FACET[®] Electronics Training System 91000-00



LabVolt Series

Datasheet



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General Description

The FACET[®] Electronics Training Systems is a unique combination of hardware and software that provides a complete learning solution. It is a modular training system that encompasses four areas of study:

- Basic Principles of Electricity and Electronics
- Digital and Microprocessor Electronics
- Industrial Electronics
- Communications

The hardware components of the FACET[®] training systems are completely safe and designed for durability. Circuits can be faulted to teach real-world troubleshooting. Students perform experiments on a wide range of electronics and electricity training modules that combine theory and application with practical skill-training techniques. Boards connect with a base unit that distributes power and controls the circuits of the different learning modules.

The courses can be provided by traditional student manual or eSeries courseware. The eSeries is an interactive multimedia courseware that enhances learning speed and retention by featuring circuit design, analysis, and troubleshooting. The instructor guide and supportive pre- and post-tests provide instructors and students with an extensive overview and working knowledge.

A complete training work station consists of the following:

- 1) Base unit
- 2) Boards
- 3) Courseware
- 4) Instruments
- 5) Options

Each component requires to make a selection between the different possible configurations. The configurations are described in the following table.

Selection 1	Selection 2	Selection 3	Selection 4
Type of Base Unit (Different voltage and language variants)	Which topics? (Different language variants)	Which type of course delivery?	Instrumentation package
Manually operated		Paper format (Student Manuals and Instructor Guides)	Traditional instruments: DMM Scope Signal generator
Computer interface	30 boards covering 30 different topics	CBT: eSeries content 1. Mind-Sight LCMS • Local network appliance • Hosted version 2. Stand-alone disk 3. SCORM	Virtual instruments: Interface and software

FACET is suitable for a multitude of training purposes in educational, industrial, and military training laboratories. Estimated TOTAL program duration: 400 hours.

1) Base Units

The FACET base units provide protection and voltage conditioning circuitry to run each FACET board. Specific features of all FACET base units include:

- Distributed ±15 V dc and variable ±0-10 V dc power to the various circuit training modules. Coarse and fine controls are provided to adjust the variable ±0-10 V dc supplies.
- Self-protection against short-circuit, reverse voltage, overvoltage, and overcurrent conditions.
- Long-life ZIF connector, with a rotary knob that locks the training module into the base unit. The ZIF connector itself is protected from damage by built-in stops.
- The fingers on the connectors are gold-plated for added durability.
- Includes an accessory kit containing terminal posts, connectors, adapters, and patch cords required to perform experiments on the FACET training module.

Base units come in two variants:

• Stand-alone

The Manual System Base Unit contains a total of thirty-two circuit modification (CM) and fault switches. Students manually select CM switches as the course progresses, while the protected fault switches are reserved for instructor use by means of an integrated locking cover assembly.

• Computerized (USB link)

The computerized base unit is linked to the computer automatically by the courseware when needed, and can also be activated via a USB port by the teacher through password-protected software. The computerized base unit contains thirty-two relays controlled by commands from the student's computer circuit modifications (CM) and faults are switched in and out automatically by the software.

A message on the student's computer screen indicates that a CM or fault is activated. In the troubleshooting exercises, faults are also inserted automatically by the computer, thereby freeing the instructor to assist students with individual activities.

2) Boards

The FACET program consist of 30 topics. Each topic is covered by a board. The boards are sold separately and can be grouped in 4 areas of study.

Basic Electronics

- DC Fundamentals
- DC Network Theorems
- AC 1 Fundamentals
- AC 2 Fundamentals
- Semiconductor Devices
- Transistor Amplifier Circuits
- Transistor Power Amplifiers
- Transistor Feedback Circuits
- Power Supply Regulation Circuits
- FET Fundamentals
- Operational Amplifier Fundamentals
- Operational Amplifier Applications
- Magnetism and Electromagnetism

Digital and microprocessors

- Digital Logic Fundamentals
- Digital Circuit Fundamentals 1
- Digital Circuit Fundamentals 2
- 32-Bit Microprocessor
- Microcontroller System Development
- Breadboard
- Digital Signal Processor (DSP)

Industrial electronics

- Transducer Fundamentals
- Motors, Generators, and Controls
- Power Transistors and GTO Thyristor
- Thyristors and Power Control Circuits

Communications

- Analog Communications
- Digital Communications 1
- Digital Communications 2
- Fiber Optic Communications
- Communications Transmission Lines
- QPSK/OQPSK/DPSK

* Does not offer troubleshooting exercises

Note that all boards are available in three different languages: English, French, and Spanish. In this data sheet, the boards are listed in English by default. This is indicated by the -20 at the end of each board part number. To obtain the same board in French, replace the -20 by -21, and to obtain it in Spanish, replace the -20 by -22.

3) Courseware

The courses can be provided by traditional manual or eSeries CBT (computer-based training) courseware.

• Standard Courseware for Manual System

FACET manuals (for Stand-Alone FACET) are offered for customers using this product in the traditional paper format. These manuals have been adapted to match the current content of the eSeries version, providing students with practical working knowledge and troubleshooting skills related to specific electronics principles.

• FACET's computer based training: the eSeries

FACET[®] eSeries enhances learning speed and retention by featuring interactive multimedia courseware for circuit design, analysis and troubleshooting.

The FACET eSeries comes in three different formats:

- eSeries: for Mind Sight.
- SCORM: this format is SCORM-based, and designed to be hosted by a third-party, SCORM 1.2 compliant management system
- Stand alone: this format is available on CD-ROM. It runs on a web browser and does not require any management system. (Note: student data, navigational tracking, and the saving of assessments are not available without an LMS. All user data is lost upon exiting the Stand-Alone curriculum.)

Mind-Sight is our Learning and Content Management System (LCMS). Mind-Sight is a powerful LCMS that operates all components of the multimedia curriculum, as well as the classroom-management system. Mind Sight can be installed as WEB based application or LAN based. Course content and class management are administered from the instructor password controlled terminal.

All courses are SCORM-compliant, meaning that they are usable with other learning management systems.

There is one course per board.

4) Instruments

Measuring and displaying instrumentation is needed to perform the courses.

Two variants are available:

- Standard hardware modules: include DMM/signal generator and oscilloscope.
- Virtual instrumentation package: the VI package consists of a USB interface unit and a software.

5) Optional Equipment

Optional equipment may include:

- Storage enclosure
- Generator buffer
- Accessory kit
- Base unit upgrade
- Microprocessor application board
- Microprocessor add-on board

Topic Coverage

- Basic Electricity & Electronics
- Digital and Microprocessor Electronics
- Industrial Electronics
- Communications Systems
- Estimated TOTAL program duration: 400 hours

Features & Benefits

- Durable construction integrating mechanical components capable of thousands of cycles of operation.
- Voltage regulation and protection against over-voltage and short-circuit conditions for safety in training.
- Minimal wiring required to save lab time.
- Variety of industrial-grade components provide broad, hands-on, real-world training experience.
- Student-controlled and computer-activated circuit modification capability.
- Fault-insertion capability to teach troubleshooting.
- Comprehensive curriculum.
- Sturdy trays for easy handling and connection to base unit.
- Mind-Sight is the only Learning Content Management System (LCMS) that seamlessly integrates with base units.
- Silk-screened circuit and component identification.
- Gold-plated zero insertion force (ZIF) connector technology.

List of Available Training Systems

Qty Description

1	Manual Base Unit with Built-In Power Supply	580866 (91000-3X)
1	Computer Interface Base Unit with Built-In Power Supply	580867 (91000-5X)
1	DC Fundamentals	580877 (91001-20)
1	DC Network Theorems	580889 (91002-20)
1	AC 1 Fundamentals	580901 (91003-20)
1	AC 2 Fundamentals	580913 (91004-20)
1	Semiconductor Devices	580925 (91005-20)
1	Transistor Amplifier Circuits	580937 (91006-20)
1	Transistor Power Amplifiers	580949 (91007-20)
1	Transistor Feedback Circuits	580961 (91008-20)
1	Power Supply Regulation Circuits	580973 (91009-20)
1	FET Fundamentals	580985 (91010-20)
1	Thyristors and Power Control Circuits	580997 (91011-20)

Model number

Model

Qty	Description	number
1	Operational Amplifier Fundamentals	581009 (91012-20)
1	Operational Amplifier Applications	581021 (91013-20)
1	Digital Logic Fundamentals	581033 (91014-20)
1	Digital Circuit Fundamentals 1	581045 (91015-20)
1	Digital Circuit Fundamentals 2	581057 (91016-20)
1	32-Bit Microprocessor	581069 (91017-20)
1	Analog Communications	581084 (91018-20)
1	Transducer Fundamentals	581096 (91019-20)
1	Magnetism and Electromagnetism	581108 (91020-20)
1	Generator Buffer	581111 (91021-00)
1	Digital Communications 1	581123 (91022-20)
1	Digital Communications 2	581135 (91023-20)
1	Motors, Generators and Controls	581147 (91024-20)
1	Fiber Optic Communications	581159 (91025-20)
1	Power Transistors and GTO Thyristor	581171 (91026-20)
1	Communications Transmission Lines	581192 (91028-20)
1	QPSK / OQPSK / DPSK	581201 (91029-20)
1	Digital Signal Processor	585736 (91031-20)
1	Accessory Kit	581215 (91052-00)
1	Breadboard	581221 (91091-20)
1	Microprocessor Application Board	581224 (91602-20)

Optional Equipment

Qty Description

Qty	Description	Model number
1	Dual-Trace Digital Storage Oscilloscope	585695 (798-10) ¹
1	Digital Multimeter / Function Generator	580851 (1247-10) ²
1	FACET [®] Storage Enclosure	585728 (1369-00)
1	MindSight Learning Content Management System - Network Appliance	_ 588921 (47513-00)
1	Extended Warranty for the FACET [®] Electronics Training System	595869 (91000-EW) ³
1	Accessory Kit	581215 (91052-00)
1	Microprocessor Application Board	581224 (91602-20)
1	Complete FACET Module Curriculum Bundle (All 29 modules) - eSeries	_ 585743 (94600-E0)
1	Complete FACET Module Curriculum Bundle (all 29 modules) - Stand-Alone	_ 585746 (94600-G0)
1	FACET Module Curriculum Bundle, Basic Electricity and Electronics - eSeries	_ 585750 (94601-E0)
1	FACET Module Curriculum Bundle, Basic Electricity and Electronics - Stand-Alone	_ 585753 (94601-G0)
1	FACET Module Curriculum Bundle, Digital and Microprocessor Electronics - eSeries	_ 585757 (94602-E0)
1	FACET Module Curriculum Bundle, Digital and Microprocessor Electronics - Stand-Alone	_ 585760 (94602-G0)
1	FACET Module Curriculum Bundle, Industrial Electronics - eSeries	_ 585763 (94603-E0)

¹ An oscilloscope is included in the Virtual Instrument Package, Model 1250.

 $^{^{2}}$ The instruments included in this package can be provided by the end-user.

³ Price can be calculated as follows: for 1 additional year *7% of total net, for 2 additional years *12% of total net and for 3 additional years *15% of total net. For details and options, contact services.didactic@festo.com.

Qty	Description	Model numbei
1	FACET Module Curriculum Bundle, Industrial Electronics - Stand-Alone	585766 (94603-G0)
1	FACET Module Curriculum Bundle, Communications - eSeries	585769 (94604-E0)
1	FACET Module Curriculum Bundle, Communications - Stand-Alone	585772 (94604-G0)

Equipment Description

Manual Base Unit with Built-In Power Supply 580866 (91000-3X)



The Manual Base Unit with Built-In Power Supply contains a total of 32 circuit-modification (CM) and fault switches. Students manually select CM switches as the course progresses, while the protected fault switches are reserved for the instructor use by means of an integrated locking cover assembly.

This base unit comprises an accessory

kit containing the terminal posts, connectors, adapters, and patch cords required to perform experiments on the FACET training module.

Two light-emitting diodes (LEDs) on the base unit also indicate that power is on and that experiments can be performed.

Additional Equipment Required to Perform the Exercises

Qty	Description	Model numbe
1	Power Cord - Nema 5-15	582145 (86331-00)
1	Power Cord - CEE 7	582146 (86331-05)
1	Power Cord - AS 3112	582147 (86331-0A)
1	Power Cord - BS 1363	582148 (86331-G0)
1	Power Cord - SEV 1011	582150 (86331-J0)
1	Power Cord - CEI 23-50	582151 (86331-L0)
1	Power Cord - NBR 14136	582152 (86331-N0)

Specifications

Parameter	Value
Power Requirements	
Service Installation	Standard single-phase ac outlet
Voltage	100-250 V ac
Current	0.4-0.65 A
Frequency	50/60 Hz
Physical Characteristics	
Intended Location	On a table able to support the weight of the equipment
Dimensions (H x W x D)	152 x 305 x 356 mm (6 x 12 x 14 in)
Net Weight	3.1 kg (6.9 lb)

Computer Interface Base Unit with Built-In Power Supply 580867 (91000-5X)



The Computer Interface Base Unit with Built-In Power Supply contains 32 relays controlled by commands from the student's computer. The computerized base unit is linked to the computer automatically by the courseware when needed, and can also be activated via a USB port by the teacher through a password-protected software. Circuit modifications (CM)

and faults are switched in and out automatically by the software. A message on the student's computer screen indicates that a CM or fault is activated. In the troubleshooting exercises, faults are also inserted automatically by the computer, thereby freeing the instructor to assist students with individual activities.

Additional Equipment Required to Perform the Exercises

Qty Description

Description	number
Power Cord - Nema 5-15	582145 (86331-00)
Power Cord - CEE 7	582146 (86331-05)
Power Cord - AS 3112	582147 (86331-0A)
Power Cord - BS 1363	582148 (86331-G0)
Power Cord - SEV 1011	582150 (86331-J0)
Power Cord - CEI 23-50	582151 (86331-L0)
Power Cord - NBR 14136	582152 (86331-N0)
	Power Cord - Nema 5-15 Power Cord - CEE 7 Power Cord - AS 3112 Power Cord - BS 1363 Power Cord - SEV 1011 Power Cord - CEI 23-50 Power Cord - NBR 14136

Specifications

Parameter	Value
Power Requirements	
Service Installation	Standard single-phase ac outlet
Voltage	100-250 V ac
Current	0.4-0.65 A
Frequency	50/60 Hz
Computer Requirements	A currently available personal computer with USB 2.0 ports, running under one of the following operating systems: Windows [®] 7 or Windows [®] 8.
Physical Characteristics	
Intended Location	On a table able to support the weight of the equipment
Dimensions (H x W x D)	152 x 305 x 356 mm (6 x 12 x 14 in)
Net Weight	3.1 kg (6.9 lb)

Model

DC Fundamentals 580877 (91001-20)



The DC Fundamentals course provides comprehensive, hands-on instruction in the terminology, principles and applications of dc circuits. Following a carefully designed instructional program, students become familiar with all components of the board. They learn how to isolate, identify, and test a series of circuits and perform troubleshooting exercises to demonstrate their mastery of the course objectives.

All dc power to the circuit board is supplied by the 15 V power supply via the base unit and its protection circuitry. Students troubleshoot dc circuit faults inserted by the computer or manually by the instructor, who alters hidden switches located under a locking cover.

A dc milliammeter is provided with the circuit board.

The circuits found on this board include:

- Batteries
- Switches
- Ohm's Law
- Series Circuit
- Parallel Circuit
- Series-Parallel Circuit
- Power
- Linear/Non-Linear Variable Resistor
- Voltage Divider
- Voltmeter/Ammeter/Ohmmeter

This board is available in the following language variants:

- English variant: 91001-20
- French variant: 91001-21
- Spanish variant: 91001-22

Topic Coverage

- Instrument, FACET Base Unit and Board Familiarization
- Symbols and Schematics
- Basic and Electrical Safety Rules
- Circuit Voltage, Current, Resistance
- DC Power Sources in Series and in Parallel Series
- Opposing DC Sources
- Switches Identification and Switching Concepts
- Ohm's Law: Circuit Resistance, Current, & Voltage

- Resistance, Voltage and Current in a Series Resistive Circuit
- Resistance, Voltage and Current in a Parallel Resistive Circuit
- Resistance, Voltage and Current in a Series-Parallel Resistive Circuit
- Power in a Series and/or Parallel Resistive Circuit
- **Rheostat and Potentiometer**
- Voltage and/or Current Dividers
- Measuring: DC Ammeter, DC Ohmmeter, DC Voltmeter
- **Troubleshooting DC Circuits 1**

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Qty	Description	number
1	DC Fundamentals (Student Manual)	_ 580644 (91560-P0)
1	DC Fundamentals (Student Workbook)	_ 580645 (91560-Q0)
1	DC Fundamentals (Instructor Guide)	_ 580647 (91560-R0) ⁴

DC Network Theorems 580889 (91002-20)



language variants:

- English variant: 91002-20
- French variant: 91002-21
- Spanish variant: 91002-22

Topic Coverage

- **Component Location and Identification** .
- **Circuit Board Operation**
- Currents and Node Currents in a Two-Element Branch Circuit
- Voltages in a Three-Element Series Circuit
- Algebraic Sum of Voltages in a Series Circuit
- Generating Loop Equations and Node Equations
- Kirchhoff's Voltage and Current Laws with a Two-Source Circuit
- Mesh Solutions, Superposition Solution and Millman's Theorem Solution of a Two-Source Circuit

Comprised of nine training circuit blocks and a constant-source current block, the DC Network Theorems Module enables students to perform practical exercises that demonstrate theoretical dc principles.

When a circuit has two voltage sources in different branches, theorems are used to solve for voltage and/or current in these circuits where Ohm's Law cannot be applied.

This board is available in the following

Model

⁴ The manuals DC Fundamentals, both the student manual and instructor guide, are also available in computer-based format.

- Thevenizing a Single-Source Network and a Dual-Source Network •
- Thevenin Resistance (RTH) and Voltage (VTH) of a Bridge Circuit
- Thevenin-to-Norton Conversion
- Norton-to-Thevenin Conversion
- Tee and Wye or Pi and Delta Networks
- Transformation of Delta and Wye Networks
- Troubleshooting Basics and DC Networks

Qty	Description
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Qty	Description	Model number
1	DC Network Theorems (Student Manual)	589693 (91561-P0) ⁵
1	DC Network Theorems (Student Workbook)	580653 (91561-Q0)
1	DC Network Theorems (Instructor Guide)	580655 (91561-R0)

AC 1 Fundamentals 580901 (91003-20)



- **RC Time Constants**
- **RC/RL Wave Shapes**

This board is available in the following language variants:

- English variant: 91003-20 ٠
- French variant: 91003-21
- Spanish variant: 91003-22

Topic Coverage

- Magnetism and how to make a Magnet •
- The Oscilloscope
- Laboratory Instruments: Oscilloscope, AC Waveform Generator, AC Amplitude Measurements
- Measuring AC Voltage, Current and Impedance •
- Measuring and Setting Frequency
- Inductors, Phase Angle, Series vs Parallel, Inductive Reactance and Impedance

This module contains nine circuit blocks on which students perform varied troubleshooting exercises in the AC 1 Fundamentals Program. Students identify and isolate the following circuits:

- **Generator Impedance**
- AC/DC Waveforms
- Phase Angle
- Inductance/Inductive Reactance
- Transformer
- Capacitance/Capacitive Reactance

⁵ The manuals DC Network Theorems, both the student manual and instructor guide, are also available in computer-based format.

- Series and Parallel RL Circuits
- Electromagnets, Solenoid, Relay
- Transformer Windings, Mutual Inductance, Turns and Voltage Ratios, Secondary Loading
- Capacitors, Series vs Parallel, Capacitive Reactance
- Series and Parallel RC Circuits
- RC Time Constants
- RC/RL Waveshapes
- Troubleshooting Basics, Troubleshooting the AC 1 Fundamentals Circuit Board

Qty	Description	Model number
1	AC 1 Fundamentals (Student Manual)	_ 580661 (91562-P0)
1	AC 1 Fundamentals (Student Workbook)	_ 580662 (91562-Q0)
1	AC 1 Fundamentals (Instructor Guide)	_ 580664 (91562-R0) ⁶

AC 2 Fundamentals 580913 (91004-20)



This board is available in the following language variants:

- English variant: 91004-20
- French variant: 91004-21
- Spanish variant: 91004-22

Topic Coverage

- Series and Parallel RLC Circuits
- Series Resonant Circuits
- Q and Bandwidth of a Series/Parallel RLC Circuit
- Resonant Frequency in a Parallel RLC Circuit
- Power Division and Power Factor
- Filters: Low-Pass, High Pass, Band-Pass and Band-Stop
- Troubleshooting Basics and Troubleshooting the AC 2 Fundamentals Circuit Board

The AC 2 Fundamentals training module is designed as a continuation of the AC 1 Fundamentals program.

The circuits found on this board include:

- RLC/Resonance/Power
- Low-Pass Filter
- High-Pass Filter
- Series Band-Pass Filter
- Parallel Band-Pass Filter
- Series Band-Stop Filter
- Parallel Band-Stop Filter

⁶ The manuals AC 1 Fundamentals, both the student manual and instructor guide, are also available in computer-based format.

Qty	Description	Model numbei
1	AC 2 Fundamentals (Student Manual)	580670 (91563-P0) ⁷
1	AC 2 Fundamentals (Student Workbook)	580671 (91563-Q0)
1	AC 2 Fundamentals (Instructor Guide)	580673 (91563-R0)

Semiconductor Devices 580925 (91005-20)



The Semiconductor Devices training module contains nine circuit blocks pertaining to skills training in semiconductor circuits. After completion of the FACET programs in AC and DC Fundamentals and AC and DC Circuits and Analysis, students are ready to train on the semiconductor module.

Students in this program will be responsible for analyzing and troubleshooting the following circuits:

- Diodes and Half-wave Rectification
- Full-wave Rectification with Power Supply Filters
- Zener Diode Regulator
- Diode Waveshaping
- Voltage Doubler
- Transistor Junction
- PNP DC Bias
- Transistor Load Lines and Gain

This board is available in the following language variants:

- English variant: 91005-20
- French variant: 91005-21
- Spanish variant: 91005-22

Topic Coverage

- Semiconductor Component Identification and Control of a Semiconductor Switch
- Diode: DC Characteristics, Diode Waveshaping
- Rectifiers: Half-Wave, Full-Wave Diode Bridge, Power Supply Filtering, Voltage Doubler
- Zener Diode and Voltage Regulation
- Transistor: Testing the Junctions, PNP Transistor Current Control Circuit, Emitter-Base Bias Potentials, Collector Current vs Base Bias, DC Circuit Voltages, Load Lines
- Troubleshooting Basics and Troubleshooting the Semiconductor Devices Circuit Board

⁷ The manuals AC 2 Fundamentals, both the student manual and instructor guide, are also available in computer-based format.

QtyDescriptionModel
number1Semiconductor Fundamentals (Student Manual)589694 (91564-P0) 81Semiconductor Fundamentals (Student Workbook)580679 (91564-Q0)1Semiconductor Fundamentals (Instructor Guide)580681 (91564-R0)

Transistor Amplifier Circuits 580937 (91006-20)



This board is available in the following language variants:

- English variant: 91006-20
- French variant: 91006-21
- Spanish variant: 91006-22

Topic Coverage

- Circuit Location and Identification
- Multistage Amplifier Introduction
- Common Base, Common Emitter and Common Collector Circuits AC/DC Operation
- Temperature Effect on Fixed Bias Circuit and Voltage Divider Bias Circuit
- Transistor Parameters Familiarization and Understanding the Specification Sheet
- RC Coupled Amplifier DC Operation, AC Voltage Gain and Phase Relationship, Frequency Response
- Transformer Coupled Amplifier AC/DC Operation, Frequency Response
- Direct Coupled Amplifier AC/DC Operation , Frequency Response
- Troubleshooting Basics and Troubleshooting Transistor Amplifier Circuits

Optional Manual(s)

QtyDescriptionModel
number1Transistor Amplifier Circuits (Student Manual)580687 (91565-P0) 91Transistor Amplifier Circuits (Student Workbook)580688 (91565-Q0)

The Transistor Amplifier Circuits module allows students to perform practical exercises that demonstrate transistor amplifier principles.

Students will identify and isolate faults within the following six circuit blocks:

- Attenuator
- Common Base/ Emitter
- Common Collector
- Bias Stabilization
- RC Coupling/ Transformer Coupling
- Direct Coupling

⁸ The manuals Semiconductor Fundamentals, both the student manual and instructor guide, are also available in computer-based format.

⁹ The manuals Transistor Amplifier Circuits, both the student manual and instructor guide, are also available in computer-based format.

Model

580690 (91565-R0)

number

Qty Description

1 Transistor Amplifier Circuits (Instructor Guide) _____

Transistor Power Amplifiers 580949 (91007-20)



This board is available in the following language variants:

- English variant: 91007-20
- French variant: 91007-21
- Spanish variant: 91007-22

Topic Coverage

- Circuit Location and Identification
- Single-Ended Power Amplifiers: Introduction, DC Operation, AC Operation, Voltage Gain, Power Gain
- Phase Splitter DC Operation
- Voltage Gain and Input/Output Signal Phase Relationship
- Push-Pull Power Amplifiers: DC Operation, AC Operation, Voltage and Power Gain
- Complementary Power Amplifiers: DC Operation, AC Operation, Voltage Gain and Power Gain
- Darlington Pair Current Gain Characteristics, Input and Output Impedance
- Troubleshooting Basics and Troubleshooting Transistor Power Amplifiers

Optional Manual(s)

Qty	Description	number
1	Transistor Power Amplifiers (Student Manual)	_ 589695 (91566-P0) ¹⁰
1	Transistor Power Amplifiers (Student Workbook)	580696 (91566-Q0)
1	Transistor Power Amplifiers (Instructor Guide)	580698 (91566-R0)

The Transistor Power Amplifiers module is designed to teach troubleshooting of transistor power amplifier circuitry. Training on this board includes identifying and isolating the following circuits:

- Single-Ended Power Amplifier
- Phase Splitter
- Push-Pull Power Amplifier
- Attenuator
- Complementary Power Amplifier
- Darlington Pair

¹⁰ The manuals Transistor Power Amplifiers, both the student manual and instructor guide, are also available in computer-based format.

Model

Transistor Feedback Circuits 580961 (91008-20)



This board is available in the following language variants:

- English variant: 91008-20
- French variant: 91008-21
- Spanish variant: 91008-22

Topic Coverage

- Component Location and Identification
- Series Feedback Amplifier Operation
- Exploration of the Following Effects: Feedback on AC Gain, Negative Series Feedback on Bandwidth, Series Feedback on Input and Output Impedance, Shunt Feedback on AC Gain, Bandwidth and Input and Output Impedance
- Shunt-Series Multistage Amplifier Current Gain, Output Gain, Voltage Gain, Output Impedance
- Differential Amplifier Operation
- Single-Ended and Differential Gain Characteristics
- Common Mode Gain and Rejection Ratio
- Troubleshooting Basics and Troubleshooting Feedback Amplifier Circuits

Optional Manual(s)

Qty	Description	Model number
1	Transistor Feedback Circuits (Student Manual)	589696 (91567-P0) ¹¹
1	Transistor Feedback Circuits (Student Workbook)	580704 (91567-Q0)
1	Transistor Feedback Circuits (Instructor Guide)	580706 (91567-R0)

The Transistor Feedback Circuits module enables students to perform practical exercises that demonstrate Transistor Feedback principles.

The circuits found on this board include:

- Series Feedback/Shunt Feedback
- Multistage Shunt-Series Feedback
- Attenuator
- Multistage Series-Shunt Feedback
- Differential Amplifier

¹¹ The manuals Transistor Feedback Circuits, both the student manual and instructor guide, are also available in computer-based format.

Power Supply Regulation Circuits 580973 (91009-20)



- Current Regulator
- Voltage Feedback Regulation
- IC Regulation
- DC to DC Converter circuitry

This board is available in the following language variants:

- English variant: 91009-20
- French variant: 91009-21
- Spanish variant: 91009-22

Topic Coverage

- Circuit Location and Identification and Power Supply Regulator Introduction
- Shunt and Series Regulators Operation, Line and Load Regulation
- Voltage Feedback Regulator Operation, Load Regulation
- Foldback Current Limiting Active Protection Circuit
- Current Regulator Operation, Line and Load Regulation
- Three-Pin IC Regulator Operation, Voltage Regulation, Current Regulation and Power Efficiency
- DC to DC Converter Operating Characteristics, Voltage Regulation and Efficiency
- Troubleshooting Basics and Troubleshooting Power Supply Regulation Circuits

Optional Manual(s)

Qty	Description	Model number
1	Power Supply Regulators (Student Manual)	589697 (91568-P0) ¹²
1	Power Supply Regulators (Student Workbook)	580712 (91568-Q0)
1	Power Supply Regulators (Instructor Guide)	580714 (91568-R0)

The Power Supply Regulation Circuits module is used to study power supply regulation circuits in a hands-on learning environment.

Through the study of the following six circuit blocks, the trainee will gain the skills necessary to be able to successfully troubleshoot the following power supply circuit malfunctions:

- Shunt Voltage Regulator
- Series Voltage Regulator

¹² The manuals Power Supply Regulation Circuits, both the student manual and instructor guide, are also available in computer-based format.

FET Fundamentals 580985 (91010-20)



- Photo Resistor
- Fiber Optic Link

This board is available in the following language variants:

- English variant: 91010-20
- French variant: 91010-21
- Spanish variant: 91010-22

Topic Coverage

- Component Location and Identification
- Oscillators Operation: Unijunction, Hartley, Colpitts
- JFET: Operating Characteristics, Effect of Gate Bias on Pinch-Off, Dynamic Characteristics, DC Amplifier Operation, Voltage Gain, DC Current Source Operation and Power/Load Voltage Variation
- MOSFET: Zero Bias Characteristic, Modes of Operation, Voltage Amplifier, Dual Gate MOSFET Mixer
- UJT: Operating Characteristics, Waveform Generation
- Thermistor and Photoresistor Operation
- Fiber Optic Light Transfer
- Troubleshooting Basics and Troubleshooting FET Circuits
- Understanding Specification Sheets: FET, Unijunction Transistor, Transducer

Optional Manual(s)

Qty	Description	Model number
1	FET Fundamentals (Student Manual)	589698 (91569-P0) ¹³
1	FET Fundamentals (Student Workbook)	580720 (91569-Q0)
1	FET Fundamentals (Instructor Guide)	580722 (91569-R0)

The FET Fundamentals module contains nine circuit blocks which enable students to perform practical exercises that demonstrate principles of JFET, MOSFET, and UJT:

- JFET
- JFET Amplifier
- JFET Current Source
- Dual Gate MOSFET
- Unijunction Transistor
- Thermistor
- Colpitts/Hartley Oscillator

¹³ The manuals FET Fundamentals, both the student manual and instructor guide, are also available in computer-based format.

Thyristors and Power Control Circuits 580997 (91011-20)



Motor

This board is available in the following language variants:

- English variant: 91011-20
- French variant: 91011-21
- Spanish variant: 91011-22

Topic Coverage

- Thyristor: Component Familiarization, Circuit Fundamentals
- Silicon Controlled Rectifier (SCR): Testing, DC Operation, Gate Trigger Voltage and Holding Current
- Rectifiers: Half-Wave Rectifier, SCR Controlled Half-Wave Rectifier, Full-Wave Rectifier, Phase Control
- UJT: Characteristics, Half and Full-Wave Phase Control
- Bidirectional Conduction, Triggering Modes (4)
- Troubleshooting Basics and Troubleshooting Thyristor Circuits

Optional Manual(s)

Qty	Description	Model number
1	Thyristor and Power Control Circuits (Student Manual)	589699 (91570-P0) ¹⁴
1	Thyristor and Power Control Circuits (Student Workbook)	580728 (91570-Q0)
1	Thyristor and Power Control Circuits (Instructor Guide)	580730 (91570-R0)

The Thyristors and Power Control Circuits module enables students to perform practical exercises that demonstrate thyristor and power control circuit fundamentals.

The system contains the following circuit blocks:

- Driver
- Silicon Controlled Rectifier (SCR)
- Triac AC Power Control
- SCR DC Gate Half-wave and Full-wave
- SCR AC Gate and UJT Half-wave and Full-wave/

¹⁴ The manuals Thyristor and Phase Control Circuits, both the student manual and instructor guide, are also available in computer-based format.

Operational Amplifier Fundamentals 581009 (91012-20)



- Open Loop Comparator
- Sine/Square Comparator

This board is available in the following language variants:

- English variant: 91012-20
- French variant: 91012-21
- Spanish variant: 91012-22

Topic Coverage

- Op Amp Types and Packages, Circuit Board Familiarization, Basic Op Amp Characteristics and Parameters
- Inverting and Non-Inverting Amplifiers Operation: DC and AC
- Voltage Follower DC Operation, AC Operation
- Typical Amplifiers Operation: Inverting Gain-of-One Amplifier, Inverting Summing Amplifier, Scaling, Averaging, Non-Inverting Summing, Difference Amplifier (AC/DC)
- Open-Loop Operation, Zener-Clamped Operation
- Sine Wave to Square Wave Converter
- Troubleshooting Basics and Troubleshooting Op Amp Circuits

Optional Manual(s)

Qty	Description	Model number
1	Operational Amplifier Fundamentals (Student Manual)	580736 (91571-P0) ¹⁵
1	Operational Amplifier Fundamentals (Student Workbook)	580737 (91571-Q0)
1	Operational Amplifier Fundamentals (Instructor Guide)	580739 (91571-R0)

The Operational Amplifier Fundamentals module introduces students to the circuitry used in analog applications.

The objective is to familiarize students with the following circuits:

- Inverting Amplifier
- Non-Inverting Amplifier
- Voltage Follower
- Inverting Summing Amplifier
- Non-Inverting Summing Amplifier
- Difference Amplifier

¹⁵ The manuals Operational Amplifier Fundamentals, both the student manual and instructor guide, are also available in computer-based format.

Operational Amplifier Applications 581021 (91013-20)



- Full-wave Bridge Driver/Conversion
- Troubleshooting the modified configurations

This board is available in the following language variants:

- English variant: 91013-20
- French variant: 91013-21
- Spanish variant: 91013-22

Topic Coverage

- Component Location and Identification
- Band Pass Filter Operation
- Integrator and Differentiator
- Low Pass and High Pass Filter Frequency Response, Phase and Transient Response
- Band Pass Filter Operator, Frequency Response, Phase Response
- DC Characteristics of an Active Voltage to Current Converter
- AC Characteristics of an Active RMS or Average Calibrated Voltage to Current Converter
- Troubleshooting Basics and Troubleshooting Op Amp Circuits
- Troubleshooting Op Amp Circuits

Optional Manual(s)

Qty	Description	number
1	Operational Amplifier Applications (Student Manual)	589700 (91572-P0) ¹⁶
1	Operational Amplifier Applications (Student Workbook)	580745 (91572-Q0)
1	Operational Amplifier Applications (Instructor Guide)	580747 (91572-R0)

The Operational Amplifier Applications module enables students to perform practical exercises that demonstrate applications of operational amplifiers.

The objective of this program is familiarization and skills training with the following circuits:

- Attenuator
- Integrator
- Differentiator
- Low- and High-Pass Filters
- Band-Pass Filters

Model

¹⁶ The manuals Operational Amplifier Applications, both the student manual and instructor guide, are also available in computer-based format.

Digital Logic Fundamentals 581033 (91014-20)



- Set/Reset Flip-Flop
- TTL/CMOS Comparison OR/NOR
- D-type Flip-Flop
- Data Bus Control
- JK Flip-Flop and XOR/XNOR circuit blocks for students to understand and troubleshoot

This board is available in the following language variants:

- English variant: 91014-20
- French variant: 91014-21
- Spanish variant: 91014-22

Topic Coverage

- Component Location and Identification
- Operation of General Circuits and IC Package Fundamentals
- Logic Functions: AND, NAND, OR, NOR, Exclusive OR, NOR Gates
- Dynamic Response of XOR/XNOR Logic Gates
- DC Operation of a NOT and an OR-TIE
- Transfer Characteristics of a Schmitt and a Standard LS TTL Gate
- Flip-Flops: Set/Reset, D-Type, Static JK, Dynamic Operation
- Tri-State Gate: Output Enable Control, Sink and Source Control
- TTL and CMOS: Static Trigger Levels, Dynamic Transfer Characteristics
- Static and Dynamic Control of a Data Bus
- Troubleshooting Basics and Troubleshooting Digital Circuits

Features & Benefits

- +5 V regulated supply
- Built-in clock circuit
- Manual input signal control

Optional Manual(s)

The Digital Logic Fundamentals module enables students to perform practical exercises that demonstrate concepts and fundamentals of digital logic circuits.

The circuit board contains the following circuits:

- Clock
- Input Signals
- Open Collector
- Tri-State Output
- AND/NAND

Qty	Description	Model number
1	Digital Logic Fundamentals (Student Manual)	589691 (52210-P0) ¹⁷
1	Digital Logic Fundamentals (Student Guide)	589765 (52210-Q0)
1	Digital Logic Fundamentals (Instructor Guide)	589692 (52210-R0)

Digital Circuit Fundamentals 1 581045 (91015-20)



- Synchronous Counter
- 4-Bit Comparator

This board is available in the following language variants:

- English variant: 91015-20
- French variant: 91015-21
- Spanish variant: 91015-22

Topic Coverage

- Component Location and Identification
- Operation of General Circuits and IC Package Fundamentals
- Basic Counter Control Functions, Ripple Counter Waveforms, Synchronous Counter Circuit Waveforms and Glue Logic
- Basic Operating Modes of the Shift Register
- Shift Register Circuit Waveforms
- Fundamental Binary Addition, Addition with Input and Output Carry
- Fundamental Binary Comparisons
- Comparators and Counter Modulus Control
- Troubleshooting Basics and Troubleshooting Digital Circuits

Features & Benefits

- +5 V regulated supply
- Built-in clock circuit
- Built-in pulse generator circuit

The Digital Circuit Fundamentals 1 module enables students to perform practical exercises that demonstrate digital circuit principles.

Students will identify the following circuits:

- Clock
- Pulse Generator
- Input Signals
- 4-bit Shift Register
- Asynchronous Ripple Counter
- 4-bit Adder

• Manual input signal control

Optional Manual(s)

Qty	Description	Model number
1	Digital Circuit Fundamentals 1 (Student Manual)	585383 (91574-P0) ¹⁸
1	Digital Circuit Fundamentals 1 (Student Workbook)	_ 580761 (91574-Q0)
1	Digital Circuit Fundamentals 1 (Instructor Guide)	_ 580763 (91574-R0)

Digital Circuit Fundamentals 2 581057 (91016-20)



- Multiplexer/Demultiplexer
- BCD Decimal Decoder/BCD Priority Encoder
- ADC/DAC
- 7-Segment Driver/Display
- Parity Generator/ Checker

This board is available in the following language variants:

- English variant: 91016-20
- French variant: 91016-21
- Spanish variant: 91016-22

Topic Coverage

- Component Location and Identification
- Operation of General Circuits and IC Package Fundamentals
- Fundamentals: BCD Decoder Operation, Priority Encoder Operation, ADC Operation, DAC Operation
- Data Selector, Multiplexer, 1-Line-to-8-Line Demultiplexer
- 1-Line-to-8-Line Demultiplexer
- LED Decoder/Driver, 7-Segment LED Display, ODD and EVEN Parity
- ODD and EVEN Parity
- Parity Generator/Checker Glue Logic
- Troubleshooting Basics and Troubleshooting MSI IC Circuits and Digital Circuits

The Digital Circuit Fundamentals 2 module is used to study and troubleshoot digital circuits using hands-on educational equipment.

Through the study of the following circuit blocks, students will gain the skills necessary to successfully troubleshoot specific circuit malfunctions:

- Clock
- Pulse Generator
- Counter

¹⁸ The manuals Digital Circuit Fundamentals 1, both the student manual and instructor guide, are also available in computer-based format.

Features & Benefits

- +5 V regulated supply
- Built-in clock circuit
- Built-in pulse generator circuit
- Built-in counter circuitry

Optional Manual(s)

QtyDescriptionModel
number1Digital Circuit Fundamentals 2 (Student Manual)589701 (91576-P0) 191Digital Circuit Fundamentals 2 (Student Workbook)580769 (91576-Q0)1Digital Circuit Fundamentals 2 (Instructor Guide)580771 (91576-R0)

32-Bit Microprocessor 581069 (91017-20)



The 32-Bit Microprocessor module builds on the student's knowledge of digital circuitry gained in Digital Logic Fundamentals, Model 91014, and Digital Circuit Fundamentals 1 and 2, Models 91015 and 91016. The 80386DX CPU can be used as a standalone unit or in conjunction with the FACET base unit to demonstrate microprocessor, memory, and I/O concepts, and communication with analog systems via A-to-D and D-to-A converters.

A keypad and a 2-line x 16-character alphanumeric LCD display allow direct interaction with the CPU. All address, data, and control signals are connected to headers for easy access and expansion to off-board circuits. Additional hardware features include 32-kbyte static RAM, 16-kbyte ROM with monitor, RS-232 serial port, 8-bit parallel port, and LED indicators for address and data buses.

An on-board logic probe, single bus cycle execution mode, and the practical, hands-on approach of the courseware guide students in the analysis and troubleshooting of 32-bit microprocessor systems. The circuit board may be used in the FACET base unit or as a stand-alone trainer.

- When used in the FACET base unit, the course can be performed through the interactive Learning Management System (LMS) format.
- When used as a stand-alone trainer, the course is performed in a conventional way by using the provided student manual and instructor guide. In that case, a power pack (provided with the stand-alone trainer) must be used to supply power to the circuit board if it is used without a base unit.

¹⁹ The manuals Digital Circuit Fundamentals 2, both the student manual and instructor guide, are also available in computer-based format.

This module is available in the following language variants:

- English variant: 91017-20
- French variant: 91017-21
- Spanish variant: 91017-22

Topic Coverage

- Introduction to the Circuit Board and its Operation
- Bus States, 32-Bit Bus Transfers
- Read and Write Cycles
- CPU Initialization
- Memory Control Signals, Address Decoding, Data Transfers
- Ports: DAC and ADC Ports, PPI and Keypad Interface, Display and Serial Ports
- Non-maskable and Maskable Interrupts, Exceptions
- Immediate, Register and Memory Addressing Modes
- Instruction Formats and Using the 80386 CPU Instructions
- Troubleshooting Basics and 32-Bit Microprocessor Troubleshooting
- Application Board Familiarization (Requires the Optional Microprocessor Application Board, Model 91602)
- DC Motor Control (Requires the Optional Microprocessor Application Board, Model 91602)
- Temperature Control (Requires the Optional Microprocessor Application Board, Model 91602)

Features & Benefits

- 16 KB monitor ROM/User ROM
- Serial data port (RS-232)
- Parallel data port (8-bit)
- Single-bus cycle control
- Single-instruction cycle control
- On-board applications interface
- On-board logic probe for signal tracing
- Optional microprocessor application board to demonstrate practical microprocessor-based temperature/motor control
- Interrupt controller
- ADC/DAC

Optional Equipment

Qty	Description	Model number
1	Microprocessor Application Board	581224 (91602-20)

Optional Manual(s)

Qty	Description	Model number
1	32-Bit Microprocessor (Student Workbook)	580777 (91577-Q0)
1	32-Bit Microprocessor (Instructor Guide)	580779 (91577-R0)

Analog Communications 581084 (91018-20)



With the Analog Communications circuit board, students can configure, operate, and troubleshoot the following circuits:

- Amplitude Modulation (AM) Transmitter and Receiver
- Single-Sideband (SSB) Transmitter and Receiver
- Frequency Modulator (FM)
- Phase Modulator (PM)
- Quadrature Detector (FM demodulation)
- Phase-Locked Loop (PLL)
- PLL FM Detector

Students learn the functions of oscillators, filters, amplifiers, LC networks, modulators, limiters, mixers, and detectors in communication circuits. Circuit modifications and faults provide students with the opportunity to develop troubleshooting skills. An optional unit covers the use of a Spectrum Analyzer.

This board is available in the following language variants:

- English variant: 91018-20
- French variant: 91018-21
- Spanish variant: 91018-22

Topic Coverage

- Analog Communication Concepts and Circuit Board Familiarization
- Amplitude Modulation, RF Power Amplifier, Balanced Modulator, RF Stage
- Mixer, IF Filter, Envelope Detector, Balanced Modulator, LSB Filter, RF Power Amplifier, Mixer, RF Stage
- Mixer and RF Power Amplifier
- RF Stage, Mixer, and IF Filter
- Product Detector and Automatic Gain Control
- Frequency and Phase Modulation
- Demodulation (Quadrature Detector)
- PLL Circuit and Operation, FM Detection with a PLL
- Troubleshooting Basics and Troubleshooting Analog Communication Circuits

Optional Manual(s)

Qty	Description	Model number
1	Analog Communications (Student Manual)	589703 (91578-P0) ²⁰
1	Analog Communications (Student Workbook)	580785 (91578-Q0)
1	Analog Communications (Instructor Guide)	580787 (91578-R0)

²⁰ The manuals Analog Communications, both the student manual and instructor guide, are also available in computer-based format.

Transducer Fundamentals 581096 (91019-20)



The Transducer Fundamentals circuit board guides the trainee through the circuits and devices used to interface computer and control circuits to the outside world. The circuit board includes eight transducer circuit blocks, an oven for demonstrating temperature transducers, an instrumentation amplifier with selectable gain, and a Reference Supply circuit block with computer interface.

Students learn the principles of input and output transducers and how physical quantities, such as heat, position, proximity and force, are converted to electrical signals for detection and processing by computer and control systems.

The circuits found on this module include: IC Transducer, Thermistor, RTD, Thermocouple, Strain Gauge, Capacitance Sensor, Ultrasonic Transducers (Transmission/Reception), and Infrared Controller (Transmission/ Reception) This circuit board can be interfaced with the 32-Bit Microprocessor board to demonstrate the principles of data acquisition and microprocessor control of external devices in process control and automation applications.

This board is available in the following language variants:

- English variant: 91019-20
- French variant: 91019-21
- Spanish variant: 91019-22

Topic Coverage

- Introduction to Transducers and the Circuit Board
- Temperature Measurement, Control, RTD, Thermocouple
- Capacitance Sensor, Touch and Position Sensing
- Strain Gauge Characteristics
- Bending Beam Load Cell (Strain Gauge)
- Ultrasonic Principles, Distance Measurement
- Infrared Transmission/Reception, IR Remote Control
- Force Measurement
- Computerized Temperature Control and Measurement (Requires the Optional 32-Bit Microprocessor Module (91017), plus these accessories: 9 V Power Supply (91730) and Flat Ribbon Cable (91627).)
- Computerized Force Measurement (Requires the Optional 32-Bit Microprocessor Module (91017), plus these accessories: 9 V Power Supply (91730) and Flat Ribbon Cable (91627).)
- Troubleshooting Transducer Circuits

Features & Benefits

Reference supply

- Temperature-controlled oven
- Instrumentation amplifier with selectable gain
- Mechanical fixture to demonstrate compressive and tensile strain measurement with a strain gauge
- Separate ultrasonic transmitter and receiver
- Infrared transmission/reception and data link

Qty	Description	Model number
1	Transducer Fundamentals (Student Manual)	589704 (91579-P0) ²¹
1	Transducer Fundamentals (Student Workbook)	580793 (91579-Q0)
1	Transducer Fundamentals (Instructor Guide)	580795 (91579-R0)

Magnetism and Electromagnetism 581108 (91020-20)



language variants:

- English variant: 91020-20
- French variant: 91020-21
- Spanish variant: 91020-22

Topic Coverage

- Magnetism, Magnetic Fields, Making a Magnet
- Electromagnet, Solenoid, Relay

Optional Manual(s)

Qty Description

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1	Magnetism and Electromagnetism (Student Manual)	_ 589705 (91580-P0) ²²
1	Magnetism and Electromagnetism (Student Workbook)	580801 (91580-Q0)
1	Magnetism and Electromagnetism (Instructor Guide)	580803 (91580-R0)

The Magnetism and Electromagnetism training module introduces students to practical, up-to-date applications in magnetism and electromagnetism. The board permits to experiment on:

- Magnetic Poles
- Magnetic Lines of Force
- Electromagnet/Solenoid
- Control Circuit/Latch
- Buzzer

This board is available in the following

Model

²¹ The manuals Transducer Fundamentals, both the student manual and instructor guide, are also available in computer-based format.

²² The manuals Magnetism and Electromagnetism, both the student manual and instructor guide, are also available in computer-based format.

Generator Buffer 581111 (91021-00)



Digital Communications 1 581123 (91022-20)



The Generator Buffer module is required for generators used in lab experiments not having an output impedance of 50 Ω .

The Digital Communications 1 module enables students to configure, operate, and troubleshoot the following circuits:

- Pulse-Amplitude Modulation
- PAM Time-Domain Multiplexing
- Pulse-Time Modulation (PWM and PPM)
- Pulse-Code Modulation and Time-Division Multiplexing of PCM Signals
- Delta Modulation
- Channel Effects

Each circuit block contains a modulator for transmission and a demodulator for reception.

Students learn the operation and function of the following:

- Sampler
- Sample/Hold
- Adder
- Ramp Generator
- Comparator
- Limiter
- Filter
- CODEC
- PLL
- Compressor
- Expander
- Integrator
- Differentiator
- Latched Compare
- Speaker Amplifier
- Channel Simulator

This board is available in the following language variants:

- English variant: 91022-20
- French variant: 91022-21
- Spanish variant: 91022-22

Topic Coverage

- Concepts of Digital Communications, Circuit Board Familiarization
- PAM Signal Generation, Demodulation, PAM TDM Transmission and Reception
- PTM Signal Demodulation and Generation
- PCM Signal Generation and Demodulation, Signal Time-Division Multiplexing
- DM Transmitter, Receiver and Noise
- Channel Bandwidth and Noise
- Troubleshooting Basics and Troubleshooting Digital Communications 2 Circuits

Features & Benefits

- Each circuit block contains a modulator for transmission and a demodulator for reception.
- Built-in channel simulator and speaker amp circuitry
- The channel simulator circuit block enables students to investigate the effects of noise and channel bandwidth on pulse and digital modulation signals
- The speaker amp circuit block permits students to connect a speaker and listen to the signals.
- Communication signals are synchronized for easy display

Optional Manual(s)

Qty	Description	Model number
1	Digital Communications 1 (Student Manual)	589706 (91581-P0) ²³
1	Digital Communications 1 (Student Workbook)	580809 (91581-Q0)
1	Digital Communications 1 (Instructor Guide)	580811 (91581-R0)

Digital Communications 2 581135 (91023-20)



The Digital Communications 2 module enables students to configure, operate, and troubleshoot the following circuits:

- NRZ, RZ, and Manchester Encoding and Decoding
- Clock Synchronizer
- Frequency-Shift Keying (FSK) Generation
- FSK Asynchronous and Synchronous Detection
- Phase-Shift Keying (PSK) Generation
- PSK Asynchronous and Synchronous Detection
- Amplitude-Shift Keying (ASK) Generation
- ASK Asynchronous and Synchronous Detection

²³ The manuals Digital Communications 1, both the student manual and instructor guide, are also available in computer-based format.

- Channel Effects
- FSK Modem

The circuits found on this board include:

- Line Encoding
- Modulators
- Channel Simulator
- Sync Detector
- Modem

This board is available in the following language variants:

- English variant: 91023-20
- French variant: 91023-21
- Spanish variant: 91023-22

Topic Coverage

- Circuit Board Familiarization and Introduction to Digital Transmission
- Encoding and Decoding
- FSK Signal Generation, Asynchronous Detection, Synchronous Detection
- PSK Signal Generation and Synchronous Detection
- ASK Signal Generation and Asynchronous Detection
- Effects of Noise on ASK and PSK Signals
- Effects of Noise on Asynchronously and Synchronously Detected FSK Signals
- Operation of an FSK Modem and DPSK Modem
- Troubleshooting Basics and Troubleshooting Digital Communications 2 Circuits

Features & Benefits

- The Channel Simulator circuit block and a bit error rate (BER) counter enable students to evaluate the effects of noise on ASK and PSK modulated carrier signals.
- The Modem circuit block contains an FSK/DPSK modem IC, which students use in a loop-back mode to observe the entire signal path.
- Communication signals are synchronized for easy display.

Optional Manual(s)

Qty	Description	Model number
1	Digital Communications 2 (Student Workbook)	580817 (91582-Q0)
1	Digital Communications 2 (Instructor Guide)	580819 (91582-R0)

Motors, Generators and Controls 581147 (91024-20)



Speed Control

The circuits found on this board include:

- DC Motor
- AC Synchronous Motor
- Phase Shifter Motor
- Stepper Motor

This board is available in the following language variants:

- English variant: 91024-20
- French variant: 91024-21
- Spanish variant: 91024-22

Topic Coverage

- DC Motor Circuits Familiarization
- Stepper Motor and AC Motor Circuits
- Analog DC Motor Positioning, PWM DC Motor Positioning
- Analog and Pulsed Speed Control of a DC Motor
- Variable Frequency Control
- The Tachometer Generator
- Troubleshooting
- Microprocessor Interface (Requires the Optional 32-Bit Microprocessor Module (91017), plus these accessories: 9 V Power Supply (91730) and Flat Ribbon Cable (91627).)

Features & Benefits

- Built-in tach generator circuit
- Procedures subdivided into short sections for more hands-on training
- Interface with the 32-Bit Microprocessor module
- Students learn the operation and function of:
 - DC motors in analog and pulse servo systems

Using the Motors, Generators and Controls module, students will configure, operate, and troubleshoot the following:

- Permanent-Magnet DC Motor in Series
- Shunt and Compound Motor Speed in Open and Closed Loop Analog and PWM Systems
- DC Servo Motor in Analog and PWM Circuits
- Stepper Motor Operation
- Drive Circuits
- Speed Control and Positioning Circuits
- AC Synchronous Motor with Variable Frequency

- Linear and pulsed signal speed control of dc motors
- Variable frequency control and speed monitoring of synchronous motors
- Speed and position control of stepper motors

Qty	Description	Model number
1	Motors, Generators, and Controls (Student Manual)	_ 589708 (91538-P0) ²⁴
1	Motors, Generators, and Controls (Student Workbook)	580825 (91583-Q0)
1	Motors, Generators, and Controls (Instructor Guide)	580827 (91583-R0)

Specifications

Parameter	Value
Physical Characteristics	
Dimensions (H x W x D)	100 x 303 x 249 mm (4 x 12 x 9.75 in)
Net Weight	1.6 kg (3.5 lb)

Fiber Optic Communications 581159 (91025-20)



The Fiber Optic Communications circuit board provides the student with a solid foundation in the theory and practice of fiber optics and communication techniques. The eleven circuit blocks provide hands-on experimentation with several varieties of fiber optic transmission and reception.

Through the interactive LMS format, the student learns the principles of both analog and digital transmission

and reception using fiber optic data links. The circuit board may be used in the FACET base unit or as a standalone trainer.

- When used in the FACET base unit, the course can be performed through the interactive Learning Management System (LMS) format.
- When used as a stand-alone trainer, the course is performed in a conventional way by using the provided Student and Instructor Guides. An external power source is required if the circuit board is used without a base unit.

This board is available in the following language variants:

- English variant: 91025-20
- French variant: 91025-21
- Spanish variant: 91025-22

²⁴ The manuals Motors, Generators, and Controls, both the student manual and instructor guide, are also available in computer-based format.

Topic Coverage

- Circuit Board Familiarization and Introduction to Fiber Optic Communications
- Scattering and Absorption Losses
- Connectors and Polishing
- Numerical Aperture and Core Area
- Bending Loss and Modal Dispersion
- Light Source
- Driver Circuit
- Source-to-Fiber Connection
- Light Detector
- Output Circuit
- Fiber Optic Test Equipment
- Optical Power Budgets
- Analog Communications
- Digital Communications (Requires the Optional 32-Bit Microprocessor Module (91017), plus these accessories: 9 V Power Supply (91730) and Adapter (31216).)
- Troubleshooting

Features & Benefits

- FACET base unit or stand-alone operation
- Interface with the 32-Bit Microprocessor module
- ST connections
- Multimode 62.5/125 cm cable
- High-speed 820 nm transmitter
- Integrated PIN photodiode and trans-impedance receiver
- Digital and analog communications channels
- Full handshake RS232 interface using time-division multiplexing (TDM) and Manchester coding
- On-board microphone and speaker
- Built-in microphone amplifier, power supply, audioamplifier and photo transmitter
- LED block

Optional Manual(s)

Qty	Description	Model number
1	Fiber Optic Communications (Student Manual)	8097735 (91584-P0) ²⁵
1	Fiber Optic Communications (Student Workbook)	580833 (91584-Q0)
1	Fiber Optic Communications (Instructor Guide)	580835 (91584-R0)

²⁵ The manuals Fiber Optic Communications, both the student manual and instructor guide, are also available in computer-based format.

Power Transistors and GTO Thyristor 581171 (91026-20)



The Power Transistors and GTO Thyristor circuit board enables students to perform hands-on exercises that demonstrate the use of different types of self-commutated switching devices commonly used in power electronics. The module contains the following six different types of self-commutated switching devices: a MOSFET, an isolated-gate bipolar transistor (IGBT), a fast IGBT, a bipolar transistor, a Darlington transistor, and a GTO thyristor. It also

contains Driver and Load sections that help students to study the various switching devices. The Driver consists of an opto-isolator and a driver for power transistors. The Load consists of resistive and inductive components as well as general purpose, fast, and ultra-fast free-wheeling diodes.

Using this training module, students learn the operation of power transistors and GTO thyristors. They observe the switching characteristics, conduction voltage drop, and losses of each switching device. Students also learn how to match free-wheeling diodes with the various types of switching devices mentioned above.

This module enables students to know which switching device should be used in a particular application according to the power levels and switching frequency. The GTO Thyristor integrated in this circuit block finally makes it possible to study GTOs at a small scale, even at very low power levels. With the FACET fault-insertion training system, students develop troubleshooting capabilities for all circuits included in the module as well as for the switching devices.

This board is available in the following language variants:

- English variant: 91026-20
- French variant: 91026-21
- Spanish variant: 91026-22

Topic Coverage

- Power Transistors and GTO Thyristor Identification
- Familiarization with the Driver Circuit Block and Load Circuit Block
- Basic Operations of Power Bipolar Transistors, Power MOSFETs and IGBTs, GTO Thyristors
- Switching Time and Conduction Voltage Drop
- Switching Power in an Inductive Load, Free-Wheeling Diode Recovery Time
- Losses in Electronic Power Switches
- Components: Bipolar Power Transistor, Darlington Power Transistor, GTO Thyristor, Power MOSFET, IGBT, Ultra-Fast IGBT

Optional Manual(s)

Qty	Description	Model number
1	Power Transistors and GTO Thyristor (Student Manual)	580837 (92920-00) ²⁶
1	Power Transistors and GTO Thyristor (Student Workbook)	_ 580845 (92920-Q0)
1	Power Transistors and GTO Thyristor (Instructor Guide)	_ 580847 (92920-R0)

Communications Transmission Lines 581192 (91028-20)



The Transmission Lines circuit board provides students with the theory and measurement skills required to implement and test communications transmission lines. Students first learn the principles and operational characteristics of transmission lines. They then learn how to conduct transmission line measurements under transient (step testing), and sinusoidal steady-state conditions. Finally, students acquire a valuable foundation in the theory and practice

of time-domain reflectometry (TDR), as well as impedance matching and transformation.

The circuit board uses two RG-174 coaxial cables, each a length of 24 meters (78.7 feet). They can be used separately or connected end-to-end. Each line has five probing points that permit observation and measurements of signals along the line, using an oscilloscope.

Two generators are provided to study the transmission line behavior: a step generator that produces a 50-kHz square-wave voltage for transient behavior testing, and a signal generator that produces a sinusoidal voltage of variable frequency (5 kHz - 5 MHz) for steady-state behavior testing. Each generator has several BNC outputs providing different output impedances.

A load section, consisting of a configurable network of resistors, inductors, and capacitors, permits connection of different load impedances to the receiving end of each line.

The circuit board may be used in the FACET base unit, or as a stand-alone trainer.

- When used in the FACET base unit, the course can be performed through the interactive Learning Management System (LMS) format. Moreover, faults can be inserted into the circuits to allow students to develop troubleshooting capabilities.
- When used as a stand-alone trainer, the course is performed in a conventional way by using the provided student manuals and instructor guides. An external power source is required if the circuit board is used without a base unit.

This board is available in the following language variants:

- English variant: 91028-20
- French variant: 91028-21

²⁶ The manuals Power Transistors and GTO Thyristor, both the student manual and instructor guide, are also available in computer-based format.

• Spanish variant: 91028-22

Additional Features

The circuit board may be used in the FACET base unit, or as a stand-alone trainer.

- When used in the FACET base unit, the course can be performed in the interactive computer-based learning (CBL) format. Moreover, faults can be inserted into the circuits to allow students to develop troubleshooting abilities.
- When used as a stand-alone trainer, the course is performed in a conventional way using the provided student manual and instructor guide. An external power source is required if the circuit board is used without a base unit.

Topic Coverage

- Introduction to the Transmission Lines Circuit Board
- Velocity of Propagation
- Behavior of a Transmission Line Under Various Load Impedances
- Attenuation and Distortion
- Determining Characteristic Impedance and Velocity of Propagation By Measuring the Distributed Capacitance and Inductance
- Voltage Reflection Coefficient at the Load and Generator with Purely Resistive Impedances
- Transient Behavior of a Line Terminated By Complex Load Impedances
- Detection and Location of Discontinuities on a Line By Using a Time-Domain Reflectometer (TDR)
- Troubleshooting
- Standing Waves and Voltage Standing-Wave Ratio (VSWR)
- Effect of Attenuation on the VSWR
- The Smith Chart, Resonant Lines, and Impedance Transformation

Optional Manual(s)

Qty	Description	Model number
1	Transmission Lines in Communication Systems (Student Manual)	580353 (36970-00) ²⁷
1	Transmission Lines (Student Workbook)	_ 580359 (36970-Q0)
1	Transmission Lines in Communication Systems (Instructor Guide)	_ 580361 (36970-R0)

²⁷ The manuals Transmission Lines in Communication Systems, both the student manual and instructor guide, are also available in computer-based format.

QPSK / OQPSK / DPSK 581201 (91029-20)



Phase-shift keying (PSK) is a method of digital communication in which the phase of a transmitted signal is varied to convey information.

The QPSK/OQPSK/DPSK circuit board provides students with the theory and measurement skills required to implement and test different types of PSK modulation and demodulation techniques used in pulse-coded modulation (PCM) schemes.

The student first learns the principles

and operational characteristics of unipolar and bipolar signals in a baseband transmission. Next, the student measures and compares BPSK, QPSK, OQPSK, and DPSK signals in the time and frequency domains using an oscilloscope and spectrum analyzer, respectively. Lastly, the student will become familiar with all components of the board; will be able to isolate, identify and test a series of circuits; and will perform troubleshooting exercises to demonstrate mastery of the course objectives.

The circuits found on this board include:

- NRZ Generator
- S/P Converter & Delay
- DPSK Encoder
- Power Supply/Regulator
- Channel Simulator
- Carrier & Phase Shift
- QPSK Modulator_I
- QPSK Modulator_Q
- Adder
- DPSK Decoder
- QPSK Demodulator_I
- QPSK Demodulator_Q
- Amplifier
- P/S Converter

This board is available in the following language variants:

- English variant: 91029-20
- French variant: 91029-21
- Spanish variant: 91029-22

ADDITIONAL FEATURES

- Communication signals are synchronized for easy display
- Digital signals observed in both time and frequency domains
- Courseware interfaces with the Virtual Instrument, Model 1250
- Built-in adjustable NRZ GENERATOR provides various bit pattern streams
- Adjustable bandwidth channel simulator

Topic Coverage

- Digital modulation
- Baseband signals, Passband signals
- Partitioning of pulse streams
- Signal constellations for MPSK, General Equations
- Heterodyning baseband signals with a carrier
- Unipolar and bipolar signals in time domain and in the frequency domain
- Binary PSK (BPSK), Quadratic PSK (QPSK), Offset QPSK (OQPSK), Differential PSK (DPSK) modulation and demodulation

Features & Benefits

- Communication signals are synchronized for easy display
- Digital signals observed in both time and frequency domains
- Courseware interfaces with the Virtual Instrument, Model 1250
- Built-in adjustable NRZ GENERATOR provides various bit pattern streams
- Adjustable bandwidth channel simulator

Optional Manual(s)

Qty	Description	Model number
1	QPSK / OQPSK / DPSK (Student Manual)	580433 (39158-00) ²⁸
1	QPSK/OQPSK/DPSK (Student Workbook)	580437 (39158-Q0)
1	QPSK\OQPSK\DPSK (Instructor Guide)	580439 (39158-R0)

²⁸ The manuals QPSK / DQPSK / DPSK, both the student manual and instructor guide, are also available in computer-based format.

Digital Signal Processor 585736 (91031-20)



The Digital Signal Processor circuit board introduces students to the vast field of digital signal processing and DSP applications. This module is built around a modern DSP and includes all of the peripherals and accessories required to run multiple DSP applications.

A version of Code Composer Studio, a typical Integrated Development Environment (IDE) used to develop, debug, and compile DSP applications,

is bundled with the module. The source code for the applications used in the courseware is also included.

The courseware covers the basic concepts of digital signal processing, as well as DSP architectures, memory, addressing, I/O, and peripherals. It also presents several essential aspects of real-time DSP processing, such as sampling, A/D and D/A conversion, and the fast Fourier transform. Practical techniques such as the use of library functions, DSP application optimization, and digital filtering algorithms, are also covered in the courseware.

The module can be used either with the FACET base unit or without the base unit as a stand-alone trainer. To use the module as a stand-alone trainer, an external +15 V / -15 V dc power source is required to power the circuit board through 4 mm input jacks.

This board is available in the following language variants:

- English variant: 91031-20
- French variant: 91031-21
- Spanish variant: 91031-22



Through a USB port with a computer, a Windows-based software (debugger) allows for a direct interraction with the program DSP registers, memory, and peripherals.

Topic Coverage

- Familiarization with DSPs and DSP programming, Overview of the DSP Circuit Board, The Integrated Development Environment (IDE) and Project Structure
- DSP Architecture, Processor Arithmetic, The Data Computation Unit, Memory, Addressing
- I/O and Peripherals, An Application Using I/Os and Peripherals
- DSP Real-time Processing, Sampling and Analog-to-Digital/Digital-to-Analog Conversion, The Fast Fourier transform (FFT), Optimizing DSP applications
- Signal Processing Applications, FIR and IIR Filters

Features & Benefits

- The module and courseware provide an introduction to DSPs, some typical DSP applications, and how DSPs are programmed. Programming experience may be helpful but is not required to perform the exercises.
- The module features the TMS320C5535 Fixed-Point Digital Signal Processor from Texas Instruments.
- Built-in accessories include a DC source, microphone pre-amplifier, audio amplifier and speaker.
- Built-in peripherals include a CODEC for A/D and D/A conversion, an I/O interface with DIP switches and an LCD display, two interrupt pushbuttons, two USB ports, and an auxiliary I/O block.

Optional Manual(s)

Qty	Description	Model number
1	Digital Signal Processor (Student Manual)	583850 (20197-00)
1	Digital Signal Processor (Instructor Guide)	583851 (20197-10)
1	Digital Signal Processor (Student Workbook)	593865 (20197-Q0)

Accessory Kit 581215 (91052-00)



The Model 91052 is a replacement kit that contains the same accessories as those provided with any of the FACET base units, Model 91000. The kit consists of miniature banana-jack jumpers and leads, alligator clips, and test point pins.

Breadboard 581221 (91091-20)



The Breadboard module is a good complement to Digital Logic Fundamentals (Model 91014) but it can also be used for teachers' custom exercises or student projects. The Breadboard module consists of three printed circuit boards designed so that students can easily connect and change circuits without the need to sold components. Students gain the understanding of the physical characteristics of components like pinouts, size, power, and impedance

voltage limits. The breadboard comes with all the leads and components required to connect the studied circuits. These circuits include astable, bistable, and monostable multivibrators, as well as Schmitt trigger (wave-squaring) circuits. A voltage source powered from the base unit provides the voltages required to power the circuits. These voltages are accessible from an additional solderless breadboard. The practical, hands-on approach of the courseware guides students in the observation and measurement of signals with an oscilloscope. As a prerequisite, students should be familiar with the operation of bipolar transistor circuits.

This board is available in three different languages: English, French, and Spanish. In this data sheet, the boards are listed in English by default. This is indicated by the -20 at the end of the board part number. To obtain the same board in French, replace the -20 by -21, and to obtain it in Spanish, replace the -20 by -22.

List of Manuals

Description	Manual
	number
Basics of Multivibrator Circuits (Student Manual)	580399 (37967-00)
Basics of Multivibrator Circuits (Instructor Guide)	580400 (37967-10)

Table of Contents of the Manual(s)

Basics of Multivibrator Circuits (Student Manual) (580399 (37967-00))

- 1 Astable Multivibrator
- 2 Bistable Multivibrator
- 3 Monostable Multivibrator
- 4 Schmitt Trigger

Topic Coverage

- Astable Multivibrator
- Bistable Multivibrator
- Monostable Multivibrator
- Schmitt Trigger

Features & Benefits

- Three printed circuit boards designed so that students can easily connect and change circuits without the need to solder components.
- All the leads and components required to connect the studied circuits.
- Astable, bistable, and monostable multivibrators
- Schmitt trigger (wave-squaring) circuits

Optional Manual(s)

Qty	Description	Model number
1	Basics of Multivibrator Circuits (Student Manual)	580399 (37967-00)
1	Basics of Multivibrator Circuits (Instructor Guide)	580400 (37967-10)

Microprocessor Application Board 581224 (91602-20)



The Microprocessor Application Board is an add-on to the 32-Bit Microprocessor, Model 91017. It allows students to study how microprocessors can control and communicate with external devices. The Application Board has two application circuits: a DC Motor Controller and a Temperature Controller.

The DC Motor Controller has a motor whose speed and direction of rotation

can be controlled by the microprocessor. Mounted on the motor's shaft is a fan blade that makes it easier for students to see the direction of rotation. The motor's shaft also has an encoder disk with optical interrupter that provides feedback on the motor speed to the microprocessor, allowing closed-loop control of the motor speed.

The Temperature Controller uses two temperature transducers whose output current is a function of their temperature. One transducer is thermally bonded to a resistor that is used as a heater. The microprocessor controls the turning on and turning off of the heater, whose status is indicated by an LED indicator. The other transducer is used as a room-temperature reference, allowing the microprocessor to perform closed-loop control of the temperature.

The Microprocessor Application Board interfaces to the 32-Bit Microprocessor Board via I/O control lines and digital-to-analog (DAC) and analog-to-digital (ADC) converters. Test points on the Application Board permit the monitoring of the digital and analog signals exchanged between the Microprocessor and Application Boards, using an oscilloscope, logic probe, or voltmeter.

Manual

Description

Microprocessor Application Board (User Guide) _____

Manual number 585395 (91747-00)

Model

number

Table of Contents of the Manual(s)

Microprocessor Application Board (User Guide) (585395 (91747-00))

- 1 Motor Speed and Direction Control
- 2 Switched Mode Motor Control
- 3 Open Loop Heater Control
- 4 Closed Loop Temperature Controller

Optional Manual(s)

Qty Description

1	Microprocessor Application Board (User Guide)	585395 (91747-00)

Specifications

Parameter	Value
Physical Characteristics	
Dimensions (H x W x D)	57 x 238 x 149 mm (2.5 x 9.25 x 5.75 in)
Net Weight	0.8 kg (1.8 lb)

Optional Equipment Description

Dual-Trace Digital Storage Oscilloscope (Optional) 585695 (798-10)



The Dual-Trace Digital Storage Oscilloscope is a low-cost oscilloscope that is ideally suited for general purpose use in any classroom laboratory. Two low capacitance probes are included with the unit.

Features & Benefits

- Color, 17.8 cm (7 in) liquid crystal display
- Multi-language, on-display menu
- 50 MHz bandwidth
- 1 GSa/s maximum sampling rate
- 10 ns/div to 50 s/div time base
- 2 mV/div to 10V/div vertical sensitivity
- ±3% accuracy
- USB and RS 232 ports
- Compact design
- Light weight

Digital Multimeter / Function Generator (Optional) 580851 (1247-10)



The Digital Multimeter / Function Generator is a compact, generalpurpose instrumentation module that provides the necessary test equipment (except the oscilloscope) to perform the courses in the FACET program. The module consists of a sine/square/ triangle waveshape function generator and an auto-ranging digital multimeter. All instruments share a common power input and are housed in a portable enclosure.

All components, switches, and terminals are mounted in a tamper-resistant manner. The module's design protects the instruments from inadvertent short circuits and overloads in the context of the FACET training system.

Manual

Description	Manual number
Digital Multimeter / Function Generator (User Guide)	583878 (20799-E0)

Features & Benefits

- Easy-to-read, silk-screened front panel
- 3¹/₂ digit auto-ranging multimeter
- Function generator
- A tilt bail is included and can be attached using a screwdriver

FACET[®] Storage Enclosure (Optional) 585728 (1369-00)



The FACET[®] Storage Enclosure is a portable enclosure that can house up to ten modules (boards) of the FACET program. The enclosure includes a locking cover and a carrying handle.

Specifications

Parameter	Value
Physical Characteristics	
Dimensions (H x W x D)	569 x 341 x 273 mm (22.4 x 13.4 x 10.7 in)
Net Weight	8.2 kg (18 lb)

MindSight Learning Content Management System - Network Appliance (Optional) 588921 (47513-00)

This variant includes the server that will be linked into your institution's LAN and the software required to run coursewares. The appliance will be licensed with all the eSeries curricula purchased and no further fees are required. An extended warranty can be purchased yearly and provides curriculum updates and replacement appliances if needed. It does not include any installed courseware.

List of Manuals

Description	Manu numb	
MindSight Installation and User Guide (User Guide)	585170 (86292-S0)	
MindSight User Guide (Student Guide)	585302 (88940-Q0)	

Power Cord - Nema 5-15 (Optional) 582145 (86331-00)



This power cord connects the equipment to a wall outlet. It is intended for use in North America, Central America, Brazil, Colombia, Ecuador, Korea, Japan, Taiwan, Thailand, and the Philippines. Power Cord - AS 3112 (Optional) 582147 (86331-0A)



Power Cord - CEE 7 (Optional) 582146 (86331-05)



others.

Power Cord - BS 1363 (Optional) 582148 (86331-G0)



Power Cord - SEV 1011 (Optional) 582150 (86331-J0)



Power Cord - CEI 23-50 (Optional) 582151 (86331-L0)



This power cord connects the equipment to a wall outlet. It is intended for use in Australia, New Zealand, China, and Argentina.

This power cord connects the equipment to a wall outlet. It is intended for use in many countries of Europe, including: Austria, Belgium, Germany, Spain, France, Finland, Portugal, Norway, Sweden, and

This power cord connects the equipment to a wall outlet. It is intended for use in the United Kingdoms, Ireland, Malaysia, Singapore, Ukraine, Hong Kong, and the United Arab Emirates.

This power cord connects the equipment to a wall outlet. It is intended for use in Switzerland.

This power cord connects the equipment to a wall outlet. It is intended for use in Italy and Chile. Power Cord - NBR 14136 (Optional) 582152 (86331-N0)



This power cord connects the equipment to a wall outlet. It is intended for use in Brazil.

Extended Warranty for the FACET[®] Electronics Training System (Optional) 595869 (91000-EW)

The Festo Didactic Extended Warranty program offers you the flexibility to add to the standard two-year manufacturer's warranty. The Extended Warranty provides coverage for up to three additional years, for a total of five years of protection on your investment for your electronics training equipment.

Extended Warranty terms are the same as the terms for the current two-year manufacturer warranty.

Accessory Kit (Optional) 581215 (91052-00)



The Model 91052 is a replacement kit that contains the same accessories as those provided with any of the FACET base units, Model 91000. The kit consists of miniature banana-jack jumpers and leads, alligator clips, and test point pins.

Microprocessor Application Board (Optional) 581224 (91602-20)



The Microprocessor Application Board is an add-on to the 32-Bit Microprocessor, Model 91017. It allows students to study how microprocessors can control and communicate with external devices. The Application Board has two application circuits: a DC Motor Controller and a Temperature Controller.

The DC Motor Controller has a motor whose speed and direction of rotation

can be controlled by the microprocessor. Mounted on the motor's shaft is a fan blade that makes it easier for students to see the direction of rotation. The motor's shaft also has an encoder disk with optical interrupter that provides feedback on the motor speed to the microprocessor, allowing closed-loop control of the motor speed.

The Temperature Controller uses two temperature transducers whose output current is a function of their temperature. One transducer is thermally bonded to a resistor that is used as a heater. The microprocessor controls the turning on and turning off of the heater, whose status is indicated by an LED indicator. The other transducer is used as a room-temperature reference, allowing the microprocessor to perform closed-loop control of the temperature.

The Microprocessor Application Board interfaces to the 32-Bit Microprocessor Board via I/O control lines and digital-to-analog (DAC) and analog-to-digital (ADC) converters. Test points on the Application Board permit the monitoring of the digital and analog signals exchanged between the Microprocessor and Application Boards, using an oscilloscope, logic probe, or voltmeter.

Manual

Description	Manual number
Microprocessor Application Board (User Guide)	585395 (91747-00)

Table of Contents of the Manual(s)

Microprocessor Application Board (User Guide) (585395 (91747-00))

- 1 Motor Speed and Direction Control
- 2 Switched Mode Motor Control
- 3 Open Loop Heater Control
- 4 Closed Loop Temperature Controller

Optional Manual(s)

Qty	Description	Model number
1	Microprocessor Application Board (User Guide)	585395 (91747-00)

Specifications

Parameter	Value
Physical Characteristics	
Dimensions (H x W x D)	57 x 238 x 149 mm (2.5 x 9.25 x 5.75 in)
Net Weight	0.8 kg (1.8 lb)

Complete FACET Module Curriculum Bundle (All 29 modules) - eSeries (Optional) 585743 (94600-E0)



Model 94600 consists of the complete FACET module curriculum.

The following learning platforms are available:

- 94600-E0 Complete FACET Module Curriculum Bundle – eSeries – EN
- 94600-E2 Complete FACET Module Curriculum Bundle – eSeries – ES
- 94600-F0 Complete FACET Module Curriculum Bundle – SCORM – EN
- 94600-G0 Complete FACET Module Curriculum Bundle Stand-Alone EN
- 94600-G2 Complete FACET Module Curriculum Bundle Stand-Alone ES

Complete FACET Module Curriculum Bundle (all 29 modules) - Stand-Alone (Optional) 585746 (94600-G0)

Model 94600 consists of the complete FACET module curriculum.

The following learning platforms are available:

- 94600-E0 Complete FACET Module Curriculum Bundle eSeries EN
- 94600-E2 Complete FACET Module Curriculum Bundle eSeries ES
- 94600-F0 Complete FACET Module Curriculum Bundle SCORM EN
- 94600-G0 Complete FACET Module Curriculum Bundle Stand-Alone EN
- 94600-G2 Complete FACET Module Curriculum Bundle Stand-Alone ES

FACET Module Curriculum Bundle, Basic Electricity and Electronics - eSeries (Optional) 585750 (94601-E0)



This FACET Module Curriculum Bundle consists of the courseware for basic electricity and electronics, Models 91001, 91002, 91003, 91004, 91005, 91006, 91007, 91008, 91009, 91010, 91011, 91012, 91013, and 91020.

The following learning platforms are available:

- 94601-E0 FACET Module Curriculum Bundle, Basic Electricity and Electronics – eSeries – EN
- 94601-E2 FACET Module Curriculum Bundle,

Basic Electricity and Electronics – eSeries – ES

- 94601-F0 FACET Module Curriculum Bundle, Basic Electricity and Electronics SCORM EN
- 94601-G0 FACET Module Curriculum Bundle, Basic Electricity and Electronics Stand-Alone EN
- 94601-G2 FACET Module Curriculum Bundle, Basic Electricity and Electronics Stand-Alone ES

FACET Module Curriculum Bundle, Basic Electricity and Electronics - Stand-Alone (Optional) 585753 (94601-G0)

This FACET Module Curriculum Bundle consists of the courseware for basic electricity and electronics, Models 91001, 91002, 91003, 91004, 91005, 91006, 91007, 91008, 91009, 91010, 91011, 91012, 91013, and 91020.

The following learning platforms are available:

- 94601-E0 FACET Module Curriculum Bundle, Basic Electricity and Electronics eSeries EN
- 94601-E2 FACET Module Curriculum Bundle, Basic Electricity and Electronics eSeries ES
- 94601-F0 FACET Module Curriculum Bundle, Basic Electricity and Electronics SCORM EN
- 94601-G0 FACET Module Curriculum Bundle, Basic Electricity and Electronics Stand-Alone EN
- 94601-G2 FACET Module Curriculum Bundle, Basic Electricity and Electronics Stand-Alone ES

FACET Module Curriculum Bundle, Digital and Microprocessor Electronics - eSeries (Optional) 585757 (94602-E0)



This FACET Module Curriculum Bundle consists of the courseware for digital and microprocessor electronics, Models 91014, 91015, 91016, 91017, 91030, and 91031.

The following learning platforms are available:

94602-E0 – FACET Module Curriculum Bundle, Digital and Microprocessor Electronics – eSeries – EN

94602-E2 – FACET Module Curriculum Bundle, Digital and Microprocessor Electronics – eSeries – ES

94602-F0 – FACET Module Curriculum Bundle, Digital and Microprocessor Electronics – SCORM –

ΕN

- 94602-G0 FACET Module Curriculum Bundle, Digital and Microprocessor Electronics Stand-Alone EN
- 94602-G2 FACET Module Curriculum Bundle, Digital and Microprocessor Electronics Stand-Alone ES

FACET Module Curriculum Bundle, Digital and Microprocessor Electronics - Stand-Alone (Optional) 585760 (94602-G0)

This FACET Module Curriculum Bundle consists of the courseware for digital and microprocessor electronics, Models 91014, 91015, 91016, 91017, 91030, and 91031.

The following learning platforms are available:

- 94602-E0 FACET Module Curriculum Bundle, Digital and Microprocessor Electronics eSeries EN
- 94602-E2 FACET Module Curriculum Bundle, Digital and Microprocessor Electronics eSeries ES
- 94602-F0 FACET Module Curriculum Bundle, Digital and Microprocessor Electronics SCORM EN
- 94602-G0 FACET Module Curriculum Bundle, Digital and Microprocessor Electronics Stand-Alone EN
- 94602-G2 FACET Module Curriculum Bundle, Digital and Microprocessor Electronics Stand-Alone ES

FACET Module Curriculum Bundle, Industrial Electronics - eSeries (Optional) 585763 (94603-E0)



This FACET Module Curriculum Bundle consists of the courseware for industrial electronics, Models 91010, 91011, 91019, 91024, and 91026.

The following learning platforms are available:

94603-E0 – FACET Module Curriculum Bundle, Industrial Electronics – eSeries – EN 94603-E2 – FACET Module Curriculum Bundle, Industrial Electronics – eSeries – ES 94603-F0 – FACET Module Curriculum Bundle, Industrial Electronics – SCORM – EN 94603-G0 – FACET Module Curriculum Bundle, Industrial Electronics – Stand-Alone – EN 94603-G2 – FACET Module Curriculum Bundle, Industrial Electronics – Stand-Alone – ES

FACET Module Curriculum Bundle, Industrial Electronics - Stand-Alone (Optional) 585766 (94603-G0)

This FACET Module Curriculum Bundle consists of the courseware for industrial electronics, Models 91010, 91011, 91019, 91024, and 91026.

The following learning platforms are available:

- 94603-E0 FACET Module Curriculum Bundle, Industrial Electronics eSeries EN
- 94603-E2 FACET Module Curriculum Bundle, Industrial Electronics eSeries ES
- 94603-F0 FACET Module Curriculum Bundle, Industrial Electronics SCORM EN
- 94603-G0 FACET Module Curriculum Bundle, Industrial Electronics Stand-Alone EN
- 94603-G2 FACET Module Curriculum Bundle, Industrial Electronics Stand-Alone ES

FACET Module Curriculum Bundle, Communications - eSeries (Optional) 585769 (94604-E0)



This FACET Module Curriculum Bundle consists of the courseware for communications, Models 91018, 91022, 91023, 91025, 91028, 91029, and 91031.

The following learning platforms are available:

• 94604-E0 – FACET Module Curriculum Bundle, Communications – eSeries – EN

- 94604-E2 FACET Module Curriculum Bundle, Communications eSeries ES
- 94604-F0 FACET Module Curriculum Bundle, Communications SCORM EN
- 94604-G0 FACET Module Curriculum Bundle, Communications Stand-Alone EN
- 94604-G2 FACET Module Curriculum Bundle, Communications Stand-Alone ES

FACET Module Curriculum Bundle, Communications - Stand-Alone (Optional) 585772 (94604-G0)

This FACET Module Curriculum Bundle consists of the courseware for communications, Models 91018, 91022, 91023, 91025, 91028, 91029, and 91031.

The following learning platforms are available:

- 94604-E0 FACET Module Curriculum Bundle, Communications eSeries EN
- 94604-E2 FACET Module Curriculum Bundle, Communications eSeries ES
- 94604-F0 FACET Module Curriculum Bundle, Communications SCORM EN
- 94604-G0 FACET Module Curriculum Bundle, Communications Stand-Alone EN
- 94604-G2 FACET Module Curriculum Bundle, Communications Stand-Alone ES

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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