USM-230914 User Manual
T-SERIES FIXED
For Red-light and Speed enforcement

Version: 1.4.1
Date: 22 Jul 2024
Status: Published

Disclaimer

Translation disclaimer
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Regulations, Standards & Guidelines

CE	Hereby Sensys Gatso declares that this product is manufactured in conformity with the essential requirements in the applicable directives, and that the relevant information conformity assessment procedures have been fulfilled.
ISO	Sensys Gatso's Management System is certified for ISO 9001 Quality management system, ISO 14001 Environmental management system and ISO 27001 Information technology – Security techniques.
RoHS & WEEE	Sensys Gatso follows the RoHS II 2011/65/EU (Restriction of Hazardous Substances) and WEEE 2012/19/EU (Waste Electrical and Electronic Equipment) directives.
WELMEC 7.2	Measuring Instruments Directive 2014/32/EU
RED	Radio Equipment Directive 2014/53/EU

Safety instructions

This manual holds information and instructions for the correct and efficient use of the T-Series Fixed. Following these instructions avoids hazardous situations, damage to the system, or a malfunction of the system.

User operation

The user needs to stay at least 20 cm distance from the radar part.

Remote operation

When the T-Series Fixed is operated via a network connection in an office environment, no special safety measures are needed.

At the roadside

When installing or adjusting the T-Series on location, always comply with the safety instructions in the Installation manual (e.g IM-E1627) .

Scope

This manual holds information and instructions for the correct and efficient use of the T-Series Fixed. Some of the items described in this document are optional and may therefore not be available in all systems. Please contact Sensys Gatso Group for details.
All images, drawings and print screens shown in this manual are indicative and can differ from the originals, due to recent adaptations to hardware or software by Sensys Gatso.

Target audience

This document is intended for users that have been trained to work with the system and are familiar with its lawful use. In addition, the user must have basic skills in working with computers and setting up network connections.

Reader liability

This manual shall be carefully read and understood by any user operating the system. If there are any questions regarding the contents of this document or the proper use of the system, please contact Sensys Gatso or its distributor. Contact details are listed on the last page of this document.

Used symbols

	Text with an exclamation mark in a red triangle means: Please read the information carefully and/or carry out the given instructions precisely. Ignoring this warning may cause personal injury, cause damage to the system, or produce false data.
	Text with an i mark in a green circle means: Please read this information to not only use the system accurately and safely, but also efficiently.
[...]	Terms within square brackets refer to function buttons that are used in the Web Based Interface. (WBI).

Cleaning

Before cleaning the radar the radar should be turned off. This can be done by switching off the system and disconnecting the power cable.
Never clean the radar without turning off the power.
Clean the radar with a cotton cloth and non-aggressive cleaning agent.

Service and maintenance

Do not open any device in the system; these may only be opened by trained SGG employees. Failure or faults should be reported to the Sensys Gatso customer service. Customer support will help to find a solution.

Precautions RF radiations

The radar used does not pose a serious threat or cause adverse effects to people working on them, or using them, nor anyone in the vicinity.
Each radar generates electromagnetic fields with a certain frequency and power where the average output power of our radars is very low, a few milliwatts.
This is not considered hazardous to health, even when used in very close proximity to the body. However, as with all technologies, it is best to work safely to minimise exposure, no matter how small it may be.
Following recommendation can be observed:

- Keep radar emission areas clear of (metallic) objects to limit reflections;
- Do not cross, stand or walk in and/or limit the time present in the radar emission area;
- Keep a distance (> 20 cm) from a powered radar unit when in the radar emission area;

Do not place (large) metal objects directly in front of the radar, this can cause reflections and may damage the radars high frequency electronics due direct reflection.

CE declaration

See CE Declaration of Conformity (DoC) in Annex A

RED declaration
Note that for the United Kingdom and France the ISM band has some Limitations. United Kingdom: the 24.150 - 24.250 GHz band is prohibited in Northern Ireland. France: the power limit is 0.1 mW EIRP for the 24.10 - 24.150 GHz band.

FR	**IE**		

FCC declaration
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

Reference documents
Additional documents belonging to the T-Series Fixed are listed hereafter:

Doc. nr.	Date	Document name
IM-E1627	12-09-2018	Rev 00 T-Series Installation manual
IM-E1710	11-28-2019	Evidence downloader november 2019
USM-230627	23 June 2023	USM-230627 Streaming ANPR to servers
MI-190148	10-08-2019	T-Series RT4 Site Survey
DoC-230613	23 June 2023	Declaration of conformity (see annex 1)

Alterations to the system
Sensys Gatso cannot guarantee adequate operation of the system or system parts if other materials than stated in this manual are used. Materials that do not comply with the specifications described in this manual may damage the product and lead to risks such as malfunctioning, short-circuiting, fire and electrical shocks. No parts of the T-Series Fixed may be altered or rebuilt without written permission of Sensys Gatso.

Software applications
Hereafter is a list of various software applications that may be used in combination with the T-Series system.

Application	Use	Source
Offline Viewer	To open en view registrations	Sensys Gatso or its distributor
Evidence Downloader	Automatically downloads evidence files from one or more T-Series systems	Sensys Gatso or its distributor
Google Chrome	Recommended web browser to access the WBI	http://www.google.com/chrome/browser/desktop/index.html
Bonjour	To search for a system with an unknown IP address	https://support.apple.com/kb/DL999?viewlocale=en_US&locale=en_US
SoapUI	To receive UTMC messages	https://www.soapui.org/downloads/soapui.html

Version table

Version	Date	Status	Remarks
0.0.0	3 July 2020	DRAFT	For review with DM
0.1.0	15 July 2020	DRAFT	Final review DTP
1.0.0	*20 July 2020*	Final	
1.0.1	16-04-2021	Final	Correction on ANPR ROI
1.1.0	11 July 2023	Published	Add RED requirements, general update for RTx
1.2.0	14 Sept 2023	Draft	Add easy alignment add update DoC
1.3.0	27 Sept 2023	Published	Checked and published
1.4.0	16 June 2024	Published	Added FCC declaration paragraph

Table of content

1. FUNCTIONALITIES OF THE T-SERIES FIXED

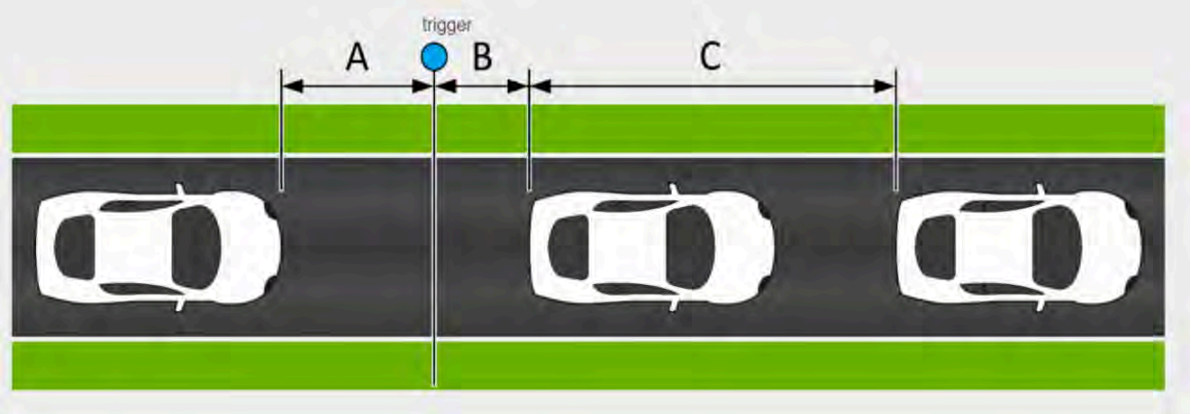
The T-Series Fixed is designed to be installed at the side of the road. It provides enforcement functions for red-light and speed violations, as well as supporting functions for collecting data of passing traffic.

1.1 Red-light enforcement

In general every passing vehicle is detected and will be tracked by the radar. When the vehicle is at the trigger line, the measurements are finished. In case of a red-light violation, the system will provide a video and three still images from the rear side of the vehicle by default. When captured from the rear, this ensures both the license plate and traffic lights are visible in the evidence file.
The radar sends a trigger at the trigger line, depicted with the line with a blue dot in the image below. The first image is a low-resolution image recorded at a set distance prior to the occurrence of a red-light offence. This distance interval A is set with respect to the front of the vehicle.

The second image is a high-resolution image and captured after interval distance or -time B. This interval is calculated starting from the trigger line.

The optional third image is also a high-resolution image and captured after interval distance or -time C. This interval is calculated starting from the vehicle position after interval B. Both intervals B and C are set with respect to the rear of the vehicle. Interval C can be used for the secondary speed verification as further described in section 8.



1.2 Speed enforcement

In general, every passing vehicle is detected and will be tracked by the radar. When the vehicle is at the trigger line, the measurements are finished. In case of a speed violation, the system will provide one high-resolution still image and a video by default. Speed enforcement can be configured per lane for receding traffic, approaching traffic, or both at the same time.
The high-resolution image is captured after interval time or - distance B. Optionally a second high-resolution image will be captured after interval distance or -time C. This interval is calculated starting from the vehicle position after interval B. Interval C can be used for the secondary speed verification as further described in section 8.
A video can be recorded and included in each evidence file. The video duration is adjustable and can be set prior and after each event. Speed enforcement is possible for a maximum of 6 lanes, including lane divider.

1.3 Dedicated lane enforcement

The dedicated lane functionality allows for enforcing dedicated truck (bus) lanes or lanes dedicated for cars only. When a violating vehicle is detected in a dedicated lane, one (high) resolution image will be taken when the front (approaching) or rear (receding) of the vehicle is at the trigger line.
Dedicated lane enforcement can be enabled per lane and can be enabled for either or both approaching or receding traffic. This functionality can be activated in the [Enforcement settings] described in section 5.

1.4 Prohibited lane enforcement

The prohibited lane functionality allows for enforcing hard shoulders, closed lanes or one way traffic lanes. When a vehicle is detected in a prohibited lane, one (high) resolution image will be taken when the front (approaching) or rear (receding) of the vehicle is at the trigger line.
Any configured lane can be set to enforce prohibited lanes in approaching-, receding- or both directions at the same time. This functionality can be activated in the [Enforcement settings].

1.5 Statistics

Apart from separate evidence files, the system provides statistics on all passing vehicles. Test registrations are also recorded and included in the statistic files. See section 9.

1.6 ANPR streaming (optional)

When the Automated Number Plate Recognition (ANPR) functionality is enabled, the user is able to activate the ANPR streaming functionality in the [Enforcement settings] as described in section 5. When activated, an image is captured of each detected passing vehicle.
The license plate of the detected vehicle is read from the image and the data is made available for back office applications using the UTMC protocol. Users can install SoapUI software to receive UTMC messages from the T-Series. More info about ANPR streaming is described in a separate manual or you can contact Sensys Gatso for more information.

1.7 Encryption (optional)

Evidence images are stored with the corresponding evidence XML data and the optional video in the MJ2 file format. Files are signed to prove the authenticity and serve as a strong evidence in the event of a court case. Evidence files can be encrypted to comply with privacy laws.

2. T-SERIES SYSTEM OVERVIEW

The T-Series Fixed hardware consists of the system box and the auxiliary box that are both housed in the pole cabinet. Connecting with the system can be done via a direct cable from a laptop, via LAN or via the internet. The T-Series is accessible through the Web Based Interface (WBI). This section gives a brief overview of both hardware and WBI.

2.1 System box

The system box is the center of the T-Series and contains all the essential modules for the enforcement functions. The camera, radar and flash unit are visible at the front side of the system box and are described hereafter.

The power, I/O, and network connector are located at the rear side of the system box. The power button has a two-color LED indicator that indicates the system status and that can be used to turn off the system. See section 3.

2.1.1 RT4.1 radar

The RT4.1 radar continuously measures speed, direction and position of all vehicles in the detection area, providing the system with the vehicle data required for all system functions.

2.1.2 GT20 camera

The GT20 camera captures images and event videos under all ambient light conditions. The images are compressed to JPEG2000 format to reduce the file size.

2.1.3 *FT3 flash*

The T-Series holds an IR LED flash panel (FT3) to provide illumination for the still images and (optional) video frames.

2.1.4 *Storage*

In addition to the modules mentioned above, the system is equipped with an internal SSD (Solid State Drive) for storing evidence files, system configuration data, logging, and video archives.

2.1.5 *Power supply*

The system box contains a DC power supply by which the externally applied DC voltage is converted into a stable voltage supply for the various system components.

2.1.6 *System controller*

The DT2 system controller contains the core business logic of the system. It controls and monitors all components. Based on input from various sources such as the radar, it decides whether a passing vehicle is a violator or not. It will gather all event information and trigger the camera.

2.2 Auxiliary box

The auxiliary box holds the Wired Traffic Light Interface (WTLI), the AC power supply and the optional FT1 flash.

2.2.1 *Wired Traffic Light Interface (WTLI)*

The WTLI measures the current status of the connected traffic lights via a wired connection to the traffic control system. This information is sent to the system box.

2.2.2 *AC power supply*

The power supply converts AC power to a stable 12V DC voltage to feed the components in the auxiliary box and the system box. The system box starts as soon as the power cord is connected from the auxiliary box and the AC power is present.

2.2.3 *FT1 flash (optional)*

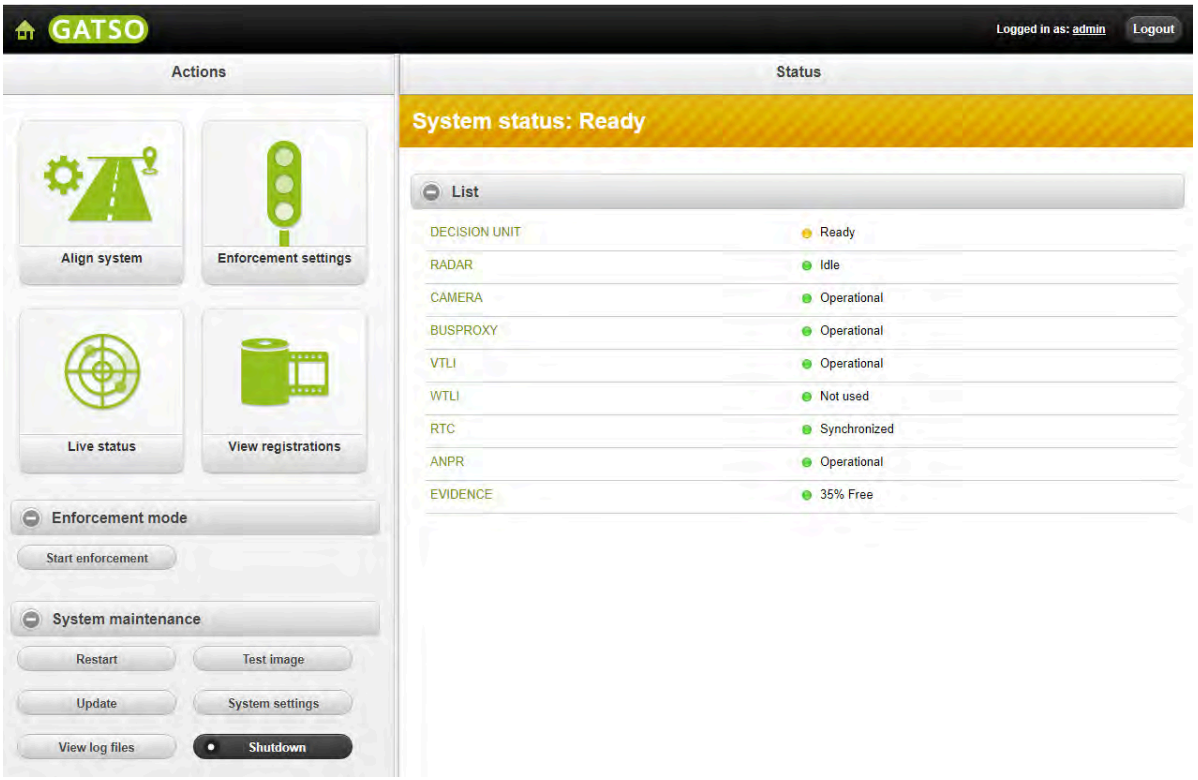
The optional FT1 flash offers additional exposure of the images. The FT1 flash supports high quality images and good recognizability of the driver and the surroundings.

2.3 T-Series pole cabinet

The pole cabinet houses the system box and auxiliary box and is mounted to a pole. The stainless steel outer shell of the cabinet protects the system from the elements.

2.4 Web Based Interface (WBI)

The WBI offers access to all key functionalities via the Google Chrome browser on a laptop, desktop computer or tablet.
The WBI is needed to align the system, to set enforcement settings and is able to show the status of the system components, to show a live view, and to access evidence files and statistics.



A brief explanation of the [Actions] elements is listed below:

Button	Description
[Align system]	The alignment procedure is described in section 4 and explains how to set up and align the T-Series.
[Enforcement settings]	Enforcement settings opens the menu to change Enforcement parameters. See section 5.
[Live status]	Live status shows the actual live stream, the traffic light status and the speed of passing vehicles. Read more in section 6.
[View registrations]	View registrations shows an overview of all registrations. The individual files can be opened, viewed and downloaded. Also statistics files can be opened, viewed and downloaded here. Read more in section 7.

A brief explanation of the [System maintenance] buttons is listed below:

Button	Description
[Restart]	Restart terminates all ongoing processes and reboots the system. Read more in section 9.1.
[Test image]	Test image offers 3 test image options; instant test image, triggered test image, and self-test. Read more in section 9.2.
[Update]	Update uploads a Sensys Gatso signed update package. Read more in section 9.3.
[System settings]	System settings takes the user to a menu where the various system settings can be viewed and edited. Read more in section 12.
[View log files]	View log files opens a list of system log files that can be viewed, downloaded and/or deleted. Read more in section 9.5.
[Shutdown]	Always use the hardware or software shutdown button before switching off the power and/or unplugging cables. This provides safe data storage and prevents system failures. Read more in section 9.6

3. CONNECTING TO THE T-SERIES

3.1 Power On/Off

When the power cable is connected from the auxiliary box to the system box, the system modules are powered. A power button with integrated two-color LED indicator shows when the system is ready for safe switching off.

The following LED status indications occur:

While the system is starting up, the indicator flashes green until the system is ready. The blinking starts within 2 s after power is connected.	
When the system is started up, the indicator lights up green continuously.	
When the enforcement status is entered, the indicator flashes every 3 s with a short pulse.	
When the system comes out of the enforcement status, the indicator lights up green continuously.	
When the power button is pressed, the indicator flashes red and the system turns off. When shutdown is completed, the indicator is off, indicating it is safe to remove the power cable.	
If the system is in an error state, the indicator lights up red continuously.	

3.2 Connecting to the system

To gain access to the system, there shall be a network connection between the system and the

device of the user. This can be done via a LAN network, via a direct cable connection between the system and the computer device or via the internet described hereafter.
The WBI can then be displayed by entering the IP address of the system in the web browser. Depending on the type of network connection, there are several ways to find the IP address of the system.

3.2.1 Connection via LAN

If the system is connected to a Local Area Network (LAN) such as an office with an internet modem or router with an active DHCP server, the T-Series automatically assigns an IP address. The assigned IP address can be found through the client list of the DHCP server. Please contact the network administrator if you do not know where to find this list.
If the IP address cannot be found as described above, it is necessary to install the freely available Apple Bonjour Service. Once Bonjour is installed, the IP address of the system can be found as follows:

1. Press [Windows Key] + [R].
2. Type “cmd” and press [Enter] to open the command prompt.
3. In the command prompt, type “ping -t GTIB-XX-XX-XXX-XXX.local” (the GTIB number is the camera number that reads on the systems type label).
4. The IP address is displayed in the command prompt.

Example label T-Series

The WBI can now be opened by entering the IP address that reads in the command prompt or by entering https://GTIB-XX-XX-XXX-XXX.local (the GTIB number is the camera number that reads on the systems type label) into the address bar of Google Chrome.

3.2.2 Direct connection (zeroconf)

The T-Series must be set to DHCP. If no DHCP server is found, then the T-Series will revert to its zeroconf address.
The zeroconf address applies when laptop and T-Series are connected directly by network cable.

Do not connect multiple T-Series to a single laptop.
Multiple connected T-Series create an IP conflict and T-Series become inaccessible.

To connect via zeroconf, take the following steps:

1. Start the T-Series without a network cable connected.
2. Put the laptop in DHCP mode (most laptops are standard in DHCP mode).
3. Wait for 6 minutes to allow the system to start up.
4. Connect the network cable between the T-Series and the laptop.
5. When the network icon in the taskbar laptop shows an exclamation mark (in Windows), the WBI can be opened in Google Chrome by entering the following address into the address bar: https://169.254.2.21.

3.2.3 Static IP

Once a first connection with the system has been established, it is possible to set a static IP to the system. Go to section 12.4.

3.2.4 WiFi connection (optional)

If the T-Series is delivered with a WiFi router, the laptop can be connected to the built-in WiFi access point. The SSID of the network is equal to the GTIB (camera) number found on the type label of the system. The default password will be provided. See also section 12.5. When the laptop is connected with this network, the WBI can be opened by typing any text in the address bar of Google Chrome, ending with .services.sensysgatso.com.

4. SYSTEM ALIGNMENT

The system alignment must be carried out each time the system is relocated. After physical installation and making a connection with the system, the next step will be to align the T-Series for correct operation. The alignment procedure can be carried out on location or remotely. The number of steps can vary, depending on the system configuration.
Access to the alignment procedure is restricted to users with the right permissions. User- and role management will be further explained in section 12. The alignment wizard can be used by one user at the time.

Preparations

Certain location data is required to inform the system regarding its environment during the alignment procedure. The following data needs to be known and entered in centimeters:

- distance between T-Series and kerb (road edge) of the nearest lane to be enforced
- distance between T-Series and reference point
- for red-light enforcement: (average) distance between T-Series and stopline(s)

The alignment procedure can only be carried out when the system is in state ‘Configuration’. Read all about system states in section 11. If the system is not in the ‘Configuration’ state, find a solution in section 11.4 Troubleshooting, or contact the installer.

For remote alignment an active network connection is required. If there is no connection or when connection fails, read section 3 for making a connection to the system or contact the network administrator. If access to the WBI is not possible, contact the network administrator.

During the alignment procedure the user is required to enter site specific data. Make sure all required data is available before starting the alignment procedure.

If during the alignment procedure the camera does not show all targeted lanes, trigger positions and selected traffic lights, abort the alignment procedure and contact the installer of the system. Once the camera view is corrected, start alignment again.

The previous alignment settings will not be overwritten until the alignment wizard has been confirmed in the last step of the alignment wizard.

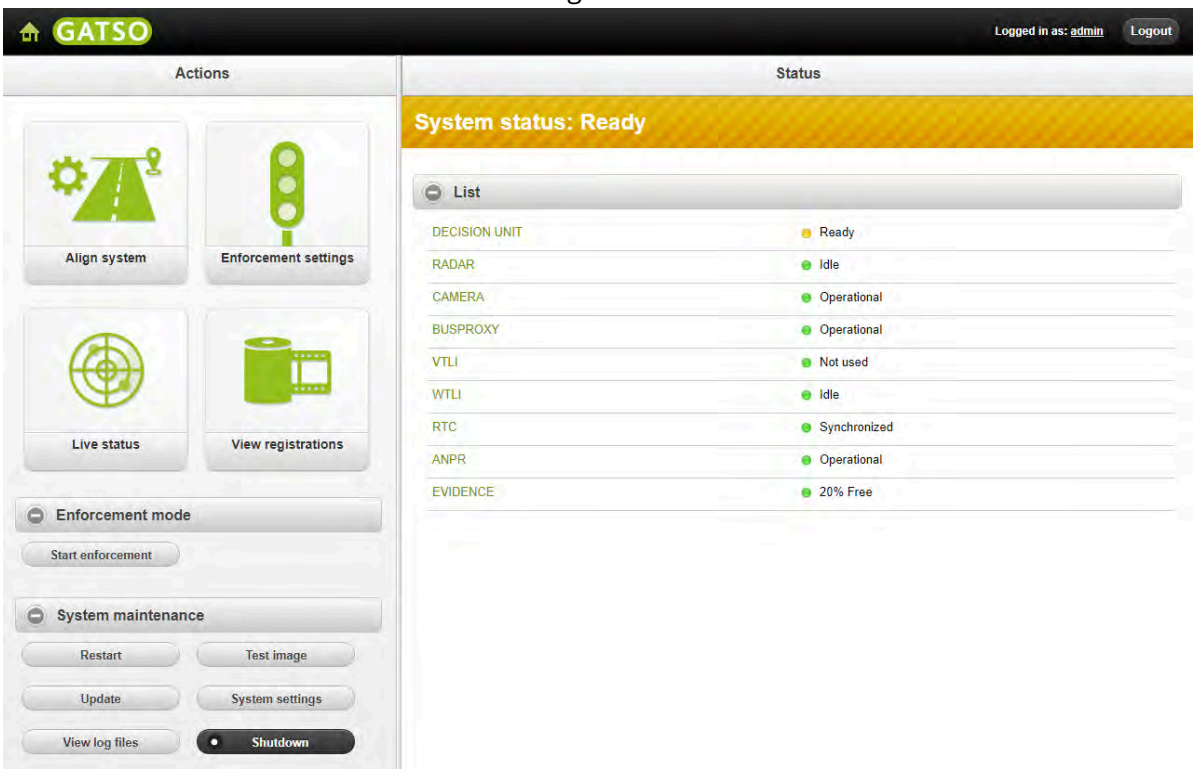
Enter the IP address of the system in the browser. The login page appears on the screen.
Enter [USERNAME] and [PASSWORD].
For the first log in, a default account will be provided by Sensys Gatso.

Users are strongly advised to change the default password upon first use.

To change a password go to [System settings] and select [User management]. Double-click on the user name and select [Change password]. Read section 12.1.
Users also have a dedicated role assigned. Go to [System settings] where you find [User management] and [Role management]. Read sections 12.1 and 12.2.
The default language is defined in the [Systems settings] and select [Language]. This will be further described in section 12.7. In case multiple languages are installed, a different language can be selected in the top right corner of the login screen.

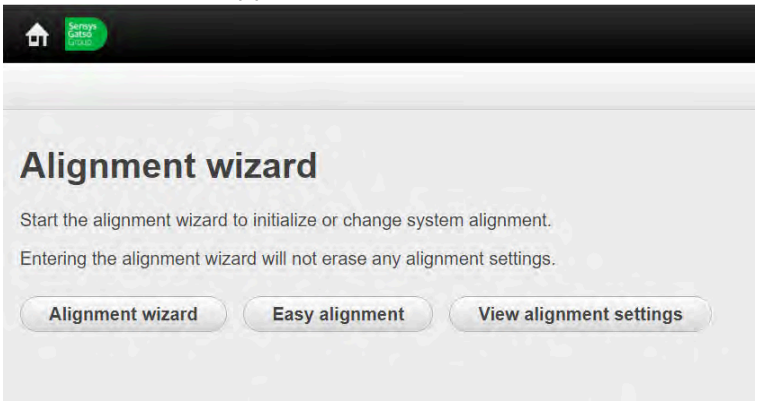
4.1 WBI dashboard

The left side of the WBI dashboard contains several 'Actions', shows the 'Enforcement mode' and displays 'System maintenance' buttons. The right hand side shows information about the system state and the status of the individual system components. The different system statuses will be described in section 11 Troubleshooting.



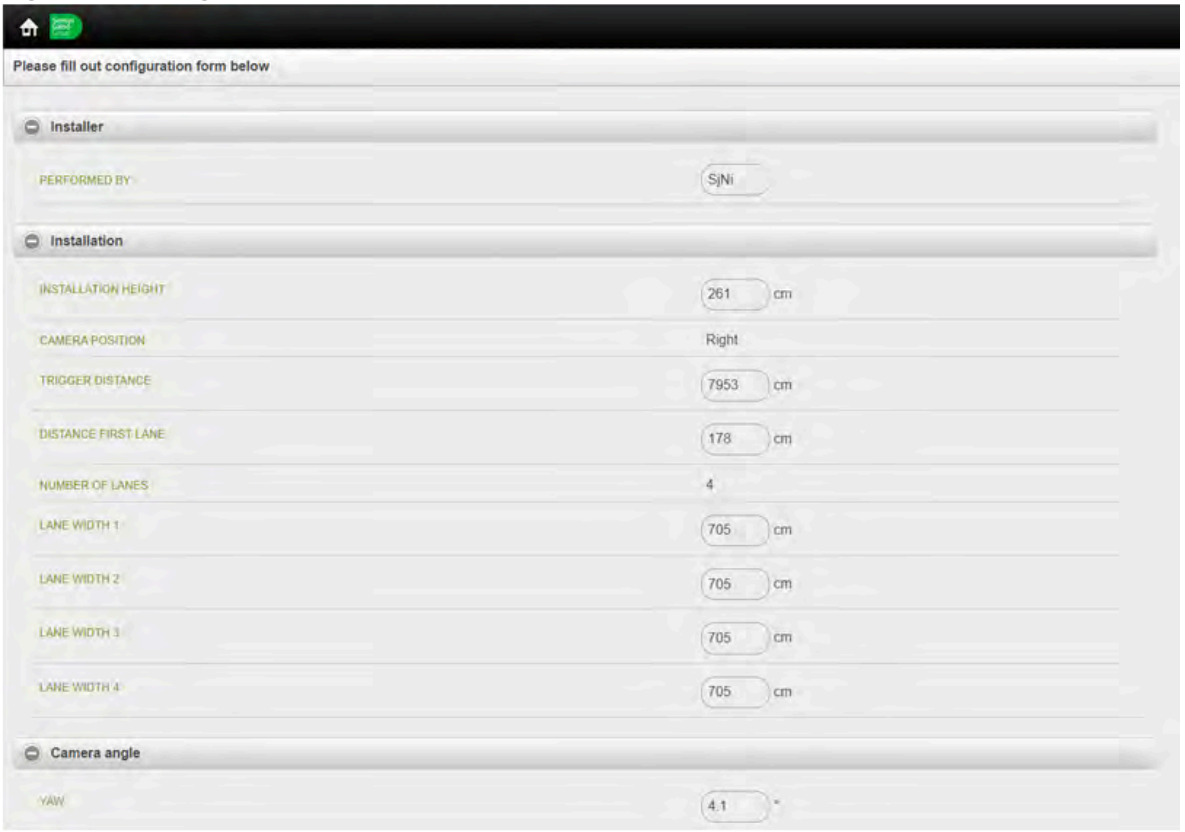
Alignment method selection

Click on [Align system] on the homepage of the WBI dashboard to start aligning the T-Series. The alignment wizard selection will appear on the screen.



The two different methods of alignment will be covered in their own dedicated sections. The alignment wizard, which was already present on older releases, offers a graphical assistant to the alignment, in which lines are drawn on the road to match the camera view. The easy alignment, an option introduced on the T-Series Release 8, allows for a faster alignment of the system, under the condition that more of the installation distances and angles have been measured on the road.

Selecting [View alignment settings] will redirect to a screen showing the current values of the alignment settings and measured distances described below.



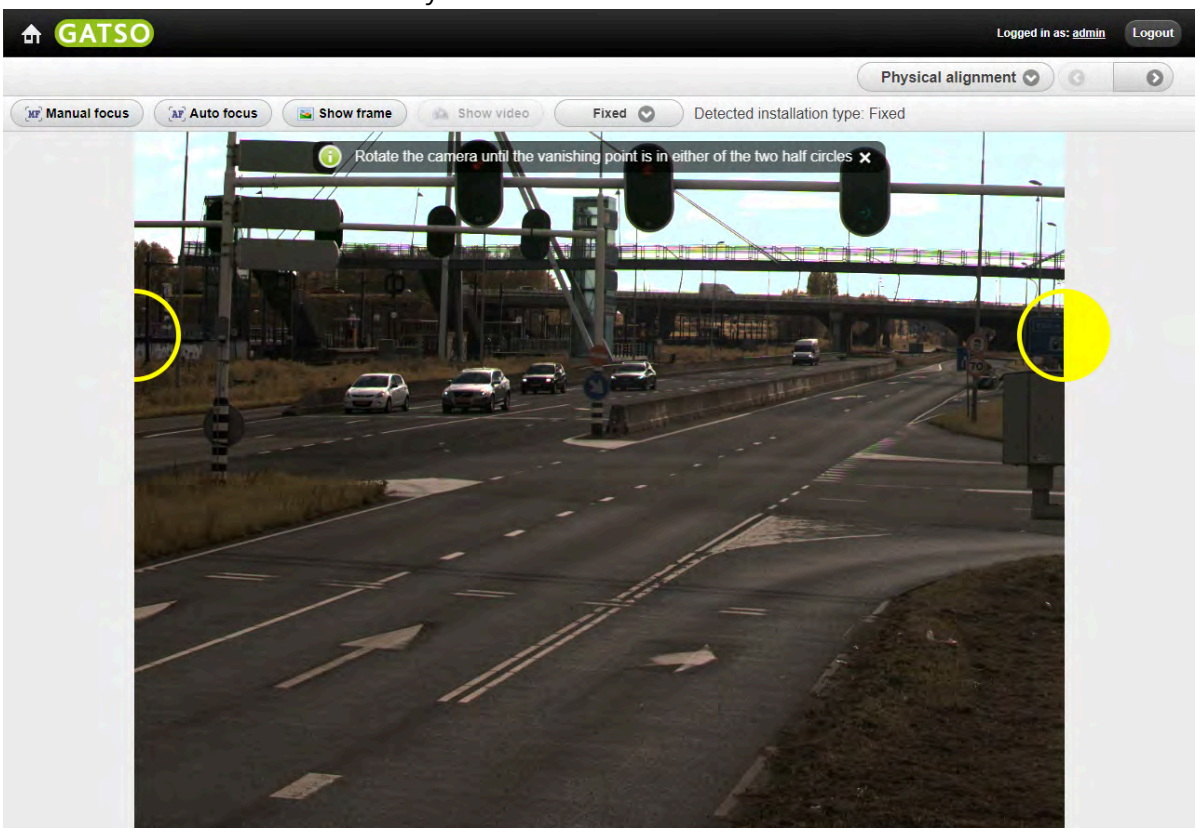
Value	Description
Performed by	The name of the authorised installer who has performed the latest alignment.
Installation height	The height, in centimeters, from the ground to the T-Series system.
Camera position	The side of the road in which the T-Series is installed.
Lock trigger lines	Selecting this checkbox will set a single trigger distance for every configured lane. Having it unchecked would allow us to configure a separate distance per lane on the road.
Trigger distance	The distance, in centimeters, at which the violations are measured and pictures are taken. If the previous checkbox was unselected we will have one entry per lane.
Distance to first lane	The distance, in centimeters, from the base of the installation pole of the T-Series to the edge of the first lane on the road, measured perpendicularly to its line.
Number of lanes	The number of lanes on the road.
Lane width	The width of each lane, in centimeters. One such field will exist per configured lane.
Camera Angles	More details on the angles below and their meaning can be found on the appropriate section of the alignment procedures.
Yaw angle	The rotation of the system on the vertical axis compared to the road axis.
Pitch angle	The horizontal angle between the system and the road axis.
Roll angle	The horizontal angle between the system and the road, perpendicular to the road axis.

Additional functionalities can be found on the right-hand side of the [View alignment settings] screen.

Button	Description
Save/Load settings	The current alignment settings can be saved by clicking the [Download alignment settings] button. This saved file can later be used to restore this alignment to its current status via the [Choose File] button, which will enable the [Upload alignment settings] option.
Download test image	This button will download a camera view from the T-Series which can be used for later reference on the physical alignment.

5. ALIGNMENT WIZARD

After selecting [Alignment wizard] on the menu on page 21, the wizard will be initialised. The screen shows the live view of the system.



Example live view with vanishing point of the road in one of the yellow circles.
The alignment procedure of the T-Series will guide you through alignment in 13 steps:

[1/13] Physical alignment
[2/13] Installation
[3/13] Lane indication
[4/13] Yaw adjustment
[5/13] Yaw and pitch
[6/13] Reference point
[7/13] Roll
[8/13] Lane widths
[9/13] Trigger distances
[10/13] Image position (Optional)
[11/13] Dual Exposure
[12/13] Traffic light indication
[13/13] Confirmation

5.1 [1/13] Physical alignment

This first step indicates the detected installation, either Portable or Fixed. Select [Fixed] from the drop-down menu above the live view. The T-Series should show “Detected installation type: Fixed” in case of a fixed installation. Always check before continuing.

5.1.1 Check alignment

Check the live view and ensure the following:

- all lanes to be enforced are visible
- for all lanes to be enforced, the photo trigger position is visible
- traffic lights are visible (only applicable for red-light enforcement)
- the circle of the vanishing point is selected at the same side of the road as the T-Series

If during the alignment procedure the camera does not show all targeted lanes, trigger positions and selected traffic lights, abort the alignment procedure and contact the installer of the system. Once the camera view is corrected, start alignment again.

5.1.2 Select vanishing point

The screen shows two yellow half circles.Select the circle at the same side of the road as the T-Series’ position. After selection of this circle, half of the circle will be filled yellow.

5.1.3 Check camera focus

The camera focus can be adjusted automatically or manually.
Select [Show video] from the menu bar to open the live view and check the camera focus. If the video resolution setting is too low, enhance the live stream quality. To do this return to the WBI dashboard and select [Systems settings]. The quality of the live stream can be adjusted by clicking on [Livestream]. Here you will find three options [LOW], [MEDIUM] and [HIGH].
Select [Show frame] above the live stream to display a still image.

5.1.4 Automatic focus

Select [Auto focus]. The live view shows the entire camera field of view. A frame is displayed with handles in the center and the corners. Use these handles to place the frame over an area for the camera to focus on. Click on [Start] to execute automatic focus.

For best focus results select a high contrast area on the image. For example, use the white striping on the road near the trigger area.

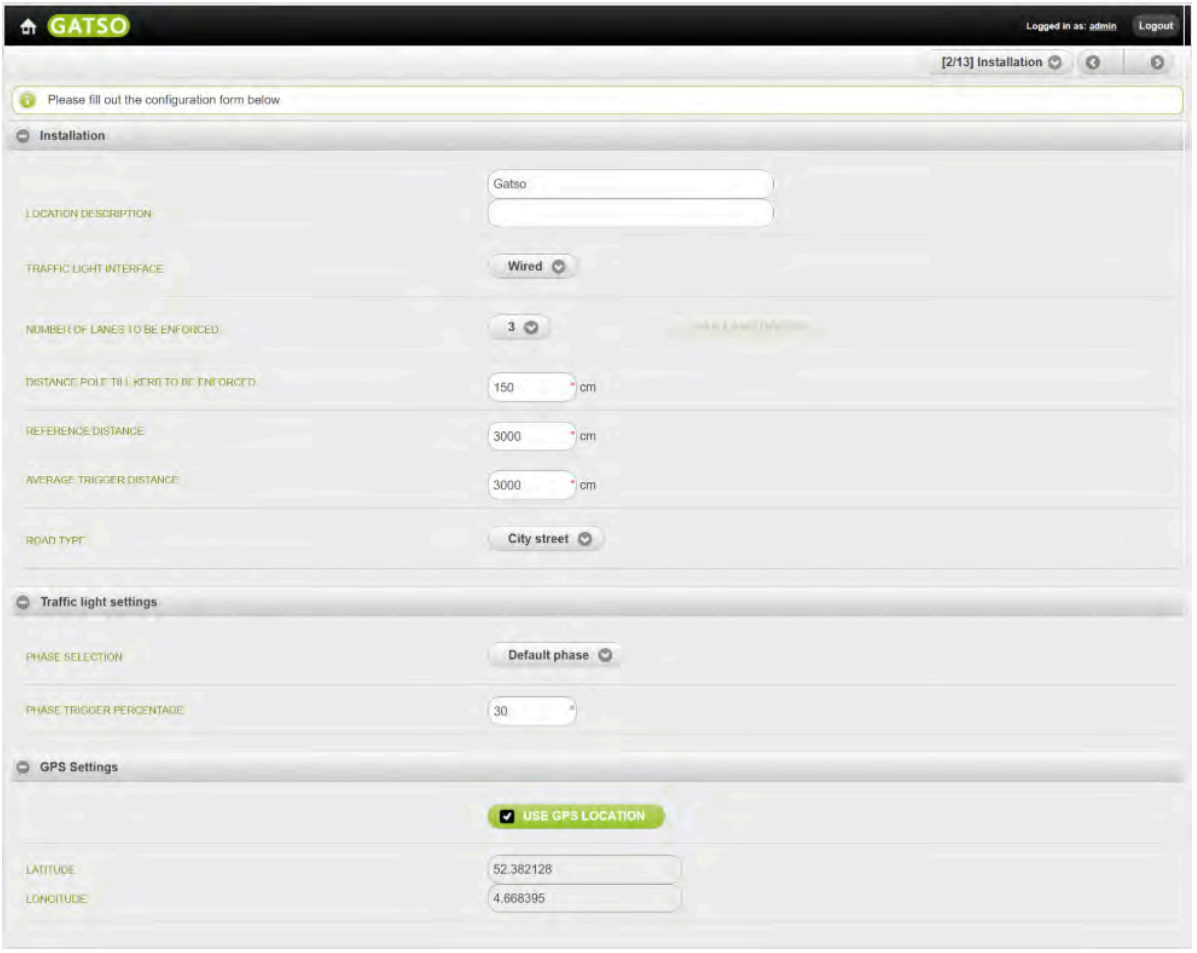
5.1.5 Manual focus

Select [Manual focus] and click on [Start]. Use [Near] and [Far] to adjust the camera focus in steps. When the camera is at the desired focus click [Done] to go to the next step.

Sensys Gatso recommends focusing the camera in the evening or at night time especially when using only the FT3 flash.

5.2 [2/13] Installation

In this step, location details must be filled in and also the use of GPS location can be enabled. Check the specific installation data provided by the installer.
During installation, it is important to measure the distances properly in order to get accurate data filled in. If not done accurately, it can lead to incorrect lane indication, incorrect trigger positions and a false violator marker.



5.2.1 Location description

Specify a unique location name for the specific installation (max. 40 characters). This text will appear on each data bar.

5.2.2 Traffic light interface

For red-light enforcement select the applicable traffic light interface. This can either be Wired or Vision in the drop-down menu. Check the correct setting with the installer. Read section 4.12 for more information. For speed enforcement only choose option [None].

5.2.3 Number of lanes to be enforced

Enter the number of lanes to be enforced. For speed enforcement it can be 1-6 lanes, for red-light enforcement 1-4 lanes.

The lane divider is a designated lane or area that is excluded from enforcement. It can be used

to define the centre median strip to avoid unwanted radar detections. One lane divider can be defined and if enabled, this lane is included in the total lane count. This functionality is not available in combination with red-light enforcement.

5.2.4 Distance pole till kerb to be enforced

Enter the distance (in centimeters) measured from the middle of the pole to the nearest kerb (road edge) of the first lane to be enforced.

5.2.5 Reference distance

The reference object can be the stop line but also any other stationary object which is visible in the image. The chosen reference object shall be at a distance between 20 and 60 meters on the same level with the road and on the same side of the road as where the system is installed. Enter the measured distance from the middle of the pole to the reference point.

The reference distance will be pinpointed on the live screen in step [6/13]. The system uses the reference distance, system yaw and pitch angle and a number of other parameters to calculate the lane widths.

If the used reference object was removed, do not continue, but contact the installer.

5.2.6 Average trigger distance (for red-light enforcement only)

Enter the distance from the pole to the stop line measured in a parallel line alongside the road. If there are multiple stop lines present, use the average distance between them.

5.2.7 Road type

Click on the drop-down menu and select the type of road. There are three options: [City street], [Country road] or [Highway]. The road type is used by the system to predict vehicle speeds and lane width during initial alignment. The selection does not influence operation during enforcement.

5.2.8 *Traffic light settings: phase selection (for red-light enforcement only)*

Phase selection shifts the camera synchronization relative to the mains voltage in steps of 120 degrees.

Traffic light synchronization is used to ensure that images are only captured when traffic light LEDs are lit. If the traffic light statuses are invisible on the live view, the T-Series is not correctly synchronized with the traffic lights. The traffic lights may not be connected to the same phase as the T-Series. If this happens, select [Previous phase]. If the problem still exists then select [Next phase]. If still not solved, please contact Sensys Gatso customer support.

Only adjust the phase when the traffic lights on the evidence images are not shown lit

5.2.9 *Traffic light settings: phase trigger percentage*

The phase trigger percentage provides the ability to shift the camera synchronization in smaller steps with respect to the phase of the mains voltage. Adjust the phase trigger percentage to fine tune the traffic light synchronization.

Perform a triggered test to check the new situation.

5.2.10 *GPS settings*

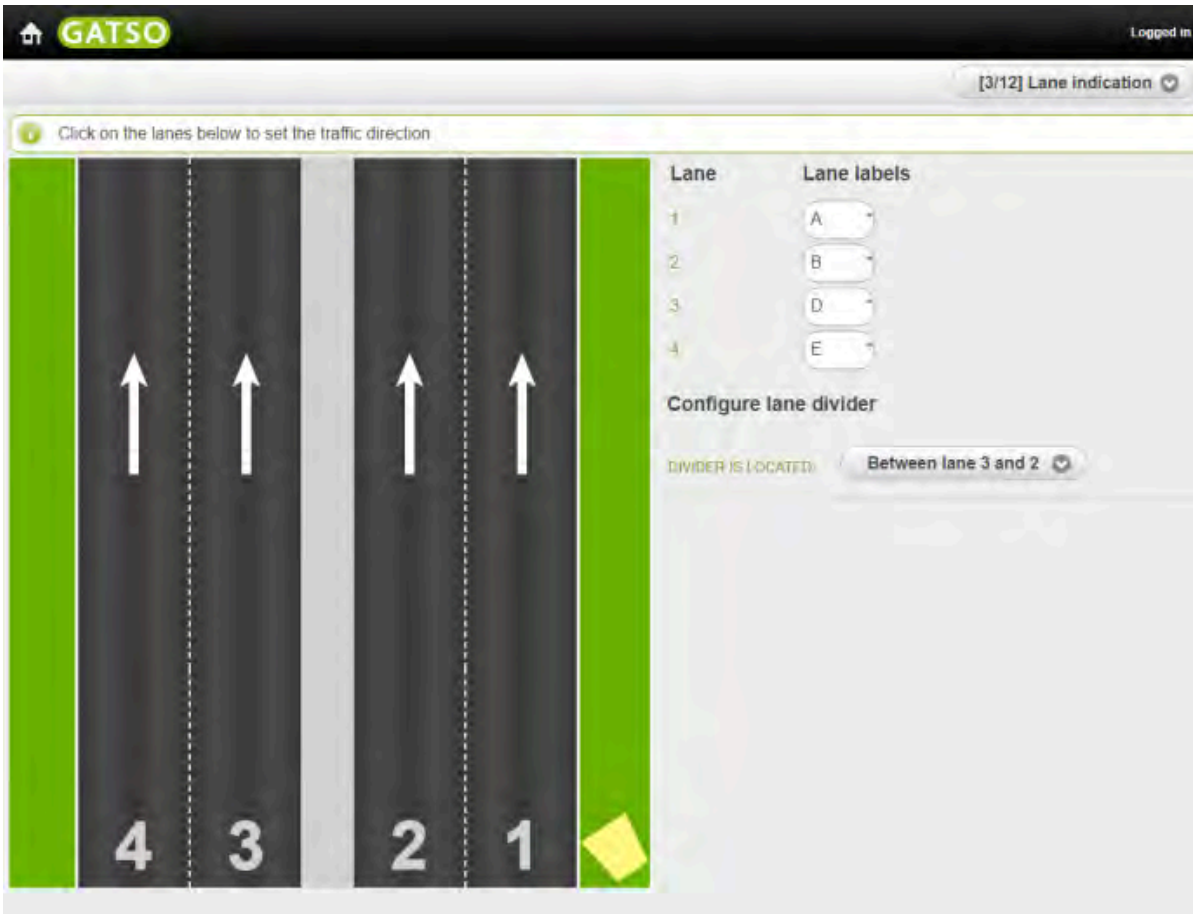
By enabling the GPS Location you can fill in Latitude (north/south compared to the equator) and Longitude (east/west compared to the prime meridian) coordinates of the installed system.

5.3 [3/13] Lane indication

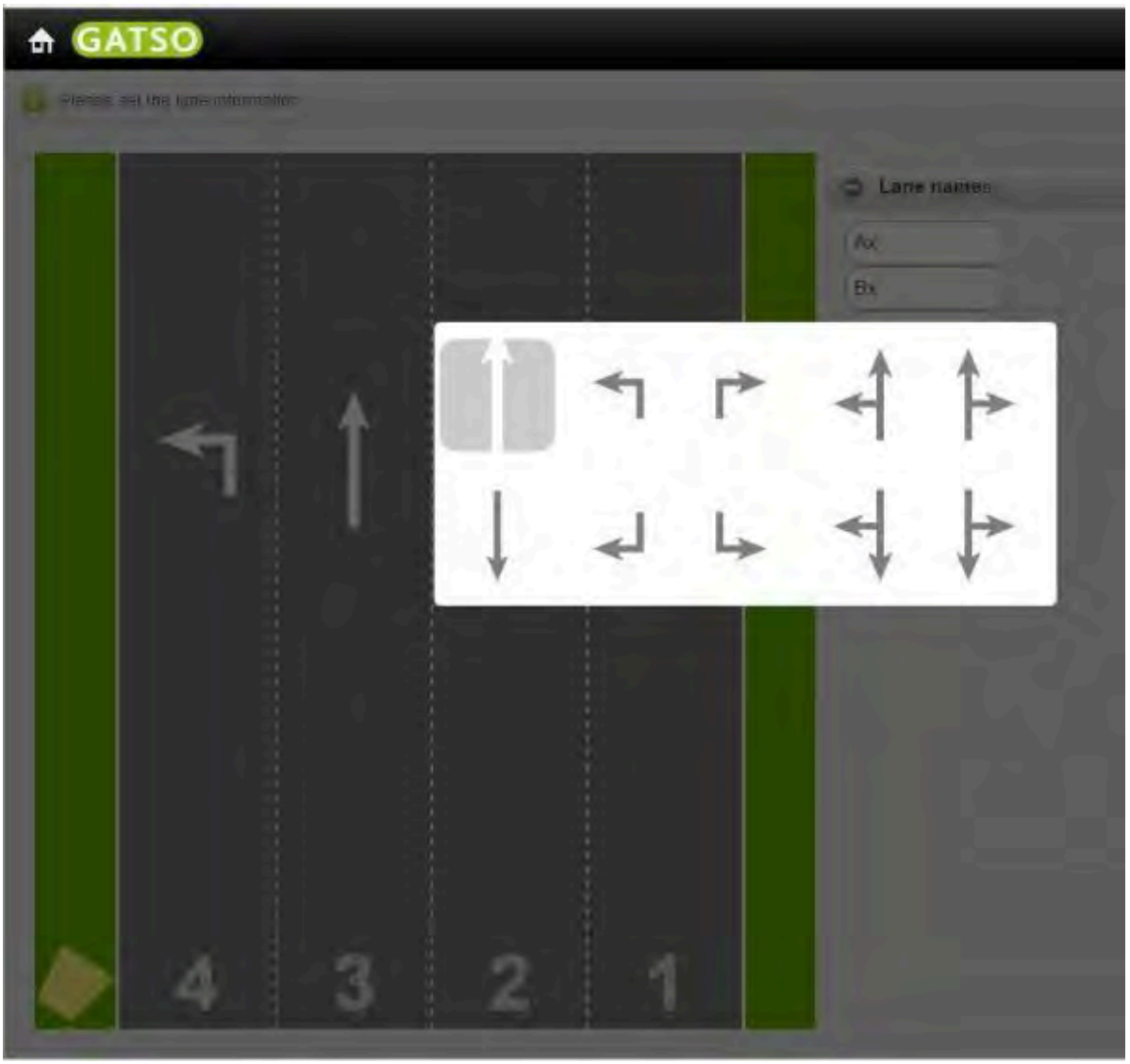
The number of lanes added in the previous step, possibly with enabled lane divider option, become visible in this third step of the alignment procedure.

The T-Series uses a fixed, built-in numbering system for the monitored lanes. Depending on the exact software configuration, this is either ascending or descending from the camera position. An individual lane name can be assigned to a lane number and this will be shown on the image data bar, the event data and the live status page.

If the lane divider option was selected in alignment step [2/13], the location of the lane divider must be assigned. The lane divider can be on the right hand side or the left hand side of the road or in between two enforced lanes.

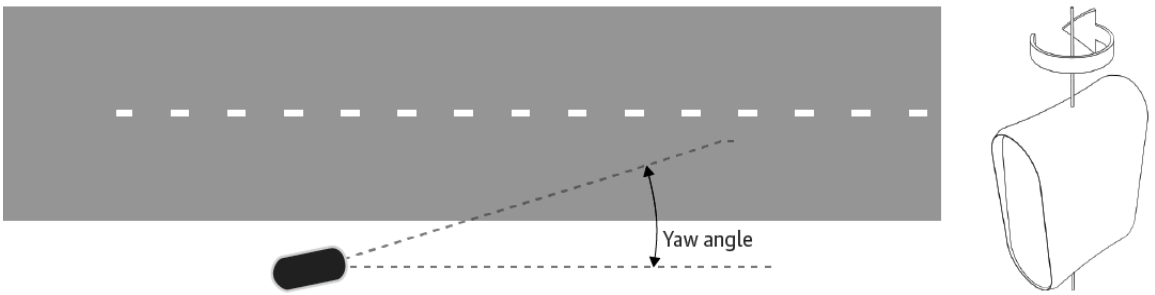


Click on a lane to view a pop-up window. Select the appropriate direction marking for each individual lane.

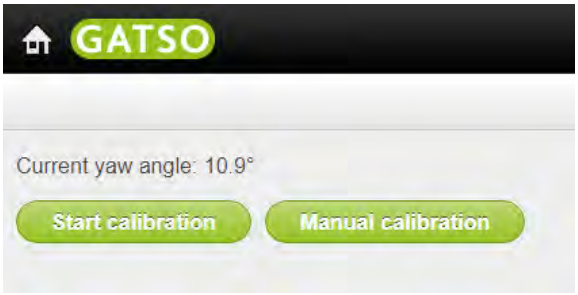


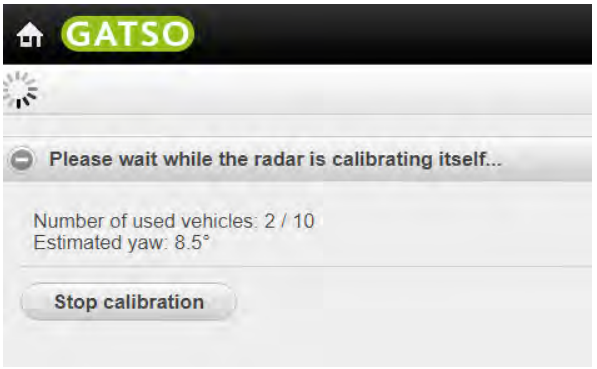
5.4 [4/13] Yaw adjustment

The yaw angle is the rotation of the system around the vertical axis compared to the road axis. The value for the yaw angle of the system needs to match the physical yaw angle the system was installed at.



In step [4/13] the following will be shown on the screen:





5.4.1 Calibrating yaw automatically

The system automatically adjusts the yaw angle based on the tracks of passing vehicles. Click on [Start calibration].
The system needs at least 10 tracks of vehicles travelling in a relatively straight line. The countdown timer shows the number of tracked vehicles. If needed, the process can be interrupted by clicking [Stop calibration].

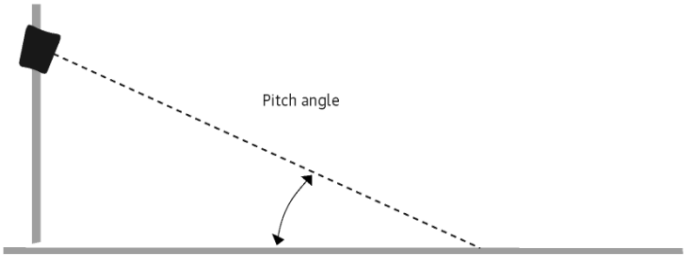
5.4.2 Calibrating yaw manually

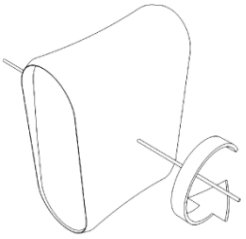
If there are not enough passing vehicles to perform automatic yaw calibration, click on [Manual calibration] and enter the yaw angle of the system. This information will have been obtained when alignment was previously performed at the same location.

Always check the yaw value with the installer data.

5.5 [5/13] Yaw and pitch

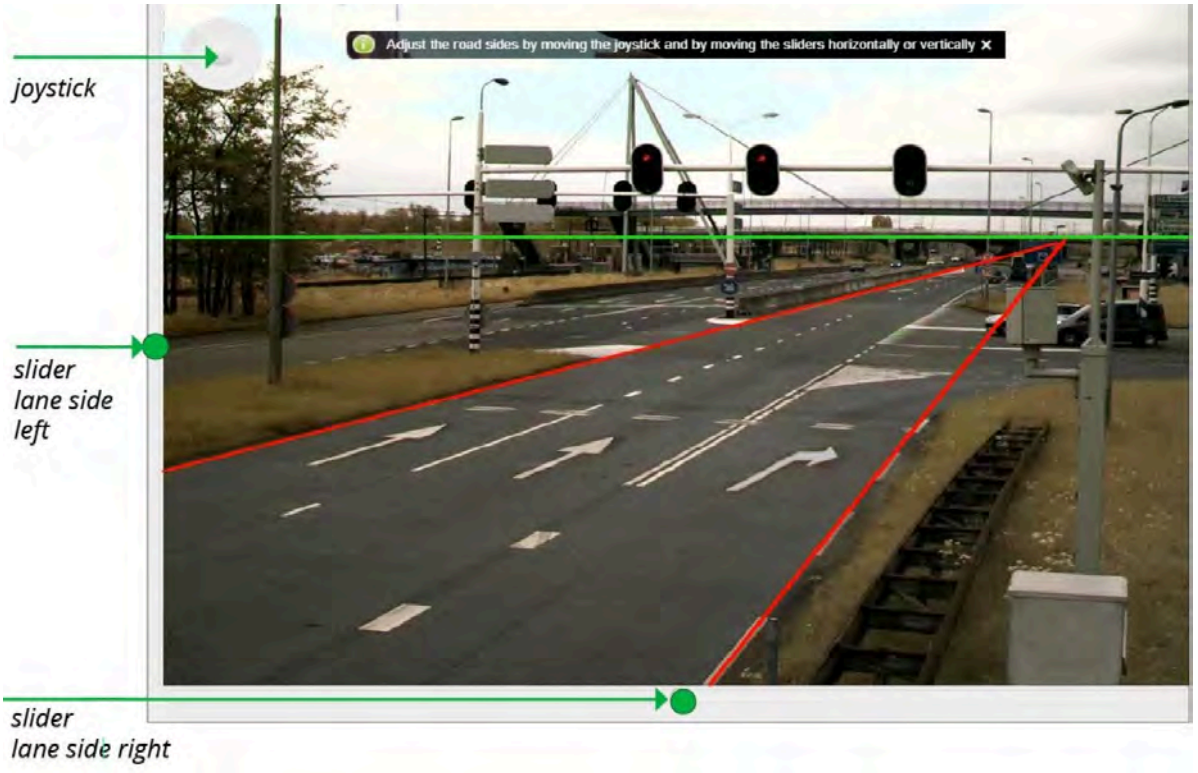
The pitch angle is the horizontal angle between the system and the road axis. In order to relate the camera view to the road geometry, the system yaw and pitch angles need to match the physical yaw and pitch angles the system has been installed with. This is done by positioning virtual lines on the camera image.





The screen shows a live situation like the example below.

1. Use the green sliders on the left and bottom side of the live image to move the red lines to the outer boundaries of the enforced lanes (see below example).
2. Use the joystick on the top-left to position the green line on the horizon in the image.
3. Use the joystick to position the intersection of the red lines with the green line on the vanishing point of the road.
4. Repeat steps if necessary to fine-tune the alignment of the lines with respect to the road edge markings.



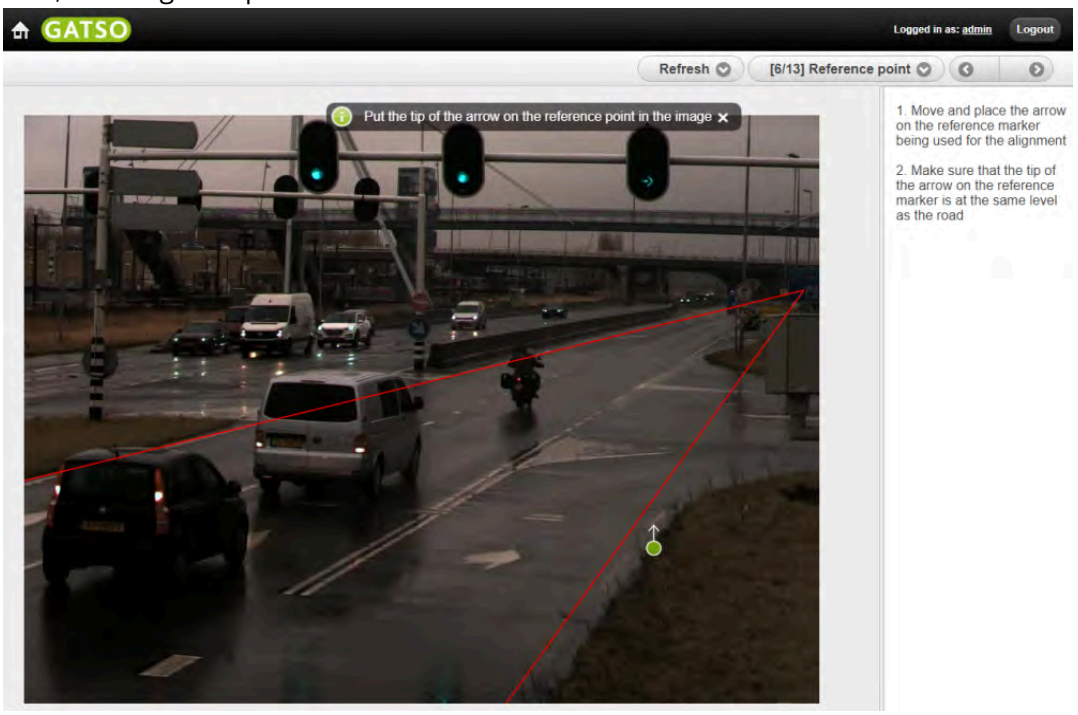
By clicking on [Red lines] in the menu bar, a different color can be selected that might be better visible on the screen. When clicking on [Refresh], the following menu pops up:

Click on [New video frame] to select a new video frame. Click on [Show Instant Test] to show a previously captured test image. Click on [New Instant Test] to capture a new test image instantaneously, independent of the traffic situation.

5.6 [6/13] Reference point

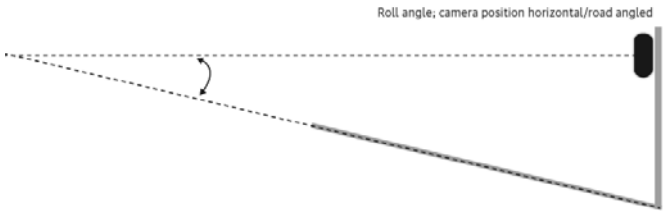
The reference distance was already entered in the alignment step "[2/13] Installation." In this step the chosen reference object will be pinpointed on the live screen to further feed the system with information on its surroundings.

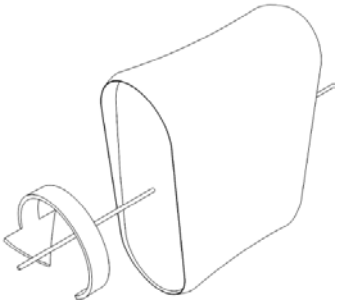
Drag and put the point of the arrow of the reference marker on the reference point in the live view, assuring the tip of the arrow is level with the road surface.



5.7 [7/13] Roll

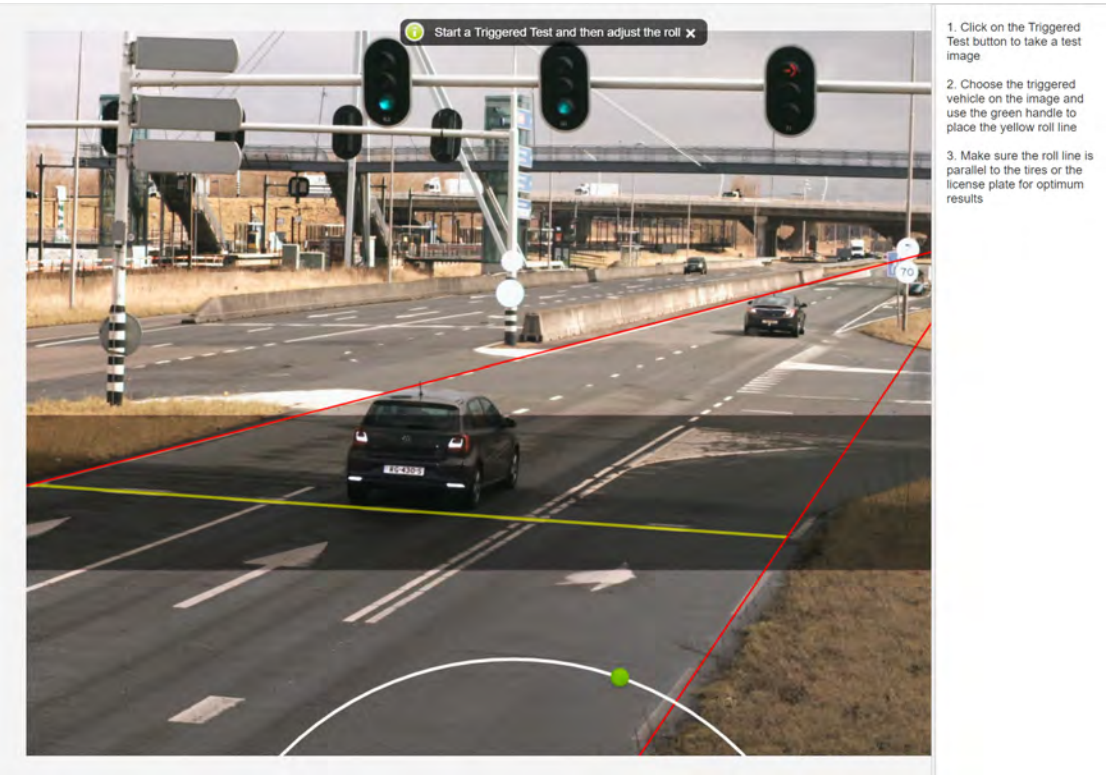
The roll angle is the horizontal angle between the system and the road, perpendicular to the road axis. In order to relate the camera view to the road geometry, the system roll angle needs to match the physical roll angles the system is installed at.





The roll angle is adjusted by rotating the green trigger line to coincide with the trigger position of the vehicle. Click on [Triggered Test] to take an image.

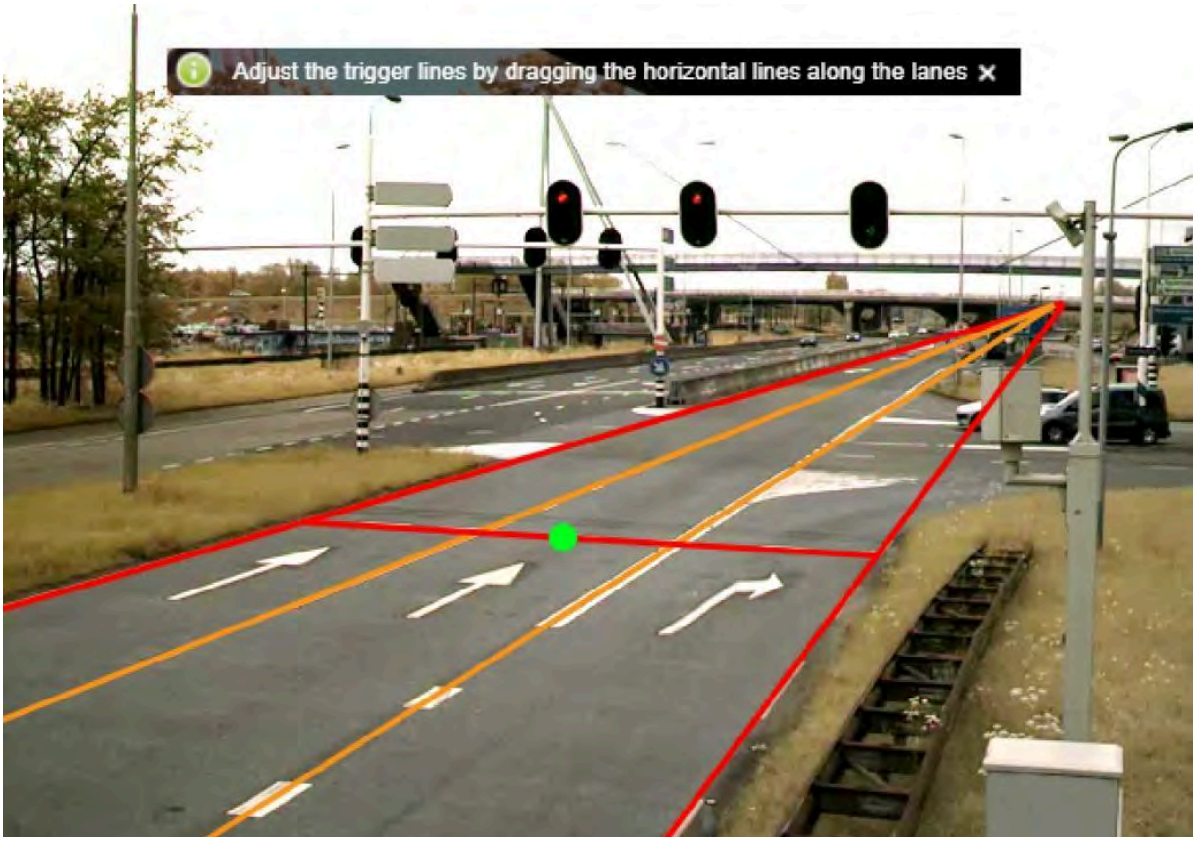
Use the green indicator on the curved slider to adjust the trigger line until the line coincides with the point where the wheels of the vehicle touch the road. If the road geometry differs per lane, the line should be an average of the road.



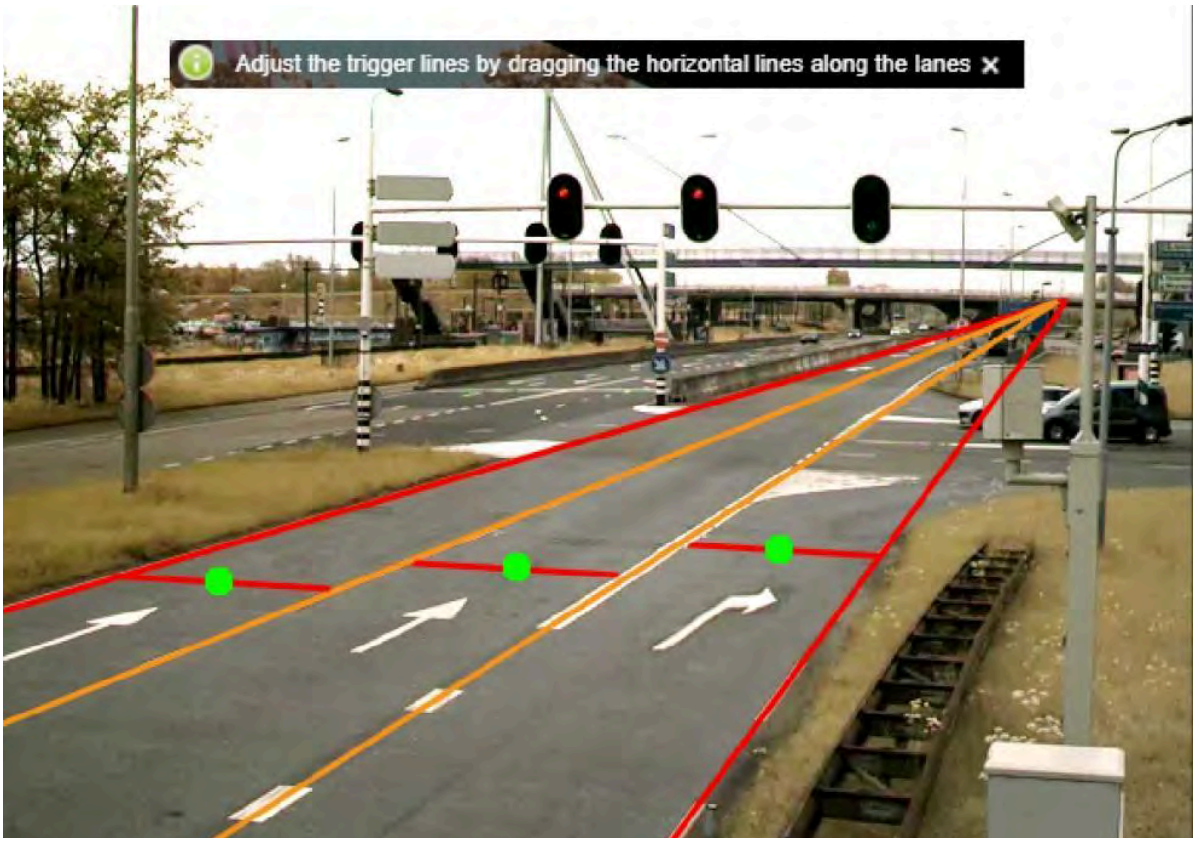
5.8 [8/13] Lane widths

The number of lanes visible on the live view should match the number of lanes as specified in step [2/13] Installation.
Click on each individual green circle and move the lines until they coincide with the road lines.
The calculated lane widths on the right pane of the page should be within +/- 15% of the (estimated) real lane width.

5.9 [9/13] Trigger distance



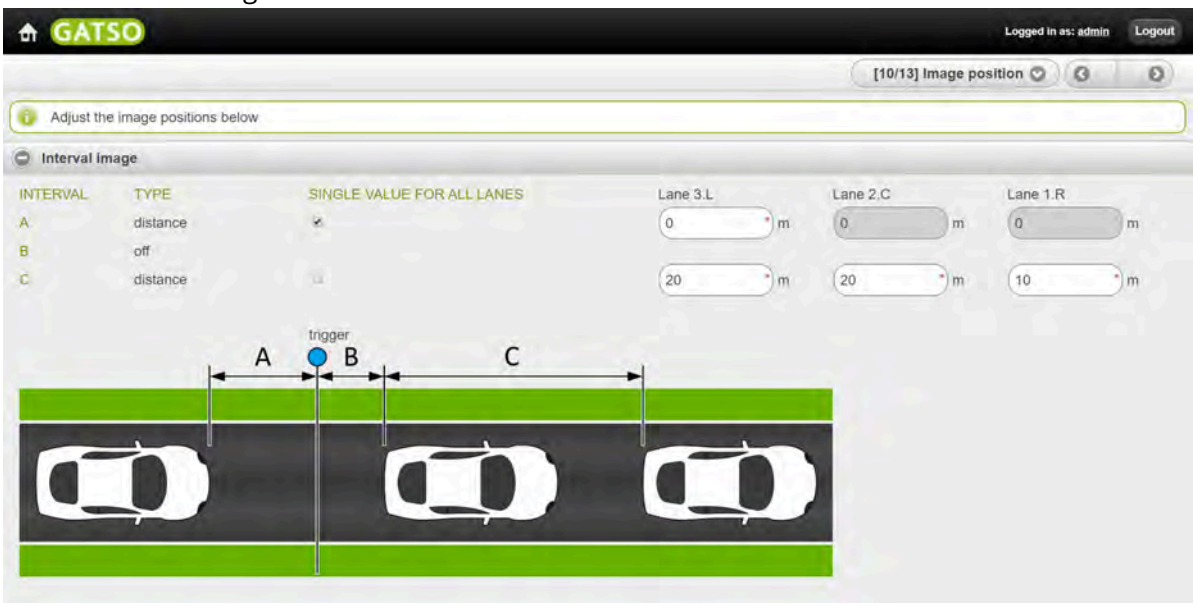
By default, the trigger line for red-light enforcement will be at the stop bar and this will be equal for all lanes (locked). If necessary, move the slider to match the trigger line with the stop bar.



The trigger distance line can be unlocked to set individual trigger lines for each individual lane. Deselect [Lock trigger lines] and click on each single green point to move the trigger line along the lane to the desired position.

5.10 [10/13] Image position

The T-Series can be configured to capture an extra (still) image of each violation. This extra camera trigger moment can be set at a specific time or distance interval C. Having an extra image offers a second and independent method to check if the speed measurement performed by the radar was correct. Read more about the Secondary speed verification method in section 8. In this step the interval time or -distance can be configured for each traffic lane and will result in a second still image after interval C.



In the example image above, the interval A is active and the set value for all lanes is 0 meter. This means that the first (low-resolution) image is captured with the front of the vehicle at the trigger line.

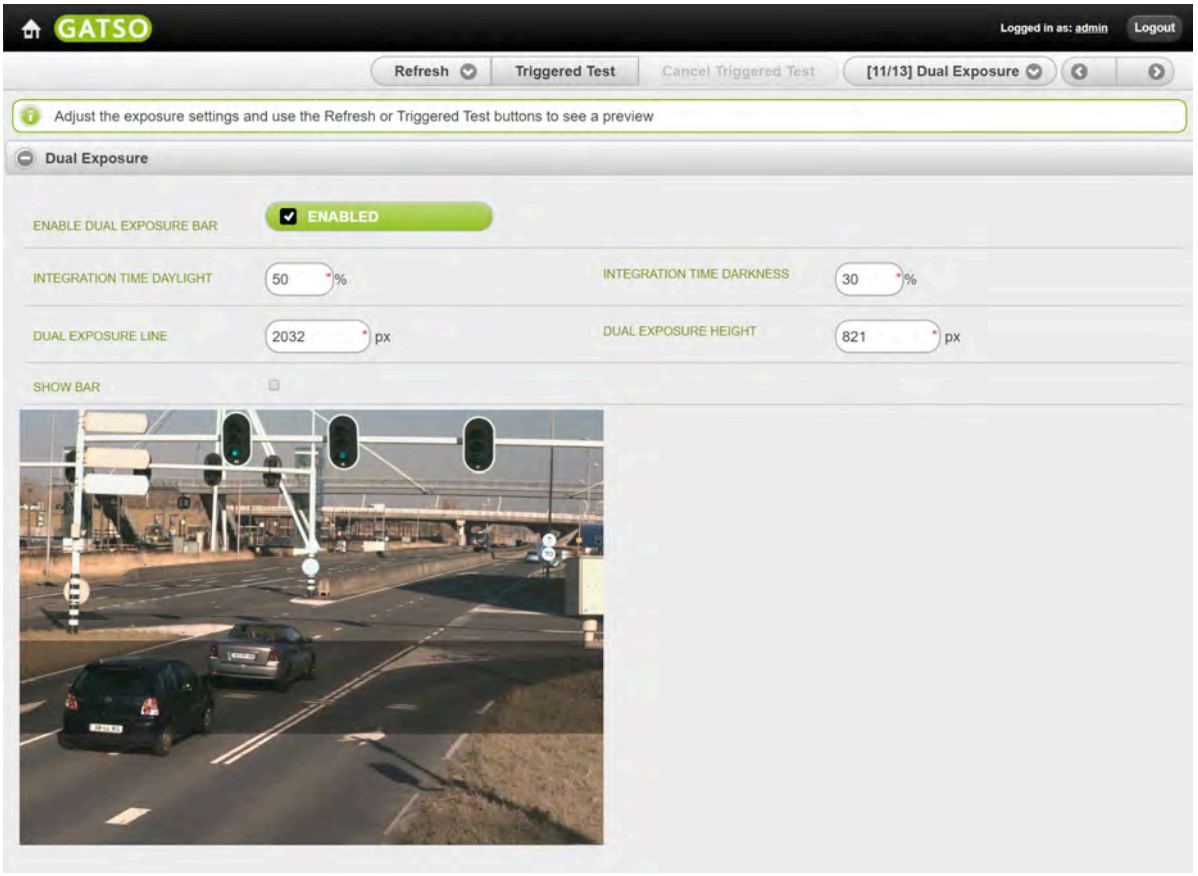
Whether the interval distance is a user-accessible setting, depends on the actual software configuration. In the above example interval B is off, resulting in the image being taken immediately after the trigger. The user cannot modify interval B in this example.

5.11 [11/13] Dual exposure

The dual exposure feature makes it possible to reduce exposure for a configurable area of the image. This may be used to avoid overexposed license plates while allowing the use of a powerful flash to illuminate the rest of the image. Note that dual exposure can be set per row (line) of pixels, not per column.

The exposure for the dark area is configured as a percentage of full exposure; a lower percentage means a darker image. Separate values can be entered for day and night (low-light) conditions.

The position of the dual exposure area is set by clicking on the image or by entering the pixel position (dual exposure line) in the text box. The height of the dual exposure area can be set by dragging the green handles or by entering the dual exposure height in the input field. By clicking on [Triggered Test] the system will generate a new test image to check the new situation. This can also be done by clicking [Refresh].


GATSO
Logged in as: admin
Logout
Refresh
Triggered Test
Cancel Triggered Test
[11/13] Dual Exposure
Adjust the exposure settings and use the Refresh or Triggered Test buttons to see a preview
Dual Exposure
ENABLE DUAL EXPOSURE BAR
ENABLED
INTEGRATION TIME DAYLIGHT
50
%
INTEGRATION TIME DARKNESS
30
%
DUAL EXPOSURE LINE
2032
px
DUAL EXPOSURE HEIGHT
821
px
SHOW BAR

5.12 [12/13] Traffic light indication

This step is only available when the traffic lights functionality (Vision or Wired) was selected in step [2/13] of the system alignment.
If the option [Wired] was selected, continue reading section Wired Traffic Light Interface (WTLI).
If the option [Vision] was selected, continue reading section Vision Traffic Light Interface (VTLI).
For both WTLI and VTLI the system checks the zero-crossing of the mains voltage to synchronize the video frames with the traffic light(s).

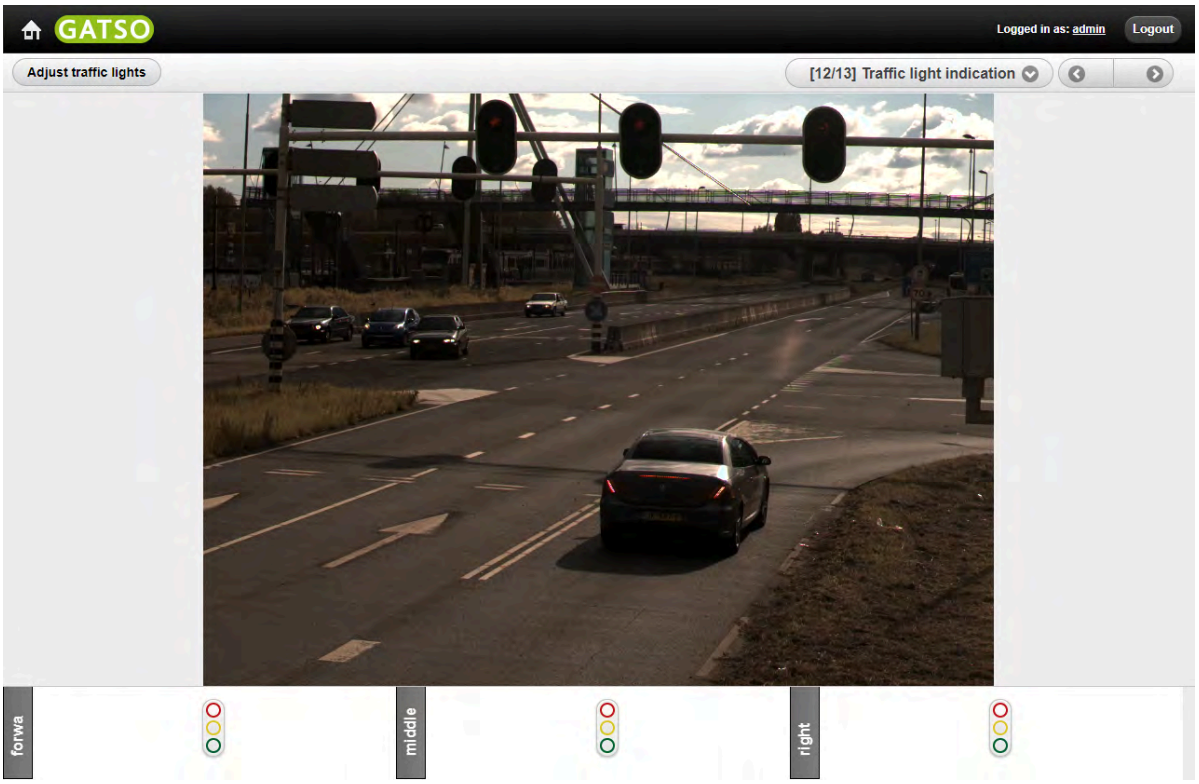
5.12.1 Wired Traffic Light Interface (WTLI)

The screen shows a live view with the traffic light information.

Please be aware that there might be a time delay between the traffic light information and the live view.

Check if the number of connected traffic lights equals the number of lanes to be enforced. In case two or more traffic lights are available for one specific lane, the installer shall decide which traffic light to connect.

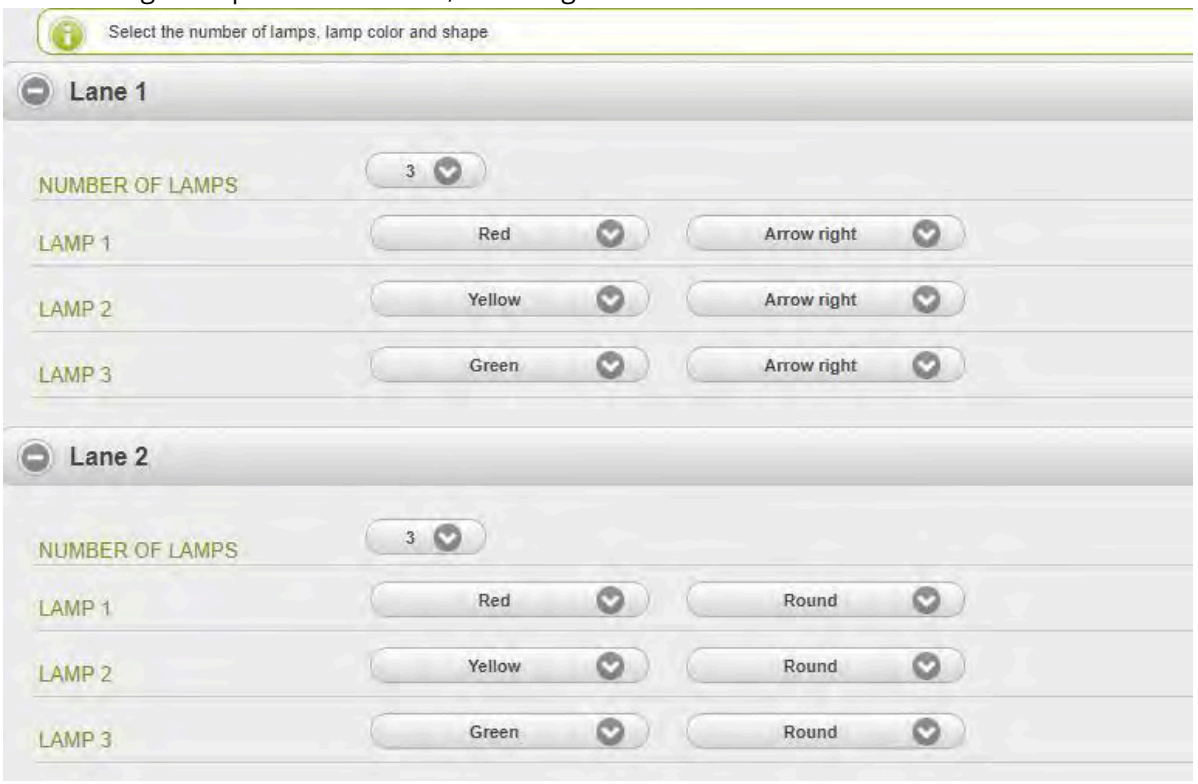
Configuring lamps for a wired connection



Click on [Adjust traffic lights] to define traffic lights colors and shapes to be displayed on the live view window and video data bar. Below picture shows the lamp configuration menu of a wired connection.

Fill in how many lamps are contained in each of the traffic lights. Select the correct color and shape for each lamp.

- traffic light colors can be red, yellow or green
- traffic light shapes can be round, Arrow right or Arrow left



5.12.2 Vision Traffic Light Interface (VTLI)

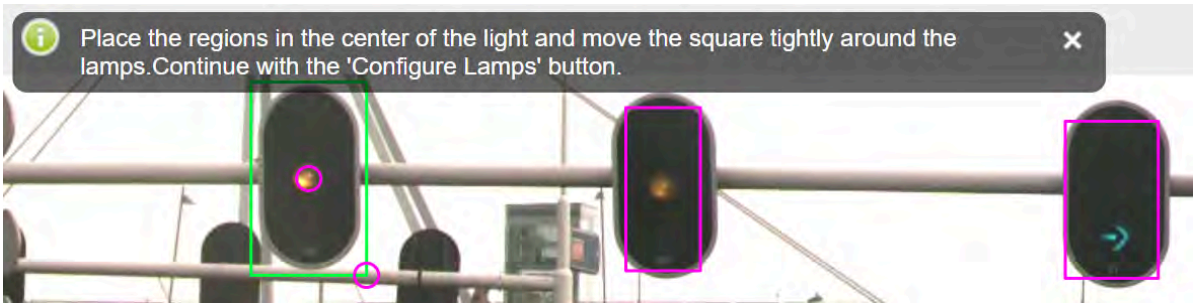
When the Vision Traffic Light Interface (VTLI) is used, the light information of the traffic lights is detected using video frames of the camera. The system needs to be trained once on a specific location. This information is stored in a training file.

Upload training files

If a VTLI training file of the location was previously defined and stored (section 10.15) or when a training file is provided by Sensys Gatso, this can be uploaded by [Upload training files]. When the training files have been uploaded, they are directly used by the VTLI and the results are shown within this step of the alignment.

In case the number of lanes has changed, the existing VTLI training file is deleted and the user must perform a new VTLI training.

Creating a VTLI training file
Click on [Adjust traffic lights] on the top-left corner. Each found traffic light will be circled by a frame; see the image below. It also maps each traffic light to a lane.



Determine the location of each traffic light. Position each traffic light frame by clicking and dragging the frame over the traffic light with the handle in the center of the frame. The number of active traffic lights shall equal the number of lanes to be enforced.
When all traffic lights have been located and accepted, the training file will be saved.

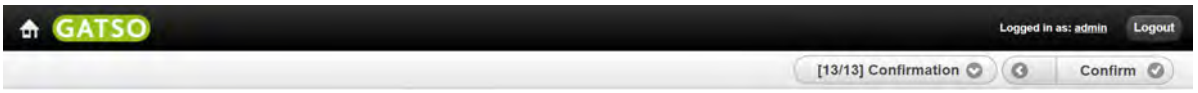
Configuring lamps for a vision connection
Fill in the number of traffic lamps corresponding with the location. Select the correct color and shape for each lamp.

- traffic light colors can be red, yellow or green
- traffic light shapes can be round, Arrow right or Arrow left

- the reset button resets the lamp configuration to the default values
- the refresh button takes a new live image
- the brightness and darkness buttons can be used to enhance the image view

After saving the changes, the live view shows again and allows the user to check whether the traffic lights were defined correctly.

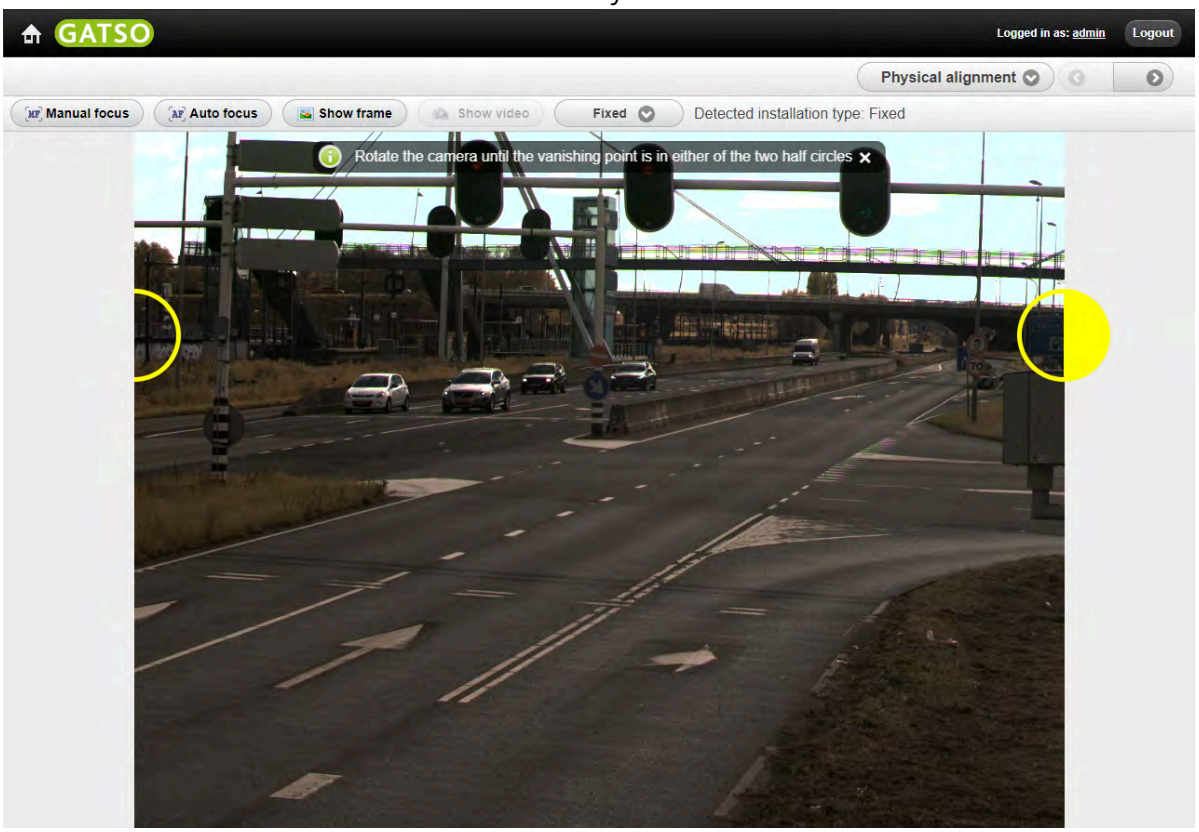
5.13 [13/13] Confirmation



The confirmation page provides a summary of all settings made during the alignment procedure. Check the information again to see if the location settings correspond with the installer data. Only after clicking [Confirm] in the top-right corner the settings will be saved and will override the previous alignment settings. After confirmation, click [Return to dashboard] or go straight to [Configure Enforcement settings].

6. EASY ALIGNMENT

After selecting [Easy alignment] on the menu on page 20, the new alignment tool will be initialised. The screen shows the live view of the system.



Example live view with vanishing point of the road in one of the yellow circles.
The alignment procedure of the T-Series will guide you through alignment in 13 steps:

[1/9] Physical alignment
[2/9] Installation
[3/9] Lane indication
[4/9] Yaw adjustment
[5/9] Easy Alignment
[6/9] Image position (Optional)
[7/9] Dual Exposure
[8/9] Traffic light indication
[9/9] Confirmation

6.1 [1/9] Physical alignment

This first step indicates the detected installation, either Portable or Fixed. Select [Fixed] from the drop-down menu above the live view. The T-Series should show “Detected installation type: Fixed” in case of a fixed installation. Always check before continuing.

6.1.1 *Check alignment*

Check the live view and ensure the following:

- all lanes to be enforced are visible
- for all lanes to be enforced, the photo trigger position is visible
- traffic lights are visible (only applicable for red-light enforcement)
- the circle of the vanishing point is selected at the same side of the road as the T-Series

If during the alignment procedure the camera does not show all targeted lanes, trigger positions and selected traffic lights, abort the alignment procedure and contact the installer of the system. Once the camera view is corrected, start alignment again.

6.1.2 *Select vanishing point*

The screen shows two yellow half circles.Select the circle at the same side of the road as the T-Series' position. After selection of this circle, half of the circle will be filled yellow.

6.1.3 *Check camera focus*

The camera focus can be adjusted automatically or manually.
Select [Show video] from the menu bar to open the live view and check the camera focus. If the video resolution setting is too low, enhance the live stream quality. To do this return to the WBI dashboard and select [Systems settings]. The quality of the live stream can be adjusted by clicking on [Livestream]. Here you will find three options [LOW], [MEDIUM] and [HIGH].
Select [Show frame] above the live stream to display a still image.

6.1.4 *Automatic focus*

Select [Auto focus]. The live view shows the entire camera field of view. A frame is displayed with handles in the center and the corners. Use these handles to place the frame over an area for the camera to focus on. Click on [Start] to execute automatic focus.

For best focus results select a high contrast area on the image. For example, use the white striping on the road near the trigger area.

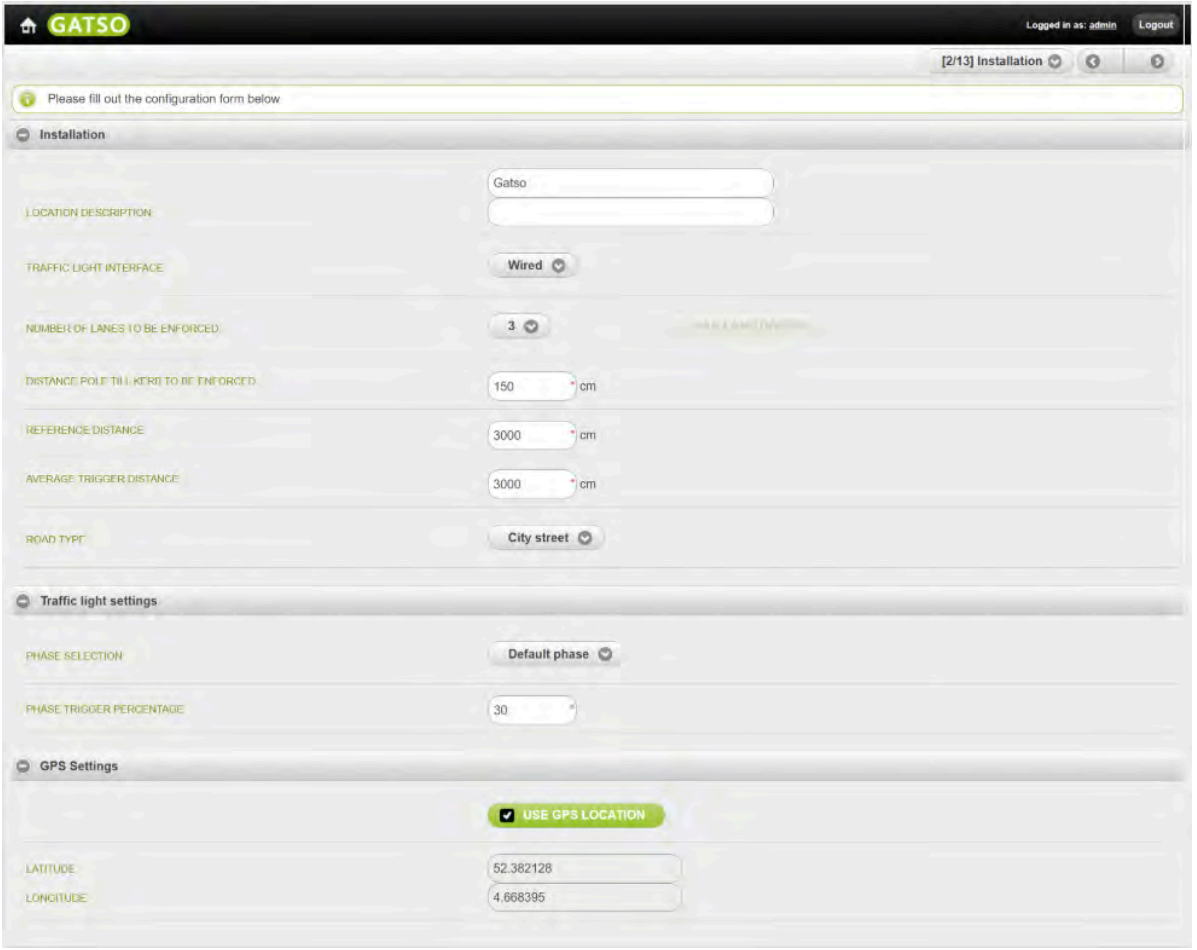
6.1.5 *Manual focus*

Select [Manual focus] and click on [Start]. Use [Near] and [Far] to adjust the camera focus in steps. When the camera is at the desired focus click [Done] to go to the next step.

Sensys Gatso recommends focusing the camera in the evening or at night time especially when using only the FT3 flash.

6.2 [2/9] Installation

In this step, location details must be filled in and also the use of GPS location can be enabled. Check the specific installation data provided by the installer.
During installation, it is important to measure the distances properly in order to get accurate data filled in. If not done accurately, it can lead to incorrect lane indication, incorrect trigger positions and a false violator marker.



6.2.1 Location description

Specify a unique location name for the specific installation (max. 40 characters). This text will appear on each data bar.

6.2.2 Traffic light interface

For red-light enforcement select the applicable traffic light interface. This can either be Wired or Vision in the drop-down menu. Check the correct setting with the installer. Read section 4.12 for more information. For speed enforcement only choose option [None].

6.2.3 Number of lanes to be enforced

Enter the number of lanes to be enforced. For speed enforcement it can be 1-6 lanes, for red-light enforcement 1-4 lanes.
The lane divider is a designated lane or area that is excluded from enforcement. It can be used to define the centre median strip to avoid unwanted radar detections. One lane divider can be defined and if enabled, this lane is included in the total lane count. This functionality is not available in combination with red-light enforcement.

6.2.4 *Distance pole till kerb to be enforced*

Enter the distance (in centimeters) measured from the middle of the pole to the nearest kerb (road edge) of the first lane to be enforced.

6.2.5 *Reference distance*

The reference object can be the stop line but also any other stationary object which is visible in the image. The chosen reference object shall be at a distance between 20 and 60 meters on the same level with the road and on the same side of the road as where the system is installed. Enter the measured distance from the middle of the pole to the reference point.

The reference distance will be pinpointed on the live screen in step [6/13]. The system uses the reference distance, system yaw and pitch angle and a number of other parameters to calculate the lane widths.

If the used reference object was removed, do not continue, but contact the installer.

6.2.6 *Average trigger distance (for red-light enforcement only)*

Enter the distance from the pole to the stop line measured in a parallel line alongside the road. If there are multiple stop lines present, use the average distance between them.

6.2.7 *Road type*

Click on the drop-down menu and select the type of road. There are three options: [City street], [Country road] or [Highway]. The road type is used by the system to predict vehicle speeds and lane width during initial alignment. The selection does not influence operation during enforcement.

6.2.8 *Traffic light settings: phase selection (for red-light enforcement only)*

Phase selection shifts the camera synchronization relative to the mains voltage in steps of 120 degrees.
Traffic light synchronization is used to ensure that images are only captured when traffic light LEDs are lit. If the traffic light statuses are invisible on the live view, the T-Series is not correctly synchronized with the traffic lights. The traffic lights may not be connected to the same phase as the T-Series. If this happens, select [Previous phase]. If the problem still exists then select [Next phase]. If still not solved, please contact Sensys Gatso customer support.

Only adjust the phase when the traffic lights on the evidence images are not shown lit

6.2.9 *Traffic light settings: phase trigger percentage*

The phase trigger percentage provides the ability to shift the camera synchronization in smaller steps with respect to the phase of the mains voltage. Adjust the phase trigger percentage to fine tune the traffic light synchronization.

Perform a triggered test to check the new situation.

6.2.10 *GPS settings*

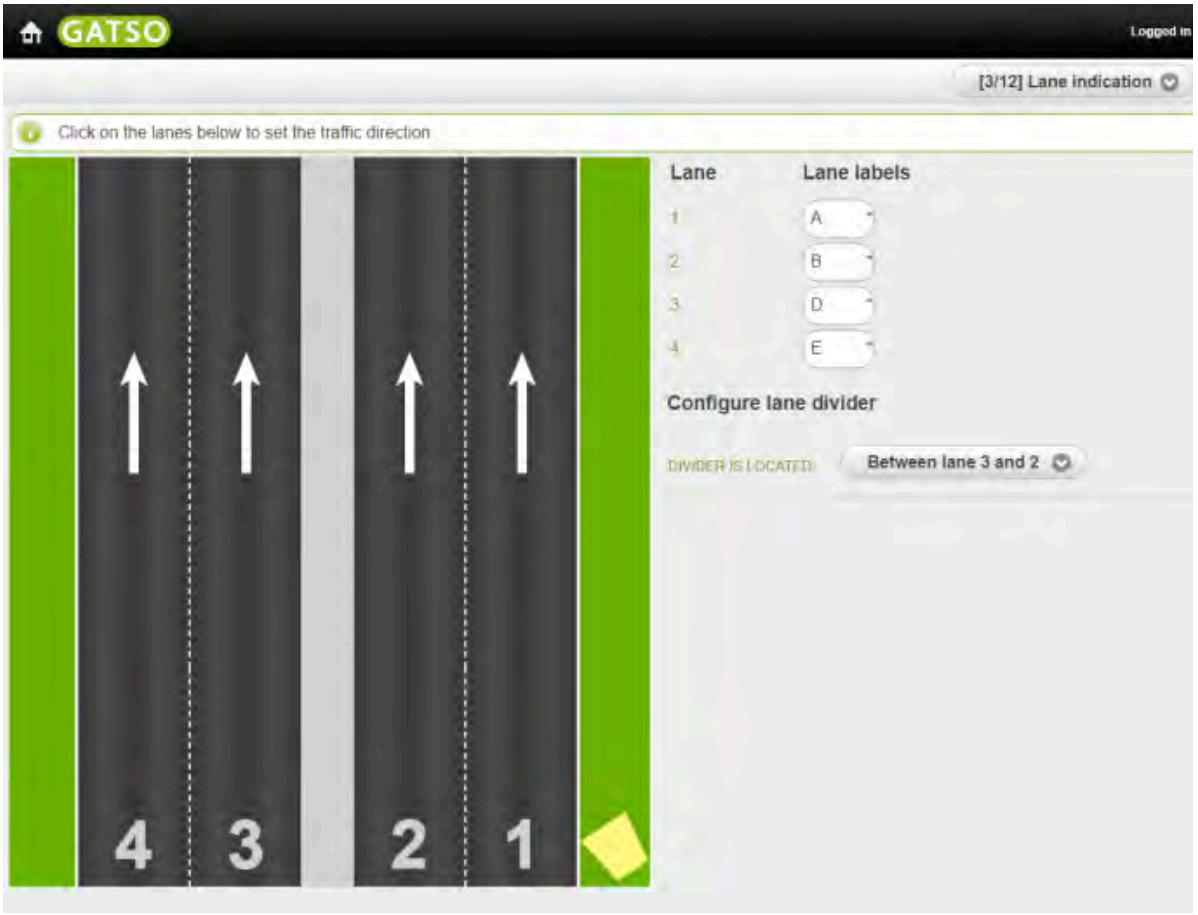
By enabling the GPS Location you can fill in Latitude (north/south compared to the equator) and Longitude (east/west compared to the prime meridian) coordinates of the installed system.

6.3 [3/9] Lane indication

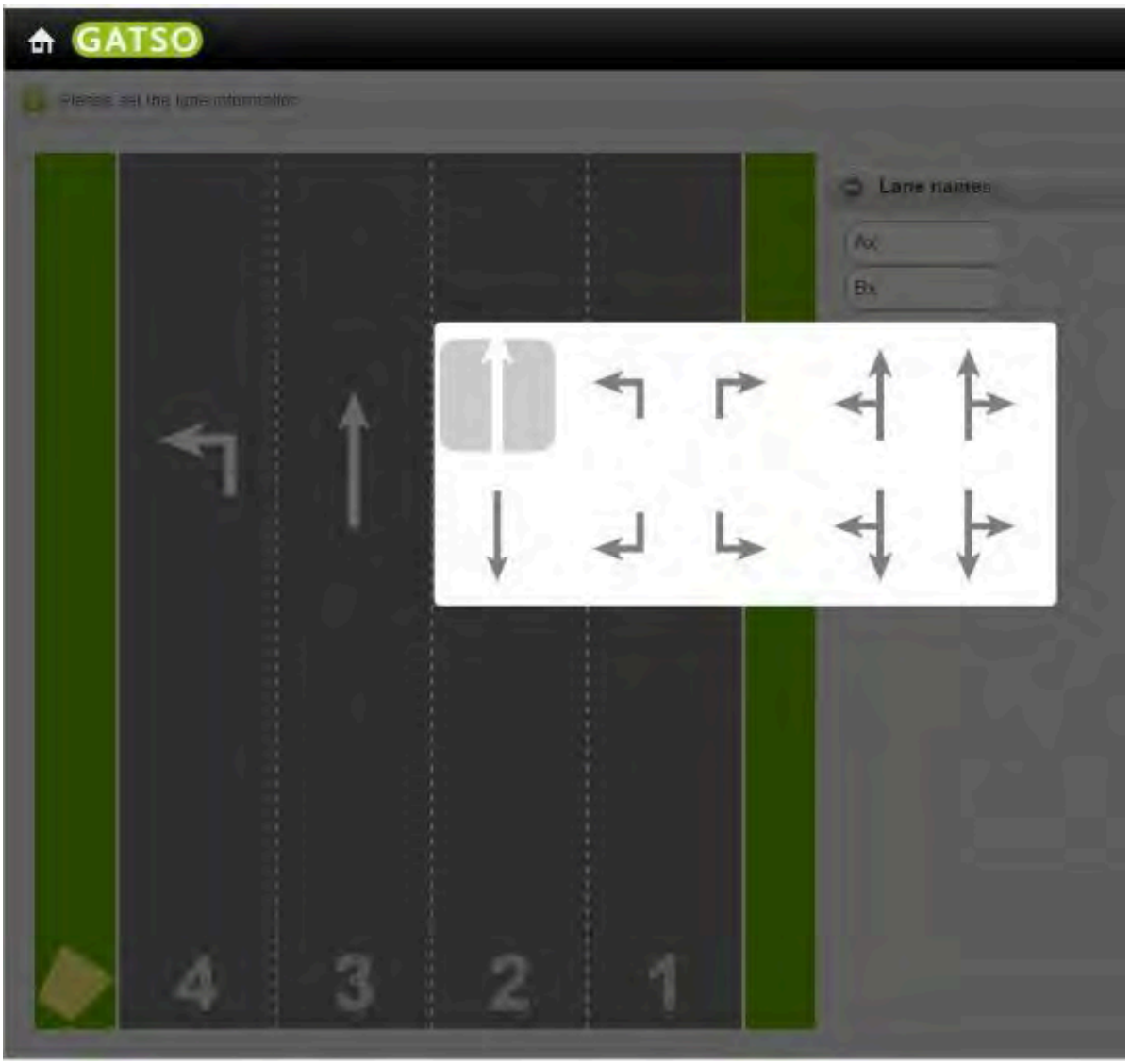
The number of lanes added in the previous step, possibly with enabled lane divider option, become visible in this third step of the alignment procedure.

The T-Series uses a fixed, built-in numbering system for the monitored lanes. Depending on the exact software configuration, this is either ascending or descending from the camera position. An individual lane name can be assigned to a lane number and this will be shown on the image data bar, the event data and the live status page.

If the lane divider option was selected in alignment step [2/13], the location of the lane divider must be assigned. The lane divider can be on the right hand side or the left hand side of the road or in between two enforced lanes.

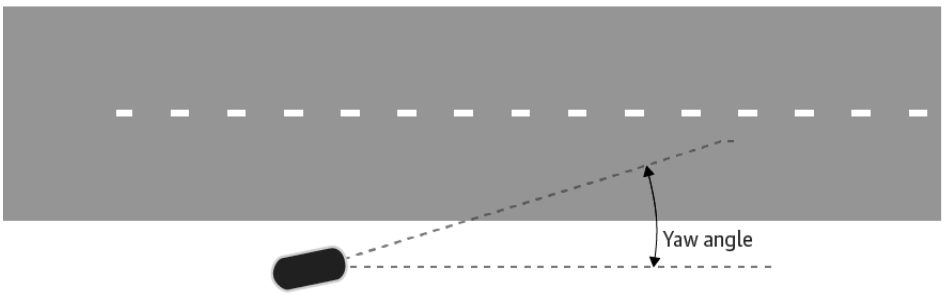


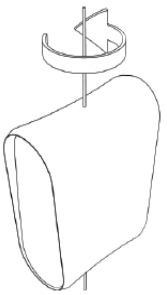
Click on a lane to view a pop-up window. Select the appropriate direction marking for each individual lane.


GATSO
Lane names
4
3
2
1

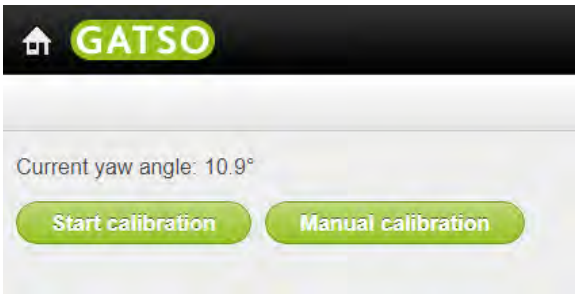
6.4 [4/9] Yaw adjustment

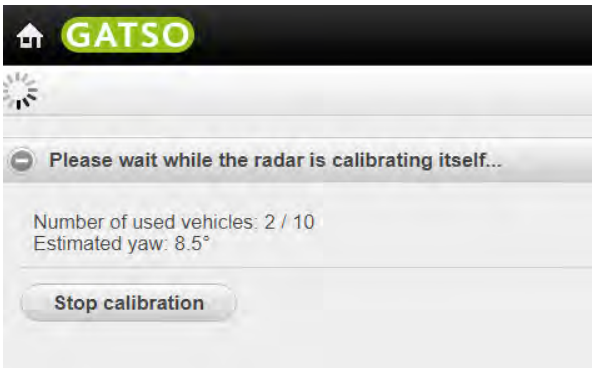
The yaw angle is the rotation of the system around the vertical axis compared to the road axis. The value for the yaw angle of the system needs to match the physical yaw angle the system was installed at.





In step [4/13] the following will be shown on the screen:





6.4.1 Calibrating yaw automatically

The system automatically adjusts the yaw angle based on the tracks of passing vehicles. Click on [Start calibration].
The system needs at least 10 tracks of vehicles travelling in a relatively straight line. The countdown timer shows the number of tracked vehicles. If needed, the process can be interrupted by clicking [Stop calibration].

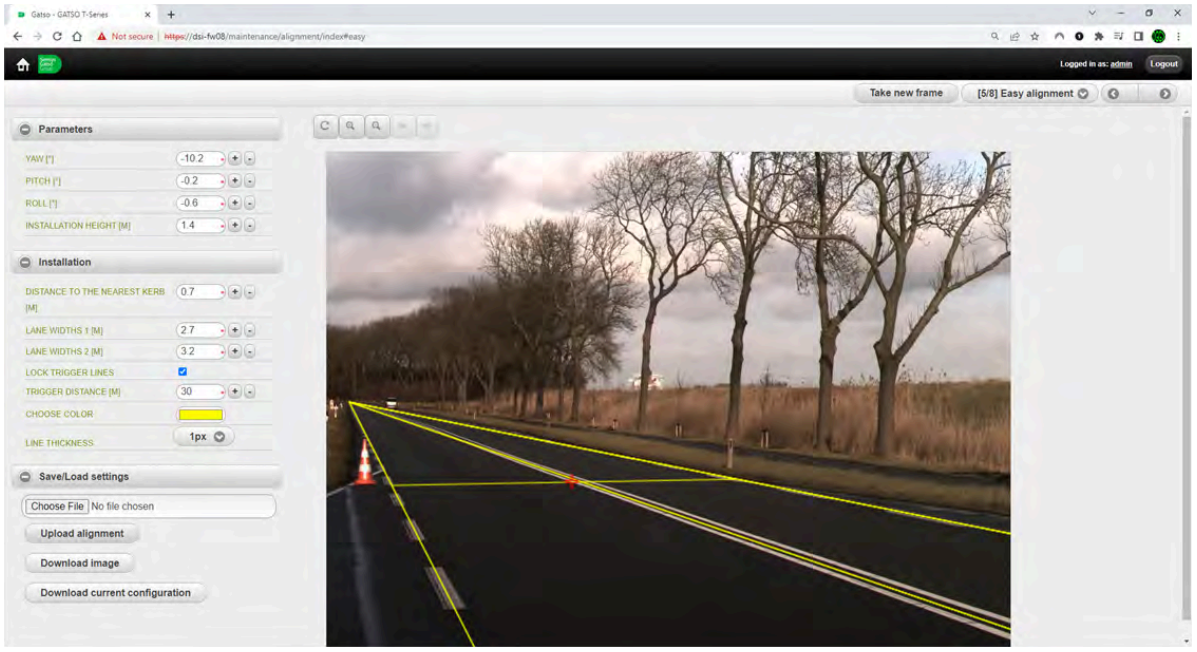
6.4.2 Calibrating yaw manually

If there are not enough passing vehicles to perform automatic yaw calibration, click on [Manual calibration] and enter the yaw angle of the system. This information will have been obtained when alignment was previously performed at the same location.

Always check the yaw value with the installer data.

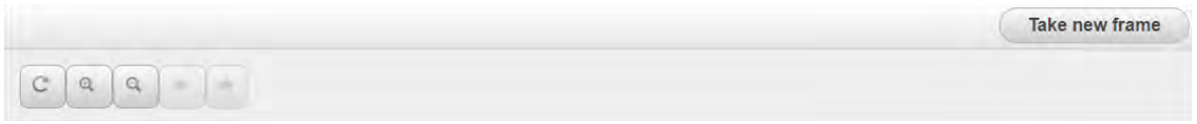
6.5 [5/9] Easy alignment

The screen below shows all of the data to be manually input in order to have the system aligned. The overlaid lines would be adjusted based on this input, and should match the actual lines on the road by the end.



6.5.1 Adjust frame

A new video frame, showing an image of the camera view, can be taken at any time via the “Take new frame” button. This frame can also be adjusted by the magnifying glass buttons immediately on top of it.



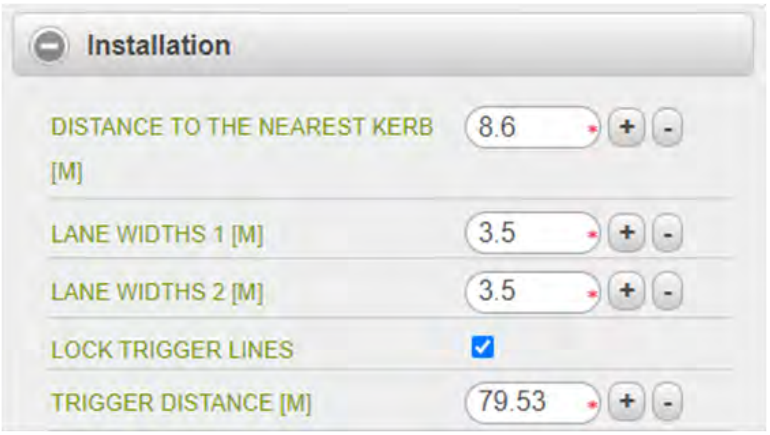
6.5.2 Parameters

This section includes values related to the position of the camera, such as its installation height and the rotation on the different axis.

While the radar yaw has been calculated in a previous step, this field refers to the camera yaw. These two values don't need to be equal, based on the different positions of both the radar and the camera, but it is highly recommended to have minimum variation.
The value would be positive if the camera is positioned at the right side of the road, or negative if on the left.

6.5.3 Installation

This data is related to the lengths and distances measured on the road, such as the width of each lane and the trigger position for events.



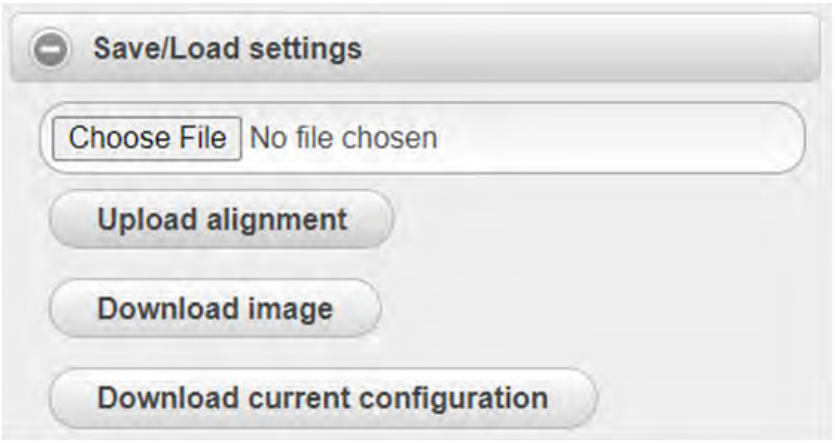
Different trigger positions per lane can be configured by unmarking the "Lock trigger lines" checkbox.

6.5.4 Overlay lines color and thickness

The color and thickness of the overlay lines can be changed to any RGB value and a thickness of 1, 2 or 3 pixels.

6.5.5 Save/Load settings

These alignment settings can also be saved and/or loaded from this page.



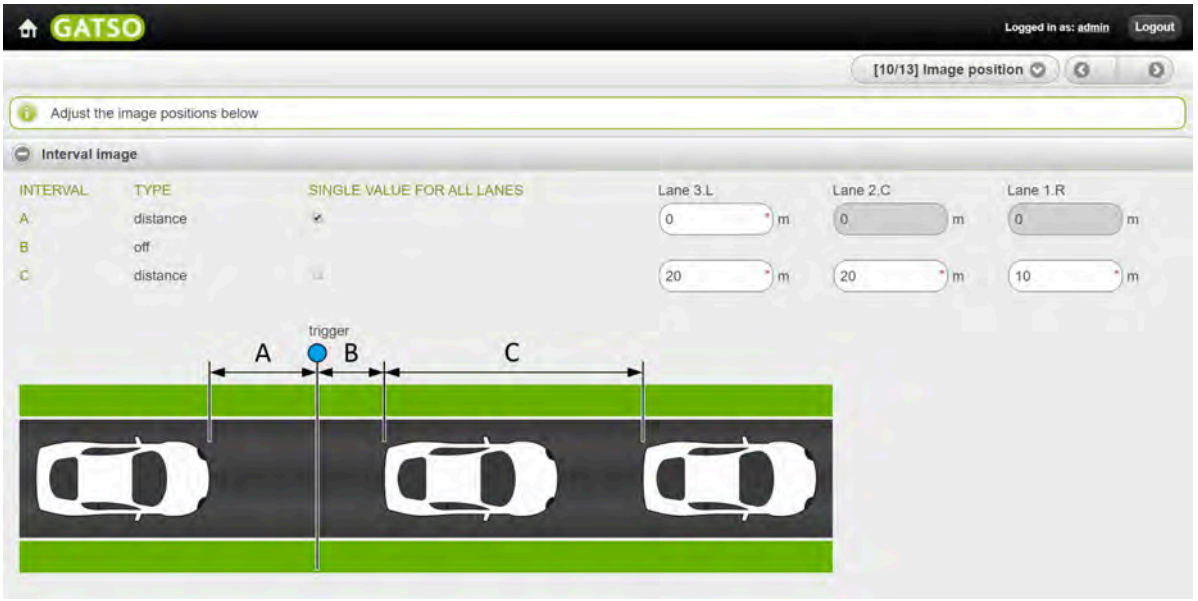
Download image saves the current alignment frame for future reference.

Download current configuration saves the currently set alignment settings so they can be loaded in the future, speeding up the alignment settings in case it needs to be redone.

In order to have these settings restored, select the “Choose File” button and navigate your computer’s drive for the location of the previously saved file. Once it has been selected, press the “Upload alignment” button to have the values recovered.]

6.10 [6/9] Image position

The T-Series can be configured to capture an extra (still) image of each violation. This extra camera trigger moment can be set at a specific time or distance interval C. Having an extra image offers a second and independent method to check if the speed measurement performed by the radar was correct. Read more about the Secondary speed verification method in section 8. In this step the interval time or -distance can be configured for each traffic lane and will result in a second still image after interval C.



In the example image above, the interval A is active and the set value for all lanes is 0 meter. This means that the first (low-resolution) image is captured with the front of the vehicle at the trigger line.

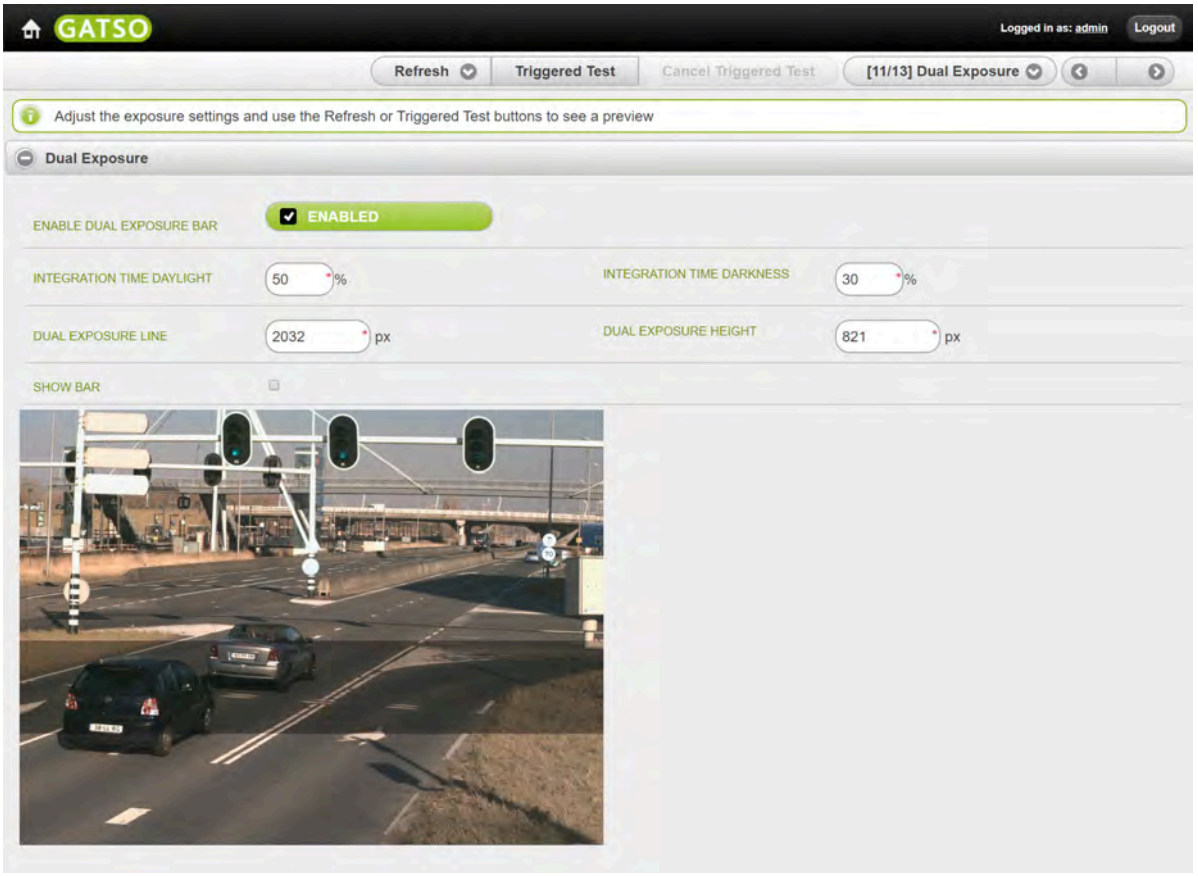
Whether the interval distance is a user-accessible setting, depends on the actual software configuration. In the above example interval B is off, resulting in the image being taken immediately after the trigger. The user cannot modify interval B in this example.

6.11 [7/9] Dual exposure

The dual exposure feature makes it possible to reduce exposure for a configurable area of the image. This may be used to avoid overexposed license plates while allowing the use of a powerful flash to illuminate the rest of the image. Note that dual exposure can be set per row (line) of pixels, not per column.

The exposure for the dark area is configured as a percentage of full exposure; a lower percentage means a darker image. Separate values can be entered for day and night (low-light) conditions.

The position of the dual exposure area is set by clicking on the image or by entering the pixel position (dual exposure line) in the text box. The height of the dual exposure area can be set by dragging the green handles or by entering the dual exposure height in the input field. By clicking on [Triggered Test] the system will generate a new test image to check the new situation. This can also be done by clicking [Refresh].



6.12 [8/9] Traffic light indication

This step is only available when the traffic lights functionality (Vision or Wired) was selected in step [2/13] of the system alignment.
If the option [Wired] was selected, continue reading section Wired Traffic Light Interface (WTLI).
If the option [Vision] was selected, continue reading section Vision Traffic Light Interface (VTLI).
For both WTLI and VTLI the system checks the zero-crossing of the mains voltage to synchronize the video frames with the traffic light(s).

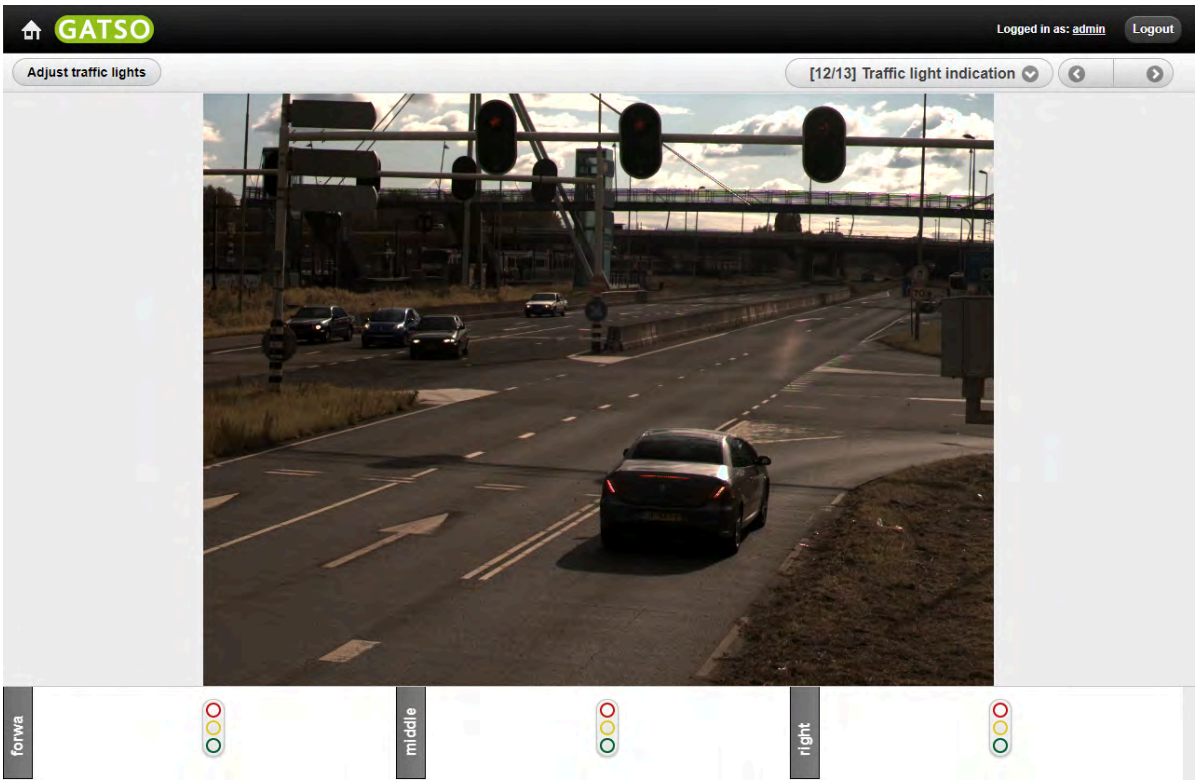
6.12.1 Wired Traffic Light Interface (WTLI)

The screen shows a live view with the traffic light information.

Please be aware that there might be a time delay between the traffic light information and the live view.

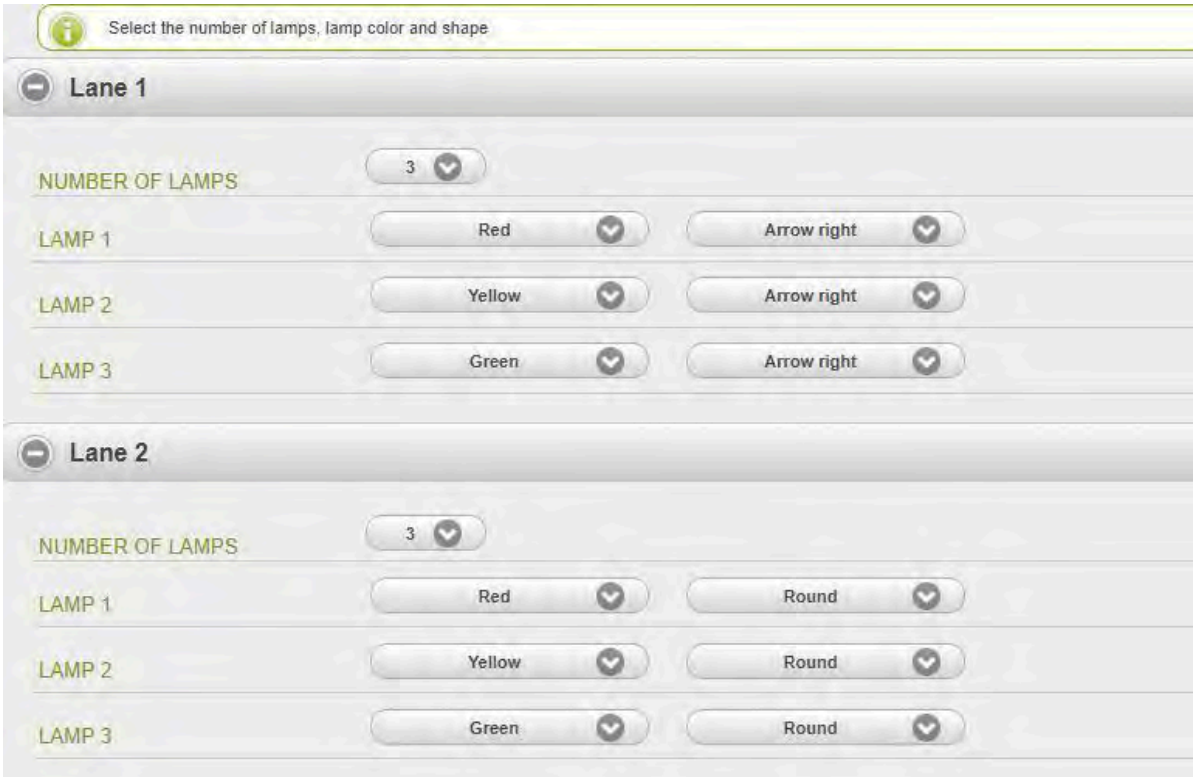
Check if the number of connected traffic lights equals the number of lanes to be enforced. In case two or more traffic lights are available for one specific lane, the installer shall decide which traffic light to connect.

Configuring lamps for a wired connection



Click on [Adjust traffic lights] to define traffic lights colors and shapes to be displayed on the live view window and video data bar. Below picture shows the lamp configuration menu of a wired connection.
Fill in how many lamps are contained in each of the traffic lights. Select the correct color and shape for each lamp.

- traffic light colors can be red, yellow or green
- traffic light shapes can be round, Arrow right or Arrow left



6.12.2 Vision Traffic Light Interface (VTLI)

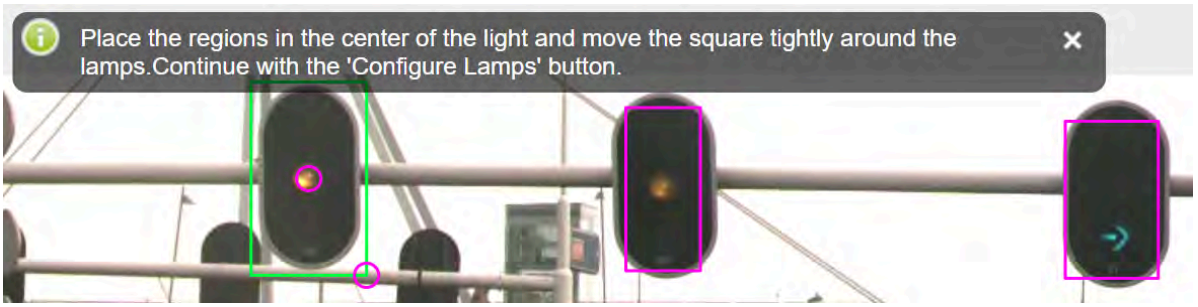
When the Vision Traffic Light Interface (VTLI) is used, the light information of the traffic lights is detected using video frames of the camera. The system needs to be trained once on a specific location. This information is stored in a training file.

Upload training files

If a VTLI training file of the location was previously defined and stored (section 12.15) or when a training file is provided by Sensys Gatso, this can be uploaded by [Upload training files]. When the training files have been uploaded, they are directly used by the VTLI and the results are shown within this step of the alignment.

In case the number of lanes has changed, the existing VTLI training file is deleted and the user must perform a new VTLI training.

Creating a VTLI training file
Click on [Adjust traffic lights] on the top-left corner. Each found traffic light will be circled by a frame; see the image below. It also maps each traffic light to a lane.



Determine the location of each traffic light. Position each traffic light frame by clicking and dragging the frame over the traffic light with the handle in the center of the frame. The number of active traffic lights shall equal the number of lanes to be enforced.
When all traffic lights have been located and accepted, the training file will be saved.

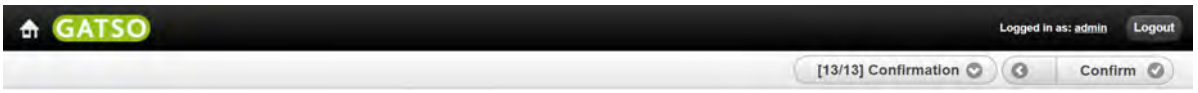
Configuring lamps for a vision connection
Fill in the number of traffic lamps corresponding with the location. Select the correct color and shape for each lamp.

- traffic light colors can be red, yellow or green
- traffic light shapes can be round, Arrow right or Arrow left

- the reset button resets the lamp configuration to the default values
- the refresh button takes a new live image
- the brightness and darkness buttons can be used to enhance the image view

After saving the changes, the live view shows again and allows the user to check whether the traffic lights were defined correctly.

6.13 [9/9] Confirmation

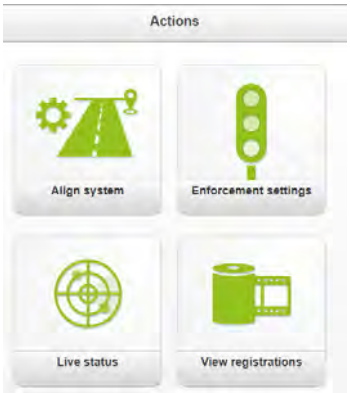


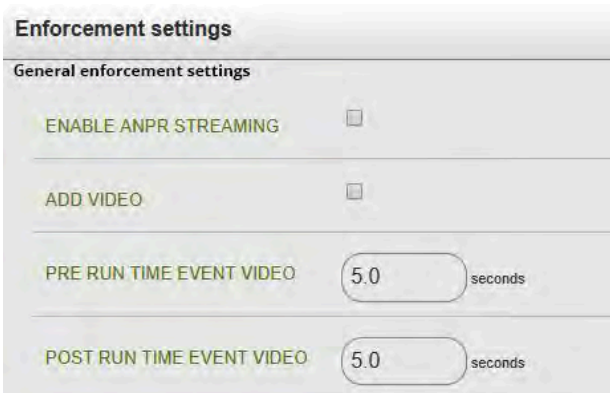
The confirmation page provides a summary of all settings made during the alignment procedure. Check the information again to see if the location settings correspond with the installer data. Only after clicking [Confirm] in the top-right corner the settings will be saved and will override the previous alignment settings. After confirmation, click [Return to dashboard] or go straight to [Configure Enforcement settings].

7. ENFORCEMENT

7.1 General enforcement settings

After completing the alignment procedure described in the previous section, the enforcement settings can be configured by clicking the [Enforcement settings] button on the dashboard. The first part describes the general enforcement settings. Make sure that enforcement settings comply with local laws and regulations.





7.1.1 Enable ANPR streaming

If the optional ANPR functionality is included in the software, the T-Series automatically reads licence plates of violating vehicles. On top of performing ANPR on violations, it is also possible to read license plates of all passing vehicles. This functionality is called ANPR streaming and is optionally available as an extension to ANPR on violations. It can be enabled in the enforcement settings as shown above. Read section 12.16 for a detailed specification of the functionality and the settings.

7.1.2 Add video

A short video can be added to an evidence file. The video run time can be set in tenths of seconds, both prior to- and after a violation is determined.

7.2 Speed enforcement settings

The T-Series Fixed classifies vehicles as a car or a truck by determining the length of the vehicle. The length threshold is adjustable (see section 12.11). The picture below shows that cars and trucks can have different speed limits and different speed threshold settings. For example, on a highway with a speed limit of 120 km/h, the speed limit shall be set to 120 km/h, whereas the speed threshold can be set at 125 km/h in order to only capture vehicles travelling with a speed equal to and above 125 km/h.

Speed enforcement and measurement direction can be switched on or off per lane. Use the utmost left checkbox to enforce speed on all lanes.

Criteria speed violation

The T-Series captures a speed violation when the following criteria are met.

- The system is in the enforcement state.
- The lane where the violation takes place is set for speed enforcement.
- The vehicle direction corresponds with the measurement direction setting of the lane where the vehicle is detected.
- The measured speed at the trigger line is equal to or higher than the speed threshold.

7.3 Red-light enforcement settings

Red-light enforcement is available for receding traffic only and can be enabled per lane. Use the utmost left checkbox to enforce red light on all lanes. The red-light threshold is the speed threshold above which the system creates an evidence file in case of a red-light violation. 20 km/h is advised.

The threshold speed setting avoids unwanted triggering caused by slow driving vehicles (during a traffic jam or caused by vehicles that stop for the red light but accidentally cross the trigger line).

The red-light grace time is the minimum time that the red light must be lit before a red-light violation is registered. The minimum yellow time setting is the time that the yellow light must have been lit before a red-light violation is registered.

Criteria red-light violation

The T-Series captures a red-light violation when the following criteria are met:

- The system is in the enforcement state.
- The lane where the violation takes place is set to red-light enforcement.
- The red light is lit when the vehicle is at the trigger line.
- The grace time has expired.
- The minimum yellow time was reached or exceeded.
- The measured speed at the trigger line is ≥ than the red threshold speed.
- The measurement direction is receding.

If it is legally required to have visual evidence that the red light was lit during the violation, users should be aware that the camera must be able to see the traffic lights.

7.4 Lane enforcement settings

7.4.1 R+S (red-light and speed) violations

The system captures a red-light and speed violation when all the criteria for a red-light violation and all the criteria for a speed violation are met. The system creates a single evidence file which shows that there has been a red-light and speed (R+S) violation.

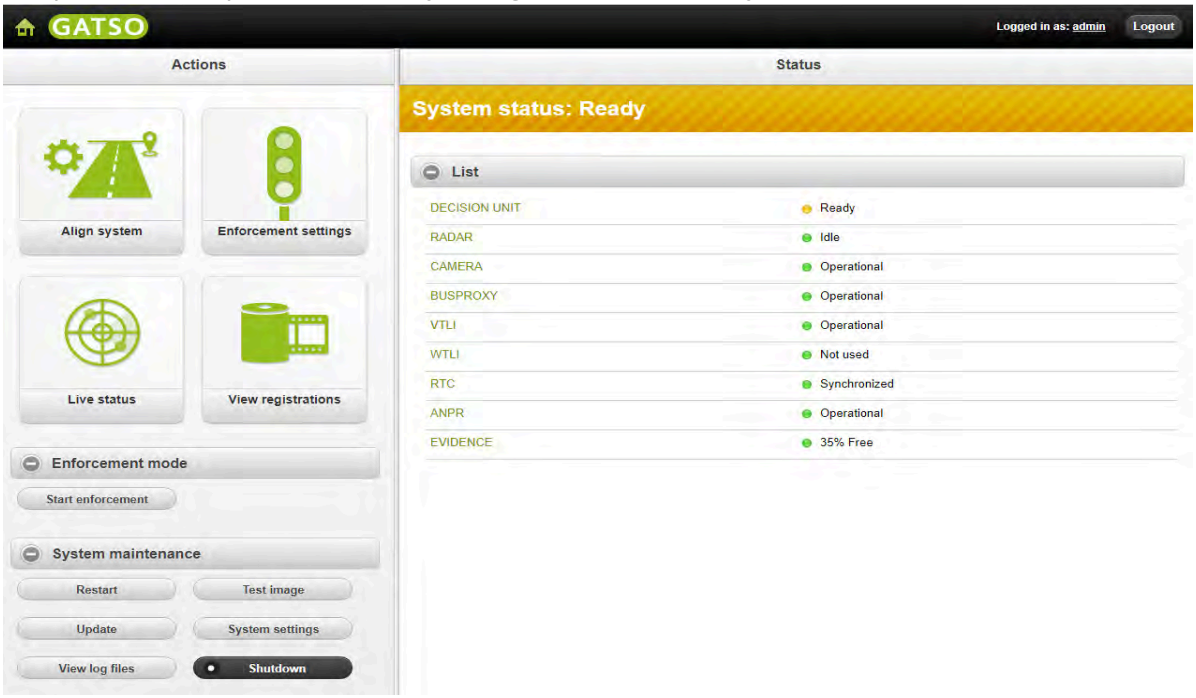
7.4.2 Prohibited lane

The system captures a prohibited lane violation if a vehicle is detected on a prohibited lane (for example hard shoulders, closed roads) and in a prohibited direction (one-way road).

7.4.3 Dedicated lane

The system captures a dedicated lane violation if a vehicle of the selected classification is detected on a selected lane in the selected direction.

Click on [Save enforcements] after updating any of the above settings. If above enforcement settings are saved, go back to the main menu. Once the system is fully configured and all components are operational, the system goes to state “Ready”.



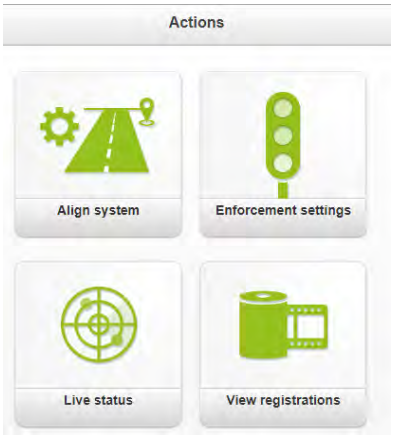
The system can now be set to enforcement by clicking on [Start Enforcement]. To end the enforcement session click on [Stop Enforcement].

7.4.4 Self-test

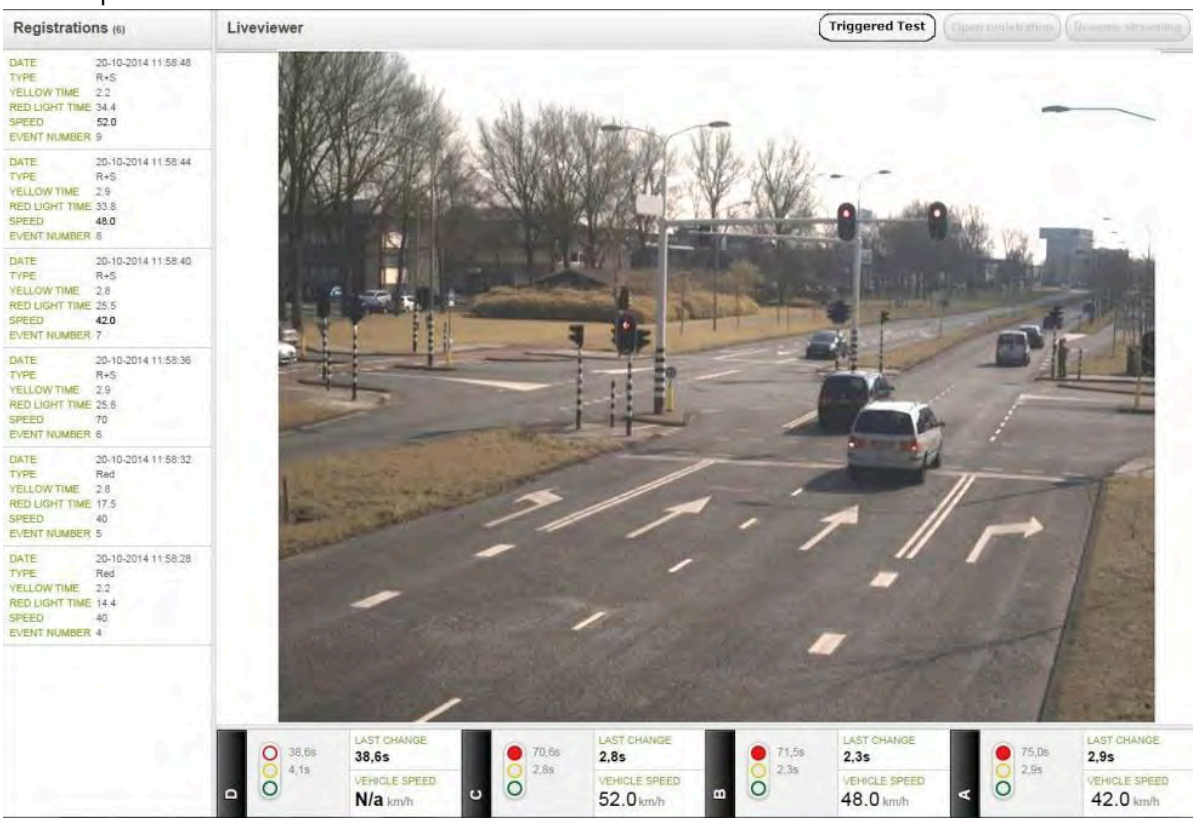
By default the T-Series system performs a self-test upon entering or leaving enforcement. Besides an automatic self-test, it is also possible to execute a manual self-test of the system. This will be explained in section 11.2. In case of a manual self-test, the system status will not show the results. Instead the test result can be checked in the self-test evidence file (see section 9.1).

8 LIVE STATUS

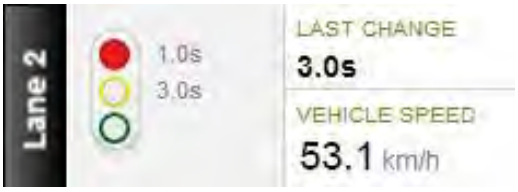
If the system is in enforcement, a live view can be seen by clicking on [Live status] in the WBI dashboard.



The left panel shows a list of the violations committed and tests executed.



Example live status
When selecting a violation from the left panel, the live viewer will pause and show a high resolution image of the violation. To return to the live viewer click on [Resume streaming]. For each lane, speed measurement, the traffic light status and associated timers are displayed at the bottom of the screen in real-time. The last change field displays the elapsed time after the latest traffic light change.



It can take a few seconds before the video stream starts.

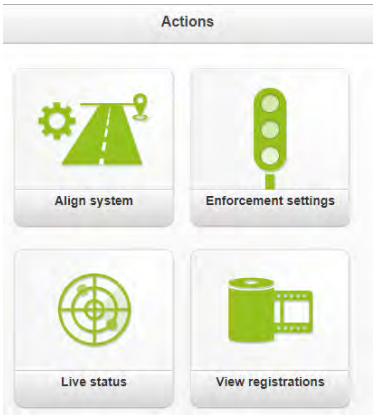
The timers on the live screen are indicative. The timers in the evidence files are leading.

The speed of approaching vehicles is displayed as a negative number.

In the registration list every evidence file can be opened and viewed separately by double clicking on it.

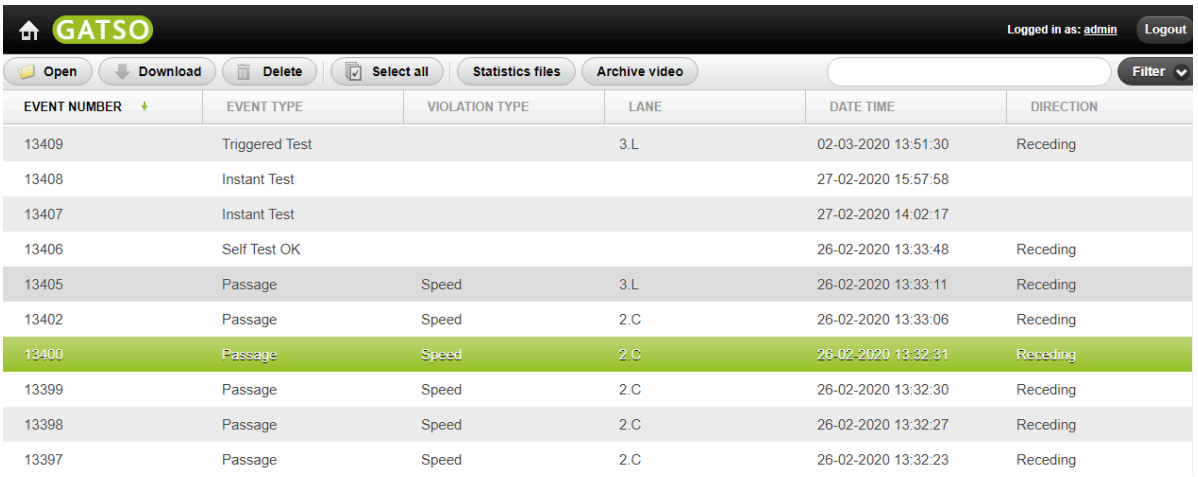
9 VIEW REGISTRATIONS

Click on [View registrations] to see an overview of the files that are stored on the system.



The registration viewer shows evidence files, statistics files, and archive videos.

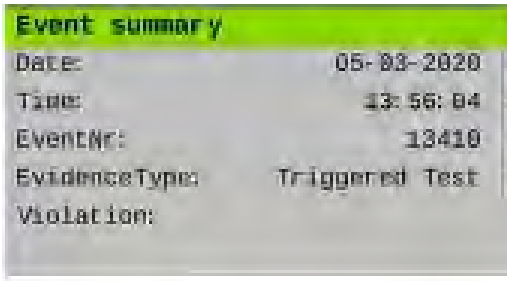
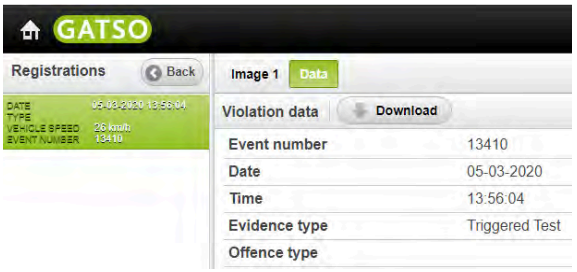
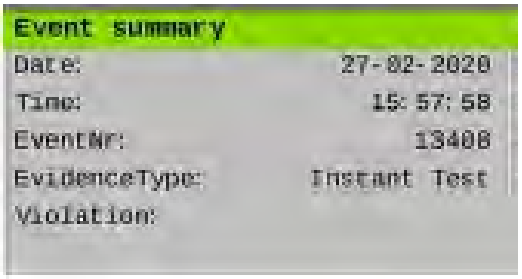
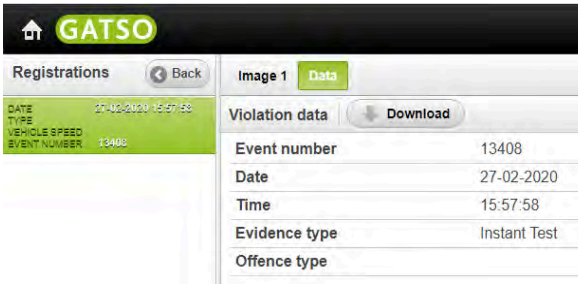
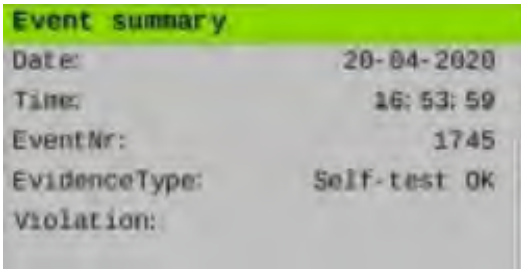
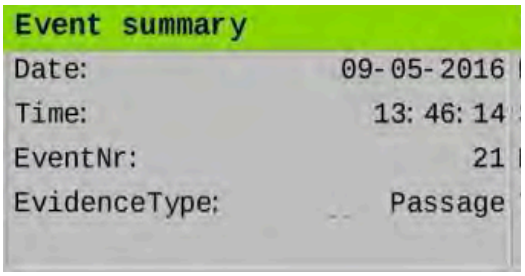
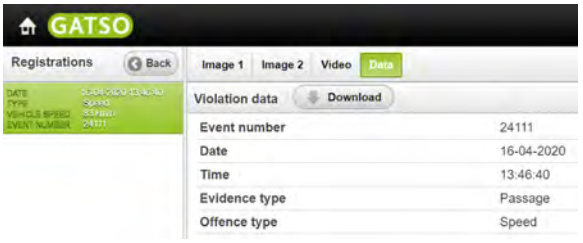
9.1 Evidence files



EVENT NUMBER	EVENT TYPE	VIOLATION TYPE	LANE	DATE TIME	DIRECTION
13409	Triggered Test		3.L	02-03-2020 13:51:30	Receding
13408	Instant Test			27-02-2020 15:57:58	
13407	Instant Test			27-02-2020 14:02:17	
13406	Self Test OK			26-02-2020 13:33:48	Receding
13405	Passage	Speed	3.L	26-02-2020 13:33:11	Receding
13402	Passage	Speed	2.C	26-02-2020 13:33:06	Receding
13400	Passage	Speed	2.C	26-02-2020 13:32:31	Receding
13399	Passage	Speed	2.C	26-02-2020 13:32:30	Receding
13398	Passage	Speed	2.C	26-02-2020 13:32:27	Receding
13397	Passage	Speed	2.C	26-02-2020 13:32:23	Receding

The list of evidence files shows several event types which are:

- Triggered Test
- Instant Test
- Self-Test
- Passage (includes all violation types as mentioned in section 1)

Image data bar	Data tab in the Registration viewer
Triggered Test	
	
Instant Test	
	
Self-Test	
	
Passage	
	

Each event can be opened, downloaded or deleted depending on the user profile defined in the role management (section 12.2). To open an event click on [Open] in the menu bar or double click on the event number. Below is an example of a speed event file consisting of two images, a video and data.

When opening an evidence file, [Image 1] will automatically be selected by default. This first evidence image will be displayed with the associated data bar and a violator marker that identifies the violating vehicle. Moving to the next or previous event can be done by clicking on [next >] or [< prev]. By clicking on [< back], the list of evidence files will be shown again.
An evidence file will be created when a passing vehicle commits a violation according to the criteria explained in section 5 or in case of a regular passage if ANPR streaming is enabled. If the system detects multiple violating vehicles at the same time (concurrent violations), separate evidence files will be created. The table below shows an overview of the evidence file contents per event type.

Event type	Low-res image	1st hi-res image	2nd hi-res image	Video	XML file
Passage - Red-light	✓	✓	optional	setting	✓
Passage - Speed	-	✓	optional	setting	✓
Passage - Streaming	-	✓	-	-	✓
Passage - Prohibited	-	✓	optional	setting	✓
Passage - Dedicated	-	✓	optional	setting	✓
Triggered Test	✓*	✓	✓	setting	✓
Instant Test	-	✓	-	-	✓
Self-Test	-	✓	✓	-	✓

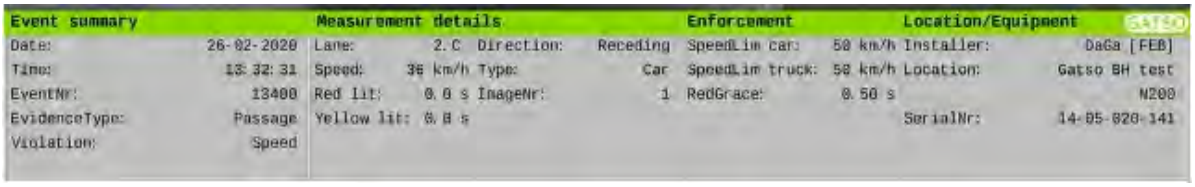
** If the system is aligned for red-light enforcement. Otherwise the evidence package will be the same as for a speed violation.*
Optional means: this depends on exact software configuration.
Setting means: this is a user-editable setting

Evidence images are saved as JPEG2000 files with the associated .xml data and the optional video in a container with the .MJ2 file format. When the files are digitally signed; the extension becomes .MJ2.p7s.
The evidence file name is built-up as: YYYYMMDDTHHMMSS+/-ZZZZ_NN-NN-NNN-NNN_PPPPP.

Character	Meaning
YYYYMMDDTHHMMSS	Date (YYYYMMDD) and local time (HHMMSS)
+/-ZZZZ	is the offset from UTC as HHMM
NN-NN-NNN-NNN	is the GTIB serial number
PPPPP	is a 5 digit ID

Example: 00000-00100/20170613T080623+0100_58-23-241-111_58881

9.1.1 *Still image data bar*



Each violation image contains a data bar with the most relevant evidence information. The data bar only reflects the traffic lane in which the offence occurred. The data bar is dependent on the exact software configuration. The default data bar is divided into four sections;

- Event summary
- Measurement details
- Enforcement
- Location/Equipment

The table below explains the possible contents of the four sections on the data bar.

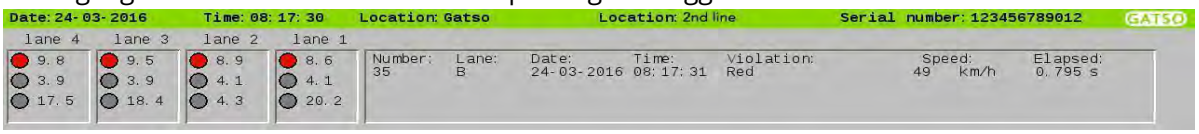
Data bar sections	Section content
Event summary	
Date:	dd-mm-yyyy
Time:	hh:mm:ss
EventNr:	Registration sequence number
EvidenceType:	Passage, Instant Test image, Self-Test or Triggered Test
Violation:	Speed, Red-Light, Dedicated, Prohibited
Measurement details	
Lane:	Lane label
Speed:	Measured speed in km/h
Red lit:	Elapsed red light time
Yellow lit:	Elapsed yellow light time
Direction:	Receding, approaching
Type:	Car or Truck
ImageNr:	Image number (1 or 2)
Interval: (only on the 2nd image)	This field only shows on the 2nd image and shows the elapsed time between the 1st and 2nd image
Enforcement	
SpeedLim car:	Speed limit for cars in km/h
SpeedLim truck:	Speed limit for trucks in km/h
RedGrace:	Grace time period that must have elapsed before red-light enforcement starts
Location/Equipment	

Data bar sections	Section content
Installer:	Name of the person or body that has performed the alignment
Location:	Location description
SerialNr:	Camera serial number
ApprovalNr: (optional)	Legal equipment approval number

9.1.2 Video data bar

The event number, lane label, date, time, evidence type, and speed are repeated in the video frames. The traffic light timers are displayed per lane.

Concurrent violations are displayed on the video data bar (with a maximum of 4 lines).
The highlighted line indicates the vehicle passing the trigger line.



Elapsed: this value will only be presented on a video data bar. It is the time difference between the time the vehicle is passing the trigger line and the time of the frame.

9.1.3 Checking evidence files

When manually verifying evidence files using the registration viewer or Offline Viewer, it is important to perform the following checks.

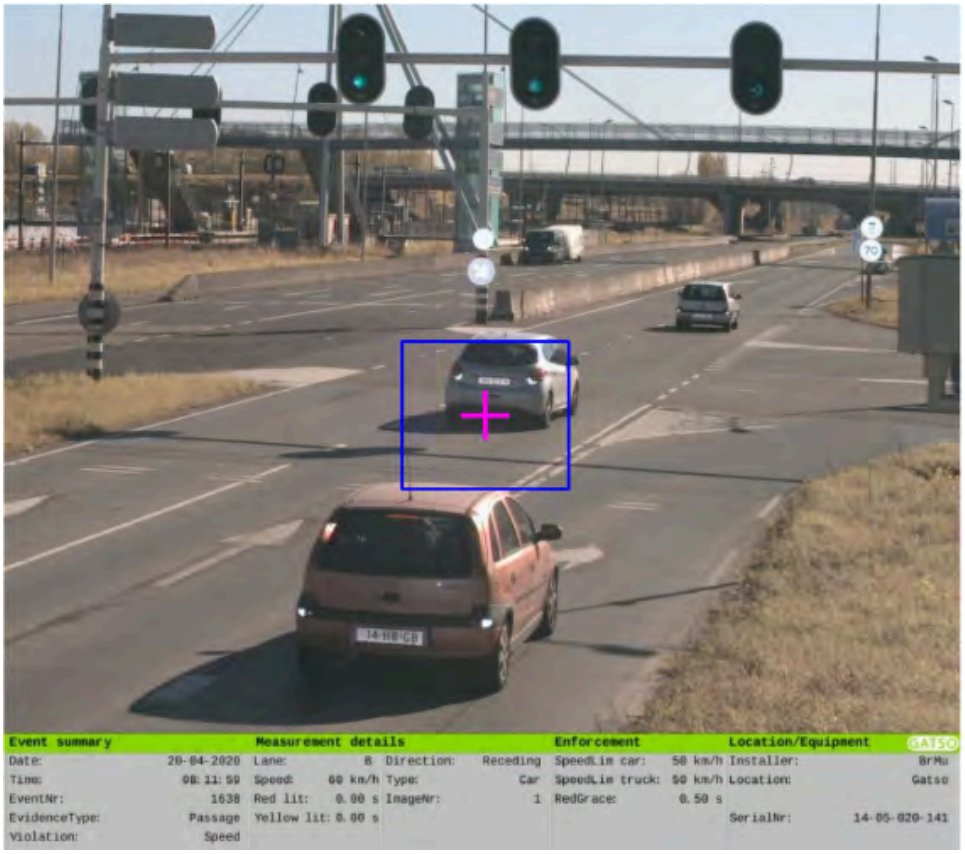
- Check if the displayed traffic status in the data bar corresponds with the traffic status in the image (if applicable).
- View a couple of previous and following images from the same file folder to see if the offending vehicle is captured at the same position.
- Check if the traffic direction on the data bar complies with the actual direction of the vehicle on the image.
- Check if the traffic lane label on the data bar complies with the traffic lane where the offending vehicle is driving.
- Check the position of the offending vehicle on image 1 and 2 to see if the measured speed is reliable in comparison to the travelled distance (interval distance/time).

Do not process a violation in situations where another vehicle blocks the view on the offending vehicle either on the 1st or the 2nd image.

9.1.4 *Violation marker*

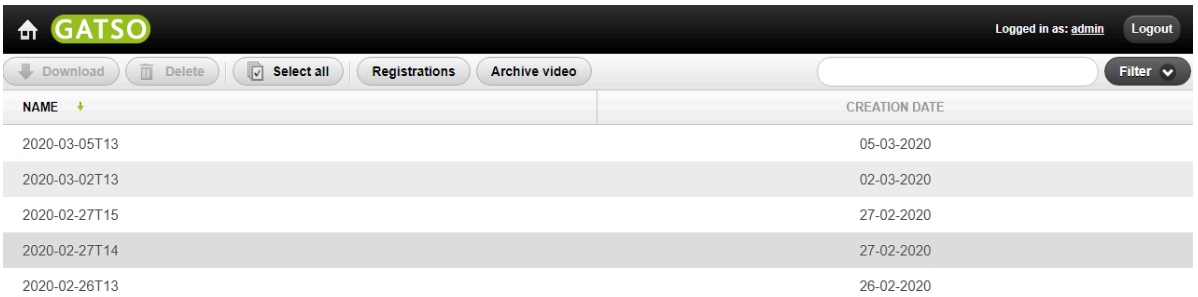
The violation marker quickly and easily identifies the violating vehicle in the picture. When enabled in the registration viewer, the violation marker shows two elements:

1) a purple cross indicating the violation vehicle
2) a blue rectangle indicating the ANPR Region Of Interest (ROI). This can be adjusted in the [System settings]. See section 12.16



9.2 Statistic files

For each vehicle that passes the trigger line, a registration is added to the statistic file which can be downloaded and viewed in the registration viewer. See below example.



The statistic files are collected per hour and can be downloaded in .csv format to a drive or network location. They can be opened using any spreadsheet application. Also test registrations are recorded and saved in the statistics file. The table below shows the content of the statistic files, ordered as in the entry.

Variable	Format / description
Date	YYYY-MM-DD
Time	HH:MM:SS + UTC Offset
Lane number	1-6
Lane label	6 character string
Speed	Speed in km/h or mph
Red time	Time in seconds with resolution of 1/100 second
Yellow time	Time in seconds with resolution of 1/100 second
Triggered test	0 = false, 1 = true
Self-test	0 = false, 1 = true
Instant test	0 = false, 1 = true
Passage	0 = false, 1 = true
Red-light violation	0 = false, 1 = true
Speed violation	0 = false, 1 = true
Car / Truck	0 = car, 1 = truck
Prohibited lane violation	0 = false, 1 = true
Dedicated lane violation	0 = false, 1 = true
Direction	+ for receding, - for approaching
Speed limit car	Car speed limit in km/h or mph
Speed limit truck	Truck speed limit in km/h or mph
Location description 1	As entered during alignment
Location description 2	As entered during alignment

9.3 Archive videos

The camera stores archive videos of 15 minutes each. These time periods start at hh:00, hh:15, hh:30 and hh:45. When a system is powered on, it will start recording at the next 15 minute mark.

Archive videos are stored in .mp4 format and can be viewed on any conventional video player. Archive video can use a different frame rate and bit rate in comparison to event videos. Frame rate and bit rate can be set in System settings. Read section 12.13.

Download files

The [Download] button on the menu bar of the Registrations Viewer enables the user to download a single or multiple evidence files from the system to a local device. Single evidence files are downloaded in .MJ2 or .MJ2.p7s format. Multiple selected files will automatically be exported to a .ZIP file. The downloaded evidence files can be viewed with the Offline Viewer provided by SGG.

Offline Viewer

The Offline Viewer is a separate tool, installed on a PC, to display the evidence files (in .MJ2 and .MJ2.p7s format).

The following files can be exported:

Format	Content
.JPG	Evidence images
.AVI	Violation video
.XML	Additional violation data
.CSV	Statistics
.MP4	Archive video

10. SECONDARY SPEED VERIFICATION

The secondary speed verification is an independent method to check the speed measurement performed by the radar. The execution of this verification depends on whether the second image of an offence is captured after a predefined time interval or distance interval.

10.1 Time interval

To verify the speed measurement, the estimated distance travelled by the vehicle is divided by the time that has elapsed between capturing the first and second image. This time is measured and subsequently displayed on the data bar of the second image. For the estimation of the travelled distance, a single characteristic of the vehicle has to be used on both images, for example the position of a wheel.

Formula: $\frac{\textit{Estimated interval distance (m)}}{\textit{Measured interval time (s)}} \textit{ x 3.6 = speed (km/h)}$

The estimated speed is to be compared with the speed measured by the radar and displayed on the first image. It is advised to allow for a maximum deviation between the speed measured by the radar and the estimated speed of 10%.
The distance travelled can be estimated with for instance the following references:

- location plans
- vehicle wheelbase
- positions other vehicles
- road markings
- satellite data (for example Google Maps)
- width of crossing traffic lanes

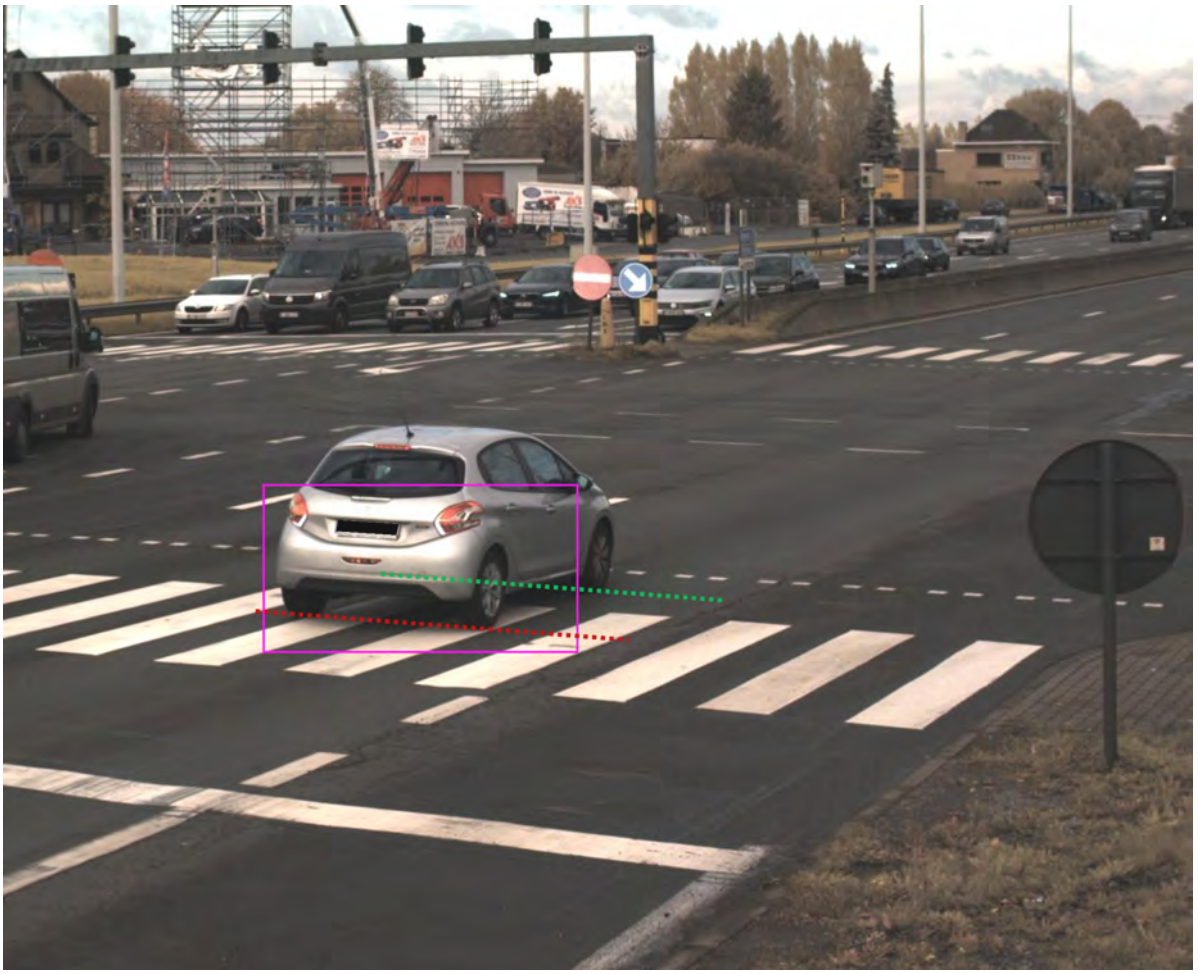
With all references, with the exception of satellite data, the perspective must be taken into account. This means, among other things, that lines with known dimensions (between them) visually become shorter or closer together, the further away they are from the camera. The dimensions of road markings can be obtained during the site inspection or installation.

Example
The data bar in the examples given below could differ depending on the exact software configuration.

The first image displays a measured speed of 84 km/h.

The second image displays the measured interval time of 0.499 s.

For an accurate estimate of the distance travelled, an overlay can be created using, for example, presentation software like Microsoft PowerPoint. Known references can be drawn over the images of the evidence file. In this example, the wheelbase of the vehicle is known to be 2.54 m and depicted with the red and green dotted lines.



With the lines copied onto the second image, the overlay can be further enriched with again the wheelbase of the vehicle and also other known parameters, such as the distance between the end of the pedestrian crossing and end of the first intermittent line demarcating the traffic lanes. In this example, this is measured during installation and known to be 8.8 m. The length of the pedestrian crossing, measured along the road axis, is also measured and known to be 4.0 m. Using this reference, distances I and III below are estimated to be 1.5 m.

The total sum of the estimated interval distance is the estimated distance I, measured distance II and estimated distance III. In this example:
Estimated interval distance: 1.5 + 8.8 + 1.5 = 11.8 m
With this, the estimated speed is as following:

$$\textit{Estimated speed:} \quad \frac{11.8\ (m)}{0.499\ (s)} \times 3.6 = 85.1\ (km/h)$$

The measured speed is 84 km/h. The estimated speed shall be between 76 and 92 km/h. The estimated speed of 85 km/h meets this requirement.

The accuracy of the estimate can be checked using the lower and upper advised limits.

$$\textit{Formula} : \frac{\textit{Speed (km/h)}}{3.6} \times \textit{Measured interval time (s)} = \textit{Travelled distance (m)}$$

$$\textit{Lower limit} : \frac{76\ (km/h)}{3.6} \times 0.499\ (s) = 10.5\ (m)$$

$$\textit{Upper limit} : \frac{92\ (km/h)}{3.6} \times 0.499\ (s) = 12.8\ (m)$$

The tolerance on the measured speed in this example allows a 2.3 m margin on the estimate of

the travelled distance. This is more than half the vehicle length. Based on the aforementioned guidelines for estimating the distance travelled, the secondary speed verification verification can be used with sufficient accuracy.

10.2 Distance interval

To verify the speed measurement, the interval distance travelled by the vehicle is divided by the time that has elapsed between capturing the first and second image. This time is measured and subsequently displayed on the data bar of the second image. In order to validate that the travelled distance is equal to the set interval distance, a single characteristic of the vehicle has to be compared with the trigger line displayed on both images, for example the position of a wheel.

Formula: $\frac{\text{Set interval distance (m)}}{\text{Measured interval time (s)}}$ x 3.6 = speed (km/h)

The calculated speed is to be compared with the speed measured by the radar and displayed on the first image. It is advised to allow for a maximum deviation between the speed measured by the radar and the calculated speed of 10%.

Example

The following example is based on a set distance interval. The data bar in the examples given below could differ depending on the exact software configuration.

The first image displays a measured speed of 78 km/h.

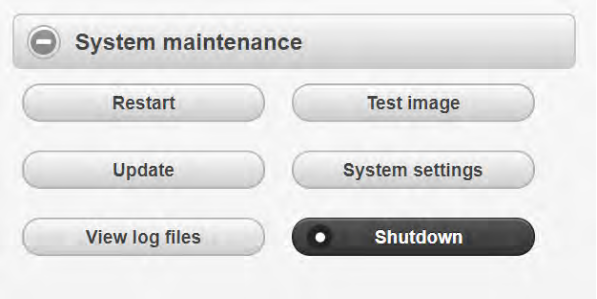
The second image displays the set interval distance of 10.00 m and measured interval time of 0.468 s. When the position of the vehicle is validated with respect to the depicted trigger lines on both images, it is clear that the actual travelled distance is equal to the set interval distance. With this, the calculated speed is as follows:

$$\text{Calculated speed: } \frac{10.00\ (\text{m})}{0.468\ (\text{s})} \times 3.6 = 76.9\ (\text{km/h})$$

The measured speed is 78 km/h. The calculated speed shall be between 70 and 86 km/h. The calculated speed of 77 km/h meets this requirement.

11. SYSTEM MAINTENANCE

This section describes the system maintenance part on the dashboard of the WBI. The menu items shown below will be explained hereafter.

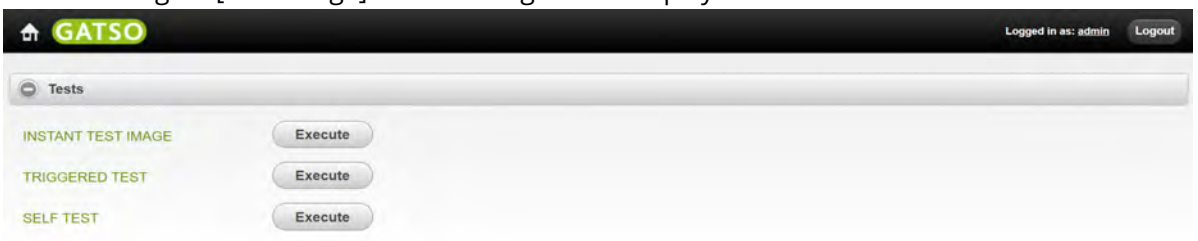


11.1 Restart

[Restart] finishes any ongoing process and reboots the system. Rebooting can take about 6 minutes. The system will not return to its latest status. The user needs to log in to the system again.

11.2 Test image

When clicking on [Test image] the following will be displayed:



11.2.1 Instant test image

When clicking on [Execute] next to INSTANT TEST IMAGE, the camera will be triggered to instantly capture an image. It will take a few seconds before the green confirmation bar appears on the top of the screen. The image data bar and the data tab (in the registration viewer) of the evidence file will register an Instant test. See more about this in section 7.

11.2.2 Triggered test

When clicking on [Execute] next to TRIGGERED TEST, the system will capture an image of the next passing vehicle, regardless whether this is a violation. It will take a few seconds before the green confirmation bar appears on the top of the screen. The image data bar and the data tab (in the registration viewer) of the evidence file will register a Triggered test. See section 7.

Use [Clear triggered test] to interrupt a triggered test, for example when no vehicles pass the system for an extended period of time. A triggered test can only be performed when the system is in system state [Enforcement].

11.2.3 Self-test

When clicking on [Execute] next to SELF-TEST, the system performs a verification of all legally relevant hardware by simulating a passing vehicle as a speed violation and verifying the results. Also the software integrity of all legally relevant components is confirmed by checking the current checksums against the saved checksums. Read also 12.9.
During the self-test the system is not in Enforcement mode and is not capable of capturing events. When the self-test has finished, the green confirmation bar appears at the top of the screen and the system returns to the same state as before the starting the self-test.

The self-test evidence file can be viewed in the registration viewer by opening the self-test event from the list of violations. By clicking on [Data] the user will find the data associated with the self-test and whether it succeeded.
The self-test evidence file will always be stored with classification “Self-Test OK” or “Self-Test Failed”. When a self-test is successful, the speed on the data bar displays 71, 72 or 73 km/h. When a self-test has failed, the speed on the data bar displays a figure as per one of the scenarios below:

Outcome self-test	Explanation
1 km/h	checksum test failed *
2 km/h	no response of the radar test
Any speed but 1, 2, 71, 72 or 73 km/h	failed self-test

** If a checksum test fails go to System Settings -> [certification] and save the checksums.*

If the self-test fails, the system will not move into the enforcement state. The operator shall first ensure that the cause of the failed self-test is resolved, and perform a successful self-test. If the self-test continues to fail, please contact Customer Support.

11.3 Update

[Update] can be used to upload a software installation package and start a system software update. The outcome of the update can be as follows:

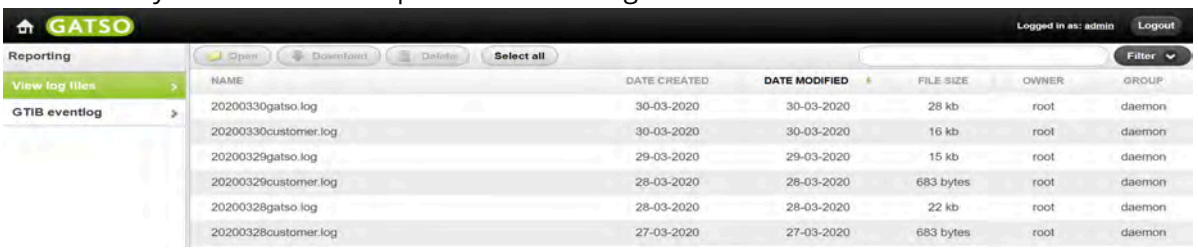
Outcome update	Explanation
System updated successfully	The system has been updated to the new version successfully.
System update failed; Reverted to previous version	Something went wrong during the update process and the system has reverted to the previous software version.
System update failed	The update process failed and the system was not able to revert to the previous version. Please contact Customer Support for help.

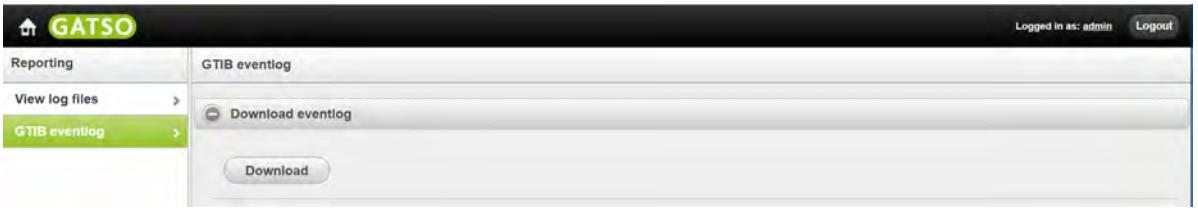
11.4 System settings

The system settings are extensively described in section 12.

11.5 View log files

[View log files] opens a list of log files that can be viewed, downloaded and/or deleted, using the buttons at the top of the screen. Deleting log files is usually not required, since old log files are automatically deleted when the partition for the log files is full.





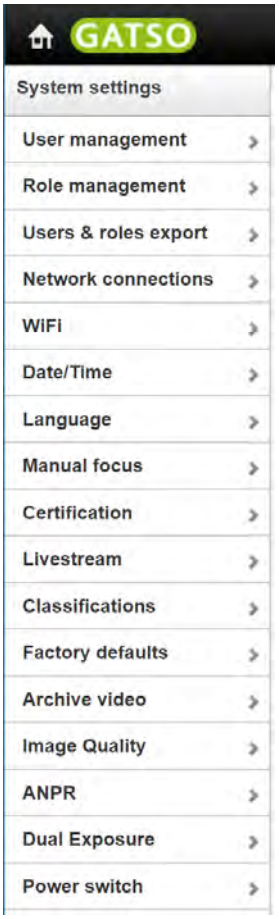
11.6 Shutdown

The [Shutdown] button in the system maintenance completes the saving of any open registrations, stores the settings and will leave the enforcement state.

Always use the hardware or software shutdown button before switching off the power and/or unplugging cables. This provides safe data storage and prevents system failures.

12. SYSTEM SETTINGS

General settings of the T-Series Fixed system can be adjusted by clicking on [System settings] on the WBI dashboard. A list of settings will appear on the display and each setting will be described in this section.

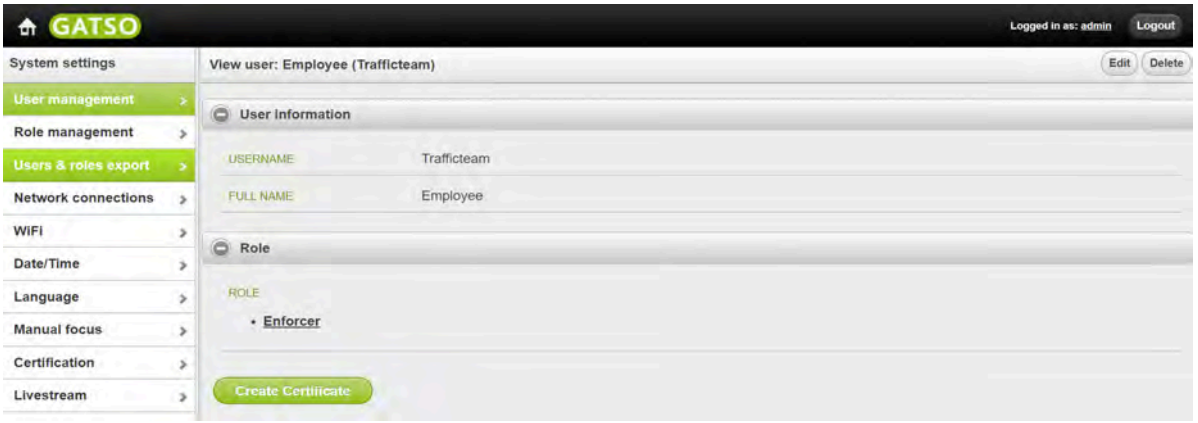


12.1 User management

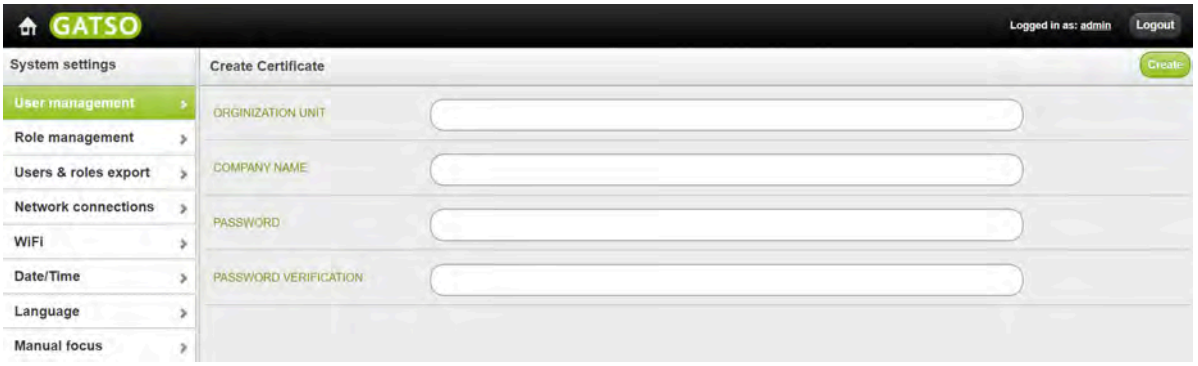
In the user management menu, users can be added, changed, and deleted. Each user can be assigned one or more roles as defined in the system. See next section 12.2.

To add a user click on [Add] and fill in the required fields.

For each user the name and role can be edited:

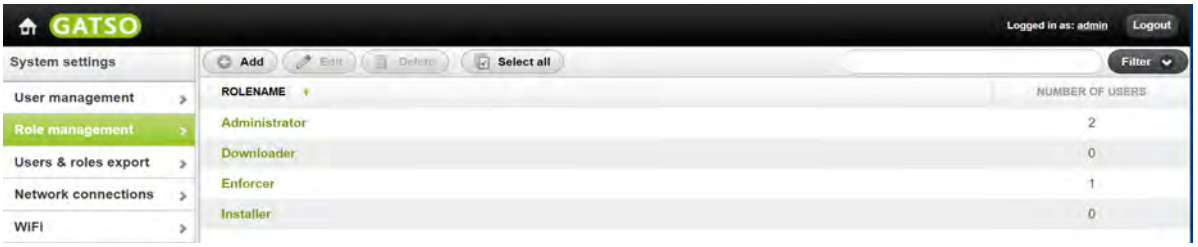


Also when clicking on [Create Certificate] a user can be assigned to a specific part of the organization.



12.2 Role management

The role management menu lists all roles and user rights as defined in the system. View the below screenshot.



For every role, Create/Edit/Delete rights can be assigned with regard to the following parts: *access, camera, files* and *system*.

12.3 Users & roles export

Data files with users and roles of this system can be downloaded or a data file from a different system can be uploaded. In this way, roles and users created on one system can be easily applied to a different system.

12.4 Network connections

In this menu, the IP address and other network settings of the system can be adjusted. Read section 3 for detailed information on IP settings.

12.5 WiFi (optional)

The optional WiFi access point can be enabled or disabled and the settings can be changed. Upon first use, the user will be provided with the default password to access the WiFi access point.

12.6 Date/Time

The date/time settings are only editable when the system is not in enforcement.

The following three options are available as a time source and will be explained below.

- RTC (Real Time Clock)
- GPS (Global Positioning System) (optional)
- NTP (Network Time Protocol) (optional)

RTC

When [RTC] is selected, the system uses the internal real time clock as a time source. This is a free running clock which is not synchronized to an external time source. It is recommended to use either GPS or NTP instead.

GPS (optional)

When [GPS] is selected, the system time is synchronized with accurate time from the GPS satellites positioning system. This option is only available when the system is equipped with a GPS module.

NTP (optional)

When [NTP] is selected, the system time is synchronized with an NTP Server. Up to two NTP servers can be configured as time sources. The first one is mandatory, the second is optional (in case the first is not available). Use an IP or DNS address to connect to a NTP server. The test buttons can be used to verify if the configured NTP Server is available.
It is important to select the appropriate time zone region. Time zones are also used to automatically switch to DST (Daylight Saving Time).

After changing the time zone, restart the system.

12.7 Language

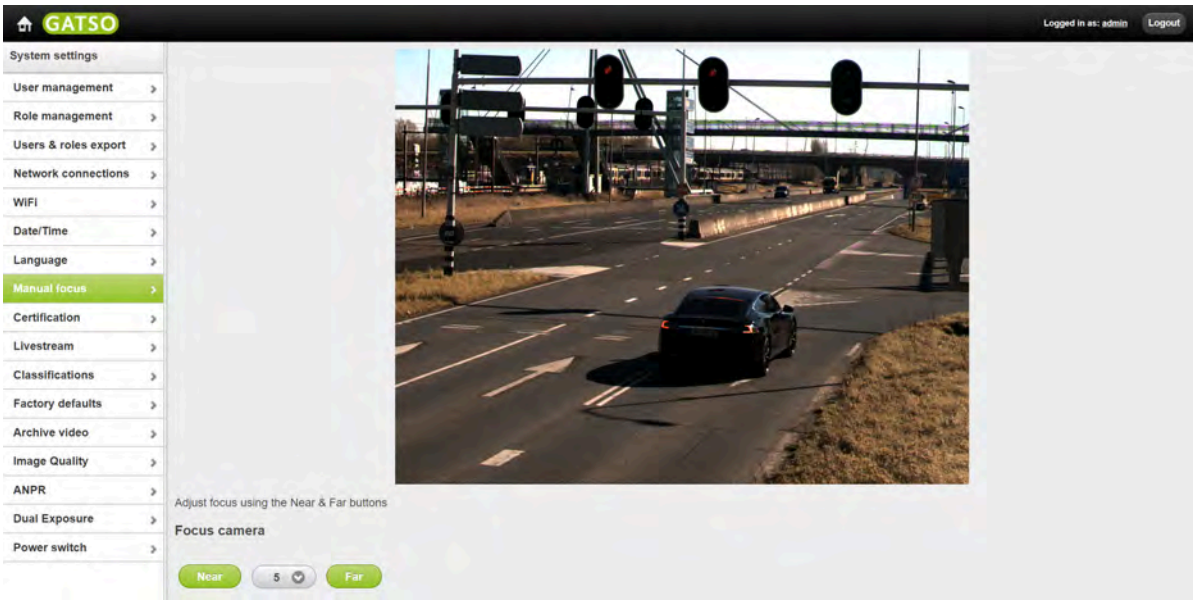
The default language used in the WBI is English. By clicking on [Language] in the system settings, the user can select a different language from the list of installed languages. The preferred language can be downloaded and also set as a new default.
The default language is the language that appears in the WBI login window each time the WBI is opened. To edit or create a translation, download an available translation file. This file can be edited on a PC to create the updated or new translation.

Editing or creating a translation should be done in consultation with Sensys Gatso. Only Sensys Gatso can implement the new translation file in the WBI, so that it becomes available in the WBI login window with the language options.

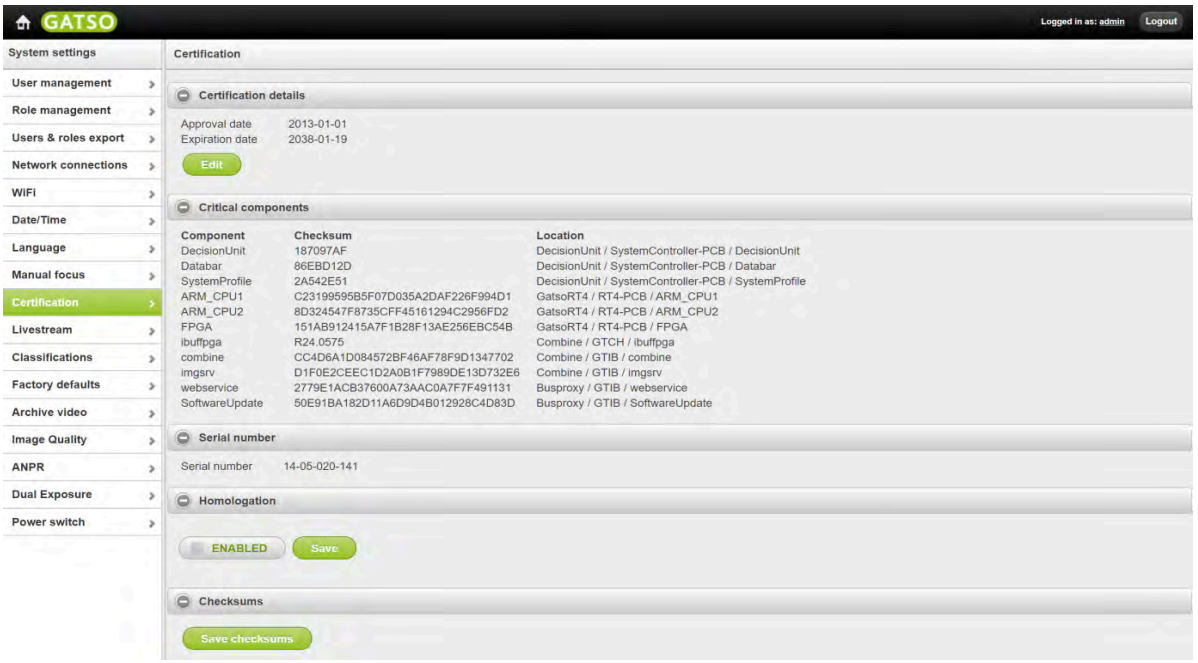
12.8 Manual focus

In this menu the camera focus can be set manually by clicking on [Near] or [Far].

Users are advised to focus the camera in the evening or at night time, especially when using infrared flash.

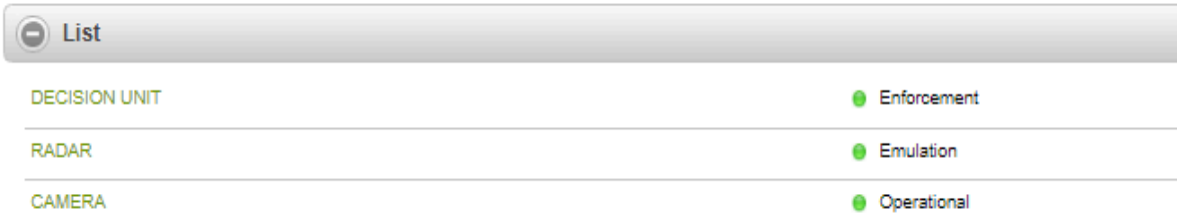


12.9 Certification



The validity of the periodic certification is shown here. The system will not be able to enforce when the periodic certification date has expired.

Homologation
Homologation is used for testing purposes and brings the system into emulation mode. The WBI dashboard shows radar in 'Emulation'. See below.



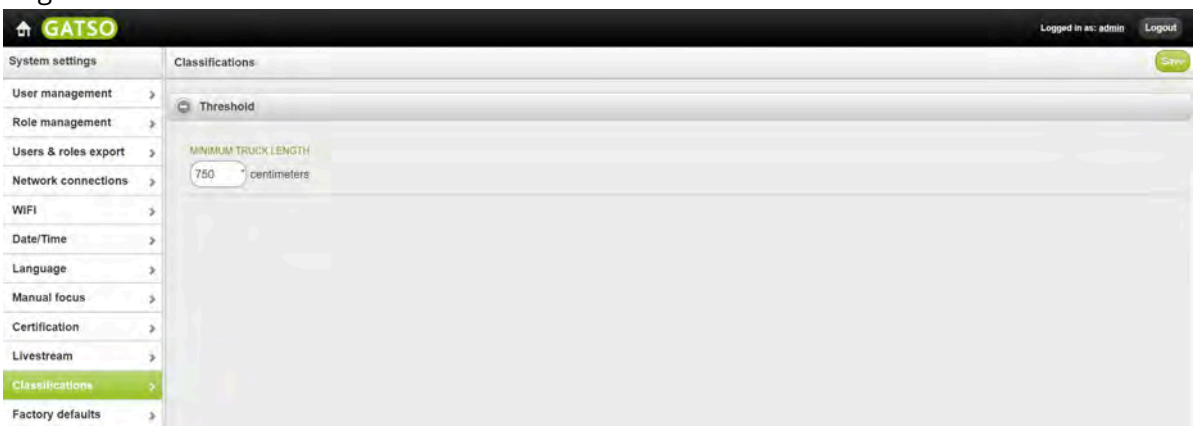
When the emulation mode is [enabled], the system will not use the signal of the RT4.1 front-end. Instead, the signal coming from the homologation connector at the bottom of the cabinet is used. Select [Stop enforcement] on the WBI dashboard to disable the homologation. After a system software [Update] the new checksums must be stored. This can be done by clicking on [Save checksums]. This can only be done with 'Admin' user rights. After saving the checksums, the system does not automatically run a self-test.
During a self-test, the system compares the re-calculated checksums with the previously stored checksums. If the checksums do not match, the self-test fails and the system cannot go into enforcement. For more information on the self-test read section 5.4.5 and 9.2.3.

12.10 Livestream

In this menu the quality of the live stream can be adjusted. The live stream quality can be set to [Low] (320 x 240 pixels), [Medium] (640 x 480 pixels) or [High] (1280 x 960 pixels). After selecting the preferred quality, click on [Save] in the upper right corner.

12.11 Classification

The T-Series classifies vehicles based on the measured vehicle length. The measured vehicle length determines if the vehicle is classified as a car or a truck.



12.12 Factory defaults

12.12.1 Backup settings

All system settings are stored on the system. It is possible to save the current set of system settings to a file on the PC or laptop. By default this will be stored in the Downloads folder. This functionality can be helpful for restoring the system settings when installing a new system box at a known location.
When clicking on [Download settings], a setting file will be created containing all current settings. This refers to alignment settings as made in section 4, enforcement settings (section 5) and above mentioned system settings.

12.12.2 Restore settings

In Restore settings a previously saved set of system settings can be uploaded onto the T-Series.

After restoring settings, the system alignment procedure must be carried out again.

12.12.3 Reset settings

The option [Reset to default settings] is not available when the system is in enforcement. To stop the enforcement select this option on the WBI dashboard.
When restoring to default factory settings, the system returns to the standard settings as upon delivery. This means that the IP settings go to their default values (DHCP) and:

- all stored evidence files will be removed
- all stored statistic files will be removed
- all stored log files will be removed
- all stored archive video files will be removed
- all stored alignment data will be removed
- all settings will be set back to default

12.13 Archive video

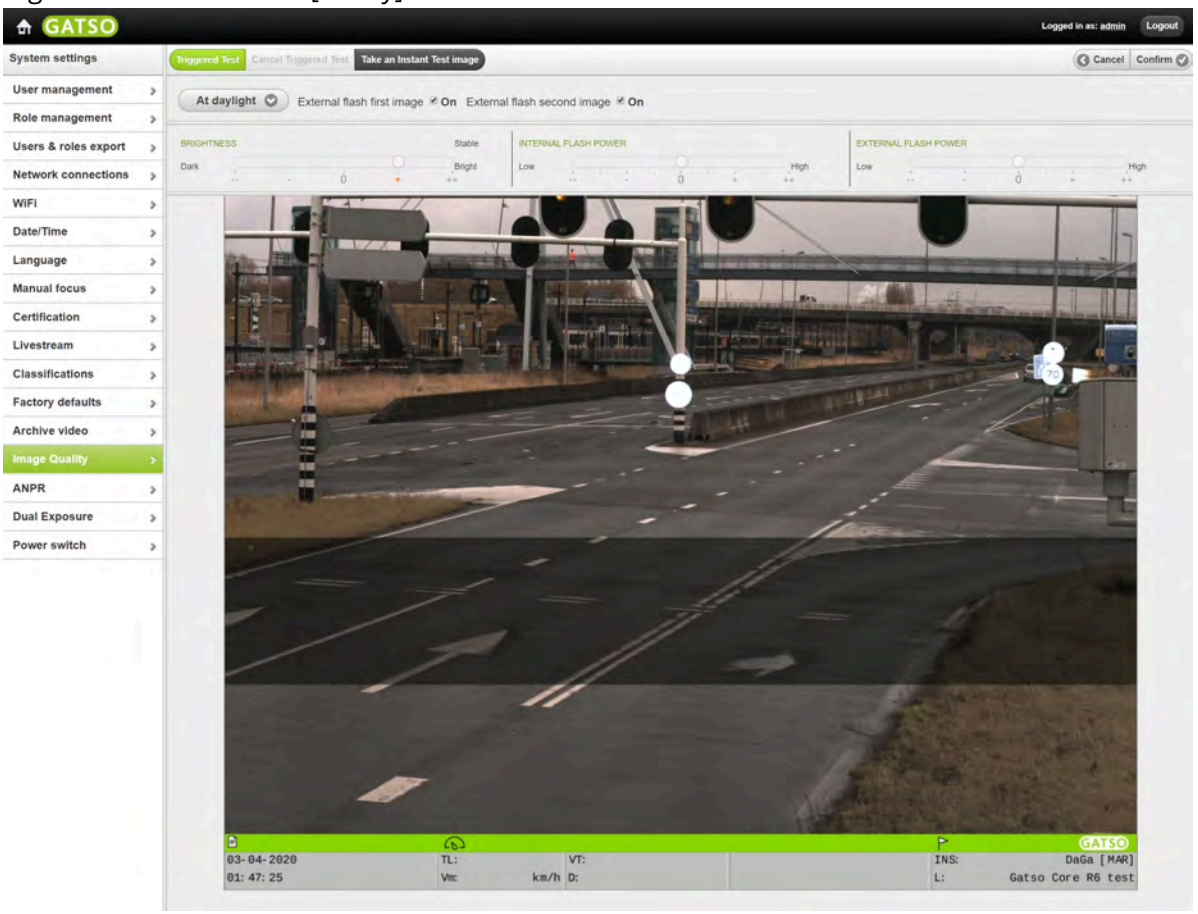
The camera stores an archive video in blocks of 15 minutes. The archive video can be stored in 3 different resolutions:

- High: 1280 x 960 pixels
- Medium: 640 x 480 pixels
- Low: 320 x 240 pixels

By increasing the resolution and bit rate values, the quality of the video will increase, but the maximum recording time will decrease.

12.14 Image quality

Image quality adjustments can be made when the system has performed a successful system alignment and is in state [Ready].



Step 1

Click on [Start] to enter the configuration mode. The Image quality page becomes editable.

Step 2

During day time select [At daylight] in the top-left corner to see the present image quality settings that apply during daylight.

Night time image quality settings must be carried out during night conditions.

Step 3

Take a test image.

The camera's image quality control constantly adapts to the current lighting condition and therefore the status indicator changes between [Stable] and [Adjusting], even when no changes have been made. Wait for status [Stable] before making a test image.

There are two ways to take a test image:

- click on [Triggered Test]: the T-Series waits for a vehicle and takes an image. These triggered test images are stored on the camera
- click on [Take an Instant test image]: the T-Series takes an image directly

The test image will be shown on the screen.

Step 4
Use the test image to check/verify the image quality settings.
Zoom in (+) and out (-) on the image in a specific area and pan the image by clicking and dragging. Normally this area will be the position of a vehicle at the trigger line to verify its license plate.
Step 5
Use the brightness slider to change to a more bright or dark setting. 0 is the factory default.
Step 6
Take another image to evaluate the new setting.
When the brightness of the license plate area is OK proceed with step 7.
Step 7
Change the flash power of the internal and (optional) external flash by one step in either direction (0 is the factory default).

The flash power during day- and night time can be adjusted. Adjusting the daylight flash can influence the night flash power and vice versa. This is caused by the flash controlling mechanism.

The flash [On] checkbox offers the possibility to turn off the internal or external flash for this image quality test and examine the influence of the flash on the image quality. During normal operation the flash [On] check box has no effect on the internal or external flash.

Step 8
Click on [Confirm] to save the settings and to use them for enforcement.

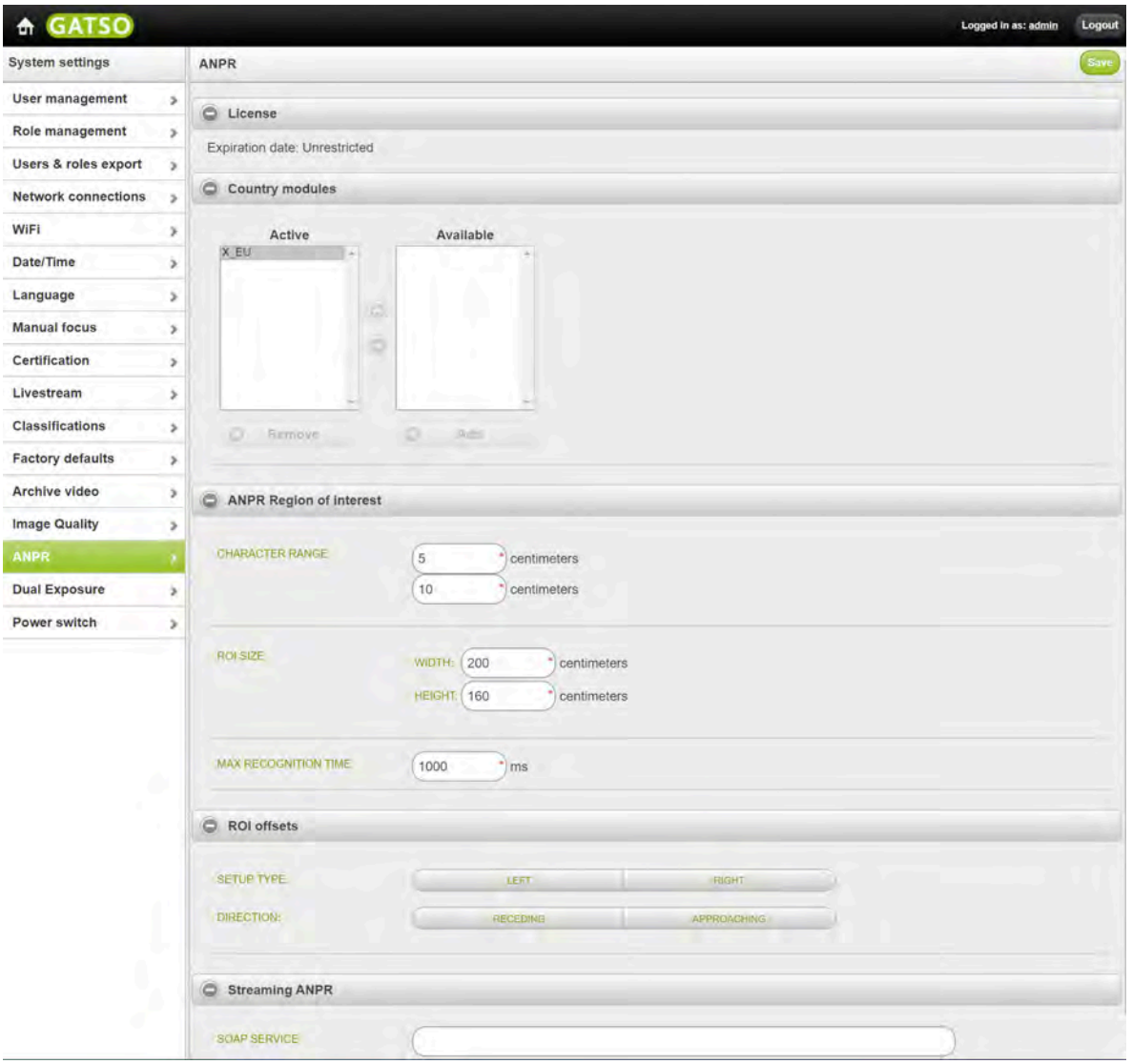
12.15 VTLI

If the T-Series system is in [Ready] status, the VTLI settings can be saved and/or be used for analysis purposes. Besides that, the factory default setting can be uploaded. The VTLI settings are saved in a .ZIP file containing two VTLI training files. To download VTLI training files only, click [Download training files].

Analysis
To perform analysis it might be necessary to collect (a large set of) images of the Region Of Interest (ROI).
Click on [Start] for the camera to start saving ROI images of all lanes. This continues (by default) for 60 seconds (i.e approximately 20 images per second per lane). A counter shows the remaining time of the storing process. If fewer images are required, click on [Stop] to stop the action earlier. Click on [Expand time] to continue the action.
When the storing process is ready, an instant test will be performed on the camera. This test evidence file is written to a .TAR file together with the stored ROI images and the VTLI training files. Please send this data to Sensys Gatso Customer support if you need assistance with the VTLI training.

12.16 ANPR

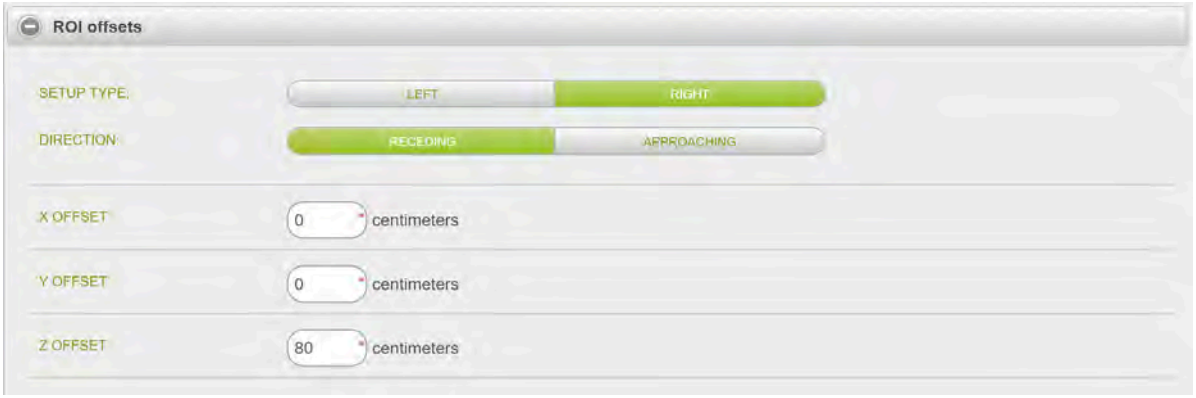
The ANPR settings page allows for configuration of the (optional) ANPR software. ANPR settings are only available when the system is in “Ready” mode.



12.16.1 ANPR ROI

Character range refers to the size of the characters on the license plates. Assure the size of expected license plates is within the set boundaries with sufficient margin. *ROI size* refers to the size of the search area for performing an ANPR read, depicted with the blue rectangle in an evidence file. *Max. recognition time* refers to the time allowed for performing an ANPR read on a license plate.

ROI offsets refers to the position of the ROI with respect to the violator marker in the evidence image.



Click on the appropriate setup type [LEFT] or [RIGHT] to indicate whether the T-Series is installed on the left or right side of the road. Also determine [RECEDING] or [APPROACHING] for the traffic direction. With the X, Y and Z offset, the user can move the ROI with respect to the violator marker. Enter a positive or negative value for the Y and Z offset to reposition the violator marker left or right (Y) or up and down (Z). The X offset moves the ROI away or closer to the camera, effectively making the ROI smaller or larger. The new settings are stored by clicking the [Save] button in the top right corner of the screen.

12.17 Dual exposure

The dual exposure setting is made in the alignment wizard described in section 4.11. The dual exposure can also quickly be switched On or Off in the Systems settings. Make sure the system is in state [Ready].

12.18 Power switch

If a system fails and there are no other means to resolve the issue, the power switch offers the possibility to perform a power cycle. This will be further explained in the annex 2.

13. TROUBLESHOOTING

This section explains system and components states. A number of troubleshooting answers are given. If problems persist or are not described in this section, please contact Sensys Gatso Customer Support.

13.1 System states

The system status shows the current status of the system.

State	Explanation
Start-up	The system is starting up. The system is in this state while it is booting; it checks whether all the required components are available. If not all components are available within a time limit, the system switches itself to the Offline state.
Configuration	The system will be in Configuration state when adjustments are being made; for example during system alignment. To continue make sure alignment is carried out and confirmed.
Ready	The system is ready and able to enforce, awaiting a user command (given through the WBI) to enter the enforcement state. The Ready state indicates that the system is fully operational, but is not yet recording violations.
Enforcement	The system is operational and in enforcement mode.
Offline	The system is not operational due to an error or malfunctioning. Read section 11.3 for solutions.
Synchronize	Settings are being synchronized between system components.
Process incomplete	The system is checking and saving evidence files that are not yet saved on the SSD caused by a power-off.
Power down	The system has started the power-down cycle and is saving all data.
Self-test failed	Read section 9.2, Test images
Validation date expired	The system enters the “Validation date expired” state when the due date as configured in the system menu has expired.

13.2 Component states

The component states indicate the current status of the main components of the system.

Component	Status
Camera, Busproxy, RTC	• Operational (able to enforce) • Pre-operational (start-up/configuring) • Idle (ready to start operation) • Unknown (device not connected or not operational)
VTLI or WTLI* *Depends on the traffic light selection during alignment	• Operational (able to enforce) • Pre-operational (start-up/configuring) • Idle (ready to start operation) • Unknown (device not connected or not operational) • No TLI (No traffic light interface used, based on alignment)
Radar	• Normal (operational) • Idle (not operational) • Unknown (not present or malfunctioning) • Homologation (responds to signals coming through the test connector underneath the system box)
File system	• -% Free
NTP/GPS	• Synchronized • Not synchronized

13.3 Troubleshooting component status

Module	Status	Solution
Bus Proxy	Offline	Shut down the T-Series and start it up again. If the problem persists, contact Sensys Gatso Customer Support.
Camera	Unknown	Shut down the T-Series and start it up again.If the problem persists, contact Sensys Gatso Customer Support.
Decision Unit	Offline	If any other component is offline, the Decision Unit is offline. Go to the page status report and save the checksums again. Then, perform a self-test from the menu test images. Check that the test is successful and the Decision Unit goes to status Ready.
GPS	Offline	Wait a few moments for the GPS to become active. Make sure GPS has an unobstructed view to the sky. If status persists replace GPS.
NTP	Not Synchronized	Wait a few moments. If the status persists check NTP server status in System settings. If not available check internet connection or select a different NTP server.
RT4.1	Idle while system is in enforcement	Stop enforcement by clicking on [Stop enforcement] on the main menu. Then click on [Start enforcement].
WTLI	Unknown	Shut down the T-Series and start it up again.If the problem persists, contact Sensys Gatso Customer Support.
VTLI	Idle	Restart alignment and configure the VTLI.

13.4 Troubleshooting general issues

	Solution
System shutdown	When the temperature inside the cabinet rises above +55° C or below -25° C the system will automatically shut down. When the inside temperature returns to the regular temperature range the system will restart and go to its last known operational state.
Connection lost	The T-Series is probably rebooting. Wait 6 minutes and log in again.
Images are blurred	Adjust the focus manually in the [System Settings] [Manual Focus] menu.
License plates overexposed	Try lowering the flash intensity first. If the problem persists contact Sensys Gatso Customer Support.
Many vehicles passing without being detected	Perform system alignment again. If the problem persists, contact Sensys Gatso Customer Support.
Measurements in the wrong lanes	Perform system alignment again. If the problem persists, contact Sensys Gatso Customer Support.
No activity in Live view	Press CTRL+F5 to refresh the Web page in the browser.
No video in WBI	Shutdown the T-Series and start it up again. If the problem persists, contact Sensys Gatso Customer Support.
Network connectivity but no WBI	Shut down the T-Series and start it up again. When connecting via the internet make sure the firewall or provider does not block the RTSP port (port 554). If the problem persists, contact Sensys Gatso Customer Support.
Unable to fetch system status	Shut down the T-Series and start it up again or performa power cycle (see Annex 2). If the problem persists, contact Sensys Gatso Customer Support.

13.5 Incomplete event queue

If a power failure occurs during the registration of a violation or if for any other reason the camera was unable to register or store an event issued by the System Controller, the incomplete event queue mechanism will notice this and make sure an “empty” violation with the same event number is created and stored by the camera. This incomplete event registration is also signed with the same signature used with real violations. This way unauthorized removal of evidence can be recognized.

14. TECHNICAL SPECIFICATIONS

14.1 General

Power supply	110 VAC - 230 VAC
Nominal power	70 W
Cold start	-10 °C
Operating temperature	-25 °C to +55 °C
Storage temperature	-40 °C to +85 °C

14.2 T-Series

Total installed weight	41 kg
Individual modules	< 15 kg
Pole cabinet size	657 x 560 x 275 cm
Outer shell	1.5 mm stainless steel
Inner shell	2.5 mm aluminium
Lock	Euro cylinder
Standard mounting	on round poles, ø 100 - 250 mm
Environmental protection	IP65

14.3 FT3 flash

Flash type	48x IR LED peak wavelength 850 nm
Flash duration	10 µs – 1000 µs
Still / Video	10 µs – 1000 µs / 10 µs – 250 µs
Still image repetition rate	max. 6 Hz
Video frame repetition rate	max. 30 Hz

14.4 FT1 flash

Flash type	Xenon tube
Peak energy	10 Ws
Flash duration	50 µs – 1000 µs
Continuous repetition rate	0.5 Hz
Burst repetition rate	30 Hz – 4 consecutive flashes

14.5 RT4.1 radar

Frequency	24.000 - 24.250 GHz
RF power	16 dBm tested (< 100mW / < 20 dBm EIRP)
Antenna type	planar
Bundle shape	oval cone
Bundle opening	62° horizontal, 16° vertical
Measurement direction	approaching and/or receding
Detection range	0 - 150 m
Trigger line range	10 - 80 m

14.6 GT20 camera

Sensor type	CMOS
Sensor size (full frame)	32.8 x 24.6 mm
Resolution	5120 x 3840 pixels
Image format	4:3
Dynamic reach	12 bit
Recording capacity	30 fps
Video stream	max. 1280 x 960s
Lens type	EF-mount
Video	10 µs – 250 µs
Image repetition rate	max. 6 Hz
Video frame repetition rate	max. 30 Hz

14.7 User setting limits

Interval distances A, B and C	0 - 25 m
Interval time B and C	0.1 - 10 s
Pre run time video	1 - 10 s (steps of 0.1 s)
Post run time video	1 - 10 s (steps of 0.1 s)
Video archive file	15 min
Speed limit for cars	0 - 300 km/h
Speed limits for trucks	0 - 300 km/h
Speed threshold for cars	0 - 300 km/h
Speed threshold for trucks	0 - 300 km/h
Red-light threshold	0 - 300 km/h
Red-light grace time	0.01 - 9.99 s
Minimum yellow time	0.01 - 9.99 s

Vehicle length (car/truck classification)	400 - 2000 cm. Default 750 cm
Speed enforcement	1 - 4 lanes
Red-light enforcement	1 - 4 lanes
Concurrent violations on the video data bar	max. 4 lines
Individual lane name	max. 6 characters (a-z, A-Z, 0-9, _\ -)
Video frame rate	1 - 30 fps
Video bitrate	100 - 1000 kb/s

ANNEX 1 Declaration Of Conformity

DECLARATION OF CONFORMITY

Applicant Company:	Sensys Gatso Netherlands B.V.
Address:	Claes Tillyweg 2 2031CW Haarlem Netherlands +3123 525 5050
Product:	**T-Series systembox**
Manufacturer:	Sensys Gatso Netherlands B.V.

Sensys Gatso Netherlands B.V. declares, under her sole responsibility, that this product

Object of the declaration

Fig1. T-Series system box with build in RT4.1 radar (bottom)

is in conformity with the Radio Equipment Regulations 2017 with reference to the following Standards / Directives applied:

- Radio Equipment Directive 2014/53/EU
- EN 300 440 v2.2.1
- EN 301 489-1 v2.2.3
- EN 301 489-3 V2.1.1
- EN 62311
- EN 62368-1:2020+A1:2020

The notified body Kiwa Nederland B.V. with notified body number 0063 has performed an assessment under the conformity procedures as described in Annex III of the directive and issued certificate number 212140692/AA/00.

Where applicable:
The issued EU-type-examination certificate: 212140692/AA/00

The approved body Kiwa LTD. with approved body number 0558 has performed an assessment under the conformity procedures as described in Schedule 3 of the RER and issued certificate number 212340037/AA/00.

Where applicable:
The issued UK type examination certificate 212340037/AA/00

When and where issued:
Date : 12 Sept 2023
Location: Amsterdam, Netherlands

Declaration signed and approved on behalf of Sensys Gatso Netherlands B.V. by:

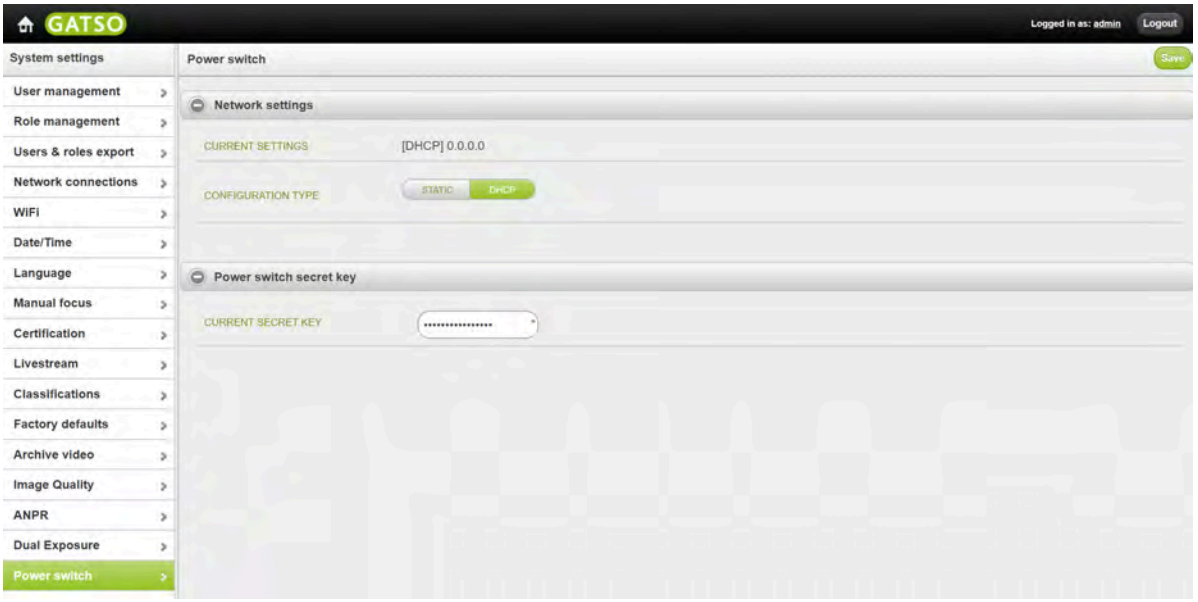
B. Mulders
Head of Engineering

Annex 2 Power Switch

Power switch
If a system fails and there are no other means to solve the issue, the power switch offers the possibility to generate a power cycle.

Be aware to only use this option when no other is available. Performing a power cycle can lead to data corruption.
The power switch has its own IP address and it is advised that users write down this address in their administration, for situations when the T-Series cannot be reached.

Select the [Power switch] from the System settings list and enter a secret key that is BASE 32 encoded and save.

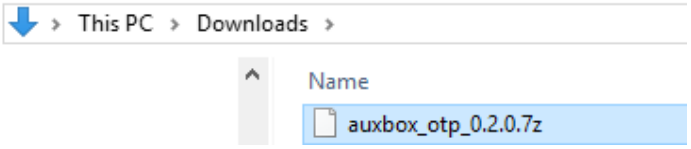


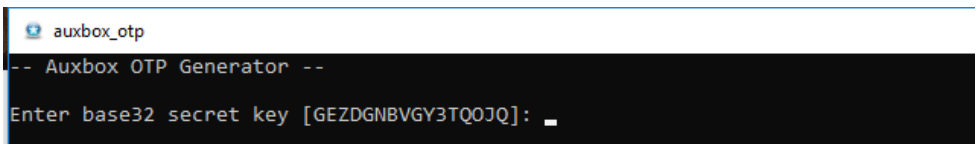
When following the steps hereafter, an OTP (One Time Password) is created to gain access to the power switch.

Create secret key
A secret key will be created with the Auxbox OTP program. Enter this key and [Save].

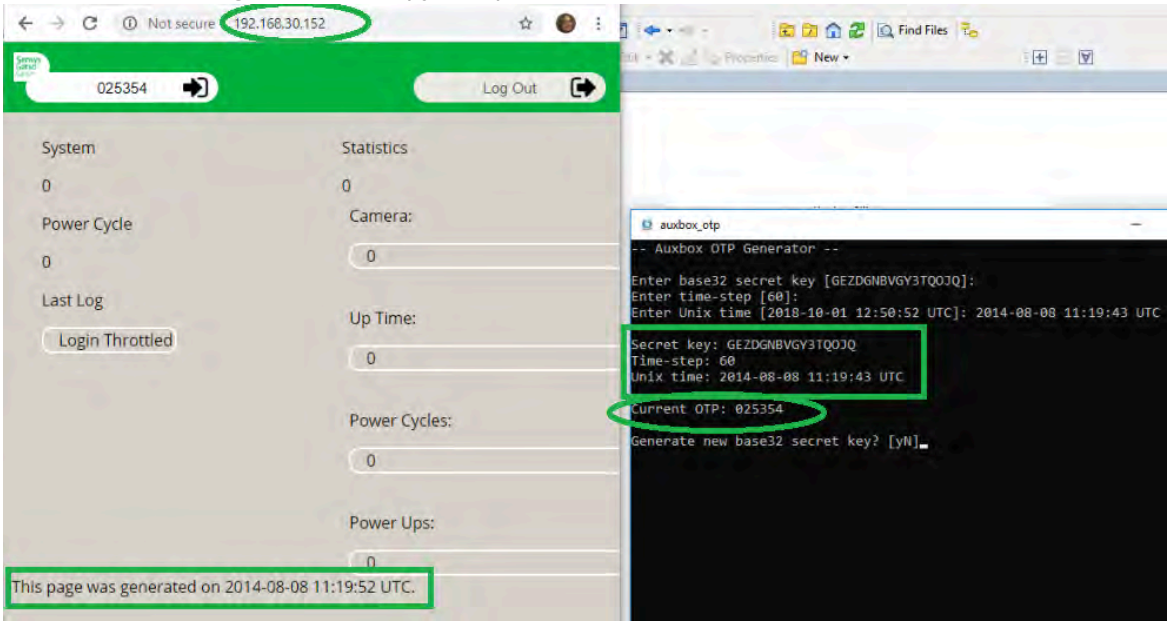
Open power switch interface
Copy the Aux box IP address and paste in the browser. Copy the time of the page generation. This has the following notation: YYYY-MM-DD HH:MM:SS UTC.

Generate OTP
Download the Auxbox_OTP.exe on your system and Open the application.



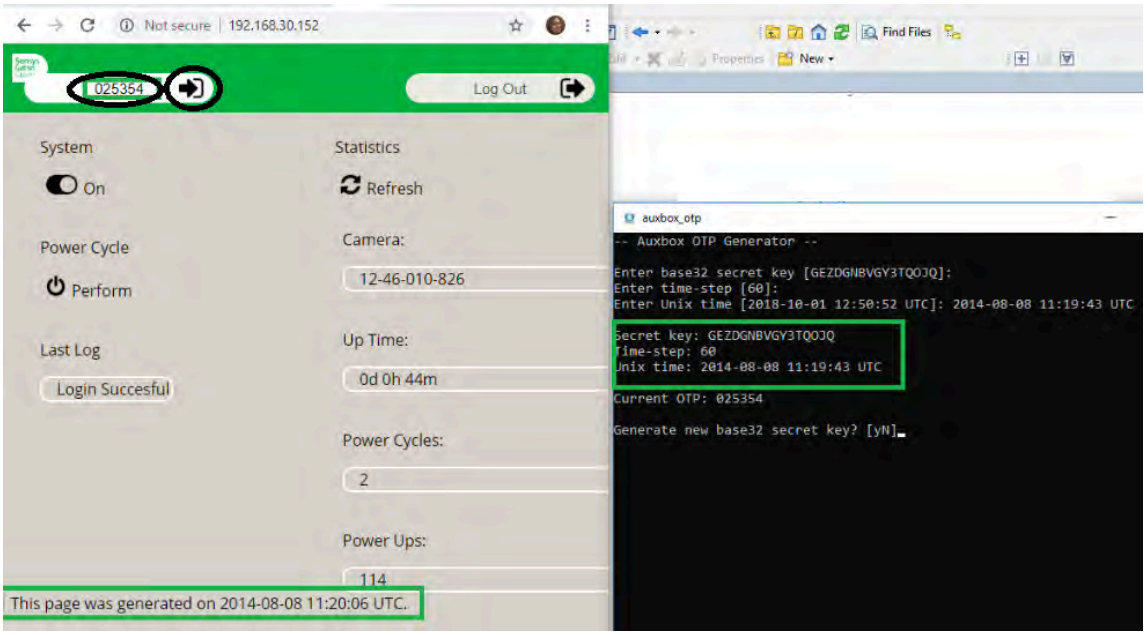


1. Enter the secret key saved on the Power Switch page and press [Enter].
2. Enter the maximum allowed time interval in seconds and press [Enter]. It is recommended. to use 60 seconds. This gives the user 60 seconds to complete the login to the power switch interface.
3. Enter the time of generation of the Aux box IP address page as copied earlier and press [Enter].
4. An OTP will be generated. Copy this password.



Log in on the power switch interface

Go back to the Aux box IP page and enter the OTP on the top-left of the page and click the arrow next to it to log in the user into the Aux box. The login should be done within the maximum allowed time interval that was entered in the previous step.



Execute a power cycle

Click on [Perform] under Power Cycle to temporarily interrupt the systems power. Wait for 6 minutes and log in on the T-Series again.69

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