Radar Processor/Display (add-on to the Basic Radar Training System)

8112498 (8097-20)

LabVolt Series

Datasheet

* The product images shown in this document are for illustration purposes; actual products may vary. Please refer to the Specifications section of each product/item for all details. Festo Didactic reserves the right to change product images and specifications at any time without notice.

Festo Didactic
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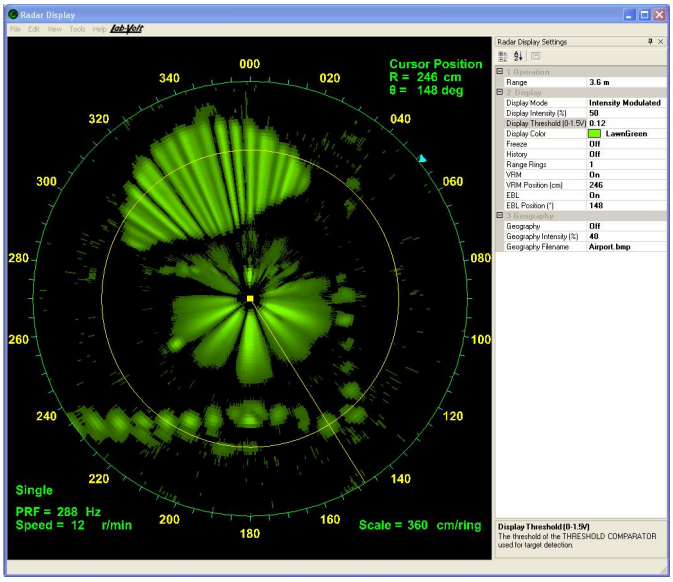
General Description

The Radar Processor/Display is used in conjunction with the Basic Radar Training System to form a complete and modern pulse radar system. The Radar Processor/Display adds the following elements to the Basic Radar Training System: radar echo signal processing functions, PPI display functions, on-screen block diagrams of the complete radar and radar processor/display subsystem, and computer-based (i.e., on-screen) instruments (oscilloscope and data monitoring system). Two major types of radar echo signal processing function are available: Moving Target Indication (MTI) and Moving Target Detection (MTD). The Radar Processor/Display also provides computer-controlled generation of clutter and interference to allow study of the MTI processing function. The following types of clutter and interference can be generated: sea clutter, rain clutter, second-trace echo, noise, and pulse interference.

The Radar Processor/Display consists of a reconfigurable training module (RTM), a power supply for the RTM, three interface modules, a set of accessories including the Radar Training System Software, two comprehensive student manuals, and a user guide. A Windows® based host computer (to be purchased separately) is required with the RTM. The Festo Radar Host Computer is recommended.



Example of a PPI display obtained with the Radar Processor/Display.

The RTM is the cornerstone of the Radar Processor/Display. This module, which uses state-of-the-art digital signal processor (DSP) technology, can be programmed to act as either an analog pulse radar (i.e., a pulse radar with MTI processing) or a digital pulse radar (i.e., a pulse radar using MTD, correlation and interpolation, and surveillance processing). Interface modules that students install in the RTM allow connection of the various signals coming from the Basic Radar Training System, as shown in Figure 1. The RTM can also be programmed to act as a tracking radar when used with the Radar Tracking Training System, Model 8096-3.

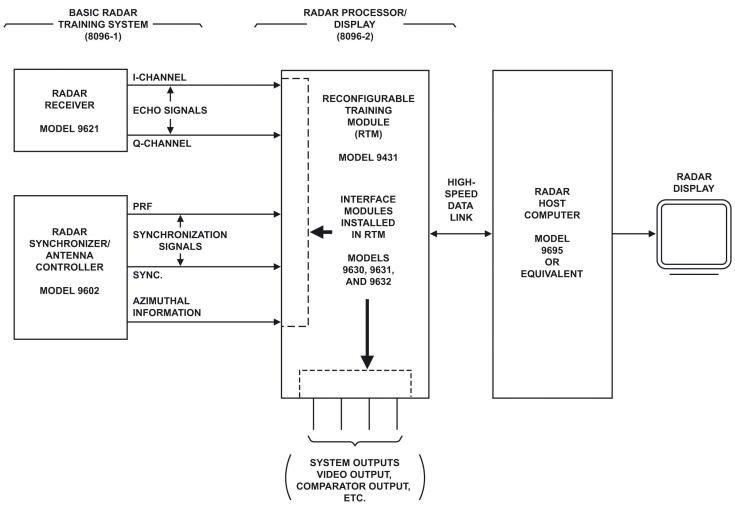


Figure 1. Simplified connection diagram of the Basic Radar Training System and Radar Processor/Display.

The RTM processes the signals from the Basic Radar Training System to detect targets, and sends data to the radar host computer via a high-speed data link (Ethernet link with TCP/IP protocol). The RTM can also generate clutter and interference which are added to the I- and Q-channel echo signals from the radar receiver, before signal processing takes place. The radar host computer, which runs the LVRTS software, uses the data produced by the RTM to display the detected targets on a PPI display. The LVRTS software is a Windows®-based application used to download programs into the DSP memory of the RTM, to select the type of radar which is implemented (see Figure 2). It also has an intuitive user interface to:

- Select the radar processing functions and adjust other parameters of the radar, such as the video gain, detection threshold, etc. (see Figure 3)
- Control the radar display functions such as the PPI display mode selection, Variable Range Marker (VRM), Electronic Bearing Line (EBL), etc. (see Figure 4)
- Display diagrams that show how to connect the equipment (see Figure 5).
- Display the functional block diagrams of the complete radar and radar processor/display subsystem (see Figure 6).
- Connect virtual probes to test points in the aforementioned block diagrams to observe real signals using the built-in oscilloscope (see Figure 7).
- Use the Data Monitor to observe and analyze the signal processing sequence involved in Moving Target Detection (see Figure 8).
- Insert faults in the system (password-protected feature) for troubleshooting purposes (see Figure 9).
- Set the parameters that control the generation of clutter and interference (see Figure 10).
- Obtain on-line help screens (see Figure 11).

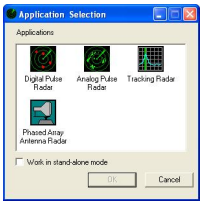


Figure 2. On-screen selection of the type of radar which is implemented.

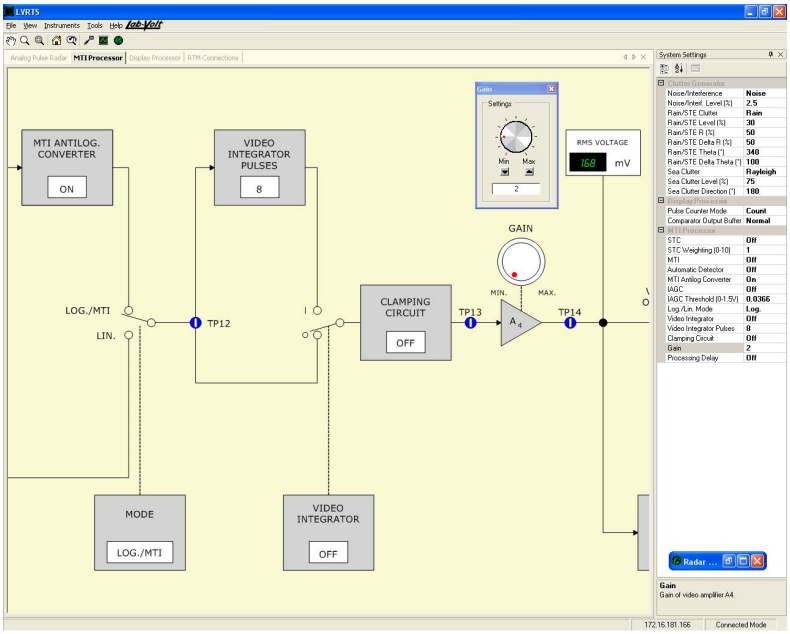


Figure 3. Computer-based control of the radar processing functions and operating parameters.

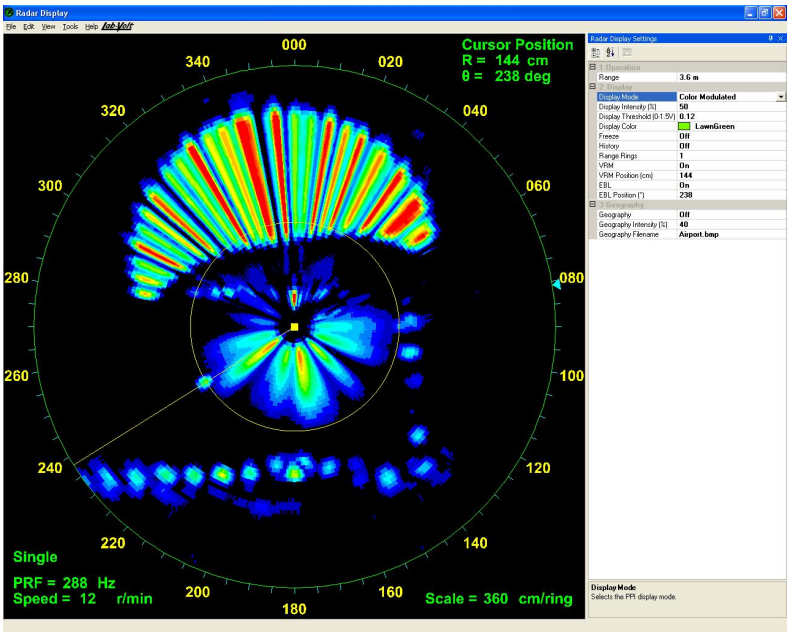


Figure 4. Computer-based control of the radar display functions.

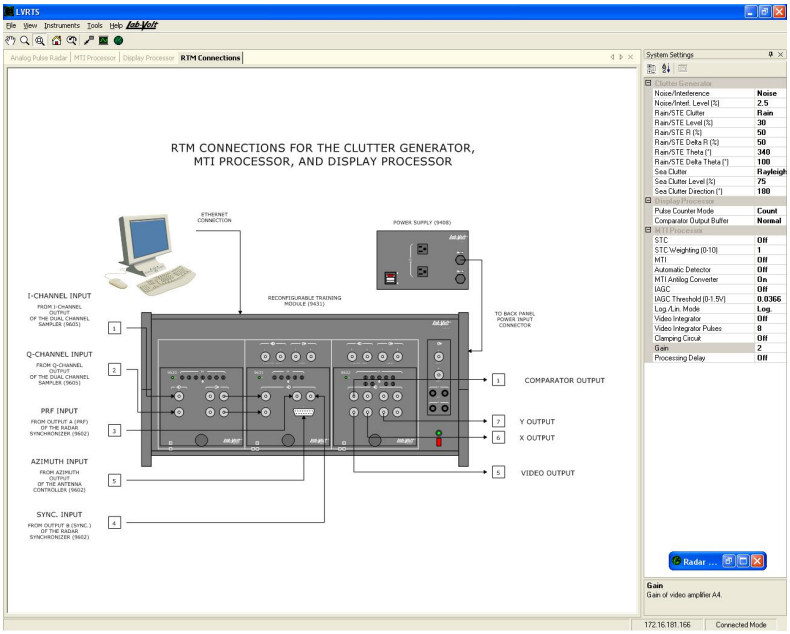


Figure 5. Window showing the interconnections to the RTM.

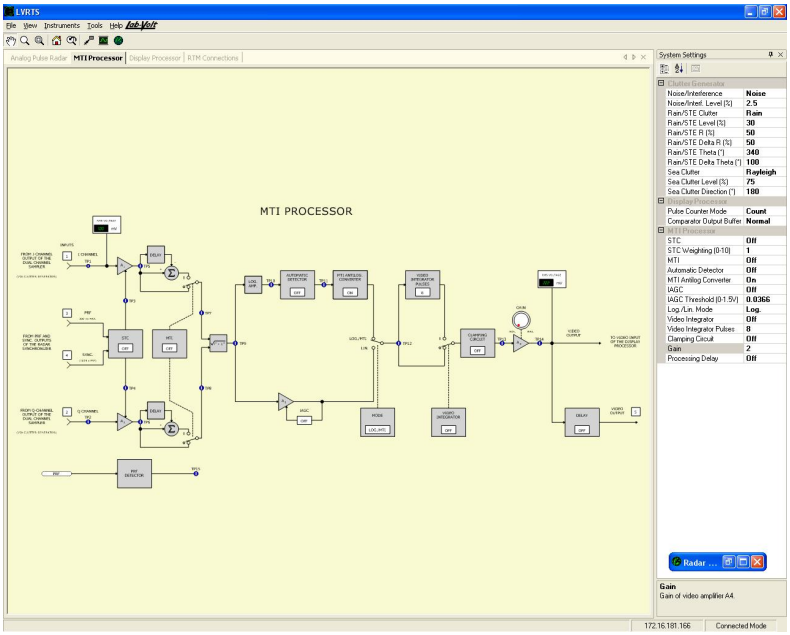


Figure 6. On-screen block diagram of the Moving Target Indicator (MTI) processor.

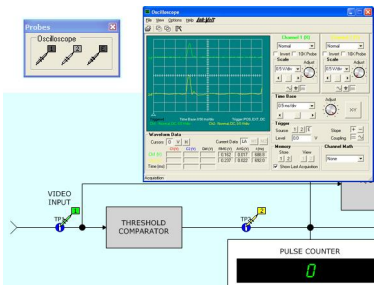


Figure 7. Real signals can be observed on the built-in oscilloscope by connecting virtual probes to test points in the on-screen block diagrams.

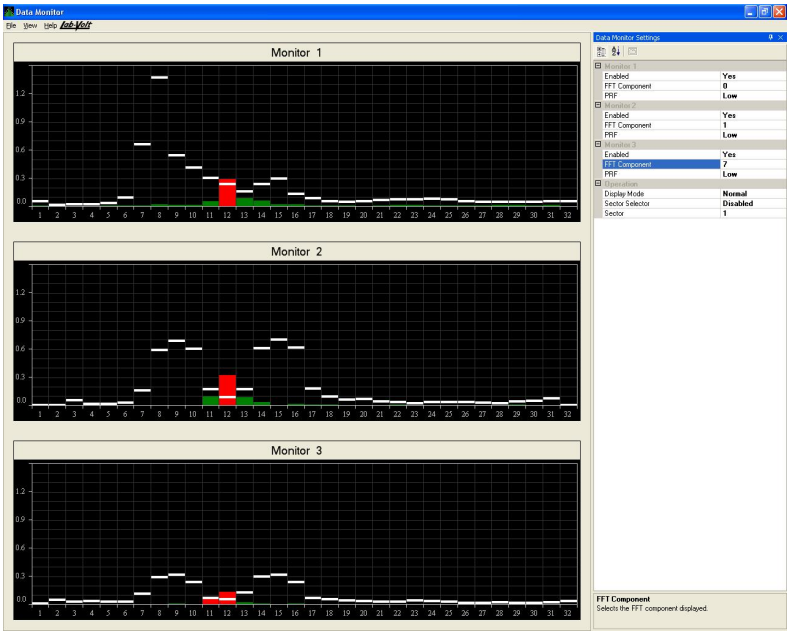


Figure 8. The Data Monitor is a powerful tool designed to study the various stages (FFT Doppler filtering, thresholding, alarm generation) of Moving Target Detection (MTD).

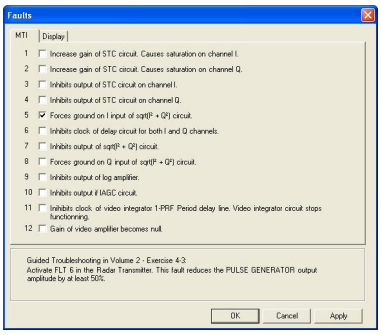


Figure 9. Faults window in the LVRTS software.

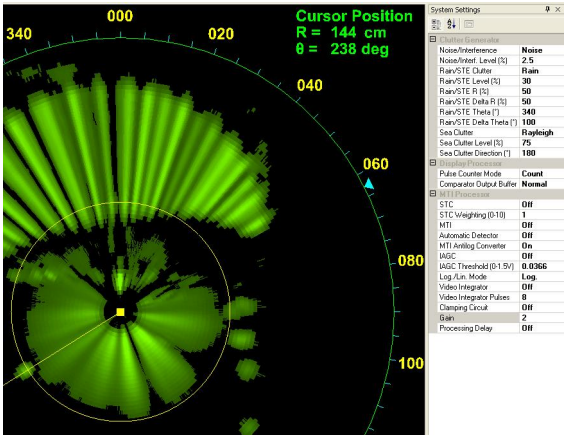


Figure 10. Computer-based control of clutter and interference generation.

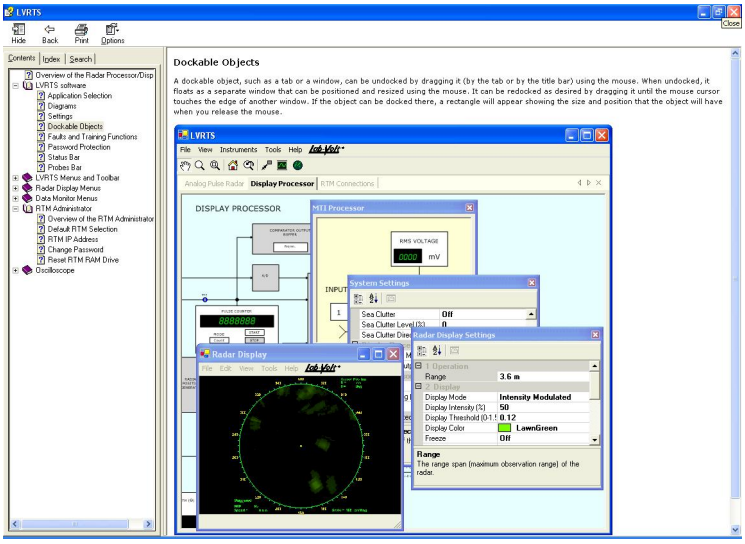


Figure 11. On-line help screens are available through a few clicks of the mouse button.

List of Equipment

Qty	Description	Model number
1	Analog MTI Processing (Student Manual)	580412 (38543-00)
1	Radar Processor/Display (User Guide)	580414 (38543-E0)
1	Digital MTD Processing (Student Manual)	580418 (38544-00)
1	RTM Power Supply	8112514 (9408-2X)
1	Reconfigurable Training Module (RTM)	8094635 (9431-30)
1	Analog/Digital Signal Combiner	8112776 (9630-10)
1	Data Acquisition Interface	8112777 (9631-10)
1	Radar Analog/Digital Output Interface	8093433 (9635-00)
1	Accessories for the Radar Processor/Display	8112516 (9688-A0)

List of Manuals

Description	Manual number
Analog MTI Processing (Workbook)	580412 (38543-00)
Radar Processor/Display (User Guide)	580414 (38543-E0)
Digital MTD Processing (Workbook)	580418 (38544-00)
Radar Training System (User Guide)	8112390

Table of Contents of the Manual(s)

Analog MTI Processing (Workbook) (580412 (38543-00))

- 3-3 Sensitivity Time Control
- 3-4 Instantaneous Automatic Gain Control
- 3-5 The Log-FTC Receiver
- 3-6 Constant False-Alarm Rate
- 4-1 Troubleshooting the MTI Processor
- 4-2 Troubleshooting the Display Processor
- 4-3 Troubleshooting an MTI Radar System

Digital MTD Processing (Workbook) (580418 (38544-00))

- 1-1 Familiarization with the Digital Pulse Radar
- 1-2 The PPI Display
- 2-1 Cell Mapping
- 2-2 Fast Fourier Transform (FFT) Processing
- 2-3 Constant False-Alarm Rate (CFAR)
- 3-1 Correlation and Interpolation (CI) Processing
- 3-2 Surveillance (Track-While-Scan) Processing
- 4-1 Troubleshooting the Digital MTD/PPI Processor

Additional Equipment Required to Perform the Exercises (Purchased separately)

Qty	Description	Model number
1	Function Generator 5 MHz / Frequency Counter	8125246 (9409-00)
1	Radar Host Computer	587465 (9695-00) [1]

System Specifications

Parameter	Value
MTI Processor (Analog)	
Functions	Functions Sensitivity Time Control (STC), moving target cancellation, logarithmic amplification, Fast Time Constant (FTC), Constant False-Alarm Rate (CFAR), Instantaneous Automatic Gain Control (IAGC), antilog conversion, 4- and 8-pulse video integration (non-coherent)
I- and Q-Channel Input Voltage Range	-1.5 to +1.5 V
Video Output Voltage Range	-10 to +10 V
On-Screen Test Points	15
Faults	12
Display Processor (Analog)	
PPI Outputs X and Y, Voltage Range	-8 to +8 V
PPI Output Z	TTL
Azimuth Input	TTL
On-Screen Test Points	8
Faults	4
MTD Processor (Digital)	
Functions	Moving Target Detection (MTD), Correlation and Interpolation, Surveillance
Coherent Processing Intervals (CPI)	2, 4/3 ratio, synchronized in azimuth
Target Tracking Capability	up to 8 targets simultaneously
I- and Q-Channel Input Voltage Range	-1.5 to +1.5 V
PPI Outputs X and Y, Voltage Range	-8 to +8 V
PPI Output Z	TTL
Azimuth Input	TTL
On-Screen Test Points	15
Faults	13
PPI Display (Digital)	
Number of Sectors	60
Sector Width	6°

[1] Comes with the software pre-installed. Can be replaced by a PC running Windows with a Ethernet port and 2 screens.

Parameter	Value
Number of Range Segments	16, 32, and 64 on 1.8-m (5.9-ft), 3.6-m (11.8-ft), and 7.2-m (23.6-ft) ranges, respectively
Range Segment Length	11.25 cm (4.4 in)
Number of Cells	960, 1920, and 3840 on 1.8-m (5.9-ft), 3.6-m (11.8-ft), and 7.2-m (23.6-ft) range, respectively

Equipment Description

RTM Power Supply 8112514 (9408-2X)

The RTM Power Supply is the power source for the Reconfigurable Training Module (RTM) used in the radar training systems. It has a multi-pin connector output, located on the back panel, that provide regulated dc voltages. Hiccup mode protection protects the outputs of the RTM Power Supply against short-circuits.

Front View

Rear View

Specifications

Parameter	Value
Power Requirements	
Service Installation	Standard single-phase ac outlet
Voltage	100-240 V ac
Current	2.5 A
Frequency	50/60 Hz
Rating of DC Power Outputs	
+5 V	2 A
+3.3 V	2.5 A
+12 V - A	1.25 A
+12 V - B	1.25 A
-12 V	0.85 A
-5 V	1 A
Physical Characteristics	
Dimensions (H x W x D)	165 x 250 x 250 mm (6.5 x 9.8 x 9.8 in)
Net Weight	5.6 kg (12.2 lb)

Reconfigurable Training Module (RTM) 8094635 (9431-30)

The Reconfigurable Training Module (RTM) consists mainly of a powerful digital signal processor (DSP), with three slots on the module front panel for installing interface modules. An Ethernet port (RJ-45) connector, located on the back panel, allows connection of the RTM to the host computer. The functionality of the training system is determined by downloading a program into the DSP memory using the host computer that runs the software. Electrical power is supplied to the RTM by the Power Supply, Model 9408, through a multipin cable that connects to the back panel.

Specifications

Parameter	Value
Interface Card Slots	
Analog/Digital	2
Digital	1
Data Link	
Data Link to Host Computer	10 Mb/s (Ethernet) or 100 Mb/s (Fast Ethernet), TCP/IP Protocol
Physical Characteristics	
Dimensions (H x W x D)	215 x 430 x 280 mm (8.5 x 16.9 x 11.0 in)
Net Weight	9.8 kg (21.6 lb)

Analog/Digital Signal Combiner 8112776 (9630-10)

The Analog/Digital Signal Combiner is a compact module designed to be installed into one of the slots on the RTM of the Radar Processor/Display. This module converts the clutter and interference generated by the DSP of the RTM to analog format, and adds it to the I- and Q-channel echo signals coming from the Radar Receiver.

The Analog/Digital Signal Combiner has two BNC-connector inputs to receive the I- and Q-channel echo signals. It also has four BNC-connector outputs. Two outputs provide the clutter and interference signals added to the I- and Q-channel echo signals. The other two outputs provide the I- and Q-channel, perturbed echo signals. All these inputs and outputs are protected from misconnections within the system. Test points are available on the module's front panel to observe all these signals using a conventional oscilloscope.

DC power is automatically supplied to the Analog/Digital Signal Combiner when it is installed into the RTM.

Specifications

Parameter	Value
Analog Inputs (2)	
Voltage Range	-10 to +10 V
Impedance	10 kΩ
Analog Outputs 3 and 4	
Voltage Range	-1 to +1 V
Impedance	600 Ω
Analog Outputs 5 and 6	
Voltage Range	-11 to +11 V
Impedance	600 Ω
Tests Points	
Test Points	6
Physical Characteristics	
Dimensions (H x W x D)	114 x 110 x 209 mm (4.5 x 4.3 x 8.2 in)
Net Weight	0.6 kg (1.4 lb)

Data Acquisition Interface 8112777 (9631-10)

The Data Acquisition Interface is a compact module designed to be installed into one of the slots on the RTM of the Radar Processor/Display. This module receives the I- and Q-channel echo signals of the radar, perturbed or not, and converts them to digital format. It also receives the PRF and synchronization signals as well as azimuth information from the Radar Synchronizer / Antenna Controller. All these signals are then routed to the RTM for digital signal processing.

The Data Acquisition Interface has two BNC-connector analog inputs to receive the I- and Q-channel echo signals. It also has two BNC-connector digital inputs where the PRF and synchronization signals are injected. A DB15 connector is provided as a digital input for the azimuth information. All these inputs are protected from misconnections within the system. Test points are available on the module's front panel to observe the input signals using a conventional oscilloscope.

DC power is automatically supplied to the Data Acquisition Interface when it is installed into the RTM.

Specifications

Parameter	Value
Analog Inputs (2)	
Voltage Range	-1.5 to +1.5 V
Impedance	10 kΩ
Digital Inputs (2)	
Parallel Digital Input	TTL, 10 bits
Test Points	4
Physical Characteristics	
Dimensions (H x W x D)	114 x 110 x 209 mm (4.5 x 4.3 x 8.2 in)
Net Weight	0.6 kg (1.4 lb)

Radar Analog/Digital Output Interface 8093433 (9635-00)

The Analog/Digital Output Interface is a compact module designed to be installed into one of the slots on the RTM of the Radar Processor/Display. This module provides analog and digital output signals generated by the RTM. The nature of the signals generated depends on the type of radar processing that the RTM performs.

The Analog/Digital Output Interface has four BNC-connector analog outputs and four BNC-connector digital outputs. All these outputs are protected from misconnections within the system. Test points are available on the module's front panel to observe the output signals using a conventional oscilloscope.

DC power is automatically supplied to the Analog/Digital Output Interface when it is installed into the RTM.

Specifications

Parameter	Value
Analog Outputs (4)	
Voltage Range	-10 to +10 V
Impedance	600 Ω
Digital Outputs (4)	TTL
Test Points	8
Physical Characteristics	
Dimensions (H x W x D)	114 x 110 x 209 mm (4.5 x 4.3 x 8.2 in)
Net Weight	0.6 kg (1.4 lb)

Accessories for the Radar Processor/Display 8112516 (9688-A0)

The Accessories for the Radar Processor/Display contains a DB15 cable, a USB port cable, an RJ-45 connector crossover cable, an Ethernet adapter (network card) to be installed in the radar host computer, two semi-circular targets, a multiple target holder to be used with the Target Positioning System and the LVRTS software CD-ROM.

Optional Equipment Description

Function Generator 5 MHz / Frequency Counter (Optional) 8125246 (9409-00)

Direct digital synthesized arbitrary function generator with an embedded frequency counter, perfect to complement telecommunication or radar training systems.

Radar Host Computer (Optional) 587465 (9695-00)

The Radar Host Computer is a Windows® based computer with the LVRTS software installed, two monitors, and a dual-output display adapter (video card) compatible with Microsoft DirectX® version 9 or later.

The Radar Host Computer is used to run the LVRTS software and is linked to the RTM of the Radar Processor/Display through a high-speed data link (Ethernet link with TCP/IP protocol). It provides the radar's PPI display and allows control of the radar processing and display functions, and much more as described in the General Description of the Radar Processor/Display.

The Radar Host Computer is not included in the Radar Processor/Display. It must be purchased separately or replaced with an equivalent personal computer. The Windows® 7 or later operating system is required to run the LVRTS software.

Reflecting the commitment of Festo Didactic to high quality standards in product, design, development, production, installation, and service, our manufacturing and distribution facility has received the ISO 9001 certification.

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