# Contents

# CAMERA SETTINGS AND IR ILLUMINATOR FOR LPR

## INTRODUCTION

Metrici LPR it is a very powerful solution for license plates recognition but in order to be able to perform at its best it needs clear images from the cameras used. Because LPR or license plate recognition is quite different from other type of video analysis and has specific characteristics and settings we kindly ask you to carefully read this manual and to follow the best practice recommendations for placing and setting the camera.

The most important rule of thumb in determining if the cameras are placed and set properly is to look at the images and to bear in mind that if you have troubles identifying the license plate then the software will not be able to identify the license plate.

It is important to mention that Metrici LPR recognizes the license plates if they are visible and have good contrast in the images. In the case of a camera set right, correct placement, and fine tuning, the program has a detection rate of almost 100%. Please bear in mind that when installing the camera, as well as during functioning of the said camera that the image and the plates must not be:

**Overexposed**



**Blured**
(because of an incorrect shutter speed)

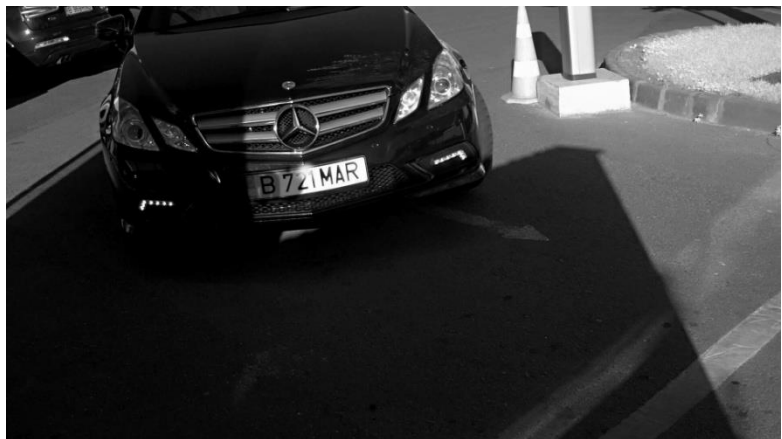

**Distorted**
(due to the viewing angle or damages to the plate)

**Dirty**



**Slightly legible**



**Uneven illuminated**

**Be aware of the placement**
Some patterns may generate a false positive



**Be aware of the reflections**
that can affect the image



# Chapter 1
## CAMERA TYPE. SENSOR

Clients often presume that license plate recognition means just placing any type of camera in front of the road and the software will fix all the problems regarding lighting, settings and will correctly detect license plates. This can not be further from the truth. Without a good image there can be no license plate recognition and choosing the proper camera is vital.

In fact, for LPR applications, the best camera choice is the one designed for this kind of detection and Metrici LPR despite beeing very good can not perform miracles, yet.

Video cameras for LPR are chosen depending on the position where it will be placed and the purpose. For parking or places where the camera can be placed near the vehicle, one can use cameras with a small (short) focal range. For highways, or surveillance in places without a barrier, it is best to use cameras with a bigger (longer) focal range.

The size of the sensor determine the quality of the image. As a fact, a bigger sensor gives a better quality of the image and a better sensibility to light comparing to a camera with same lens but a smaller sensor. Also, the same lens mounted in front of a bigger sensor seems to have a shorter focal range than a similar camera with a smaller sensor.

## Chapter 2
## CAMERA RESOLUTION

Camera resolution it is based on the ability of the lens to reproduce small details and the ability of the sensor to read said details. A bar test pattern comprised of black and white lines of various density is used to measure the resolution. The density is usually measured in lines per millimeter (lines/mm). Both black and white lines are taken into account when the resolution is measured.

Contrast transfer function represents the "response" of the lens to different density in lines per millimeter.

When studying the specifications of a lens that may be used for license plate recognition, the amount of linepairs per millimeter (LP/mm) it can project onto a sensor should be accounted for.

Bigger sensor size provides higher resolution.

However, the resolving power may be affected by other factors. In particular, resolution may vary depending on different f-stop values (resolution is at its minimum when the iris is completely open). Minimum resolution value is provided in the lens specifications. As the iris is closing, the resolution becomes higher (residual optical-system aberrations are reduced). It's important to keep in mind that focusing errors may reduce resolving power as well.

These calculations have an informative purpose only. Camera producers have special products for LPR technology. They choose the lens/sensor pair as to get maximum

results in terms of detection keeping in mind the distance of detection and other parameters.

# Chapter 3
# IR ILLUMINATOR

We recommend using Metrici LPR with a IR (infrared) illuminator both day and night or a camera that has IR included and activated both day and night in combination with a special Metrici low-pass filter for the lens, which will limit only the amount of visible light. This filter is usually delivered by Metrici LPR, if it is not already installed on the lens.
We also recommend setting the camera to "night time" mode all the time.
The video camera and the IR illuminator, if it's separated, must be mounted as close together as possible. Because of the retro-reflective properties of the license plate, a beam of light sent at an angle will be reflected back on the same direction so the optical axis of the camera must be as close and parallel as possible to the optical axis of the IR illuminator.
That is why the placement of the ensemble with the optical axis perpendicular to the license plate it is not critical.

*The usual way is placing the two pieces of equipment one below the other, 1-3 meters high, 1-2 meters next to the street. There are allowed inclinations of up to +/- 20 degrees for the license plate in any direction.*



20º

20º

10º

10º
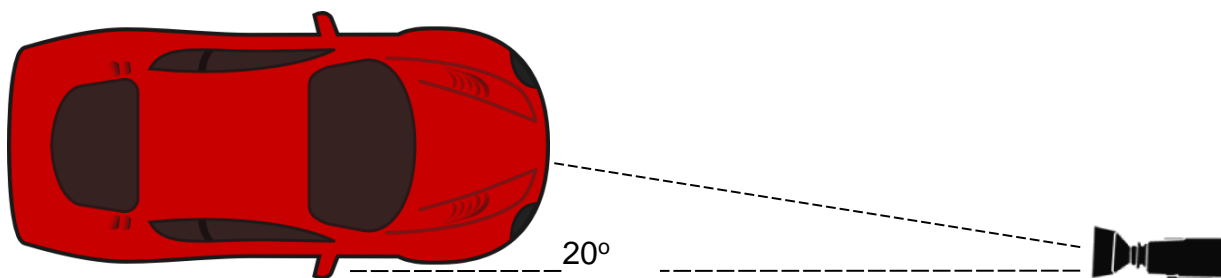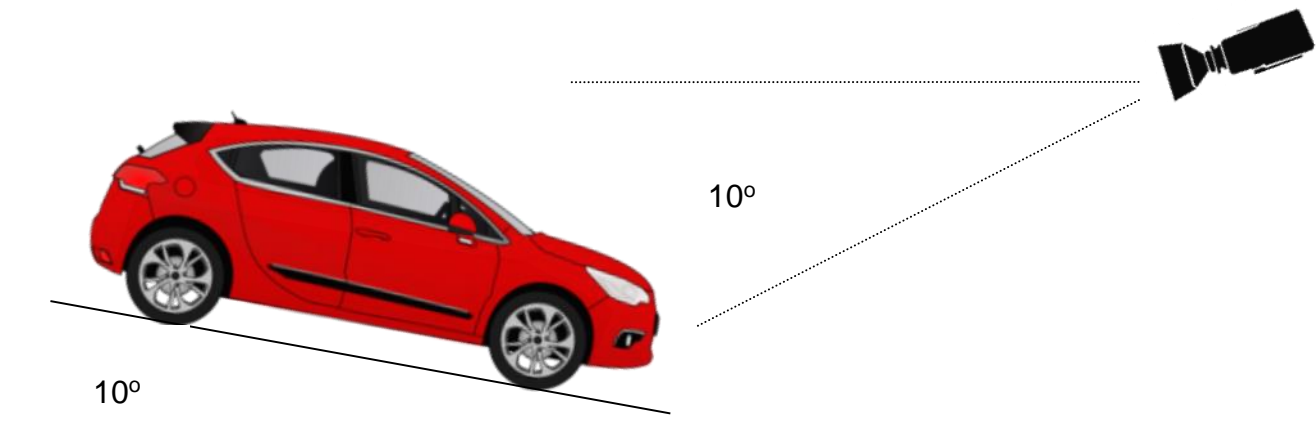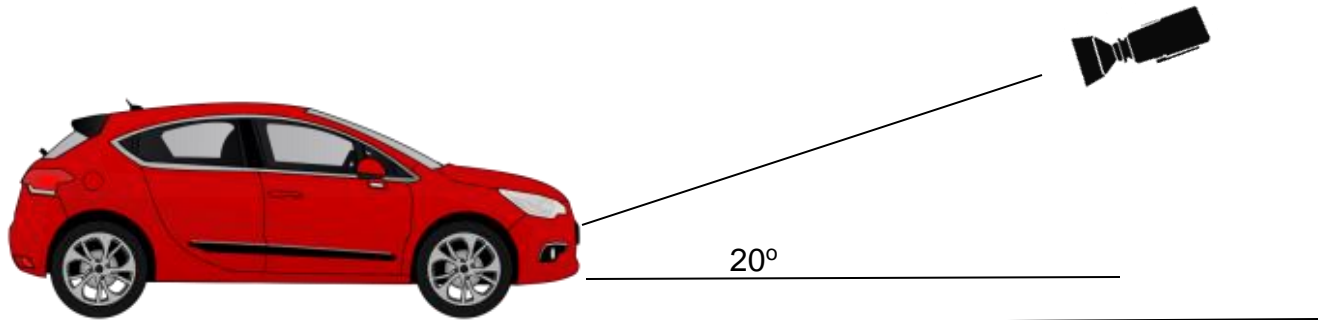
**WARNING!**

*Settings and placement of the camera must take into account the position of the Sun, shadows during the day, all year long, not just in the moment of installation. In case that there is no shadow on the detection area, one must avoid placing the camera on the East-West direction because of the effects at dawn and sunset. Also take into account the shadow that different objects, buildings can project on the detection perimeter. Some of these problems can be mitigated by use of a the special optic filter Metrici low-pass and/or with additional IR illumination, as recommended.*

# Chapter 4
# SHUTTER SPEED

When choosing the video camera and IR illuminator, one should bear in mind that in order for the detection to be accurate the width of the license plate on the frame (in the captured image) must be minimum 200 pixels.

You can use a smaller resolution camera, but with a bigger zoom, or a bigger resolution camera with a smaller zoom

**Camera lens angle of view (degrees) vs maximum distance of plate detection**

| Lens angle of view (degrees) | 7.5 | 10 | 15 | 30 |
|---|---|---|---|---|
| Maximum detection distance(m) | 30 | 25 | 20 | 10 |

**WARNING!**

> *When choosing a zoom camera, or fix focal lens, one must choose a IR illuminator with similar properties (angle of view, distance). For example, we will not choose a 15 degree angle camera and a 120 degree IR illuminator, because this would mean reduced performance for the whole package*

- The shutter speed must be correlated to the speed of vehicles and illumination conditions. You can pick a camera with a long shutter speed (1/60 or smaller) only if the cars are moving slowly, On the other hand, a short shutter speed means a small amount of light to the sensors: in such cases, the image might be underexposed, dark

- It is important for license plates to have a sharp image, regardless of the illumination conditions at this point

- A common mistake is setting the unit for day time, without taking into account the night conditions

**WARNING!**

> *A car traveling 50 km//h covers a distance of 13.88 m every second. For a camera with a shutter speed of 1/30 sec, the car moved 0.46 m in a single*

*frame This means a blurred image and the impossibility to recognize the plate*

Depending on the relative speed of the vehicle, we recommend the next settings for shutter speed:

**Shutter speed vs. vehicle speed**

| Speed | 10km/h | 30km/h | 50km/h | 90km/h | 130 km/h |
|---|---|---|---|---|---|
| Shutter speed | 1/250 | 1/500 | 1/1000 | 1/1500 | 1/2000 |

When we can't increase the shutter speed as needed, a solution is to lower car's relative speed. For this we change the detection angle comparing to the direction of movement: front view, small height, small horizontal angle.

# Chapter 5
# FRAME RATE

Besides choosing a correct shutter time, it is very important to select the best frame rate.

The faster the speed of the cars, the more important is the frame rate. Analysis application needs 2-3 good frames with the same license plate in order to have a high recognition success rate.

The hi-tech components of detection (cameras, filters, IR illuminators), as well as their location have a crucial role in the overall performance of LPR.

When working in parking mode, with trigger detection, a video-stream of 5-6 fps is enough for plate recognition.
When working in continuous mode, a frame-rate of minimum 15 fps it is recommended.

# Chapter 6
# FOCAL LENGTHS

Camera's angle of view is linked to the focal length (f:). It is necessary to remind you that a small focal length (wide lens) means a large angle of view and vice versa. A wide angle of view and a small focal length means a short distance of detection because the objects in a frame will appear smaller.

Also, the smaller the sensor, the smaller the angle of view.
The following table is showing the distance at which a normal license plate appears as about 200 pixels in a full HD image (1920x1080) on a 1/3 inch sensor camera.

.

| Distance to the licence plate (m) | Focal length of the lens (mm) |
|---|---|
| 3 | 4 |
| 4 | 5 |
| 4.5 | 6 |
| 6 | 8 |
| 8 | 10 |
| 9 | 12 |
| 11 | 14 |
| 12 | 16 |
| 14 | 18 |
| 15.5 | 20 |
| 17 | 22 |
| 18.5 | 24 |
| 20 | 26 |
| 22 | 28 |
| 23 | 30 |
| 26 | 34 |
| 29 | 38 |
| 31 | 40 |
| 34 | 44 |
| 38 | 50 |

In locations where detection will not be made at access points with barriers, it is recommended to use zoom lenses, for example 5-50 mm, as they offer more flexibility.

The distance between camera's placement and the area to monitor is determined by the

lens focal length.

## 6.1 DEPTH OF FIELD

DOF- depth of field – is defined as the distance between the nearest and most far away object that seem sharp in an image. A large DOF can be achieved by setting a small iris aperture value and using alternate means to compensate the small amount of light received by the sensor (IR illuminator). Broadly speaking, a LPR system has the need of a DOF as big as possible.

## Chapter 7
## WORKING MODE

### 7.1 Color or black&white

When choosing the type of camera, color or monochrome (black and white), one must remember that monochrome mode allows for better detection in low light. Besides, this type of cameras have a higher sensitivity to light than color ones. You might choose either one for LPR without affecting the performance of Metrici LPR.

### 7.2 Video settings

Regarding video settings, one must remember that brightness level must be as low as possible, and contrast should be high when working in normal mode, without IR illumination. As you know, Metrici LPR recommends using IR lights all the time. Thus, the settings should be as follows.

- Sharpness 10%

- Color Level 50%

- Brightness 50%

- Contrast 50%

## 7.3 Video processing. Data transmission

For the access points with barriers, where the speed is reduced, the camera can be set to work in H.264 mode that needs a smaller bandwidth for data. In such case, of a H.264 format, one will chose a "frame interval" (also known as "I Frame Interval") of 1 or a value that will not affect the quality of the image- this image must not be blurred, pixelated, with chromatic aberrations. The bigger this value, the more is affecting the image quality, especially if there is some movement in the frame

H.264 is now the most popular and efficient standard of video compression.

MJPEG video format offers better quality but needs a larger bandwidth and a greater amount of resources.

Metrici LPR can recognize any license plate that meets the minimum requirements of sharpness. When using an IP system, please choose a "videostream compression" that will deliver maximum amount of details in respect to the bandwidth.

**Framerate & bandwith**

| Scenery | Minimum framerate | MB/s |
|---|---|---|
| Parking (<20 km/h) | 5 fps | 10 |
| City Surveillance (<50 km/h) | 10 fps | 20 |
| City Surveillance (<80 km/h) | 15 fps | 30 |
| Highway (<120 km/h) | 20 fps | 40 |
| Highway (<240 km/h) | 25 fps | 45 |

**Warning!**

*Video format changes overall performance*

## Chapter 8
## CAMERA SETTINGS AND INTERDICTIONS

### 8.1 Automatic Gain Control

Any "video gain" is in fact adding digital noise and the overall result is a low quality image. That is why we recommend to uncheck the option "automatic gain control",  and to set the gain value as  low as possible. Bad lighting will be compensated with IR illuminator or additional light.

### 8.2 Digital noise reduction

As in the previous case, this option will be set to zero/deactivated. This technology is based on comparing two frames for reducing afterwards the different details between the two. The nearest pixels are compared, and the noise is reduced thus increasing the subjective quality of the image – but this leads to the loss of details and information that could be useful for LPR.

### 8.3 Auto focus: sharpness

After initial settings of the focus when installing the camera, auto focus should be deactivated.

### 8.4 Backlight compensation/correction

This function also needs to be deactivated for LPR, as is based on Auto Gain Control.

### 8.5 Wide Dynamic Range

Should also be unchecked/deactivated.

## Chapter 9
## IMAGE SETTINGS AND VIDEO STREAM
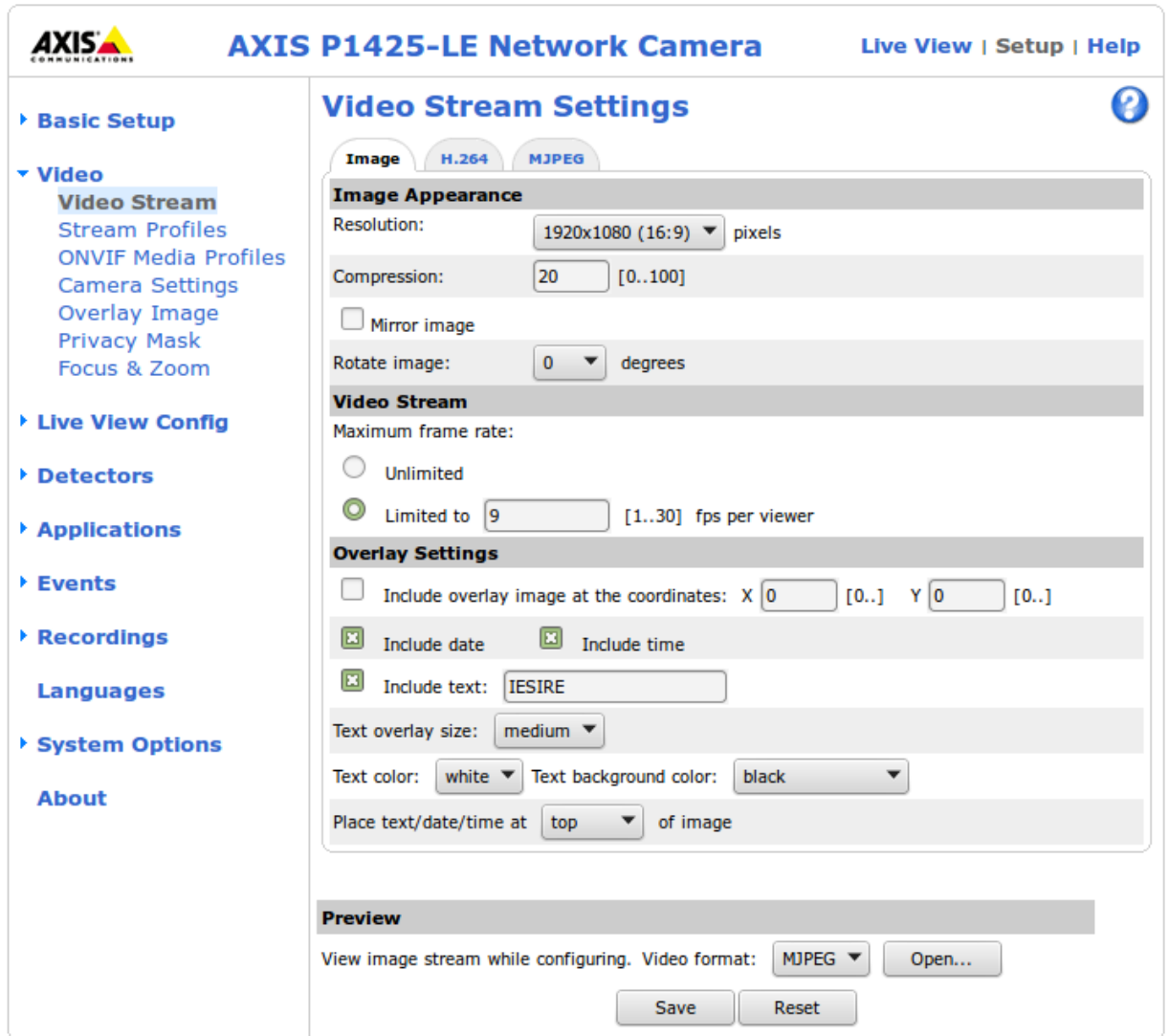
The settings in this next example although refer to an Axis camera can be used for any camera model, by any producer in order to obtain the best results from Metrici LPR.

In order for an IP camera to be used in LPR analysis, a few parameters must be modified. Enter the web interface of Axis camera, sign in, choose **Setup** menu , and

**Video Stream sub-menu** (in **Video tab**)

**NOTE**

> *Please bear in mind that the interface of other brands of cameras will be different, but should provide similar settings*



We recommend using the next settings:

* Resolution: **1920x1080**;

* Compression: between **10 ~ 30** (the smaller is this value, the better the quality, but the bigger the bandwidth);

* Maximum frame rate: **5 for parking with barriers** and no more than 10~15 for LPR on the street.

*Overlay settings refers to writing the date and time on every image

Next  **Camera Setting** tab

* Sharpness: **0 ~ 10**;
* Wide Dynamic Range / Enable Dynamic Contrast: **unchecked**;
* Exposure control: **Automatic**;

\* Max exposure time: the same as in Shutter & Gain;

\* Enable Backlight compensation: **unchecked**;

\* Shutter: **Fixed, 1/500s** for parking, 1/1000s or 1/2000s for public road;

\* Gain: **Auto**;

\* Max gain: **9 dB**;

\* Enable automatic iris adjustment: **checked**;

\* IR cut filter: **Off** –

\* Enable IR illumination: **checked**

*WARNING!*

- *Metrici LPR uses the retro-reflective properties of plates, so we recommend using IR all the time. Axis camera needs to have a new rule set for activating the IR light. Enter the Events menu, Action Rules Setup. Define a new rule as in the next example.*

# Chapter 10
# PLACEMENT. CONCLUSION

The next table contains camera installation parameters for highway surveillance designed for cameras with 1/3" sensor. These parameters provide minimal distance from camera installation place to surveillance area of specified width (3 and 6 meters). The distance between camera installationpoint (e.g. streetlight post, arch) and surveillance area as well as required focal length vary depending on vertical camera angle and height of installation.
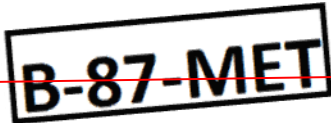
| Installation height, m | 4 | 6 | 10 | 15 | 20 |
|---|---|---|---|---|---|
| Surveillance area width, m | 3 | | | | |
| Vertical angle, degrees | 30 | 30 | 30 | 30 | 30 |
| Focal length, mm | 11 | 17 | 28 | 42 | 56 |
| Near area, m | 5 | 8,2 | 15 | 23,6 | 32 |
| Focal point, m | 7 | 10,4 | 17 | 26 | 34,6 |
| Far area, m | 10 | 13,5 | 20 | 29 | 37,4 |
| | | | | | |
| Surveillance area width, m | 6 | | | | |
| Vertical angle, degrees | 30 | 30 | 30 | 30 | 30 |
| Focal length, mm | 6 | 8 | 14 | 21 | 28 |
| Near area, m | 4 | 6,5 | 13 | 21,5 | 30 |
| Focal point, m | 7 | 10,4 | 17 | 26 | 34,6 |
| Far area, m | 17 | 19,2 | 24 | 32 | 40,4 |

The higher the camera is installed, the higher is the possibility to detect license plates, even in heavy traffic but the increased height also brings in image distorsion and the risk to exceed the 20 degrees angle.

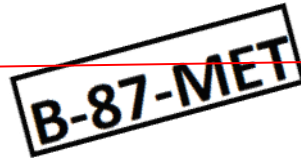- Place the camera as such as an imaginary horizontal line should cross

both the first and the last symbol on the license plate

**Corect**                                                  **Incorect**

- The license plate should be in the center of the image
- Maximum vertical angle is 20 degrees
- Maximum horizontal angle for LPR is 20 degree. In general this value should be lower than 15 – 20 degrees
- Avoid the objects that can block the view: posts, trees, barrier, fences, billboards. Keep in mind that some of these might change position.
- Contact Metrici LPR support engineers any time if you have a question about the camera settings

The settings in this guide are not mandatory, but recommendations born from countless tests performed by Metrici LPR engineers, the experience of integrators, and the everyday use of Metrici LPR clients.

Different settings might be chosen, using this manual as a general guide, depending on equipment and/or location in order to achieve the best detection results.