RADAR TECHNOLOGY LABORATORY

Mod. M702/EV

INTRODUCTION

This RADAR LABORATORY is designed to study radar technologies and systems used in maritime navigation.
All devices are of professional type.

It consists of a main Trainer unit and of various accessory units:

- **Radar Trainer mod. M702/EV** based on a modern and complete digital radar system, modified for the teaching of operation and installation of a radar system.
  Troubleshooting and servicing are also included.
  This is the basic configuration of the program.
  This Trainer consists of a large silk-screen printed panel, including:
  - Block diagrams, wiring diagram and test points
  - Components and circuits completely visible on the fore panel
  - Fault simulator
  - Radar indicator Unit

  It is also provided with an outdoor unit, complete with support, that includes:
  - Slot Antenna and dummy load
  - Transmission and receiving circuits
- **µP Fault Simulator mod. M702-F/EV** for microprocessor-controlled fault control, via a keyboard and with a digital display
- **Interactive Software mod. SW-M702/EV** for carrying out Lessons, Exercises and Troubleshooting with a PC
- **Electronic Compass mod. M702-C/EV** that supplies information on navigation direction and North
- **GPS Receiver mod. M702-G/EV** that applies information on geographic position
- **Radar Image Simulator mod. M702-T/EV** that replaces the outdoor unit and supplies actual stored informations

	Radar Lab - Available versions			
	Basic	**with µP Faults**	**with Software**	**Full**
Radar Trainer mod. M702/EV	✔	✔	✔	✔
µP Fault Simulator mod. M702-F/EV		✔	✔	✔
Interactive SW mod. SW-M702/EV			✔	✔
Electronic Compass mod. M702-C/EV	✓	✓	✓	✔
Radar Image Simul. mod. M702-T/EV	✓	✓	✓	✔
GPS Receiver mod. M702-G/EV	✓	✓	✓	✔

✔ *Indispensable* | ✓ *Optional unit*

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RADAR TRAINER mod. M702/EV

TRAINING PROGRAM

- Introduction to radar techniques
  - Incident and reflected wave
  - Echo effect: it generates an echo that can move radially and angularly on the screen
  - Pulse duration/repetition frequency ratio
  - Power/range ratio
  - Continuous-wave (CW) radar
  - Radar equation
- Proper interpretation of radar diagram with reference to physical phenomena and to technological limits
- Block description and circuit analysis of radar
- PRF (Pulse Repetition Frequency) generator and transmitter trigger
- Gate signal generator
- Solid state modulator
- Magnetron transmitter
- Control of antenna rotation
- Circulator and limiter for input protection
- Solid-state preamplifier and mixer
- Logarithmic receiver
- Echo signal processing
- Echo signal acquisition
- Interference rejection
- Correlation and first integration
- Video circuits:
  - Horizontal and vertical deflection
  - Video signal and memory
  - On-screen display (OSD) for navigation and for setting data
- Radar image generator
- "Switch mode" power supply
- Instructions of use
- Measurements on radar different parts
- Troubleshooting

TECHNICAL SPECIFICATION

Silk-screen printed panel:

- Compact panel
- 28 test points at the most significant points of the circuits
- Cards mounted near the related electric diagram
- Dimensions: 650x800 mm

Indicator:

- Type: 15" of diagonal, high resolution, RGB color LCD TFT
- Pull-Down and Pull-Up menus

Example of display on the indicator

Active elements:
- Rings
- Target
- Mini-Arpa
- Cursor
- Bar graphs...

- Mini Arpa functions:
  - with automatic tracking up to 12 targets with manual initialization
  - inquire object for target data acquisition
- Representation: PPI raster scanning with image shown continuously and updated
- Video:
  - resolution of 1024x768 pixels
  - Dot pitch 0.297
  - 16-level quantization
  - backlight: CCFL twin lamps, 50000 P.O.H. replaceable
- Image stop: it "freezes" the image to study it
- Echo stretch: it points out the slightly perceptible echoes
- Computing speed:
  - speed calculation (kT)
  - course calculation (°)
- Guard zones:
  - Sectorial GZ: 3 maximum available selectable guard zones
  - Polygonal GZ: 6 maximum available guard zones selectable by maximum 6 points
  - When an echo appears within the area limits, a visual and acoustic alarm is enabled
- Plot:
  - it leaves the tracks of all echoes, for the representation of the last positions
  - selectable: 15s, 30s, 1m, 3m, 6m
- Off-center representation: 55% of the ray in all directions and ranges
- Ranges:
  - 1/16, 1/8, 1/4, 1/2, 3/4, 3/2, 3, 6, 12, 24, 48 N.M.
  - 96, 48, 24, 12, 6, 3, 1.5, 1, 0.5, 0.25 km
- Fixed markers:
  - 6: ¾ to 48 N.M. range
  - 2: 1/16 to 1/2 N.M. range
- Distance between fixed markers: 1/32, 1/16, 1/8, 1/4, 1/2, 1, 2, 4, 8 N.M.
- Mobile markers: 2 with value display
- Electronic cursors: 2 with value display
- Electronic pointer: 1 with value display
- Reference line: 1
- Controls:
  - GAIN
  - FTC (Fast Time Constant)
  - STC (Sensitivity Time Control)
  - Electronic tuning of Local Oscillator: manual or automatic
  - Pulse duration: short or long
  - Interference Rejection
  - Echo Stretch
  - Navigation modes: Head-UP, North-UP or Course-UP
  - EBL (Electronic Bearing Line)
  - VRM (Variable Range Marker)
  - HL (Head Line)
- Indication of ship data:
  - Latitude
  - Longitude
  - Speed
  - Actual course
- Illumination of two-color background:
  - Blue for the day (2 settings)
  - Black for the night (2 settings)
  - Object color for any display object

- Joystick for EBL and VRM positioning, changing of menu functions, cursor positioning, off-centering, etc…
- NMEA-0183 interface for electronic compass
- NMEA-0183 interface for SATNAV/GPS/Loran C

Fault simulator:

- Included in the silk-screen printed panel
- Key-locked compartment
- 15 pre-set faults
- Possibility of inserting 15 faults simultaneously

Outdoor unit:

- Stand for antenna inserted in the Trainer unit
- Slot antenna (for outdoor use):
  - Type: slotted waveguide 4 ft with radome
  - Biasing: horizontal
  - Radiation amplitude (-3 dB): horizontal 1.8°, vertical 25°
  - Speed of rotation: 22 r.p.m. ± 2 r.p.m.
  - Gain: 27 dB
- Transmitter-Receiver:
  - Peak power: 4 kW
  - Frequency: 9410 MHz ± 30 MHz
  - Modulator: solid state
  - Receiver: logarithmic
  - Pulse amplitude: 0.08 µs (1/16-1/8-1/4-1/2-3/4-3/2 nautical miles), 0.3 µs (3/4-3/2-3-6-12 nautical miles), 0.6 µs (3-6-12 nautical miles), 1.2 µs (12-24-48 nautical miles)
- Dummy load (for indoor use)
- 15 m multicore cable for connecting the antenna with the main unit
- 25mm diam. mast **(not included)** for outdoor use

Power supply: 230 Vac 50 Hz single-phase - 140 VA
(Other voltage and frequency under request)
Dimensions: 760 x 910 x 410 mm (without outdoor unit)
Total weight: 70 kg

SUPPLIED WITH

STUDENT HANDBOOK
THEORETICAL-EXPERIMENTAL MANUAL. PRACTICAL EXERCISES: MEASUREMENT, PARAMETERS VARIATION

TEACHER HANDBOOK
DESCRIPTION OF THE FAULT SIMULATOR

µP FAULT SIMULATOR (optional) mod. M702-F/EV

This external and optional unit replaces the original Fault Simulator available in Radar Trainer mod. M702/EV.
It supplies a microprocessor-controlled fault control in Radar Trainer mod. M702/EV via a keyboard.
This accessory must be supplied together with Radar Trainer mod. M702/EV and it cannot be sold separately.

µP Fault simulator mod. M702-F/EV

TECHNICAL SPECIFICATION

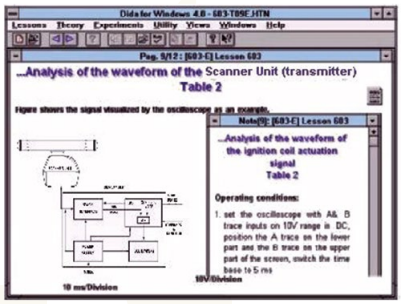
- 4-key keypad
- Digital Display of 16x2 characters
- Simultaneous insertion of several faults
- Signalling of unsuccessful troubleshooting attempts
- Storage of:
  - Attempts carried out by students during troubleshooting
  - Time spent by students for troubleshooting
- USB port available on Radar Trainer mod. M702/EV for controlling the fault simulator unit via PC with the optional software mod. SW-M702/EV

INTERACTIVE SOFTWARE (optional) mod. SW-M702/EV

This software must be installed in a PC for Students' use.

TECHNICAL SPECIFICATION

- It is used to carry out Lessons, Exercises, Troubleshooting with a PC connected with Radar Trainer mod. M702/EV via a USB port
- It manages the µP Fault Simulator mod. M702-F/EV unit directly during Troubleshooting
- **The software can only be used in conjunction with the microprocessor-controlled fault simulator mod. M702-F/EV.**



Interactive software - mod. SW-M702/EV

ELECTRONIC COMPASS (optional) mod. M702-C/EV

This modern compass based on Solid-State sensor (remote unit) supplies information about the boat's course even in difficult sea conditions continuously.

TECHNICAL SPECIFICATION

- Measures:
  - Prow: 0° to 359°
  - Accuracy: 1° (static), 2° (dynamic)
  - Display resolution: 0.1°
- Display: 4", colour
- Data interface: RS422 compatibility
- Cables included: power supply and data
- Interface: NMEA0183
- Power supply: from Radar Trainer
- Sensors:
  - 3-axis magnetic compass
  - 3-axis accelerometer
  - 3-axis rate gyro
- Fixture system: tripod

Remote unit mod. M702-C/EV

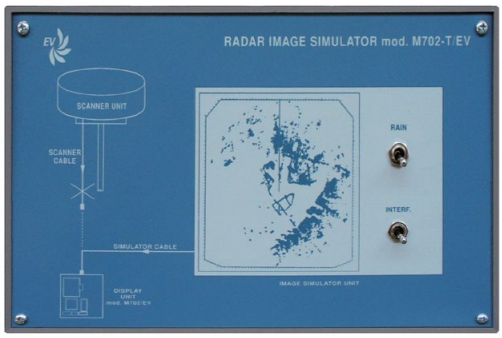
Display unit mod. M702-C/EV

RADAR IMAGE SIMULATOR (optional) mod. M702-T/EV

This modern and compact unit is connected with Radar Trainer Display Unit mod. M702/EV instead of the Scanner unit (outdoor unit) which includes the slot antenna, the transmitter and the receiver, to provide a radar actual image, stored and continuously repeated.

TECHNICAL SPECIFICATION

- Compact unit
- Output radar image with:
  - 4 moving targets
  - coastal line
  - weather disturbance
  - other radar disturbance
- Continuous repetition of the image
- Cable included: for the interconnection with Trainer Radar mod. M702/EV
- Power supply: from Trainer Radar mod. M702/EV



Radar image simulator - mod. M702-T/EV

GPS RECEIVER (optional) mod. M702-G/EV

This modern system for professional use can receive and process GPS (Global Position System) data and supply them to Radar Trainer M702/EV. It consists of an indoor unit that can be perfectly and easily assembled to Radar Trainer mod. M702/EV, and of an outdoor antenna provided with tripod.
The wide and high-resolution, Touch-Screen LCD display included in the indoor unit, allows the planning of the system and the display of the received information. It can display the data of 12 satellites simultaneously.
Functions of track planning, distance, speed and alarm are available.

TECHNICAL SPECIFICATION

General characteristics:

- Accuracy:
  - position: 25m CEP (Circular Error Probability)
  - speed: 0.1 m/s
  - time: ±1 µs
- Maximum speed: 515 m/s (about 1000 kn)
- Data interface compatibility: RS232 e RS422
- Cables included: power supply, antenna (10m) and data

Indoor unit:

- LCD display: backlit, STN type, dimensions 120x90 mm
- Channels: 12
- Refresh speed: 0.1 s
- Power supply: from Radar Trainer mod. M702/EV

Outdoor Unit:

- Polarization: circular clock-wise
- Frequency: 1575.42 MHz
- Antenna Gain: 3.5 dBi
- Power supply Gain Low Noise: 30 dB
- Impedance: 50 Ω
- Azimuth coverage: omnidirectional

Outdoor unit - mod. M702-G/EV

Internal unit - mod. M702-G/EV

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