IAI ELTA Systems Ltd.
Group & Subsidiary of ISRAEL AEROSPACE INDUSTRIES LTD.

Unclassified

HUMAN DETECTION SYSTEM

EL/M - 2107

(HDS)

USER MANUAL

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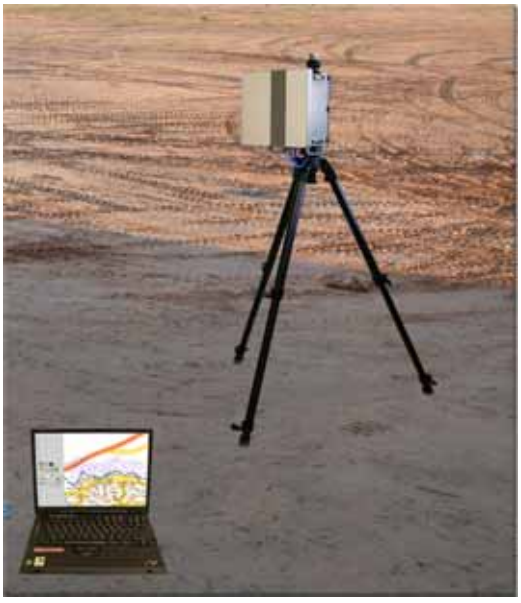
1. SCOPE

This document presents the Human Detection System (HDS) developed and manufactured by ELTA, a subsidiary of Israel Aircraft Industry Ltd. Given are a general radar overview, technical specification and matters related to supply support provisions and quality assurance.

The purpose of this document is to assist a potential user in the assessments of the radar proposed, operational constrains, human and technical resources at his disposal etc. Also, it is in both; Manufacturer and potential user best interest, that the latter establish an approach based on the information enclosed and his requirements as regards the prospect of operating the HDS.



1.1. System Goal

The HDS goal is to detect and automatically alert entering and outgoing moving persons and vehicles within defined preset boundaries. As it is a very complicated process, customer should have an operational watch-keeping concept, in which the HDS will be one element in the integrated Sensors, Monitors, Command Communication and Control system.

1.2. Applicable Documents

The following documents of the issue in effect 1999 form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification or the detailed design which is an Intellectual Proprietary (IP) of ELTA, the contents of this specification and IP design shall be considered a superseding requirement.

a. ISO-9001
b. MIL-HDBK 217F
c. MIL-STD-810C
d. MIL-STD-1472D
e. RS-232
f. RS-422

2. SYSTEM OVERVIEW

- The system is based on ELTA's vast experience in high-resolution technology and innovative radars.
- The system automatically detects moving objects and persons within the covered area.
- It allows segregation of persons maneuvering in permitted zones and those who try to intrude unauthorized areas.
- The system allows continuous monitoring and detection in all weather conditions.
- Programmable automatic alerts according the areas status. (Restricted zones according to time frames, buffer zones, etc')
- **Applications**

  - ***Installations' Security***

    Securing the inside and the outside boundaries such as: power plants, factories, army bases, air and sea- ports, jails, embassies and other governmental facilities etc'

  - ***Traffic Control***

    Tracks authorized and non permitted personnel and vehicles within selected areas

  - ***Border protecting***

    Enhancing the border guard capability by monitoring and detecting maneuvers away from the border line/fence, thus helping to prevent any intrusion even before the arrival of the potential trespasser to the border line/fence.

- **Singular and Neted Configurations**

  The system provides a very accurate and reliable tactical situation of selected areas together with exceptionally low fault alarms rate and a very low operator's workload all year long in all weather condition.

  HDS can be built up gradually by simply adding unites to the network of the system.

- **Features**

  - Automatic detection of moving targets
  - High range accuracy and resolution.
  - Visual and audio alarms for each detection or when objects are detected in restricted zone.
  - PC NT based control unit with friendly HMI.
  - Simple and easy to operate, very low workload on operator.
  - Display background area on actual digital map/picture.
  - Lightweight and low power consumption.
  - Simple networking of several main units to one PC.
  - Capability to operate via remote control from a distant command post.
  - Interoperability with additional sensors and security systems.
  - Easy installation and concealment and Modular assembly
  - High reliability, low maintenance, no calibration needed.
  - Growth potential

HDS - DESCRIPTION AND TECHNICAL SPECIFICATIONS

3.1. Radar Overview

The HDS is a sensor that detects moving human being, vehicles and other objects that might move in the physical and electronic boundaries as defined in this specification. The radar is comprised of a transceiver LRU connected to an antennae array module that were design to be mounted on top of a mast, buildings or any other static component of infrastructure providing undisturbed line of sight in the sector of interest. The installation asset, which is an external item, may be chosen by

the users to conform to their needs. The HDS detects and classifies moving objects in real time within a defined false alarm rate (Detection and false alarm rate are shown in paragraph 2.3). The location and track of these targets may be then automatically processed, monitored and displayed as an alert in real time to attract the operators' attention to a immediate and real hazard. The radar has a modular hardware and software structure and is noted by its high reliability and fully digital solid-state design.

An IBM PC compatible with a color display, enabling the automatic detection operation, may perform the control and display functions of the HDS.

As an option, the radar can send the detection to a central computer via RS-422 or RS-232.

A Low Light TV camera or other visual sensors may be controlled for automatic locking and tracking upon alert of detection. The slaving of the visual sensor is done via the IBM PC compatible and RS-422 line.

3.2. HDS Specifications

Following are the HDS specifications:

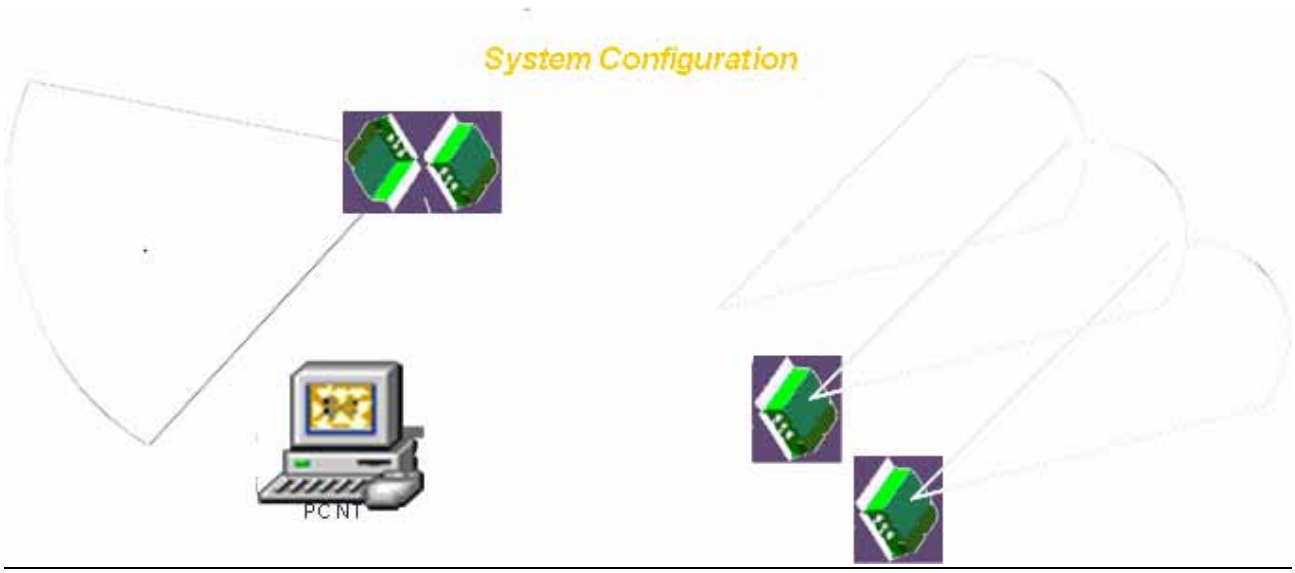
a.	Working method:	high resolution Doppler radar
b.	Frequency:	C band
c.	Max range Detection:	300m for persons
d.	Min range Detection:	15m
e.	Detection Speed >=	0.1 m/sec
f.	Target separation: Azimuth	10º
	Range >	7m
g.	Range accuracy:	±1m
h.	Azimuth accuracy:	±3º
i.	Beam with: Horizontal	80º
	Vertical	15º
j.	Power:	24v
k.	Power consumption:	20w
l.	Communication:	via RS- 422
m.	MEU weight:	3.5kg

3.3. Probability of Detection

The HDS was tested in various terrain, roads and vegetation environment as: gravel, sand, asphalt, agriculture terrain and natural vegetation. The results, based on statistical basis are 90% detection rate for regular moving targets ($0.5m^2$).

3.4. Human Detection System - HDS

The HDS is based on an Ultra Wide Bandwidth (UWB) waveform and processing logic, enabling high resolution imaging of moving objects, in the area of interest. Advanced state-of-the-art digital processing and software algorithms are used to perform real time detection of moving objects, measurements, analysis and recognition at a low false alarm level - thus enabling reliable, automatically alerted, real time watch keeping operation. The HDS consists of an Antenna array, a Transceiver and connecting cables. It also may include in an integrated configuration a visualization system to support identification and recognition.



Transceiver

The transceiver is a self-contained unit incorporating a number of components in a ruggedized case 15x23x9 cm in size and 2 Kg weight. The transceiver is full solid state and digital, it includes smart waveform generator, for the HDS transmitter and receiver, signal and data processing/control and the power supply.

c. Transceiver

3.4.1. Antenna Array

The Antenna array is comprised of up to two (2) antenna array modules. The system works with a single transceiver one transmitting antenna module and two receiving antennas module. The antenna modules are separated, covered by radome.

Antenna Array (Application demonstrated for example only)

3.4.2. Connecting Cables

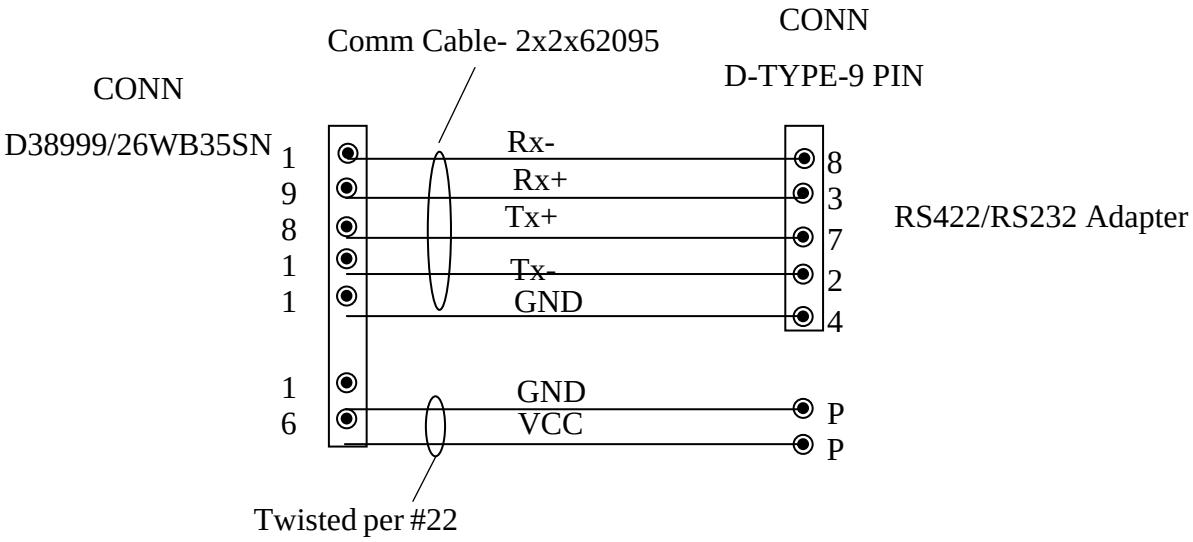
The HDS also includes all the (HDS internal) connecting cables between the HDS components: - between the Antenna Array, the Transceiver module and the External customer's PC display station (cables will be applied in accordance with customers' requirements).

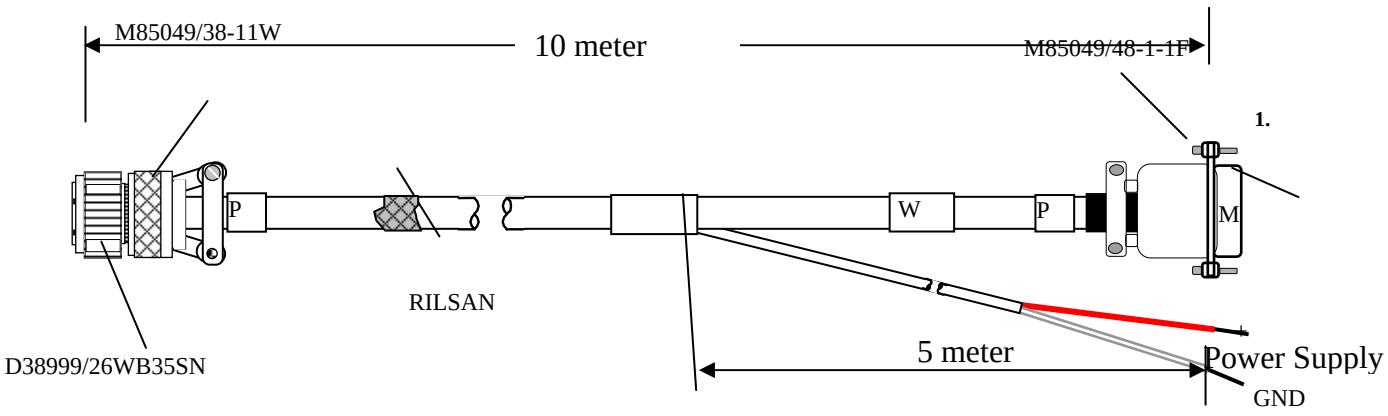
3.4.2.1. ELM-2107 Power and communication Connector for version 1021E500-001

This connector is numbered J1 Type: D38999/26WB35SN

PIN No'	FUNCTION
1	24VRTN
2	(spare)
3	(spare)
4	(spare)
5	(spare)
6	+24VDC
7	(spare)
8	Tx+
9	Rx+
10	(spare)
11	GND
12	Tx-
13	Rx-

3.4.2.2. Connection and Power Cable W12 1013D712-001





3.4.3. Electro Optical Tracking (optional)

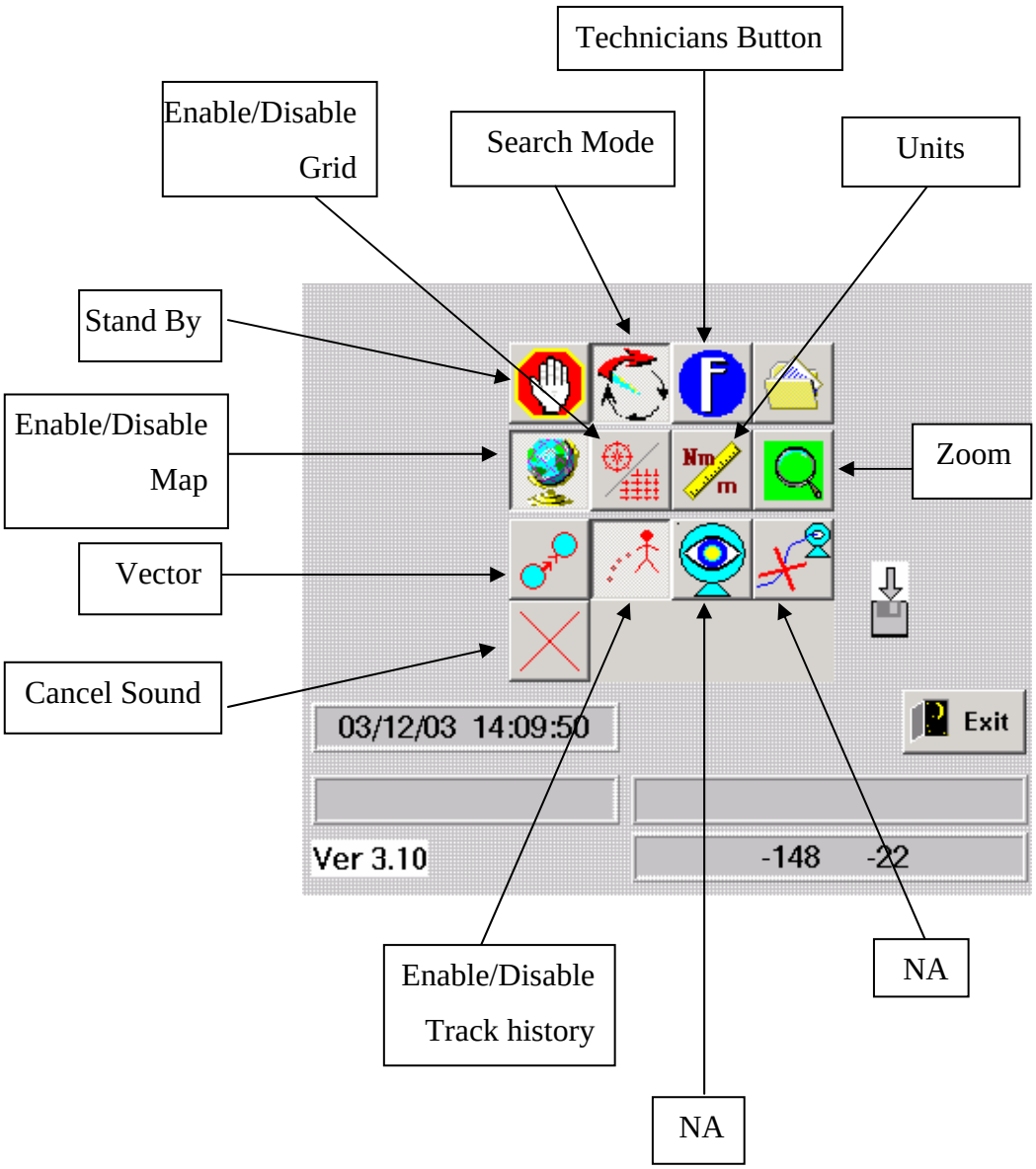
The detected Targets will be automatically displayed, an audio alert will be activated and the camera will lock and track the detected object. The HDS provides for a command from the HDS through an RS-422 communication link to a controller that will operate the Electro Optical camera and tracker.

3.5. System Operation

The HDS operating control consol is based on an IBM PC (or compatible) with a color display, which controls all the HDS functions. The Operating Control Software is written under Window NT in C++. The PC controls the HDS via RS-232 or RS-422. The control is done throughout windows on the screen, using a mouse that features the following buttons and displays:

a. Standby-initiates communication between HDS components and the PC and go to CW mode and processing the signals,.
b. Search Mode- initiates the command for scanning, detecting and data processing.

3.5.1. Control Buttons



3.6. Environmental Conditions

The HDS maintains its specified performance when exposed to the environmental conditions as detailed herein:

a. **Operating temperature**- -15°C to +55°C
b. **Storage**- -40°C to +85°C
c. **Humidity**- Up to 95% relative humidity
d. **Salt atmosphere**- Exposure to salt sea atmosphere (48 hours,5% NaCL)
e. **Wind**- During operation - 50 Knots
f. **Sand and dust**- Expositor to sand and dust particles as encountered in operational areas (11grams/M3, wind 50 knots)
g. **Solar radiation**- Exposure to solar radiation(105 W/ft2)
h. **Vibration**- Sinusoidal vibration in accordance with MIL-STD-810C, method 514.2, proc.VIII.
i. **Mechanical shock**-Shock characteristics: half Sine wave 30 G, 11 msec.

3.7. EL/M-2107 Operation Procedure

3.7.1. At start up standby command will send to the Radar

3.7.2. Waiting for legal Ack from the radar, If there isn't Ack or the Ack was illegal then send again the command until three times, if the command was fail then going to recovery procedure.

3.7.3. Waiting for Radar Wakeup command

3.7.4. After gets wakeup command, send Operate command, operate command is dividing to three commands:

3.7.4.1. Send params command

3.7.4.2. Status command

3.7.4.3. Search command

After each send command the control unit should wait for Ack from the radar and behave like paragraph 3.7.2

3.7.5. In search state if there isn’t plots from the radar, then go to recovery state,

3.7.6. Every communication fail or radar fail will be written to

LOG file with the fail Time.

4. INSTALLATION INSTRUCTIONS FOR ELM – 2107 SYSTEM

4.1. Software installation

1. Insert the installation CD.
2. Select the RUN option from the START menu.
3. Click on Browse..
4. Select file: install.bat
5. Click on Open.
6. The install file will create a directory named HDS and copy some files to it.
7. Create new shortcut named HDS from c:\hds\Programs\HDS.exe

4.2. Hardware installation

General: The ELM 2107 is fixes device and placed on the roof or a pole

1. Connect the radar to the holder (see attached pictures); use 4 NF… screws (provided with the radar).
   Make sure that the connectors are facing down and the elevation slot on the holder is facing up.
2. Install the holder with the radar on a pole (2.5 – 3.5m above ground level), the elevation should be 0 to –3 deg relative to the ground, make sure that there are no blocking objects in front of the radar (like: fences, poles, walls, trees…)
3. Connect P1 connector to J1 on the radar panel.
4. Connect the other side of the cable to COM1 of the PC (RS232 9pin Dtype connector of the RS422/RS232 converter).
5. Connect the white wire (+24volts) to the positive output of the power supply, the black wire to the negative output of the P.S.
6. The recommended power supply is 24 VDC / 1AMP min. (the min. voltage is 20VDC and the max. voltage is 30VDC).
   WARNING!! To avoid damage to the RS232 converter Always Make sure that the RS232 converter is connected to the PC and the PC is turned on, before turning on the power supply.
7. Turn on the PC, make sure that the HDS icon is on screen.

8. Turn on the power supply.
9. Activate the HDS program, make sure that there is a green light on upper left of the screen. (Red light indicates no communication) .
10. The Radar is now ready for detection.
11. Detections will be marked in **red** dots, the blue dots are under the program threshold.

5. NOTES AND WARNING

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

WARNING:

Changes or modifications to this equipment not expressly approved by the party responsible for compliance (ELTA Ltd.) could void the user's authority to operate the equipment.

WARNING:

"To comply with FCC RF exposure requirements, the antenna used for this transmitter must be installed to provide a separation distance of at least 2 meters from all persons."