REMINGTON ELSAG LAW ENFORCEMENT SYSTEMS, LLC

REMINGTON-ELSAG LAW ENFORCEMENT SYSTEMS, LLC

AutoDetector3-Mobile
(MPH900X)

Technical Description

10/23/2007

Rev 1.0

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1   General Description

The objective of this document is the description of the architecture, the modules and the working principles of the product AutoDetector 3 Mobile (alias Mobile Hunter 900 X).

The document includes an introductory section that explains the principles of operations, a block diagram of the device, an explanation of the WLAN circuit and pictures of the open device.

1.1 Definitions and abbreviations

AFE	Analog Front End
ANPR	Automatic Number Plate Recognition
AD3-M	AutoDetector 3-Mobile Unit
B/W	Back and White (camera or image)
CCD	Charge Coupled Device
LED	Light Emitting Diode
GPS	Global Positioning System
GUI	Graphic User Interface
HW	Hardware
LPR	License Plate Reader
MDT	Mobile Data Terminal
MPW	Mobile Power and Wireless unit
O2CR	Outdoor Optical Character Recognition.
SOC	System on a Chip
SW	Software
WIFI	Each of the following radio network protocols: ➢ 802.11b (based on DSSS at 2.4GHz) • 802.11a (based on OFDM at 5GHz).
WLAN	Wireless Local Area Network

1.2 Principle of Operations

The AutoDetector is a mobile license plate recognition system that reads and archives vehicle license plates numbers in real time using new generation digital cameras and special video processing hardware and software.

The AutoDetector can be installed on conventional marked or unmarked police vehicles to provide continuous license plates collection during normal patrol missions. If a wanted plate's database is available, the system is able to generate real-time visual and sound alarms, alerting the officers that a wanted vehicle has been detected.

The product is a combination of hardware modules and software algorithms that implements the following main functions:

1) *Image acquisition and processing*: This module must provide digital images at a quality sufficient for the success of the image analysis algorithms. This target is achieved using an IR illuminator and a special optical setup that together decreases interference of ambient light. The special cameras are mounted on the vehicle roof or in other positions. They scan the traffic lanes adjacent to the vehicles on both left and right sides.

2) *The recognition process*: This is an optimal combination of "pattern matching" techniques at the single character level (classical OCR) and high level contextual analysis where structural and geometrical information on the license plate models are exploited.

3) *The user Interface*: This is software running on the on-board computer or Mobile Data Terminal (MDT). Every read and the relative images (color and black/white) are displayed in real time. In case of a positive match on the wanted plate database (Hot List), an alarm (siren) goes off. Details about the license plate are also shown (stolen vehicle, stolen plate, suspended licenses, …)

4) *Communication System*: The on-board unit is coordinated and managed by a central Operations Center. The central system has to update the Hot List and upload the reads at the end of the patrol mission (plate numbers, vehicle GPS location timestamp and images). The product includes hardware to facilitate the communication via a WLAN based on 802.11 G

The main requirements that must be achieved by the products are the following:

1) *High Reading accuracy*. The recognition rate must be higher than 95% of moving plates on both the same or opposite traffic directions.
2) *Reading of moving and stationary (parked) vehicles.*
3) *License plate diversity*. All the different typologies of USA, Mexico and Canada plates must be recognized, including vanity and special plates.

4) *Vehicles Typology*. The license plate can be mounted indifferently on cars, trucks, motorbikes.
5) *Independence from light condition*. The system must work day and night in any weather condition.
6) *Reduced Dimensions and power consumption*. Being an on-board device dimensions and power consumption must be kept as low as possible.
7) *Conformity to laws and required certifications*.

The AutoDetector is activated through the vehicle ignition key and is immediately operational. In the mission preparation phase, the system connects to the Ground Stations via WLAN or other wireless devices and downloads a new version of the Hot List if available. As an alternative, data can be downloaded manually through a portable memory device connected to the MDT USB port.

When the vehicle moves the AutoDetector automatically starts reading license plates without further user's actions. Whenever a read matches against an entry of the Hot List, an alarm goes off and the officer can take appropriate actions. The user confirms that the alarm is legitimate checking the license plate image shown on the MDT screen.

Every alarm is stored on the MDT on-board database. Every alarm and read records include GPS location, timestamp, alarm class, color overview image, license plate b/w image.

At the end of the patrol mission, collected data are transferred to the central Operations Center manually or automatically via WLAN.

Collected data can be optionally stored and searched for investigative or statistics purposes.

Users' Warning
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment

1.3 System Components

AutoDetector
AD3-M/2

AutoDetector
AD3-M/1

AutoDetector
AD3-M/3

AutoDetector
AD3-M/4

AUTODETECTOR CABLE
(HC3.3004.105.02)

AUTODETECTOR CABLE
(HC3.3004.105.02)

AUTODETECTOR CABLE
(HC3.3004.105.02)

AUTODETECTOR CABLE
(HC3.3004.105.02)

to PC

LAN CABLE
(HC3.3004.105.03)

POWER SUPPLY CABLE
(HC3.3004.105.01)

FUSE
5 A

FUSE
15 A

blue — +12 V Battery
brown — +12 V Key
yellow/green — GND

Device
AD3-MPW

WIRELESS LAN
ANTENNA
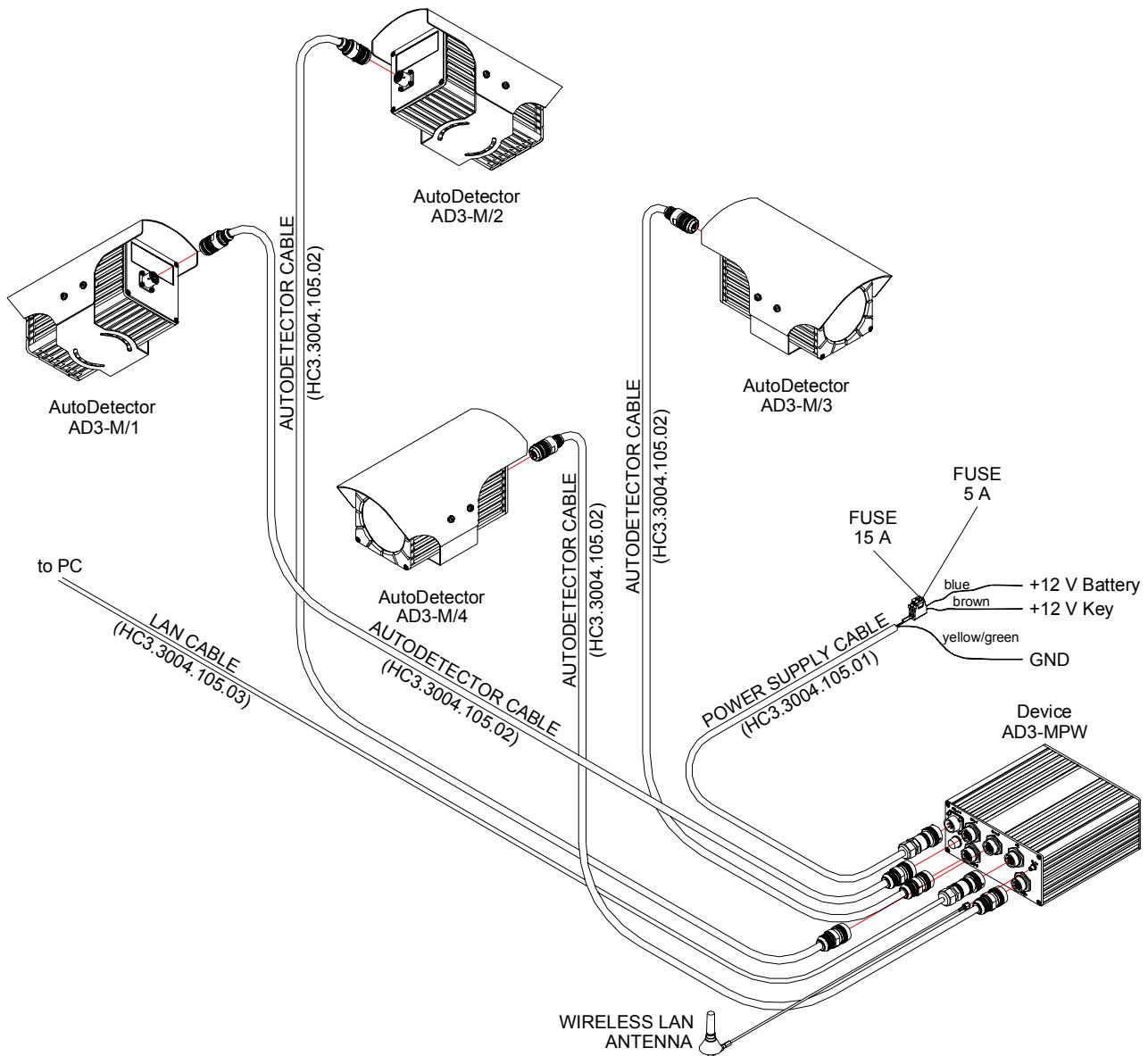
Figure 1: The main components of the AutoDetector and their connections are shown.

The system is composed by the following items:
- o AutoDetector AD3-M: This is a smart IP camera able to acquire and process images
- o The AutoDetector AD-MPW device. This is a power supply and a WLAN device.
- o Cables
- o WLAN Antenna (not included)
- o MDT (not included, not shown in Figure 1)

1.3.1 AD-MPW

The device is usually placed in the vehicle trunk or in the glove box. It must be connected to each AD3-M sensor (up to 4), to the MDT and to the vehicle battery and ignition signal.

Figure 2: The MPW device.

The AD3-MPW includes:
- o A 5 ports Ethernet switch
- o IR Strobo power supply and control
- o WLAN device

The enclosure is IP54.

1.3.2 Smart Sensor AD3-M

Figure 3: The AD3-M smart sensor

The smart sensor is a special device specifically designed to read plates in an outdoor environment.

The retro-reflectivity of license plates, together with the high sensitivity of CCD cameras suggested the employment of pulsed LED illuminators, to exploit the reflection of IR light to achieve good contrast between characters and the reflective background.

Different wavelength LED can be used, ranging from 740 nm to 880 nm (invisible IR).

The sensor is made up of the following components:

- o B/W progressive camera, used to read plates
- o Overview Color camera, whose purpose is to provide the vehicle image.
- o Processing unit composed by 3 processors: FPGA for image acquisition and pre-processing, a DSP running the OCR and a microprocessor for high level post-processing and communication management.
- o IR illuminator LED equipped with a special proprietary optics that is able to focus the emitted power in the target area.
- o Temperature sensors and heaters allows the system to control the internal environment and prevent overheat damages.

The Smart Sensors can be provided with different optics setups according to different application requirements.

2   Block Diagram

In the following details of the AD3-MPW device shall be described. We focus on this device because it includes the WLAN subsystem, which requires to be certified since it is an intentional radiator.

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In the following Table each section is referred to the respective electrical scheme, available in file **eb141_8611_01_02.pdf.**

Section	Drawing Name	Drawing Number	Description
SWITCH ETH	SWITCH SECTION	1/11, 2/11	This is an Ethernet Switch. It includes an Ethernet connection to the WLAN section.
PHY ETH	PHY ETX	3/11	This is an additional Fast Ethernet interface
	LED	4/11	LED section to signal the device status
Baseband SoC WLAN	WLAN Section	5/11, 6/11	WLAN "system on a chip"
SDRAM and Flash	Flash & RAM Section	7/11	Support memory for the WLAN section
uC	uC Section	8/11	MicroController
AFE RF	RF Section	9/11	Analog Front End of the radio section
Power Section	Power Section	10/11	

The power Strobo boards electrical schemes are in **3b141_8630_01_03.pdf**
The purpose of this section is to provide pulsed current to the LPR camera IR illuminators.

3   Label Sample and Location

This is a provisional label, pending FCC certification. The label shall be modified as soon as the FCC certification shall be achieved.
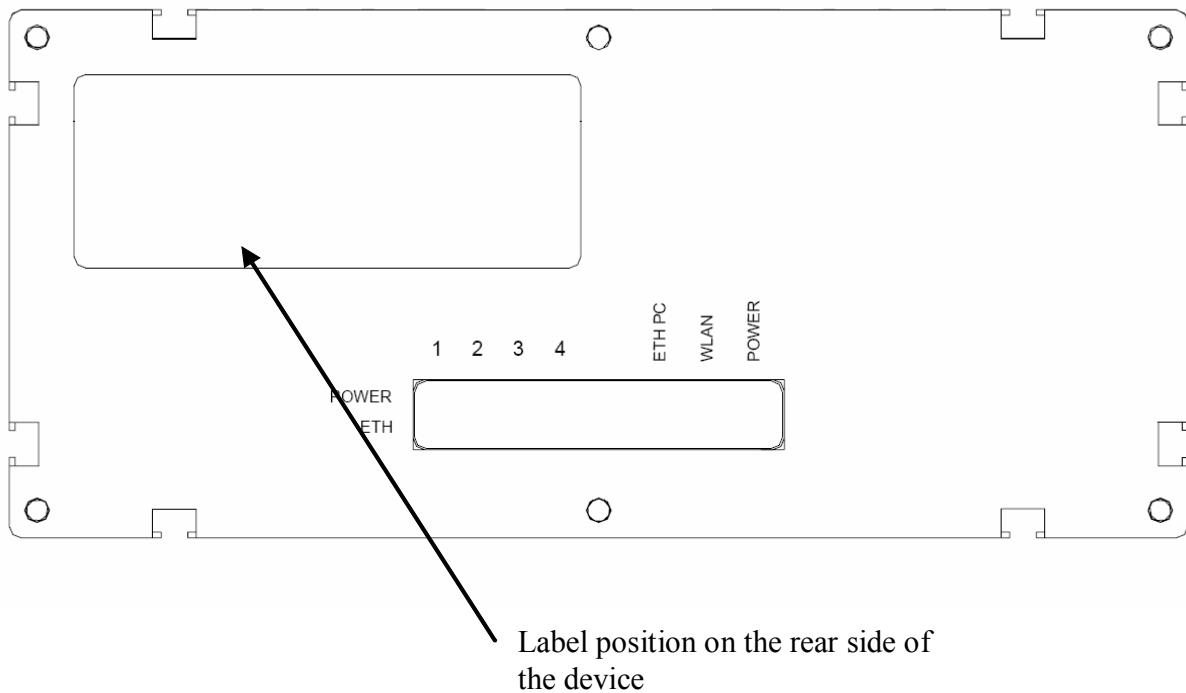
Figure 5: Position of the label.
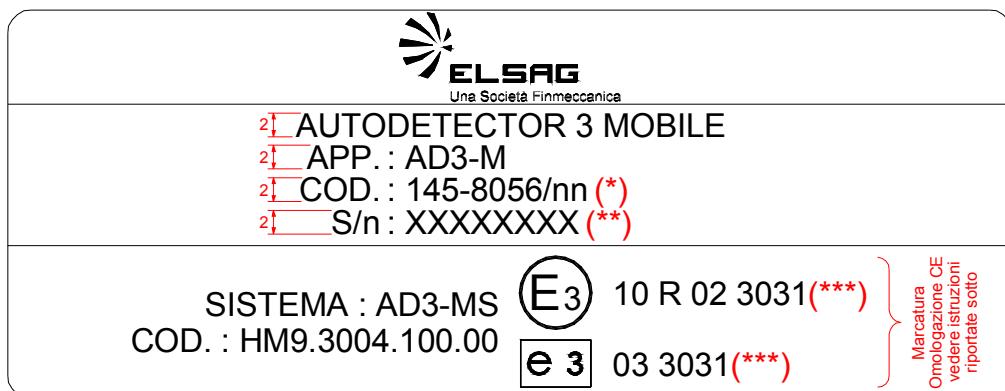
Figure 6: Design of the provisional label.

The label components are the following:

- Elsag s.p.a. logo (the manufacturer)
- The official name of the product **AD3-MPW** **A**UTODETECTOR 3 MOBILE
- The manufactured part list code number: HM9.3004.100.00
- Part number 145-8064/01.01.
- Serial number:J07NNNNNN:, where,
    J is the production facility code
    07 is the production year
    NNNNNN e' il numero sequenziale di produzione.
- CE mark according to "Council Directive 93/68/EEC"
- Automotive marks "E" and "e".
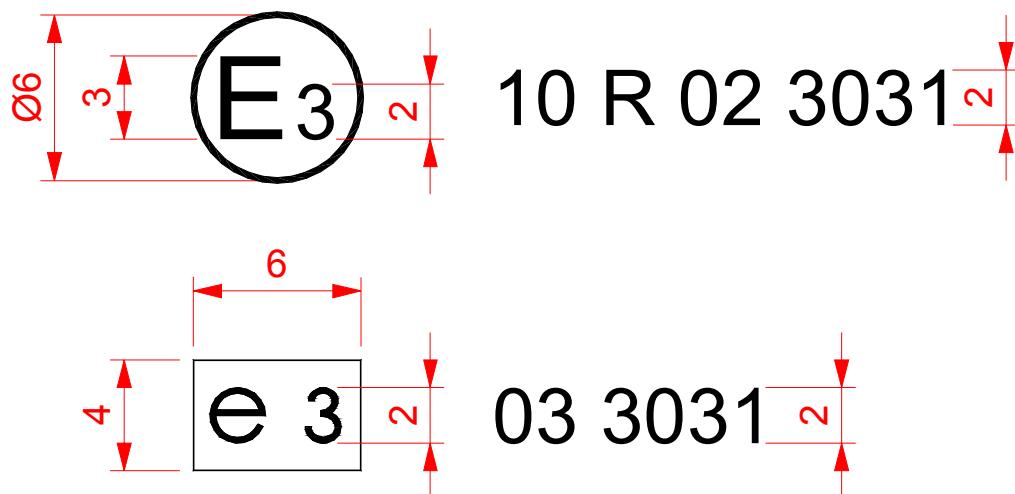
Figure 7: Detailed format of the "E" and "e" marks together with certification numbers.

4.4 Antennas

The product is distributed without an enclosed antenna because its selection depends on specific installation constraints. A 2 dB omnidirectional antenna is advisable. The use of directional antennas may affect the output radiated power and, therefore, the regulation compliance.

As an example one of the suggested antennas is specified in Figure 8.

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TEL-CAB
Telecommunications and cables

M 8

TÜV SUD
ISO 9001

Type n° T-AT306
MAGNETIC WIRELESS LAN / UMTS

SPECIFICATIONS

Material:	Nylon 6
Colour:	Black
Net weight (g):	65
Dimensions (mm)	
Lenght :	88
Diameter:	29
Temperature (°C):	-30° - +80°

TECHNICAL DATA :

Antenna type:	1/4 l Mobile Antenna
Frequency range	
W-LAN:	2400 ÷ 2485 MHz
UMTS:	1920 ÷ 2170 MHz
Impedance (Ohms):	50
Max power (W):	10
V.S.W.R.	less than 2.0
Polarization:	Vertical
Emission:	Omnidirectional
Gain (dBi):	2.14
Rod section:	2
Cable lenght:	RG 174 mm.2500
Connector:	SMA M.
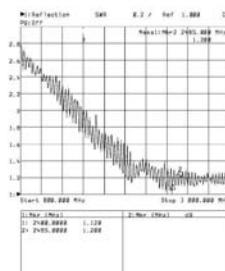
Figure 8: Example of compatible antenna.

5   Photographs

Figure 9: AD3-MWP device top view.

Figure 10: AD3-MWP: Connector side.

Figure 11: AD3-MWP: Lateral view.