (TDPs) when there is a triggering event. Examples include the following:

- A vehicle whose estimated speed is above the speedThreshold (see Section 3.3.1.11)
- A triggering event where an external device requests that data be gathered - for example wrong-way driver detection n (see Section 4.4)
- Each time a license plate is read

Trigger data packets are zip archives ([https://en.wikipedia.org/wiki/Zip_\(file_format\)](https://en.wikipedia.org/wiki/Zip_(file_format))) that contain a set of files associated with the event. The zip file may be encrypted to prevent tampering (see Section 5.1), and would need to be un-encrypted to get access to the internal files. A TDP will always contain an event.xml file that lists data associated with the event. An example showing some of the data contained in an event.xml file from a TDP is given below.

```
<TriggerDataPacket>
  <cameraMacAddress type="std::string">f8:dc:7a:04:10:3c</cameraMacAddress>
  <timestamp type="std::string">1513385031580</timestamp>
  <timeZoneOffset_s type="int">-28800</timeZoneOffset_s>
  <latitude type="double">48.662967</latitude>
  <longitude type="double">-123.417548</longitude>
  <currentSpeedLimit_kph type="double">70.000000</currentSpeedLimit_kph>
  <irVideoFilename type="std::string"></irVideoFilename>
  <irVideoFrameCount type="int">76</irVideoFrameCount>
  <colorVideoFilename type="std::string"></colorVideoFilename>
  <colorVideoFrameCount type="int">76</colorVideoFrameCount>
  <colorPictureFilename type="std::string">colorFrame.jpg</colorPictureFilename>
  <colorPictureFrameNumber type="int">20</colorPictureFrameNumber>
  <irPictureFilename type="std::string">irFrame.jpg</irPictureFilename>
  <irPictureFrameNumber type="int">20</irPictureFrameNumber>
  <subImageFrameNumber type="int">-1</subImageFrameNumber>
  <violatingSpeed_kph type="double">84.400627</violatingSpeed_kph>
  <violatingSpeedError_kph type="double">3.695502</violatingSpeedError_kph>
  <violatingSpeedError95_kph type="double">3.695502</violatingSpeedError95_kph>
  <focalLength_mm type="double">19.365000</focalLength_mm>
  <panAngle_deg type="double">25.142711</panAngle_deg>
  <tiltAngle_deg type="double">9.558597</tiltAngle_deg>
  <numPlateRecords type="int">3</numPlateRecords>
  <softwareVersion type="std::string">9758</softwareVersion>
  <characterHeight_mm type="double">67.000000</characterHeight_mm>
  ...
</TriggerDataPacket>
```

Some important values include the camera Mac Address, the GPS coordinates of the device (latitude and longitude), the current timestamp (which is a Unix timestamp - see https://en.wikipedia.org/wiki/Unix_time), and the local timeZoneOffset.

A TDP will also typically contain one or more image files in standard formats such as .png or .jpg. These images are referred to by filename in the event.xml file along with a timestamp when the images were acquired. Image examples may include an IR and/or Color overview image taken at the time of the event, along with one or more plate sub-images that may be used when estimating vehicle speed (see Section 4.2) or when performing automated license plate reading (see Section 4.1).

The screenshot displays a typical Traffic Data Page (TDP) interface. It features a main image of a vehicle (a dark SUV) with a license plate '879-HLT'. Above the image are 'IR' and 'Color' tabs. To the right is a map showing the vehicle's location at an intersection. Further right are several smaller images of the license plate '879-HLT'. Below these elements is a table with the following data:

Date	Location	Limit	Plate Number	Speed
2016-08-24 17:37:49	McDonald Park Rd - Quad	105	879HLT	108.2

At the bottom of the interface are navigation buttons: '<<', 'Validate', 'Print', 'Send', 'Close', and '>>'.

Figure 22: Typical TDP contents without video.

Depending on configuration settings, a TDP may also contain one or two (IR and color) video clips that were acquired around the time of the event.










 colorFrame.jpg	Size: 50.5 KB
 colorVideo_1472088567030.mp4 Length: 00:00:11	Size: 425 KB
 event.xml	Size: 66.1 KB
 irFrame.jpg	Size: 87.8 KB
 irVideo_1472088567030.mp4 Length: 00:00:04	Size: 476 KB
 plate_frame27_618.png	Size: 10.0 KB
 plate_frame28_618.png	Size: 8.02 KB
 plate_frame29_618.png	Size: 6.40 KB
 plate_frame30_618.png	Size: 5.51 KB

Figure 23: Typical TDP File contents including event.xml, images, and two video .mp4 files.

For more details on TDPs and how they may be used in a back-office system, please refer to **Technical Specification: TrafficCam Interface Protocols** – available by request from Viion.