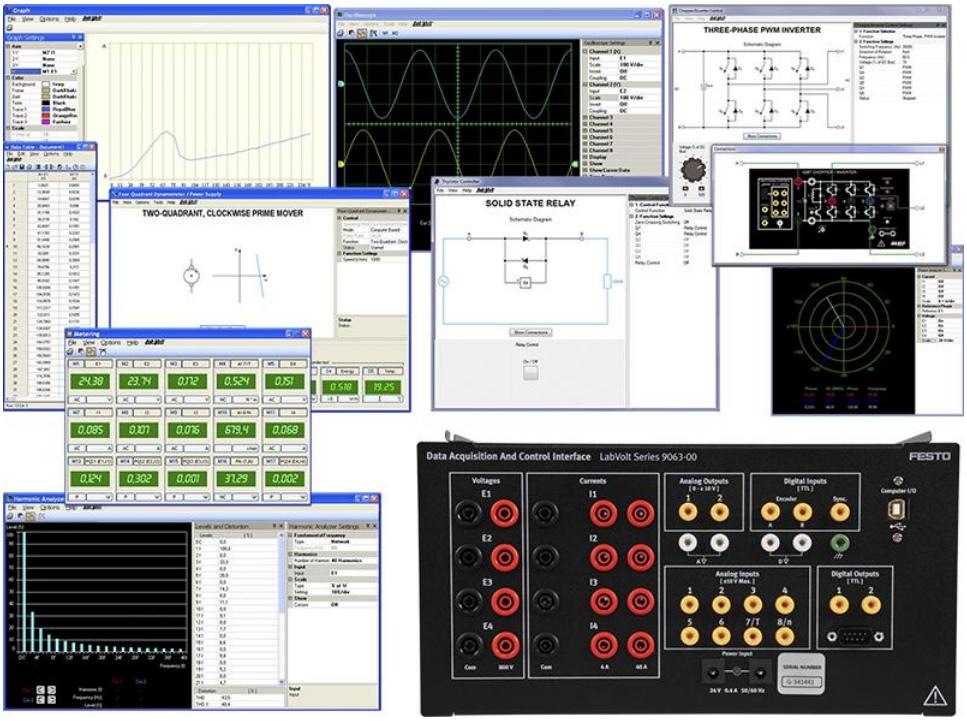
Data Acquisition and Control Interface
9063

LabVolt Series

Datasheet



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Festo Didactic
en 220 V - 60 Hz
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Table of Contents

General Description

The Data Acquisition and Control Interface (DACI) is a versatile USB peripheral enclosed in a half-size EMS module. The DACI is intended to be used with the LVDAC-EMS software. Together, the DACI and LVDAC-EMS provide a complete set of modern computer-based instruments to measure, observe, analyze, and control electrical and mechanical parameters. The provided instruments include voltmeters, ammeters, power meters, frequency meters, efficiency meters, impedance meters, power factor meters, energy meters, torque and speed meters, an oscilloscope, a phasor analyzer, a harmonic analyzer, and a spectrum analyzer. The DACI and LVDAC-EMS also allow manual and timed data recording. The recorded data can be saved to files in any specified location, graphically represented with the provided graph plotting tool, and exported into a spreadsheet application.

The DACI and LVDAC-EMS can also be used with the Four-Quadrant Dynamometer/Power Supply, Model 8960, to implement a variety of control functions for advanced training in various fields of electricity and new energy, including electric power technology, ac/dc rotating machines, renewable energy, transmission lines, and power electronics.

The DACI performs data acquisition to feed raw signal data to the LVDAC-EMS computer based instruments, and it performs various types of control functions, mainly to control the electronic switches of the IGBT Chopper/Inverter module, Model 8837, or those of the Power Thyristors module, Model 8841.

To activate data acquisition for a specific computer-based instrumentation function, a license for this function must be ordered for each DACI on which the function is to be used. Similarly, to activate a specific control function, a license for this function must be ordered for each DACI on which the function is to be used.

The firmware (program used to run the microcontroller) of the DACI can be upgraded anytime by using the device firmware upgrade (DFU) included with the latest version of LVDAC-EMS available on the Festo Didactic website.

The DACI and the LVDAC-EMS software are standard features in the Electric Power Technology Training Systems, Series 8010, and in the Computer-Assisted 0.2 kW Electromechanical Training System, Model 8006.

The DACI and the LVDAC-EMS software can also be excellent add-ons to several other training systems, such as:

- 0.2 kW Electromechanical Training System, Model 8001
- 2 kW Electromechanical Training System, Model 8013
- 0.2 kW Power Electronics Training System, Model 8032
- 0.2 kW Electric Power Transmission Training System, Model 8055
- 2 kW Electric Power Transmission Training System, Model 8059

Note: each DACI, Model 9063-0X, must be ordered with at least one function license (e.g., the Computer-Based Instrumentation Function Set, Model 9069-1) unless it is an extension module to another Model 9063-xx which has a control function that needs an extension module (like the Three-Phase PWM Rectifier/Inverter Control Function Set, Model 9069-5, or the High-Voltage DC Transmission System Control Function, Model 9069-7).

Model 9063 – Data Acquisition and Control Interface

The Data Acquisition and Control Interface (DACI) performs two main functions: data acquisition feeding raw signal data to the computer-based instruments, and data acquisition for implementing a control function. Each DACI can perform these two functions at the same time. However, when a complex control function is implemented, the DACI stops data acquisition for the computer-based instruments and performs only data acquisition for the control function.

The DACI has four isolated, high-level voltage inputs and four isolated, high-level current inputs. All these inputs are fitted with 4 mm banana safety jacks to make connections to electric power circuits quick, safe, and easy. The DACI also has eight low-level, analog inputs which allow measurement of other circuit parameters. Two of these inputs can be used to measure torque and speed using a dynamometer (Model 8960-1 or 8960-2).

Finally, the DACI is provided with three digital inputs which can be monitored through the LVDAC-EMS software. Two of these digital inputs are used as an incremental encoder input (A-B) for speed measurement and the third input is used for synchronization. The eight low-level analog inputs and the three digital inputs are all fitted with miniature (2 mm) safety banana jacks to avoid accidental connection to high-level outputs.

The DACI has a parallel digital output which can be used to control power electronics modules like the IGBT Chopper/Inverter, Model 8837, and the Power Thyristors, Model 8841. This output can also be used to control other types of modules. The parallel digital output provides TTL-level signals on a 9-pin, D-type connector. The DACI includes two additional digital outputs that also provide TTL-level signals. The DACI also includes two software-programmable analog outputs which can be used to control a dynamometer or a power electronics module. The two additional digital outputs and the two analog outputs are all fitted with miniature (2 mm) safety banana jacks. All inputs and outputs of the DACI are protected against improper connections and overvoltage/ overcurrent conditions.

The user guide included with the DACI provides detailed information about the module operation. Interconnection between the DACI and the personal computer running software LVDAC-EMS is through a standard USB cable included with the module.

To activate the data acquisition for any instrumentation function, a license for that specific instrumentation function must be ordered for each DACI that will be used with the instrumentation function. Similarly, to activate the data acquisition for any specific control function, a license for that specific function, must be ordered for each DACI that will be used to perform this control function.

Model Variants

The DACI is available in several model variants. Each variant has a unique combination of functions pre-activated in its hardware. The available model variants are listed in the following table. Other model variants will be added to the table as they become available.

Description		Variant (Model 9063-X)									
Function Sets	Part Number	-0	-A	-B	-C	-D	-E	-F	-G	-H	-J
Complete Function Set	9069-0		●								
Computer-Based Instrumentation	9069-1			●	●	●	●	●	●	●	●
Chopper/Inverter Control	9069-2				●	●	●	●			
Thyristor Control	9069-3					●				●	●
Home Energy Production Control	9069-4						●	●		●	
Three-Phase PWM Rectifier/Inverter Control	9069-5							●			
BLDC Motor/PMSM Control	9069-6										
High-Voltage DC (HVDC) Transmission System Control	9069-7									●	●
Static Var Compensator (SVC) Control	9069-8									●	●
Software Development Kit (SDK)	9069-9										
Synchronous Generator Control	9069-A										
Static Synchronous Compensator (STATCOM) Control	9069-B									●	●
Synchroscope	9069-C								●		
Doubly-Fed Induction Generator (DFIG) Control	9069-D										
Power Line Series Compensation	9069-S										

DACIs with a specific combination of pre-activated functions other than those listed above can also be ordered. To order a customized DACI, request DACI Model 9063-0 (DACI with no functions pre-activated) and state each function (Model 9069-X) you wish to be pre-activated.

It is important to know that LVDAC-EMS can accept more than one Data Acquisition and Control interface connected through USB on a single computer. When connected to the same computer, two DACIs will share their control functions. It means, for instance, that in the High-Voltage DC Transmission System application which requires two DACIs to control two separate Power Thyristors modules, Model 8841-2, you would only need one DACI that has the High-Voltage DC (HVDC) Transmission System Control Function Set, Model 9069-7, activated. Then, any other DACI connected to the same computer will be able to use the shared control function as well.

LVDAC-EMS Software

The LVDAC-EMS software is a freeware which can be downloaded anytime from the Festo Didactic website (www.labvolt.com). The LVDAC-EMS software is a user-friendly tool that facilitates the use of the various functions which can be implemented with USB peripherals such as the Data Acquisition and Control Interface (DACI), Model 9063, and the Four-Quadrant Dynamometer / Power Supply, Model 8960-2.

The LVDAC-EMS software also includes a firmware update for the DACI. When a DACI is connected to a newer version of LVDAC-EMS, the user can easily update the module using a simple update wizard.

LVDAC-EMS Functions

The functions that are currently available for the DACI, Model 9063, are described below. All functions can be activated in any DACI by purchasing a license for that specific function and then performing the upgrade procedure on the DACI. New functions will be added to this datasheet as they become available.

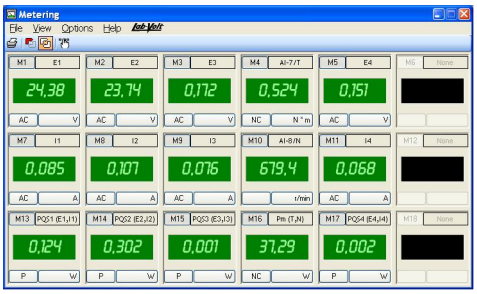
Instrumentation Functions

The instrumentation functions of LVDAC-EMS replace a multitude of actual data acquisition devices (e.g., voltmeters, ammeters, oscilloscopes, synchroscopes) with a series of computer-based instruments that display the data measured by the DACI. The instrumentation functions currently available in LVDAC-EMS are described below.

Model 9069-1 – Computer-Based Instrumentation Function

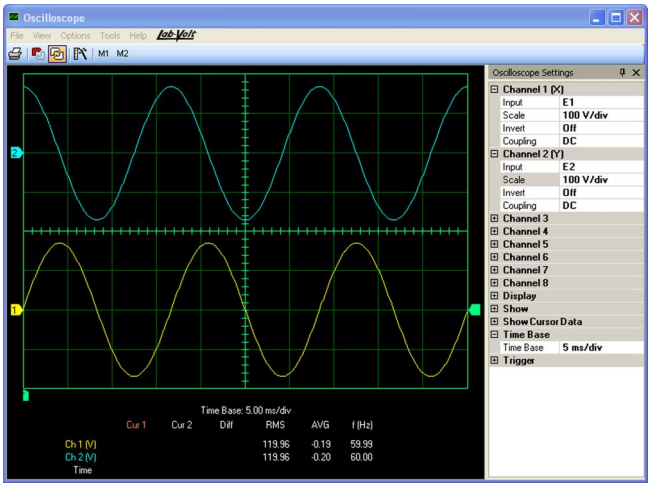
The Computer-Based Instrumentation Function, Model 9069-1, includes the following computer-based instruments:

- Metering
- Data Table and Graph
- Oscilloscope
- Phasor Analyzer
- Harmonic Analyzer



Metering

The Metering window displays up to eighteen meters that can be configured to measure a multitude of parameters (e.g., voltage, current, active power, reactive power, apparent power, efficiency, impedance, power factor, frequency, energy, torque, speed, mechanical power, phase angle, phase shift). The name of each meter can be edited to identify the measured circuit parameter. The voltage and current meters have several modes of operation that allow measurement of the mean (DC) value, RMS value, crest factor, RMS value of a particular harmonic (up to the 15th), RMS value of the harmonics, and total harmonic distortion (THD). The layout of the meters in the Metering window can be customized by the user.

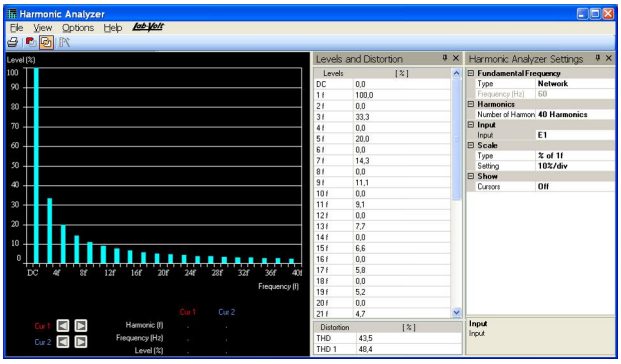


Oscilloscope

The Oscilloscope can display up to eight waveforms simultaneously. Each waveform is of a different color for easy identification. Each channel has independent vertical controls similar to those found on conventional oscilloscopes. An automatic scale setting function allows the sensitivity of each channel to be set automatically according to the magnitude of the observed parameter. The time base and trigger controls are similar to those found on most oscilloscopes. The RMS value, average value, and frequency of each of the observed parameters can be displayed in a table in the Oscilloscope window. Two vertical cursors can be activated to perform precise measurements at particular points on the displayed waveforms. The Oscilloscope has two memory channels for saving the displayed waveforms.

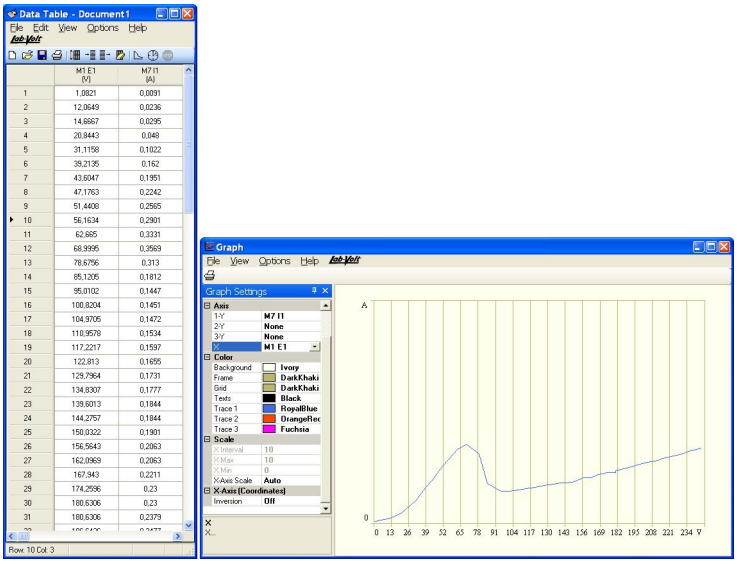
Phasor Analyzer

The innovative Phasor Analyzer displays the phasors related to measured voltages and currents instead of the values and waveforms related to these voltages and currents. The Phasor Analyzer allows circuit voltages and currents to be monitored easily for relative amplitudes and phase differences simply by looking at their respective phasors. This produces a unique and dynamic display of the voltages and currents in a circuit (especially in three-phase circuits) that cannot be obtained with conventional instruments. The RMS value, phase angle, and frequency of the voltage or current related to each phasor are displayed in a table in the Phasor Analyzer window.



Harmonic Analyzer

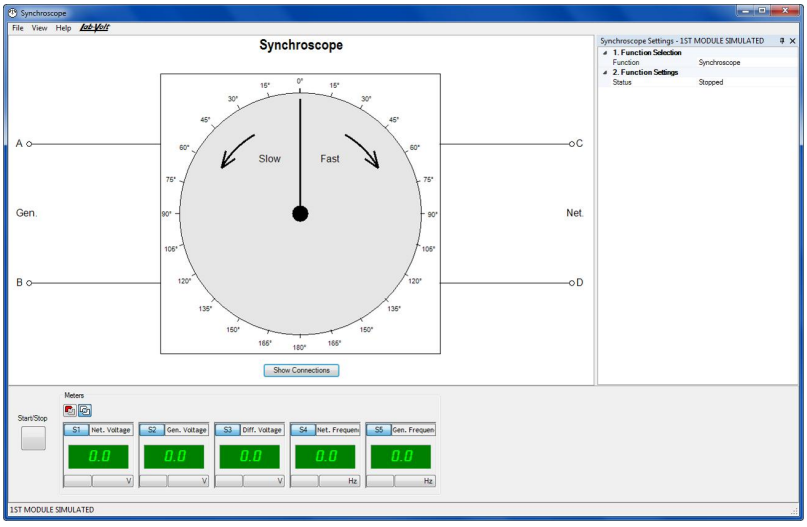
The Harmonic Analyzer allows observation and analysis of the harmonic components in the measured voltages and currents. The fundamental frequency can either be set to the ac power network frequency, manually by the user, or automatically to the frequency of the fundamental component of the selected voltage or current. The number of harmonic components displayed can be varied between 5 and 40. The harmonic components of the selected voltage or current can be displayed using a vertical scale graduated in either absolute or relative values. Various vertical scale settings are available. A group of data displays in the Harmonic Analyzer indicates the values of the dc component, fundamental component, and harmonic components of the selected voltage or current, as well as the total harmonic distortion (THD). Vertical and horizontal cursors can be activated to perform precise measurements at particular points on the display.



Data Table and Graph

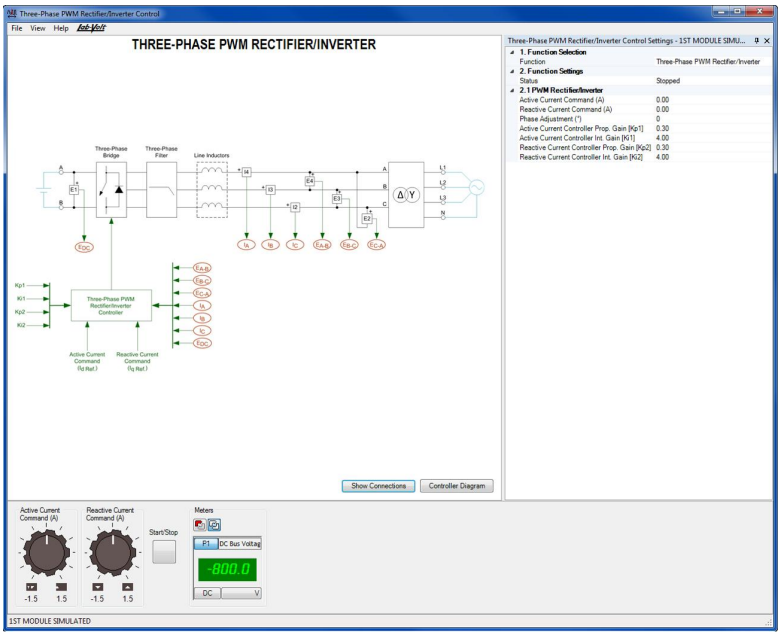
The values indicated by the meters or indicators of all computer-based instruments and control functions (see later in this section for more detail about control functions) in LVDAC-EMS can be recorded in the Data Table window. A timer option is provided to help record data at specific time intervals. The values recorded in the Data Table can be saved to a file. The recorded data can also be used to plot graphs by selecting which parameter(s) to plot in the Graph window. This allows lab results to be plotted quickly and easily. More complex graphs can be created by exporting the contents of the Data Table window to any popular spread sheet program, such as Microsoft® Excel®.

Model 9069-C – Synchroscope Function



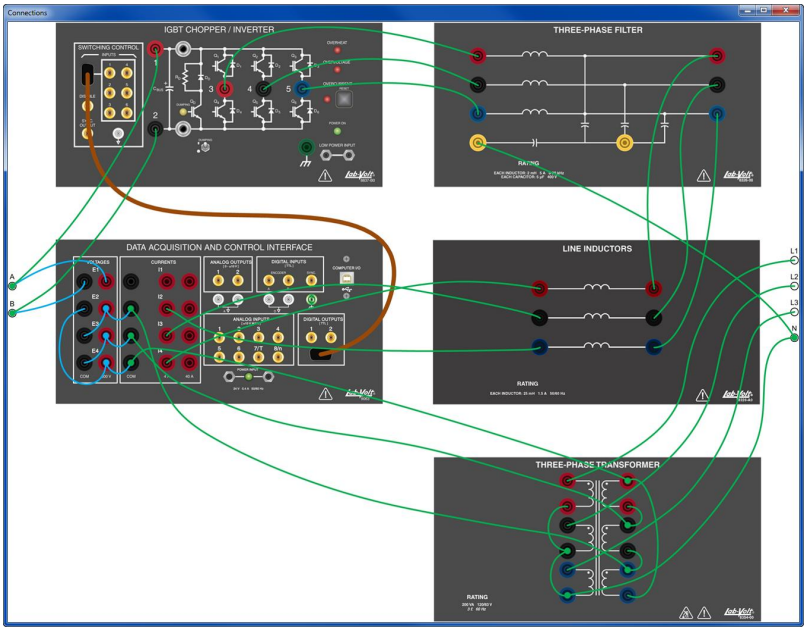
The Synchroscope Function is used for the synchronization of synchronous generators. This function emulates the operation of an actual synchroscope by showing on-screen the dial indicating the phase angle difference between the generator voltage and the network voltage. In addition, the Synchroscope Function includes meters displaying various parameters important to generator synchronization (e.g., network voltage and frequency, generator voltage and frequency, voltage difference between the network and the generator).

Control Function Sets



Example of a control function window.

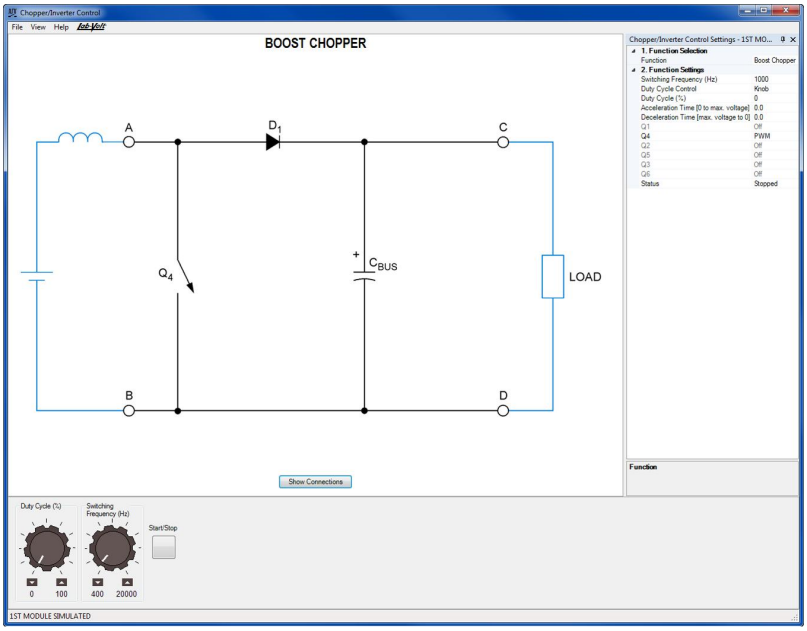
Several sets of computer-based functions (function sets) allowing control of power electronics modules can be activated in the DACI. Each control function in a set allows the implementation of a power electronics device or system. Control of any of the required power electronics modules is achieved by first connecting the DACI to both the host computer (via a USB connection) and to the required power electronics module, and accessing the desired control function via the LVDAC-EMS software running on the host computer. Each control function has a specific set of user-friendly controls for easy operation of the device implemented (see figure on the right for an example of a control function window).



Example of a connection diagram accessed from a control function window.

Each control function also gives access to one or more schematic and connection diagrams (see figure on the right for an example of a connection diagram) that show all connections required to implement the device. The switching and/or firing signals necessary to control the implemented device are produced by the DACI and routed to the power electronics module used. The control function sets currently available in LVDAC-EMS are described in the following pages.

Model 9069-2 – Chopper/Inverter Control Function Set

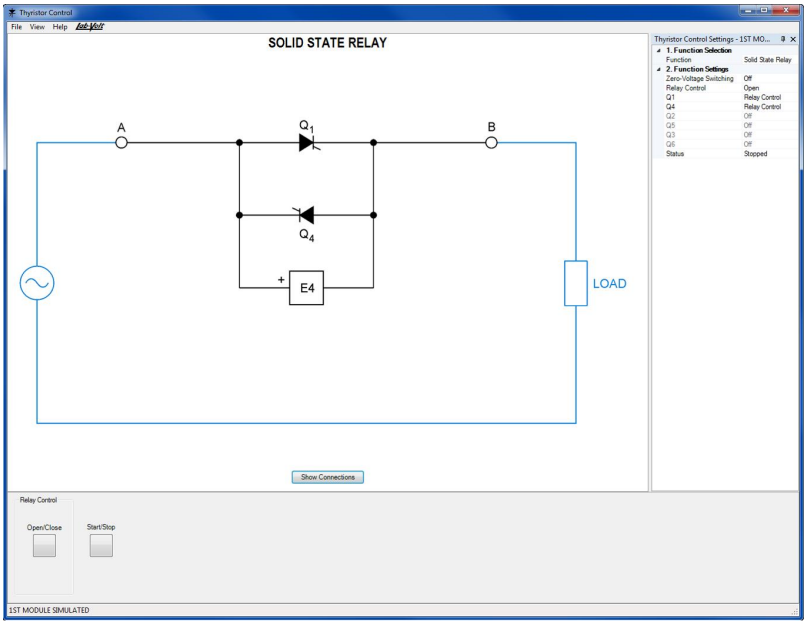


The Chopper/Inverter Control Function Set enables the following choppers and inverters to be implemented using the DACI and the IGBT Chopper/ Inverter, Model 8837-B:

Buck Chopper (high-side switching)
Buck Chopper (low-side switching)
Buck/Boost Chopper
Boost Chopper
Four-Quadrant Chopper
Buck Chopper with Feedback
Boost Chopper with Feedback
Single-Phase, 180° Modulation Inverter
Single-Phase PWM Inverter
Three-Phase, 180° Modulation Inverter
Three-Phase PWM Inverter

- Three-Phase PWM Inverter (constant V/f ratio)
- Insulated DC-to-DC Converter
- Four-Quadrant DC Motor Drive without Current Control
- Four-Quadrant DC Motor Drive

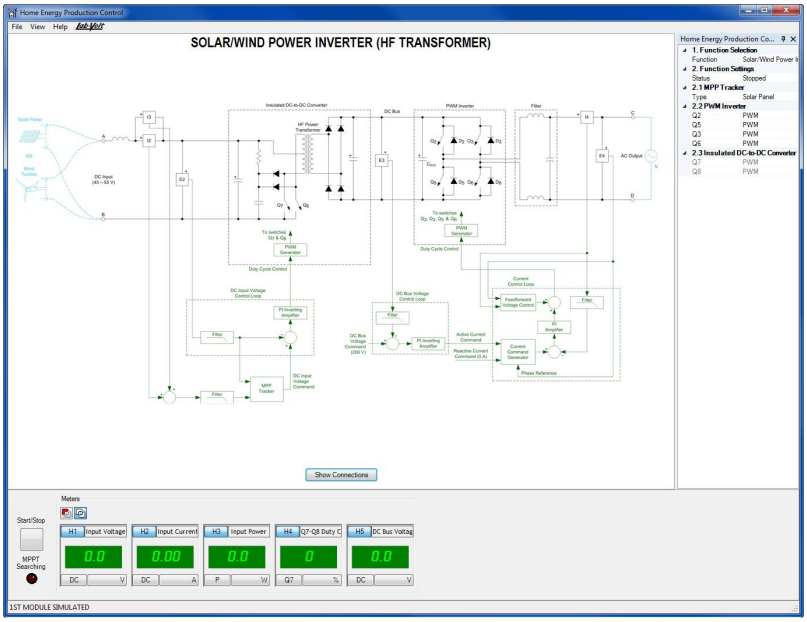
Model 9069-3 – Thyristor Control Function Set



The Thyristor Control Function Set enables the following thyristor-based devices to be implemented using the DACI and the Power Thyristors, Model 8841:

Thyristor Single-Phase Half-Wave Rectifier
Thyristor Single-Phase Bridge
Thyristor Three-Phase Bridge
Thyristor Three-Phase Bridge with Feedback
Solid-State Relay
Thyristor Single-Phase AC Power Control
Thyristor Three-Phase AC Power Control
Direct-On-Line Starter
Soft Starter

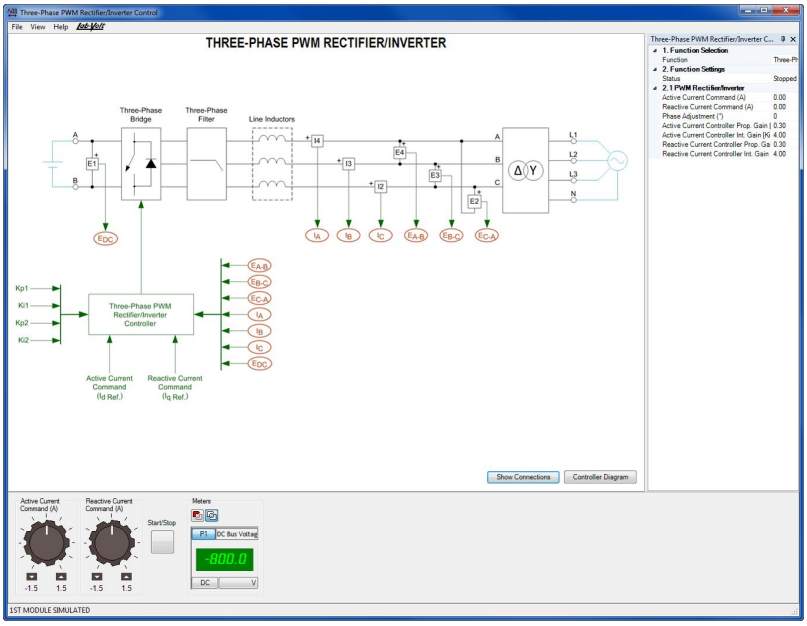
Model 9069-4 – Home Energy Production Control Function Set



The Home Energy Production Control Function Set enables the following devices required for home energy production to be implemented using the DACI, the IGBT Chopper/Inverter, Model 8837-B, and the Insulated DC-to-DC Converter, Model 8835:

Single-Phase Stand-Alone Inverter
Single-Phase Grid-Tied Inverter
Solar Power Inverter (LF Transformer)
Solar/Wind Power Inverter (HF Transformer)

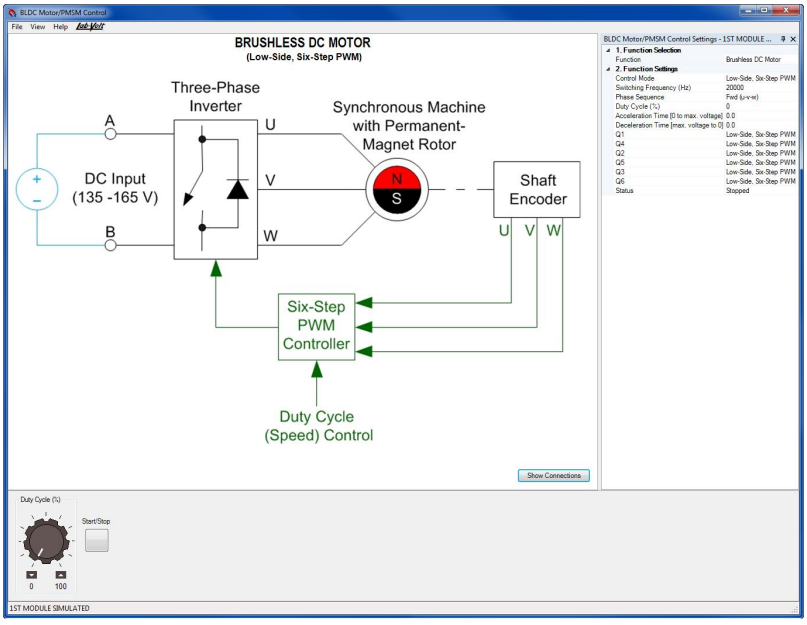
Model 9069-5 – Three-Phase PWM Rectifier/Inverter Control Function Set



The Three-Phase PWM Rectifier/ Inverter Control Function Set enables the following three-phase PWM rectifiers/inverters to be implemented using the DACI and the IGBT Chopper/ Inverter, Model 8837-B:

Three-Phase PWM Rectifier/Inverter
PWM Rectifier/Inverter with Buck/Boost Chopper

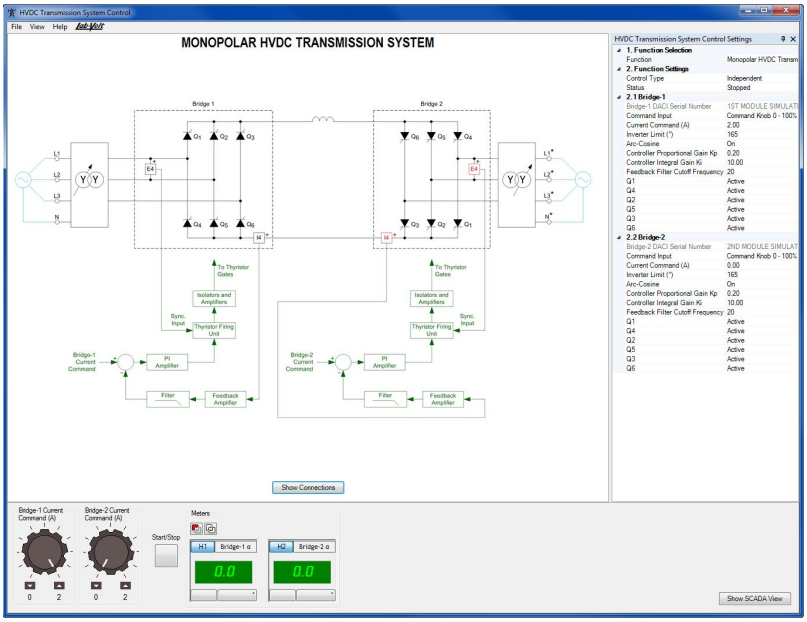
Model 9069-6 – BLDC Motor/PMSM Control Function Set



The BLDC Motor/PMSM Control Function Set enables the following control types for brushless dc (BLDC) motors and permanent-magnet synchronous machines (PMSM) to be implemented using a DACI and a IGBT Chopper/Inverter, Model 8837-B, or using two DACIs and two IGBT Chopper/Inverter, Model 8837-B:

Three-Phase, Six-Step 120° Modulation Inverter
Brushless DC Motor
Permanent Magnet Synchronous Motor Drive
Wind Turbine with Permanent Magnet Synchronous Generator

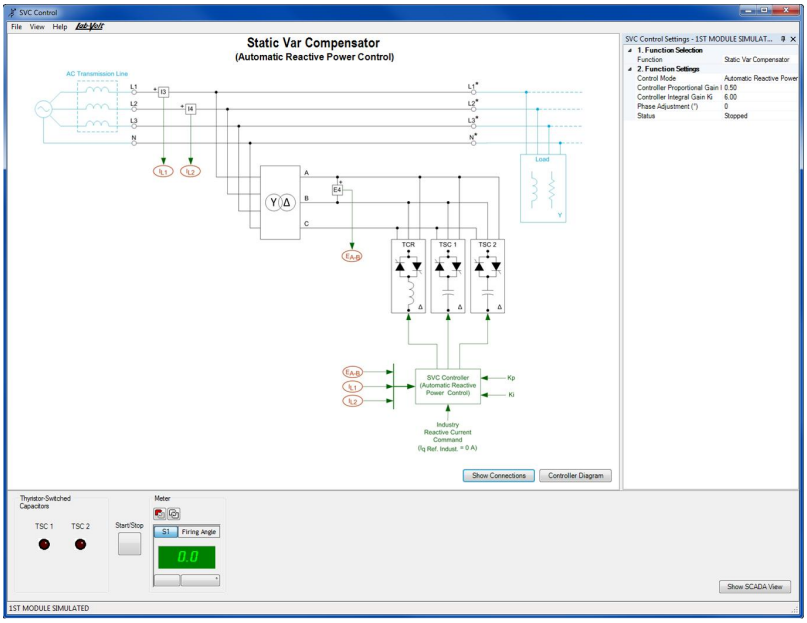
Model 9069-7 – High-Voltage DC (HVDC) Transmission System Control Function Set



The High-Voltage DC (HVDC) Transmission System Control Function Set enables the following devices required for the study of HVDCs to be implemented using two DACIs and two Power Thyristors, Model 8841:

Dual Thyristor Bridge
Monopolar HVDC Transmission System
12-Pulse Converter

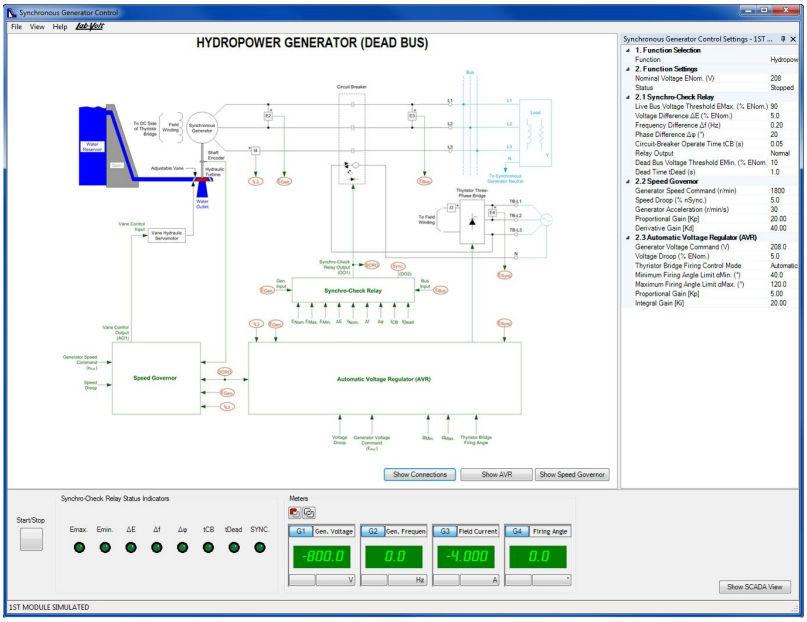
Model 9069-8 – Static Var Compensator (SVC) Control Function Set



The Static Var Compensator (SVC) Control Function Set enables the following devices required for the study of SVCs to be implemented using the DACI and the Power Thyristors, Model 8841:

Static Var Compensator (Manual Control)
Static Var Compensator (Automatic Voltage Control)
Static Var Compensator (Automatic Reactive Power Control)

Model 9069-A – Synchronous Generator Control Function Set

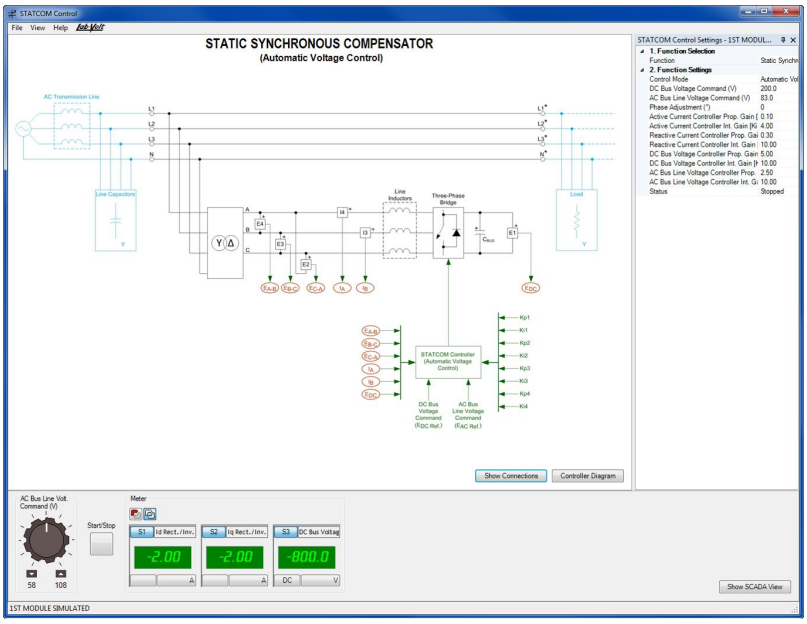


The Synchronous Generator Control Function Set enables the control of synchronous generators using different prime movers (emulated using the Four-Quadrant Dynamometer/Power Supply, Model 8960-2) and different control types for each prime mover. The function set allows the following prime movers and control types to be implemented using the DACI and the Power Thyristors, Model 8841:

- Hydropower Generator (Generator Paralleling - Balanced Bus)

Hydropower Generator (Dead Bus - Balanced Load)
Hydropower Generator (Infinite Bus)
Hydropower Generator (Balanced Infinite Bus)

Model 9069-B – Static Synchronous Compensator (STATCOM) Control Function Set



The Static Synchronous Compensator (STATCOM) Control Function Set enables the following devices required for the study of STATCOMs to be implemented using the DACI and the IGBT Chopper/Inverter, Model 8837-B:

Static Synchronous Compensator (Automatic Voltage Control)
Static Synchronous Compensator (Automatic Reactive Power Control)

Software Development Functions

Model 9069-9 – 9063 SDK (Software Development Kit)

The 9063 SDK (Software Development Kit) offers the possibility to control various inputs and outputs of the Data Acquisition and Control Interface, Model 9063 using third-party rapid prototyping software like Mathworks® MATLAB, National Instruments® LabVIEW, and other programming tools that support Microsoft® .NET Framework 3.5. The SDK gives users the possibility to build their own advanced functions using Model 9063. The SDK includes the following:

- DLL files for communication with the DACI
- Documentation related to the functions
- MATLAB (2010 or later) and LabVIEW (2009 or later) example programs.

The following functions are available using the SDK:

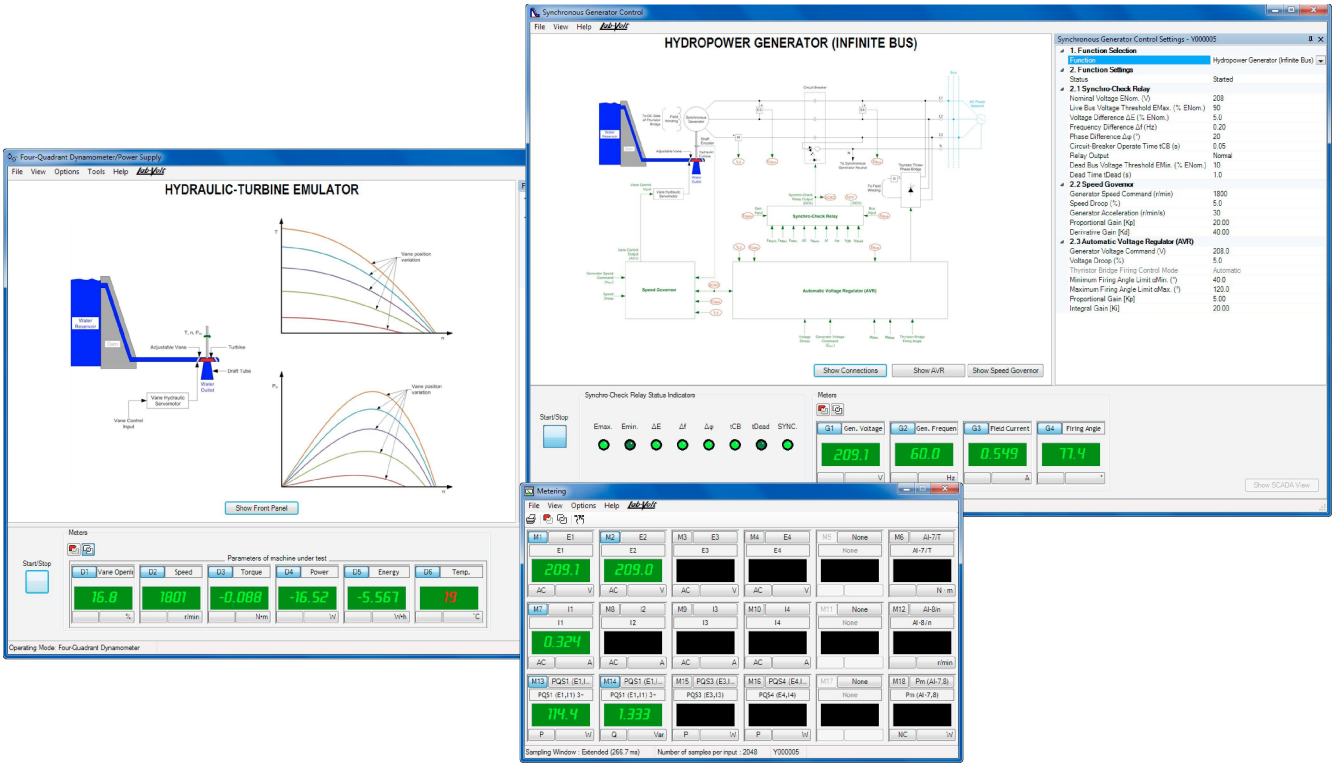
- Acquisition through the voltage and current inputs
- Acquisition through the encoder inputs
- Acquisition through the analog inputs
- Control of the digital outputs
- Control of the analog outputs

Important Notice: One Model 9069-9 must be ordered for each Data Acquisition and Control Interface, Model 9063, to unlock the SDK features.

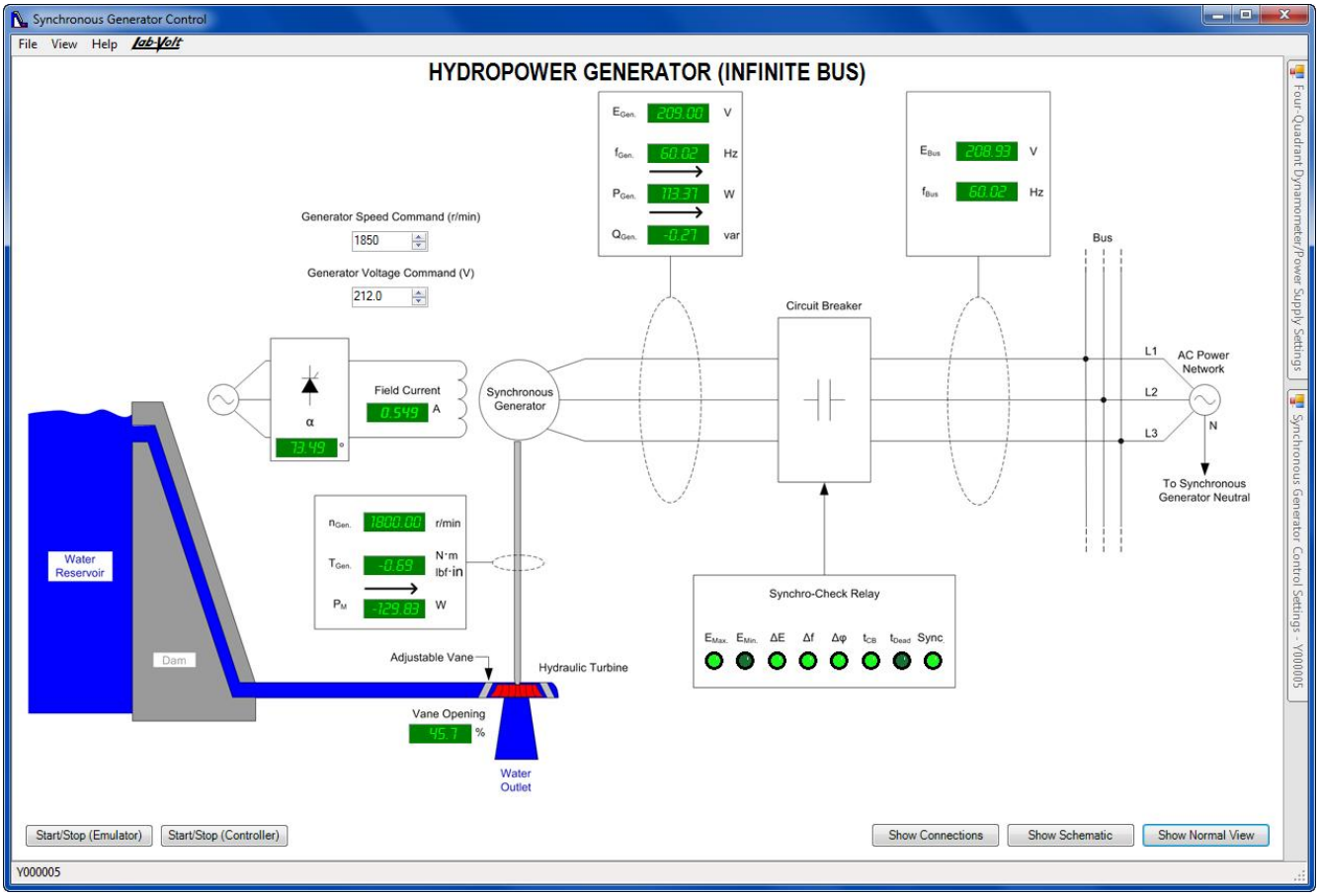
SCADA – Supervisory Control And Data Acquisition

The LVDAC-EMS software and the Data Acquisition and Control Interface allow complex power system applications such as hydropower generators, large-scale wind turbines (PMSG and DFIG), high-voltage direct-current (HVDC) transmission systems, static var compensators (SVCs), and static synchronous compensators (STATCOMs) to be implemented. SCADA windows are available in the LVDAC-EMS software for these complex applications to ease system control and monitoring, as well as to allow students to quickly understand what is going on in these applications. Each SCADA view consists of a simplified diagram of the application integrating the main system controls as well as meters showing the values of the meaningful system parameters. All other system controls remain available through a parameter setting window which is easily accessed from the SCADA window. SCADA windows are currently available for the following applications:

- Static Var Compensator (SVC) - Automatic Voltage Control
- Static Var Compensator (SVC) - Automatic Reactive Power Control
- Wind Turbine with Permanent-Magnet Synchronous Generator (PMSG)
- High-Voltage DC (HVDC) Transmission - Monopolar HVDC Transmission System
- Hydropower Generator - Dead Bus
- Hydropower Generator - Infinite Bus
- Hydropower Generator - Generator Paralleling
- Static Synchronous Compensator (STATCOM) - Automatic Voltage Control
- Static Synchronous Compensator (STATCOM) - Automatic Reactive Power Control
- Three-Phase PWM Inverter (for doubly-fed induction generator application)
- Doubly-Fed Induction Generator (DFIG)



Normal windows of the Hydropower Generator application.



SCADA window of the Hydropower Generator application.

Features & Benefits

- Increases students' understanding of electric power systems and power electronics circuits
  - Many flexible measuring instruments and control functions are available.
  - Pre-built SCADA interfaces ease the view and understanding of the process taking place.
  - LVDAC-EMS features a user-friendly Data Acquisition and Control interface
  - Curriculum includes student manuals and instructor guide with all the necessary theory taught prior to the hands-on experiments
- Ensures users' safety
  - Safety jacks are used for connection to electric power circuits.
  - Inputs and outputs are protected against improper connections and overvoltage/overcurrent conditions.
- Affordable compared to conventional equipment
  - Virtual tools lower the cost of acquisition and replacement of accessories
- Free software and updates
- Flexible, user-friendly, computer-based, measurement and instrumentation tools and control functions
- Software development kit (SDK) for customization of LVDAC-EMS

List of Available Training Systems

Qty	Description	Model number
1	Data Acquisition and Control Interface	579677 (9063-00)
1	Data Acquisition and Control Interface (with All Function Sets)	581447 (9063-A0)
1	Data Acquisition and Control Interface	579680 (9063-B0)
1	Data Acquisition and Control Interface	579683 (9063-C0)
1	Data Acquisition and Control Interface	579686 (9063-D0)
1	Data Acquisition and Control Interface	579689 (9063-E0)
1	Data Acquisition and Control Interface	581449 (9063-F1)
1	Data Acquisition and Control Interface	579692 (9063-G0)
1	Data Acquisition and Control Interface	579694 (9063-H0)
1	Data Acquisition and Control Interface	579695 (9063-J0)

Additional Equipment Required to Perform the Exercises (Purchased separately)

Qty	Description	Model number
1	AC 24 V Wall Mount Power Supply	579696 (30004-20)

Equipment Description

Data Acquisition and Control Interface 579677 (9063-00)

The Data Acquisition and Control Interface (DACI) is a versatile USB peripheral used for measuring, observing, analyzing, and controlling electrical and mechanical parameters in electric power systems and power electronics circuits. For these purposes, a set of computer-based instruments as well as a variety of control functions are available for the DACI. These instruments and control functions are accessed through the LVDAC-EMS software. The LVDAC-EMS software, as well as all available upgrades, is free and can be downloaded anytime on the Festo Didactic website.

Together, the DACI and the LVDAC-EMS software allow training in various areas such as electric power technology, ac/dc machines, renewable energy, transmission lines, and power electronics using modern and versatile measuring instruments and control functions. LVDAC-EMS also offers the possibility to use pre-built SCADA interfaces for several applications to ease the view and understanding of the process taking place. The user guide provided allows students to quickly become familiar with the instruments and control functions available.

Model 9063-0 includes only the DACI, Model 9063, with no control function set activated. This enables the user to customize the DACI by individually picking the computer-based instruments and control function sets that he wants to activate in the DACI.

Alternately, variant 9063-0 is also used in several courses as an extension module. This means that it is used in conjunction to another DACI in which particular control function sets are activated. Both DACIs are connected to a single computer running LVDAC-EMS. When used in such a way, variant 9063-0 shares all control function sets activated in the other DACI. For example, if the Computer-Based Instrumentation Function, Model 9069-1, and the Three-Phase PWM Rectifier/Inverter Control Function Set, Model 9069-5, are activated in the other DACI, these function sets will also be available in variant 9063-0. This enables the user to perform courses requiring the use of more than one DACI without having to activate the same control function sets in all DACIs.

Manual

Description	Manual number
Computer-Based Instruments for EMS (User Guide)	585219 (86718-E0)

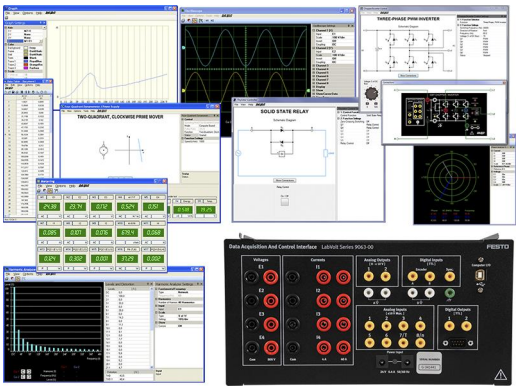
Table of Contents of the Manual(s)

Computer-Based Instruments for EMS (User Guide) (585219 (86718-E0))

Additional Equipment Required to Perform the Exercises (Purchased separately)

Qty	Description	Model number
1	Personal Computer	579785 (8990-00) [1]

Data Acquisition and Control Interface (with All Function Sets) 581447 (9063-A0)



The Data Acquisition and Control Interface (DACI) is a versatile USB peripheral used for measuring, observing, analyzing, and controlling electrical and mechanical parameters in electric power systems and power electronics circuits. For these purposes, a set of computer-based instruments as well as a variety of control functions are available for the DACI. These instruments and control functions are accessed through the LVDAC-EMS software. The LVDAC-EMS software, as well as all available upgrades, is free and can be downloaded anytime on the Festo Didactic website.

Together, the DACI and the LVDAC-EMS software allow training in various areas such as electric power technology, ac/dc machines, renewable energy, transmission lines, and power electronics using modern and versatile measuring instruments and control functions. LVDAC-EMS also offers the possibility to use pre-built SCADA interfaces for several applications to ease the view and understanding of the process taking place. The user guide provided allows students to quickly become familiar with the instruments and control functions available.

Model 9063-A includes the DACI, Model 9063, with the following function sets activated:

- Computer-Based Instrumentation Function, Model 9069-1
- Chopper/Inverter Control Function Set, Model 9069-2
- Thyristor Control Function Set, Model 9069-3
- Home Energy Production Control Function Set, Model 9069-4
- Three-Phase PWM Rectifier/Inverter Control Function Set, Model 9069-5
- BLDC Motor/PMSM Control Function Set, Model 9069-6
- HVDC Transmission System Control Function Set, Model 9069-7
- SVC Control Function Set, Model 9069-8
- 9063 SDK (Software Development Kit), Model 9069-9
- Synchronous Generator Control Function Set, Model 9069-A
- STATCOM Control Function Set, Model 9069-B
- Synchroscope Function, Model 9069-C

Manual

Description	Manual number
Computer-Based Instruments for EMS (User Guide)	585219 (86718-E0)

[1] Refer to the Computer Requirements in the System Specifications section of this datasheet if the computer is to be provided by the end-user. Only one computer is required per station. This model is available in multiple voltage- and frequency dependent variants. Contact a Festo representative to obtain the correct part number.

Table of Contents of the Manual(s)

Computer-Based Instruments for EMS (User Guide) (585219 (86718-E0))

- 1 Familiarization with the Metering Window and the Data Table
- 2 Familiarization with the Oscilloscope
- 3 Familiarization with the Phasor Analyzer
- 4 Familiarization with the Harmonic Analyzer
- 5 Measuring Three-Phase Power Using the Metering Window

Additional Equipment Required to Perform the Exercises (Purchased separately)

Qty	Description	Model number
1	Personal Computer	579785 (8990-00) [2]
1	AC 24 V Wall Mount Power Supply	579696 (30004-20) [3]

Specifications

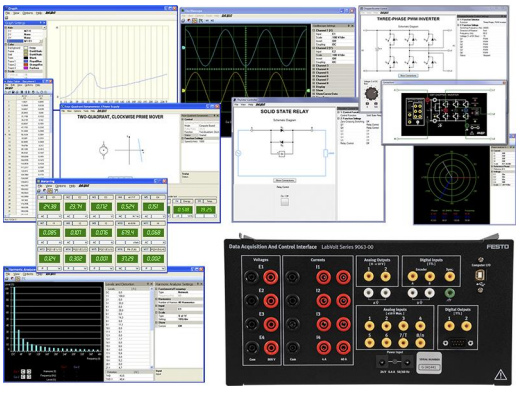
Parameter	Value
Insulated Voltage Inputs (4)	
Range (Low / High Scales)	-80 to +80 V / -800 to + 800 V (user-selectable through software)
Impedance (Low / High Scales)	326.6 kΩ / 3.25 MΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Insulated Current Inputs (4)	
Range (Low / High Scales)	-4 to +4 A / -40 to + 40 A (25 A rms)
Impedance (Low / High Scales)	5 mΩ / 50 mΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Analog Inputs (8)	
Voltage Range	-10 to +10 V
Impedance	› 10 MΩ
Bandwidth	DC to 125 kHz
Measured Parameters	User-selectable through software
Parameter-to-Voltage Ratio	User-determined through software
A/D Converter for Insulated and Analog Inputs (16)	
Type	Successive approximation
Resolution	12 bits
Integral Non-Linearity	≤ ±1.5 LSB
Differential Non-Linearity	≤ ±1 LSB
Maximum Sampling Rate	600 ksamples/s (one channel)
FIFO Buffer Size	16 ksamples
Analog Outputs (2)	
Voltage Range (2)	-10 to +10 V
Operational Load Impedance	› 600 Ω
D/A Converter for Analog Outputs (2)	
Type	Resistor string
Resolution	12 bits
Integral Non-Linearity	≤ ±8 LSB

[2] Refer to the Computer Requirements in the System Specifications section of this datasheet if the computer is to be provided by the end-user. Only one computer is required per station. This model is available in multiple voltage- and frequency dependent variants. Contact a Festo representative to obtain the correct part number.

[3] Required if power is not supplied by the Power Supply, Model 8821-2. This model is available in multiple voltage- and frequency dependent variants. Contact a Festo representative to obtain the correct part number.

Parameter	Value
Differential Non-Linearity	-0.5 to +0.7 LSB
Digital Inputs (3)	
Types	Encoder (2), synchronization (1)
Signal Level	0-5 V (TTL compatible)
Maximum Input Frequency	50 kHz
Impedance	5 kΩ
Digital Outputs (9)	
Types	Control (6 on a DB9 connector and 2 on 2 mm banana jacks), synchronization (1 on a DB9 connector)
Signal Level	0-5 V (TTL compatible)
Maximum Output Frequency	20 kHz (software-limited)
Impedance	200 Ω
Control Functions	
Activated Sets	Computer-Based Instrumentation Function, Model 9069-1
	Chopper/Inverter Control Function Set, Model 9069-2
	Thyristor Control Function Set, Model 9069-3
	Home Energy Production Control Function Set, Model 9069-4
	Three-Phase PWM Rectifier/Inverter Control Function Set, Model 9069-5
	BLDC Motor/PMSM Control Function Set, Model 9069-6
	HVDC Transmission System Control Function Set, Model 9069-7
	SVC Control Function Set, Model 9069-8
	9063 SDK (Software Development Kit), Model 9069-9
	Synchronous Generator Control Function Set, Model 9069-A
	STATCOM Control Function Set, Model 9069-B
	Synchroscope Function, Model 9069-C
Computer I/O Interface	USB 2.0 full speed via type-B receptacle
Power Requirements	24 V - 0.4 A - 50/60 Hz
Accessories	
Included Accessories	2 m USB interconnection cable (1)
	24 V power cable (1)
	2 mm banana plug test leads (3)
	DB9 connector control cable (1)
Physical Characteristics	
Dimensions (H x W x D)	154 x 287 x 410 mm (6.1 x 11.3 x 16.1 in)
Net Weight	3.9 kg (8.6 lb)

Data Acquisition and Control Interface 579680 (9063-B0)



The Data Acquisition and Control Interface (DACI) is a versatile USB peripheral used for measuring, observing, analyzing, and controlling electrical and mechanical parameters in electric power systems and power electronics circuits. For these purposes, a set of computer-based instruments as well as a variety of control functions are available for the DACI. These instruments and control functions are accessed through the LVDAC-EMS software. The LVDAC-EMS software, as well as all available upgrades, is free and can be downloaded anytime on the Festo Didactic website.

Together, the DACI and the LVDAC-EMS software allow training in various areas such as electric power technology, ac/dc machines, renewable energy, transmission lines, and power electronics using modern and versatile measuring instruments and control functions. LVDAC-EMS also offers the possibility to use pre-built SCADA interfaces for several applications to ease the view and understanding of the process taking place. The user guide provided allows students to quickly become familiar with the instruments and control functions available.

This model includes the function set "Computer-Based Instrumentation Function".

Manual

Description	Manual number
Computer-Based Instruments for EMS (User Guide)	585219 (86718-E0)

Table of Contents of the Manual(s)

Computer-Based Instruments for EMS (User Guide) (585219 (86718-E0))

- 1 Familiarization with the Metering Window and the Data Table
- 2 Familiarization with the Oscilloscope
- 3 Familiarization with the Phasor Analyzer
- 4 Familiarization with the Harmonic Analyzer
- 5 Measuring Three-Phase Power Using the Metering Window

Additional Equipment Required to Perform the Exercises (Purchased separately)

Qty	Description	Model number
1	AC 24 V Wall Mount Power Supply	579698 (30004-2A) [4]

Software

Qty	Description	Model number
1	SCADA for LVDAC-EMS	8094377 (8973-00) [5]
1	Complete Function Set	581451 (9069-00)
1	Chopper/Inverter Control Function Set	581453 (9069-20)
1	Thyristor Control Function Set	581454 (9069-30)
1	Home Energy Production Control Function Set	581455 (9069-40)
1	Three-Phase PWM Rectifier/Inverter Control Function Set	581456 (9069-50)
1	BLDC Motor/PMSM Control Function Set	581457 (9069-60)
1	High-Voltage DC (HVDC) Transmission System Control Function Set	579790 (9069-70)
1	Static Var Compensator (SVC) Control Function Set	581458 (9069-80)
1	Software Development Kit (SDK)	581459 (9069-90) [6]
1	Synchronous Generator Control Function Set	579788 (9069-A0)
1	Static Synchronous Compensator (STATCOM) Control Function Set	581460 (9069-B0)
1	Synchroscope Function	579789 (9069-C0)
1	Doubly-Fed Induction Generator (DFIG) Control Function Set	587056 (9069-D0)
1	Power Line Series Compensation Function Set	581461 (9069-S0)

Specifications

Parameter	Value
Insulated Voltage Inputs (4)	
Range (Low / High Scales)	-80 to +80 V / -800 to + 800 V (user-selectable through software)
Impedance (Low / High Scales)	326.6 kΩ / 3.25 MΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)

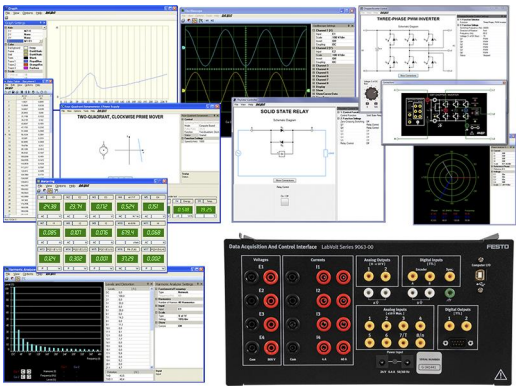
[4] Not required if another 24 VAC source is included, such as the variable three-phase power supply.

[5] Software allowing the monitoring of up to 5 Stations through OPC.

[6] For MatLab, LabView, etc.

Parameter	Value
Insulation	800 V
Maximum Voltage (Any Terminal vs GND)	283 V ac / 400 V dc
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Insulated Current Inputs (4)	
Range (Low / High Scales)	-4 to +4 A / -40 to + 40 A (25 A rms)
Impedance (Low / High Scales)	5 mΩ / 50 mΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Maximum Voltage (Any Terminal vs GND)	283 V ac / 400 V dc
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Analog Inputs (8)	
Voltage Range	-10 to +10 V
Impedance	› 10 MΩ
Bandwidth	DC to 125 kHz
Measured Parameters	User-selectable through software
Parameter-to-Voltage Ratio	User-determined through software
A/D Converter for Insulated and Analog Inputs (16)	
Type	Successive approximation
Resolution	12 bits
Integral Non-Linearity	≤ ±1.5 LSB
Differential Non-Linearity	≤ ±1 LSB
Maximum Sampling Rate	600 ksamples/s (one channel)
FIFO Buffer Size	16 ksamples
Analog Outputs (2)	
Voltage Range	-10 to +10 V
Operational Load Impedance	› 600 Ω
D/A Converter for Analog Outputs (2)	
Type	Resistor string
Resolution	12 bits
Integral Non-Linearity	≤ ±8 LSB
Differential Non-Linearity	-0.5 to +0.7 LSB
Digital Inputs (3)	
Types	Encoder (2), synchronization (1)
Signal Level	0-5 V (TTL compatible)
Maximum Input Frequency	50 kHz
Impedance	5 kΩ
Digital Outputs (9)	
Types	Control (6 on a DB9 connector and 2 on 2 mm banana jacks), synchronization (1 on a DB9 connector)
Signal Level	0-5 V (TTL compatible)
Maximum Output Frequency	20 kHz (software-limited)
Impedance	200 Ω
Control Functions	
Activated Set	Computer-Based Instrumentation Function, Model 9069-1
Computer I/O Interface	USB 2.0 full speed via type-B receptacle
Power Requirements	24 V - 0.4 A - 50/60 Hz
Accessories	
Included Accessories	2 m USB interconnection cable (1)
	24 V power cable (1)
	2 mm banana plug test leads (3)
	DB9 connector control cable (1)
Physical Characteristics	
Dimensions (H x W x D)	154 x 287 x 410 mm (6.1 x 11.3 x 16.1 in)
Net Weight	3.9 kg (8.6 lb)

Data Acquisition and Control Interface 579683 (9063-C0)



The Data Acquisition and Control Interface (DACI) is a versatile USB peripheral used for measuring, observing, analyzing, and controlling electrical and mechanical parameters in electric power systems and power electronics circuits. For these purposes, a set of computer-based instruments as well as a variety of control functions are available for the DACI. These instruments and control functions are accessed through the LVDAC-EMS software. The LVDAC-EMS software, as well as all available upgrades, is free and can be downloaded anytime on the Festo Didactic website.

Together, the DACI and the LVDAC-EMS software allow training in various areas such as electric power technology, ac/dc machines, renewable energy, transmission lines, and power electronics using modern and versatile measuring instruments and control functions. LVDAC-EMS also offers the possibility to use pre-built SCADA interfaces for several applications to ease the view and understanding of the process taking place. The user guide provided allows students to quickly become familiar with the instruments and control functions available.

Model 9063-C includes the DACI, Model 9063, with the following function sets activated:

- Computer-Based Instrumentation Function, Model 9069-1

- Chopper/Inverter Control Function Set, Model 9069-2

Manual

Description	Manual number
Computer-Based Instruments for EMS (User Guide)	585219 (86718-E0)

Table of Contents of the Manual(s)

Computer-Based Instruments for EMS (User Guide) (585219 (86718-E0))

- 1 Familiarization with the Metering Window and the Data Table
- 2 Familiarization with the Oscilloscope
- 3 Familiarization with the Phasor Analyzer
- 4 Familiarization with the Harmonic Analyzer
- 5 Measuring Three-Phase Power Using the Metering Window

Additional Equipment Required to Perform the Exercises (Purchased separately)

Qty	Description	Model number
1	Personal Computer	579785 (8990-00) [7]
1	AC 24 V Wall Mount Power Supply	579696 (30004-20) [8]

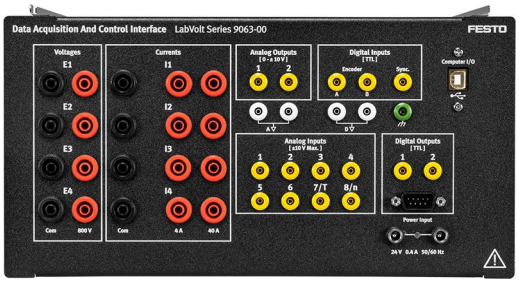
[7] Refer to the Computer Requirements in the System Specifications section of this datasheet if the computer is to be provided by the end-user. Only one computer is required per station. This model is available in multiple voltage- and frequency dependent variants. Contact a Festo representative to obtain the correct part number.

[8] Required if power is not supplied by the Power Supply, Model 8821-2. This model is available in multiple voltage- and frequency dependent variants. Contact a Festo representative to obtain the correct part number.

Specifications

Parameter	Value
Insulated Voltage Inputs (4)	
Range (Low / High Scales)	-80 to +80 V / -800 to + 800 V (user-selectable through software)
Impedance (Low / High Scales)	326.6 kΩ / 3.25 MΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Insulated Current Inputs (4)	
Range (Low / High Scales)	-4 to +4 A / -40 to + 40 A (25 A rms)
Impedance (Low / High Scales)	5 mΩ / 50 mΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Analog Inputs (8)	
Voltage Range	-10 to +10 V
Impedance	› 10 MΩ
Bandwidth	DC to 125 kHz
Measured Parameters	User-selectable through software
Parameter-to-Voltage Ratio	User-determined through software
A/D Converter for Insulated and Analog Inputs (16)	
Type	Successive approximation
Resolution	12 bits
Integral Non-Linearity	≤ ±1.5 LSB
Differential Non-Linearity	≤ ±1 LSB
Maximum Sampling Rate	600 ksamples/s (one channel)
FIFO Buffer Size	16 ksamples
Analog Outputs (2)	
Voltage Range (2)	-10 to +10 V
Operational Load Impedance	› 600 Ω
D/A Converter for Analog Outputs (2)	
Type	Resistor string
Resolution	12 bits
Integral Non-Linearity	≤ ±8 LSB
Differential Non-Linearity	-0.5 to +0.7 LSB
Digital Inputs (3)	
Types	Encoder (2), synchronization (1)
Signal Level	0-5 V (TTL compatible)
Maximum Input Frequency	50 kHz
Impedance	5 kΩ
Digital Outputs (9)	
Types	Control (6 on a DB9 connector and 2 on 2 mm banana jacks), synchronization (1 on a DB9 connector)
Signal Level	0-5 V (TTL compatible)
Maximum Output Frequency	20 kHz (software-limited)
Impedance	200 Ω
Control Functions	
Activated Sets	Computer-Based Instrumentation Function, Model 9069-1
	Chopper/Inverter Control Function Set, Model 9069-2
Computer I/O Interface	USB 2.0 full speed via type-B receptacle
Power Requirements	24 V - 0.4 A - 50/60 Hz
Accessories	
Included Accessories	2 m USB interconnection cable (1)
	24 V power cable (1)
	2 mm banana plug test leads (3)
	DB9 connector control cable (1)
Physical Characteristics	
Dimensions (H x W x D)	154 x 287 x 410 mm (6.1 x 11.3 x 16.1 in)
Net Weight	3.9 kg (8.6 lb)

Data Acquisition and Control Interface 579686 (9063-D0)



The Data Acquisition and Control Interface (DACI) is a versatile USB peripheral used for measuring, observing, analyzing, and controlling electrical and mechanical parameters in electric power systems and power electronics circuits. For these purposes, a set of computer-based instruments as well as a variety of control functions are available for the DACI. These instruments and control functions are accessed through the LVDAC-EMS software. The LVDAC-EMS software, as well as all available upgrades, is free and can be downloaded anytime on the Festo Didactic website.

Together, the DACI and the LVDAC-EMS software allow training in various areas such as electric power technology, ac/dc machines, renewable energy, transmission lines, and power electronics using modern and versatile measuring instruments and control functions. LVDAC-EMS also offers the possibility to use pre-built SCADA interfaces for several applications to ease the view and understanding of the process taking place. The user guide provided allows students to quickly become familiar with the instruments and control functions available.

Model 9063-D includes the DACI, Model 9063, with the following function sets activated:

- Computer-Based Instrumentation Function, Model 9069-1

- Chopper/Inverter Control Function Set, Model 9069-2

- Thyristor Control Function Set, Model 9069-3

Manual

Description	Manual number
Computer-Based Instruments for EMS (User Guide)	585219 (86718-E0)

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Computer-Based Instruments for EMS (User Guide) (585219 (86718-E0))

Additional Equipment Required to Perform the Exercises (Purchased separately)

Qty	Description	Model number
1	Personal Computer	579785 (8990-00) [9]
1	AC 24 V Wall Mount Power Supply	579696 (30004-20) [10]

[9] Refer to the Computer Requirements in the System Specifications section of this datasheet if the computer is to be provided by the end-user. Only one computer is required per station. This model is available in multiple voltage- and frequency dependent variants. Contact a Festo representative to obtain the correct part number.

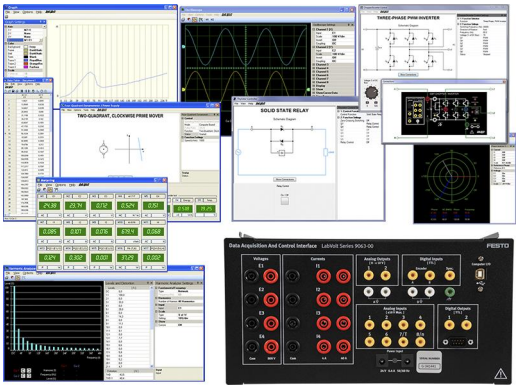
[10] Required if power is not supplied by the Power Supply, Model 8821-2. This model is available in multiple voltage- and frequency dependent variants. Contact a Festo representative to obtain the correct part number.

Specifications

Parameter	Value
Insulated Voltage Inputs (4)	
Range (Low / High Scales)	-80 to +80 V / -800 to + 800 V (user-selectable through software)
Impedance (Low / High Scales)	326.6 kΩ / 3.25 MΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Insulated Current Inputs (4)	
Range (Low / High Scales)	-4 to +4 A / -40 to + 40 A (25 A rms)
Impedance (Low / High Scales)	5 mΩ / 50 mΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Analog Inputs (8)	
Voltage Range	-10 to +10 V
Impedance	› 10 MΩ
Bandwidth	DC to 125 kHz
Measured Parameters	User-selectable through software
Parameter-to-Voltage Ratio	User-determined through software
A/D Converter for Insulated and Analog Inputs (16)	
Type	Successive approximation
Resolution	12 bits
Integral Non-Linearity	≤ ±1.5 LSB
Differential Non-Linearity	≤ ±1 LSB
Maximum Sampling Rate	600 ksamples/s (one channel)
FIFO Buffer Size	16 ksamples
Analog Outputs (2)	
Voltage Range (2)	-10 to +10 V
Operational Load Impedance	› 600 Ω
D/A Converter for Analog Outputs (2)	
Type	Resistor string
Resolution	12 bits
Integral Non-Linearity	≤ ±8 LSB
Differential Non-Linearity	-0.5 to +0.7 LSB
Digital Inputs (3)	
Types	Encoder (2), synchronization (1)
Signal Level	0-5 V (TTL compatible)
Maximum Input Frequency	50 kHz
Impedance	5 kΩ
Digital Outputs (9)	
Types	Control (6 on a DB9 connector and 2 on 2 mm banana jacks), synchronization (1 on a DB9 connector)
Signal Level	0-5 V (TTL compatible)
Maximum Output Frequency	20 kHz (software-limited)
Impedance	200 Ω
Control Functions	
Activated Sets	Computer-Based Instrumentation Function, Model 9069-1
	Chopper/Inverter Control Function Set, Model 9069-2
	Thyristor Control Function Set, Model 9069-3
Computer I/O Interface	USB 2.0 full speed via type-B receptacle
Power Requirements	24 V - 0.4 A - 50/60 Hz
Accessories	
Included Accessories	2 m USB interconnection cable (1)
	24 V power cable (1)
	2 mm banana plug test leads (3)
	DB9 connector control cable (1)
Physical Characteristics	
Dimensions (H x W x D)	154 x 287 x 410 mm (6.1 x 11.3 x 16.1 in)

Parameter	Value
Net Weight	3.9 kg (8.6 lb)

Data Acquisition and Control Interface 579689 (9063-E0)



The Data Acquisition and Control Interface (DACI) is a versatile USB peripheral used for measuring, observing, analyzing, and controlling electrical and mechanical parameters in electric power systems and power electronics circuits. For these purposes, a set of computer-based instruments as well as a variety of control functions are available for the DACI. These instruments and control functions are accessed through the LVDAC-EMS software. The LVDAC-EMS software, as well as all available upgrades, is free and can be downloaded anytime on the Festo Didactic website.

Together, the DACI and the LVDAC-EMS software allow training in various areas such as electric power technology, ac/dc machines, renewable energy, transmission lines, and power electronics using modern and versatile measuring instruments and control functions. LVDAC-EMS also offers the possibility to use pre-built SCADA interfaces for several applications to ease the view and understanding of the process taking place. The user guide provided allows students to quickly become familiar with the instruments and control functions available.

Model 9063-E includes the DACI, Model 9063, with the following function sets activated:

- Computer-Based Instrumentation Function, Model 9069-1
- Chopper/Inverter Control Function Set, Model 9069-2
- Home Energy Production Control Function Set, Model 9069-4

Manual

Description	Manual number
Computer-Based Instruments for EMS (User Guide)	585219 (86718-E0)

Table of Contents of the Manual(s)

Computer-Based Instruments for EMS (User Guide) (585219 (86718-E0))

- 1 Familiarization with the Metering Window and the Data Table
- 2 Familiarization with the Oscilloscope
- 3 Familiarization with the Phasor Analyzer
- 4 Familiarization with the Harmonic Analyzer
- 5 Measuring Three-Phase Power Using the Metering Window

Additional Equipment Required to Perform the Exercises (Purchased separately)

Qty	Description	Model number
1	Personal Computer	579785 (8990-00) [11]

[11] Refer to the Computer Requirements in the System Specifications section of this datasheet if the computer is to be provided by the end-user. Only one computer is required per station. This model is available in multiple voltage- and frequency dependent variants. Contact a Festo representative to obtain the correct part number.

Qty	Description	Model number
1	AC 24 V Wall Mount Power Supply	579696 (30004-20) [12]

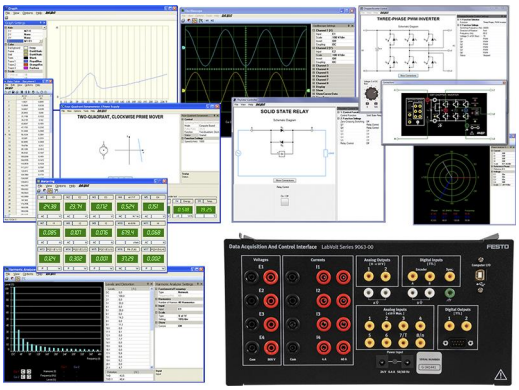
Specifications

Parameter	Value
Insulated Voltage Inputs (4)	
Range (Low / High Scales)	-80 to +80 V / -800 to + 800 V (user-selectable through software)
Impedance (Low / High Scales)	326.6 kΩ / 3.25 MΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Insulated Current Inputs (4)	
Range (Low / High Scales)	-4 to +4 A / -40 to + 40 A (25 A rms)
Impedance (Low / High Scales)	5 mΩ / 50 mΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Analog Inputs (8)	
Voltage Range	-10 to +10 V
Impedance	› 10 MΩ
Bandwidth	DC to 125 kHz
Measured Parameters	User-selectable through software
Parameter-to-Voltage Ratio	User-determined through software
A/D Converter for Insulated and Analog Inputs (16)	
Type	Successive approximation
Resolution	12 bits
Integral Non-Linearity	≤ ±1.5 LSB
Differential Non-Linearity	≤ ±1 LSB
Maximum Sampling Rate	600 ksamples/s (one channel)
FIFO Buffer Size	16 ksamples
Analog Outputs (2)	
Voltage Range (2)	-10 to +10 V
Operational Load Impedance	› 600 Ω
D/A Converter for Analog Outputs (2)	
Type	Resistor string
Resolution	12 bits
Integral Non-Linearity	≤ ±8 LSB
Differential Non-Linearity	-0.5 to +0.7 LSB
Digital Inputs (3)	
Types	Encoder (2), synchronization (1)
Signal Level	0-5 V (TTL compatible)
Maximum Input Frequency	50 kHz
Impedance	5 kΩ
Digital Outputs (9)	
Types	Control (6 on a DB9 connector and 2 on 2 mm banana jacks), synchronization (1 on a DB9 connector)
Signal Level	0-5 V (TTL compatible)
Maximum Output Frequency	20 kHz (software-limited)
Impedance	200 Ω
Control Functions	
Activated Sets	Computer-Based Instrumentation Function, Model 9069-1
	Chopper/Inverter Control Function Set, Model 9069-2
	Home Energy Production Control Function Set, Model 9069-4
Computer I/O Interface	USB 2.0 full speed via type-B receptacle

[12] Required if power is not supplied by the Power Supply, Model 8821-2. This model is available in multiple voltage- and frequency dependent variants. Contact a Festo representative to obtain the correct part number.

Parameter	Value
Power Requirements	24 V - 0.4 A - 50/60 Hz
Accessories	
Included Accessories	2 m USB interconnection cable (1)
	24 V power cable (1)
	2 mm banana plug test leads (3)
	DB9 connector control cable (1)
Physical Characteristics	
Dimensions (H x W x D)	154 x 287 x 410 mm (6.1 x 11.3 x 16.1 in)
Net Weight	3.9 kg (8.6 lb)

Data Acquisition and Control Interface 581449 (9063-F1)



The Data Acquisition and Control Interface (DACI) is a versatile USB peripheral used for measuring, observing, analyzing, and controlling electrical and mechanical parameters in electric power systems and power electronics circuits. For these purposes, a set of computer-based instruments as well as a variety of control functions are available for the DACI. These instruments and control functions are accessed through the LVDAC-EMS software. The LVDAC-EMS software, as well as all available upgrades, is free and can be downloaded anytime on the Festo Didactic website.

Together, the DACI and the LVDAC-EMS software allow training in various areas such as electric power technology, ac/dc machines, renewable energy, transmission lines, and power electronics using modern and versatile measuring instruments and control functions. LVDAC-EMS also offers the possibility to use pre-built SCADA interfaces for several applications to ease the view and understanding of the process taking place. The user guide provided allows students to quickly become familiar with the instruments and control functions available.

Model 9063-F includes the DACI, Model 9063, with the following function sets activated:

- Computer-Based Instrumentation Function, Model 9069-1
- Chopper/Inverter Control Function Set, Model 9069-2
- Home Energy Production Control Function Set, Model 9069-4
- Three-Phase PWM Rectifier/Inverter Control Function Set, Model 9069-5

Manual

Description	Manual number
Instrumentation informatisée pour EMS (User Guide)	8151944 (86718-E1)

Additional Equipment Required to Perform the Exercises (Purchased separately)

Qty	Description	Model number
1	Personal Computer	579785 (8990-00) [13]

[13] Refer to the Computer Requirements in the System Specifications section of this datasheet if the computer is to be provided by the end-user. Note that only one computer is required per station.

Qty	Description	Model number
1	AC 24 V Wall Mount Power Supply	579696 (30004-20) [14]

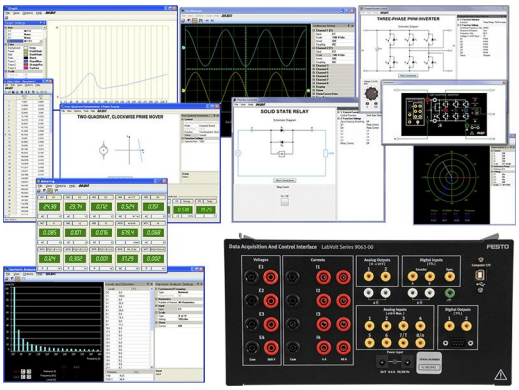
Specifications

Parameter	Value
Insulated Voltage Inputs (4)	
Range (Low / High Scales)	-80 to +80 V / -800 to + 800 V (user-selectable through software)
Impedance (Low / High Scales)	326.6 kΩ / 3.25 MΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Insulated Current Inputs (4)	
Range (Low / High Scales)	-4 to +4 A / -40 to + 40 A (25 A rms)
Impedance (Low / High Scales)	5 mΩ / 50 mΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Analog Inputs (8)	
Voltage Range	-10 to +10 V
Impedance	› 10 MΩ
Bandwidth	DC to 125 kHz
Measured Parameters	User-selectable through software
Parameter-to-Voltage Ratio	User-determined through software
A/D Converter for Insulated and Analog Inputs (16)	
Type	Successive approximation
Resolution	12 bits
Integral Non-Linearity	≤ ±1.5 LSB
Differential Non-Linearity	≤ ±1 LSB
Maximum Sampling Rate	600 ksamples/s (one channel)
FIFO Buffer Size	16 ksamples
Analog Outputs (2)	
Voltage Range (2)	-10 to +10 V
Operational Load Impedance	› 600 Ω
D/A Converter for Analog Outputs (2)	
Type	Resistor string
Resolution	12 bits
Integral Non-Linearity	≤ ±8 LSB
Differential Non-Linearity	-0.5 to +0.7 LSB
Digital Inputs (3)	
Types	Encoder (2), synchronization (1)
Signal Level	0-5 V (TTL compatible)
Maximum Input Frequency	50 kHz
Impedance	5 kΩ
Digital Outputs (9)	
Types	Control (6 on a DB9 connector and 2 on 2 mm banana jacks), synchronization (1 on a DB9 connector)
Signal Level	0-5 V (TTL compatible)
Maximum Output Frequency	20 kHz (software-limited)
Impedance	200 Ω
Control Functions	
Activated Sets	Computer-Based Instrumentation Function, Model 9069-1
	Chopper/Inverter Control Function Set, Model 9069-2
	Home Energy Production Control Function Set, Model 9069-4
	Three-Phase PWM Rectifier/Inverter Control Function Set, Model 9069-5

[14] Required if power is not supplied by the Power Supply, Model 8821-2. This model is available in multiple voltage- and frequency dependent variants. Contact a Festo representative to obtain the correct part number.

Parameter	Value
Computer I/O Interface	USB 2.0 full speed via type-B receptacle
Power Requirements	24 V - 0.4 A - 50/60 Hz
Accessories	
Included Accessories	2 m USB interconnection cable (1)
	24 V power cable (1)
	2 mm banana plug test leads (3)
	DB9 connector control cable (1)
Physical Characteristics	
Dimensions (H x W x D)	154 x 287 x 410 mm (6.1 x 11.3 x 16.1 in)
Net Weight	3.9 kg (8.6 lb)

Data Acquisition and Control Interface 579692 (9063-G0)



The Data Acquisition and Control Interface (DACI) is a versatile USB peripheral used for measuring, observing, analyzing, and controlling electrical and mechanical parameters in electric power systems and power electronics circuits. For these purposes, a set of computer-based instruments as well as a variety of control functions are available for the DACI. These instruments and control functions are accessed through the LVDAC-EMS software. The LVDAC-EMS software, as well as all available upgrades, is free and can be downloaded anytime on the Festo Didactic website.

Together, the DACI and the LVDAC-EMS software allow training in various areas such as electric power technology, ac/dc machines, renewable energy, transmission lines, and power electronics using modern and versatile measuring instruments and control functions. LVDAC-EMS also offers the possibility to use pre-built SCADA interfaces for several applications to ease the view and understanding of the process taking place. The user guide provided allows students to quickly become familiar with the instruments and control functions available.

This model includes the DACI with the following function sets activated:

- Computer-Based Instrumentation Function

- Synchroscope Function

Manual

Description	Manual number
Computer-Based Instruments for EMS (User Guide)	585219 (86718-E0)

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Computer-Based Instruments for EMS (User Guide) (585219 (86718-E0))

- 1 Familiarization with the Metering Window and the Data Table
- 2 Familiarization with the Oscilloscope
- 3 Familiarization with the Phasor Analyzer
- 4 Familiarization with the Harmonic Analyzer
- 5 Measuring Three-Phase Power Using the Metering Window

Additional Equipment Required to Perform the Exercises (Purchased separately)

Qty	Description	Model number
1	Personal Computer	579785 (8990-00) [15]
1	AC 24 V Wall Mount Power Supply	579696 (30004-20) [16]

Specifications

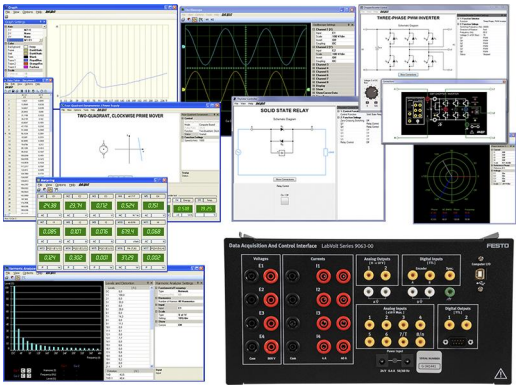
Parameter	Value
Insulated Voltage Inputs (4)	
Range (Low / High Scales)	-80 to +80 V / -800 to + 800 V (user-selectable through software)
Impedance (Low / High Scales)	326.6 kΩ / 3.25 MΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Insulated Current Inputs (4)	
Range (Low / High Scales)	-4 to +4 A / -40 to + 40 A (25 A rms)
Impedance (Low / High Scales)	5 mΩ / 50 mΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Analog Inputs (8)	
Voltage Range	-10 to +10 V
Impedance	› 10 MΩ
Bandwidth	DC to 125 kHz
Measured Parameters	User-selectable through software
Parameter-to-Voltage Ratio	User-determined through software
A/D Converter for Insulated and Analog Inputs (16)	
Type	Successive approximation
Resolution	12 bits
Integral Non-Linearity	≤ ±1.5 LSB
Differential Non-Linearity	≤ ±1 LSB
Maximum Sampling Rate	600 ksamples/s (one channel)
FIFO Buffer Size	16 ksamples
Analog Outputs (2)	
Voltage Range (2)	-10 to +10 V
Operational Load Impedance	› 600 Ω
D/A Converter for Analog Outputs (2)	
Type	Resistor string
Resolution	12 bits
Integral Non-Linearity	≤ ±8 LSB
Differential Non-Linearity	-0.5 to +0.7 LSB
Digital Inputs (3)	
Types	Encoder (2), synchronization (1)
Signal Level	0-5 V (TTL compatible)
Maximum Input Frequency	50 kHz
Impedance	5 kΩ
Digital Outputs (9)	
Types	Control (6 on a DB9 connector and 2 on 2 mm banana jacks), synchronization (1 on a DB9 connector)
Signal Level	0-5 V (TTL compatible)
Maximum Output Frequency	20 kHz (software-limited)

[15] Refer to the Computer Requirements in the System Specifications section of this datasheet if the computer is to be provided by the end-user. Only one computer is required per station. This model is available in multiple voltage- and frequency dependent variants. Contact a Festo representative to obtain the correct part number.

[16] Required if power is not supplied by the Power Supply, Model 8821-2. This model is available in multiple voltage- and frequency dependent variants. Contact a Festo representative to obtain the correct part number.

Parameter	Value
Impedance	200 Ω
Control Functions	
Activated Sets	Computer-Based Instrumentation Function, Model 9069-1
	Synchroscope Function, Model 9069-C
Computer I/O Interface	USB 2.0 full speed via type-B receptacle
Power Requirements	24 V - 0.4 A - 50/60 Hz
Accessories	
Included Accessories	2 m USB interconnection cable (1)
	24 V power cable (1)
	2 mm banana plug test leads (3)
	DB9 connector control cable (1)
Physical Characteristics	
Dimensions (H x W x D)	154 x 287 x 410 mm (6.1 x 11.3 x 16.1 in)
Net Weight	3.9 kg (8.6 lb)

Data Acquisition and Control Interface 579694 (9063-H0)



The Data Acquisition and Control Interface (DACI) is a versatile USB peripheral used for measuring, observing, analyzing, and controlling electrical and mechanical parameters in electric power systems and power electronics circuits. For these purposes, a set of computer-based instruments as well as a variety of control functions are available for the DACI. These instruments and control functions are accessed through the LVDAC-EMS software. The LVDAC-EMS software, as well as all available upgrades, is free and can be downloaded anytime on the Festo Didactic website.

Together, the DACI and the LVDAC-EMS software allow training in various areas such as electric power technology, ac/dc machines, renewable energy, transmission lines, and power electronics using modern and versatile measuring instruments and control functions. LVDAC-EMS also offers the possibility to use pre-built SCADA interfaces for several applications to ease the view and understanding of the process taking place. The user guide provided allows students to quickly become familiar with the instruments and control functions available.

Model 9063-H includes the DACI, Model 9063, with the following function sets activated:

- Computer-Based Instrumentation Function, Model 9069-1
- Thyristor Control Function Set, Model 9069-3
- Home Energy Production Control Function Set, Model 9069-4
- HVDC Transmission System Control Function Set, Model 9069-7
- SVC Control Function Set, Model 9069-8
- STATCOM Control Function Set, Model 9069-B

Manual

Description	Manual number
Computer-Based Instruments for EMS (User Guide)	585219 (86718-E0)

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Computer-Based Instruments for EMS (User Guide) (585219 (86718-E0))

- 1 Familiarization with the Metering Window and the Data Table
- 2 Familiarization with the Oscilloscope
- 3 Familiarization with the Phasor Analyzer
- 4 Familiarization with the Harmonic Analyzer
- 5 Measuring Three-Phase Power Using the Metering Window

Additional Equipment Required to Perform the Exercises (Purchased separately)

Qty	Description	Model number
1	Personal Computer	579785 (8990-00) [17]
1	AC 24 V Wall Mount Power Supply	579696 (30004-20) [18]

Specifications

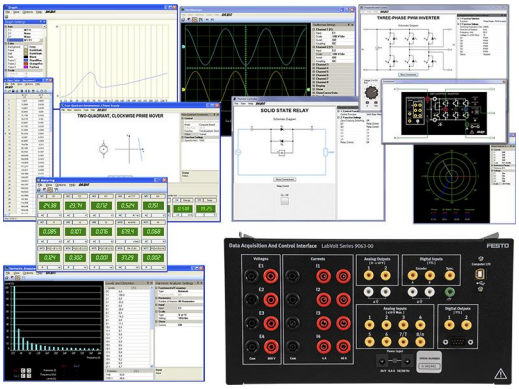
Parameter	Value
Insulated Voltage Inputs (4)	
Range (Low / High Scales)	-80 to +80 V / -800 to + 800 V (user-selectable through software)
Impedance (Low / High Scales)	326.6 kΩ / 3.25 MΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Insulated Current Inputs (4)	
Range (Low / High Scales)	-4 to +4 A / -40 to + 40 A (25 A rms)
Impedance (Low / High Scales)	5 mΩ / 50 mΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Analog Inputs (8)	
Voltage Range	-10 to +10 V
Impedance	› 10 MΩ
Bandwidth	DC to 125 kHz
Measured Parameters	User-selectable through software
Parameter-to-Voltage Ratio	User-determined through software
A/D Converter for Insulated and Analog Inputs (16)	
Type	Successive approximation
Resolution	12 bits
Integral Non-Linearity	≤ ±1.5 LSB
Differential Non-Linearity	≤ ±1 LSB
Maximum Sampling Rate	600 ksamples/s (one channel)
FIFO Buffer Size	16 ksamples
Analog Outputs (2)	
Voltage Range (2)	-10 to +10 V
Operational Load Impedance	› 600 Ω
D/A Converter for Analog Outputs (2)	
Type	Resistor string
Resolution	12 bits
Integral Non-Linearity	≤ ±8 LSB

[17] Refer to the Computer Requirements in the System Specifications section of this datasheet if the computer is to be provided by the end-user. Only one computer is required per station. This model is available in multiple voltage- and frequency dependent variants. Contact a Festo representative to obtain the correct part number.

[18] Required if power is not supplied by the Power Supply, Model 8821-2. This model is available in multiple voltage- and frequency dependent variants. Contact a Festo representative to obtain the correct part number.

Parameter	Value
Differential Non-Linearity	-0.5 to +0.7 LSB
Digital Inputs (3)	
Types	Encoder (2), synchronization (1)
Signal Level	0-5 V (TTL compatible)
Maximum Input Frequency	50 kHz
Impedance	5 kΩ
Digital Outputs (9)	
Types	Control (6 on a DB9 connector and 2 on 2 mm banana jacks), synchronization (1 on a DB9 connector)
Signal Level	0-5 V (TTL compatible)
Maximum Output Frequency	20 kHz (software-limited)
Impedance	200 Ω
Control Functions	
Activated Sets	Computer-Based Instrumentation Function, Model 9069-1
	Thyristor Control Function Set, Model 9069-3
	Home Energy Production Control Function Set, Model 9069-4
	HVDC Transmission System Control Function Set, Model 9069-7
	SVC Control Function Set, Model 9069-8
	STATCOM Control Function Set, Model 9069-B
Computer I/O Interface	USB 2.0 full speed via type-B receptacle
Power Requirements	24 V - 0.4 A - 50/60 Hz
Accessories	
Included Accessories	2 m USB interconnection cable (1)
	24 V power cable (1)
	2 mm banana plug test leads (3)
	DB9 connector control cable (1)
Physical Characteristics	
Dimensions (H x W x D)	154 x 287 x 410 mm (6.1 x 11.3 x 16.1 in)
Net Weight	3.9 kg (8.6 lb)

Data Acquisition and Control Interface 579695 (9063-J0)



The Data Acquisition and Control Interface (DACI) is a versatile USB peripheral used for measuring, observing, analyzing, and controlling electrical and mechanical parameters in electric power systems and power electronics circuits. For these purposes, a set of computer-based instruments as well as a variety of control functions are available for the DACI. These instruments and control functions are accessed through the LVDAC-EMS software. The LVDAC-EMS software, as well as all available upgrades, is free and can be downloaded anytime on the Festo Didactic website.

Together, the DACI and the LVDAC-EMS software allow training in various areas such as electric power technology, ac/dc machines, renewable energy, transmission lines, and power electronics using modern and versatile measuring instruments and control functions. LVDAC-EMS also offers the possibility to use pre-built SCADA interfaces for several applications to ease the view and understanding of the process taking place. The user guide provided allows students to quickly become familiar with the instruments and control functions available.

Model 9063-J includes the DACI, Model 9063, with the following function sets activated:

- Computer-Based Instrumentation Function, Model 9069-1
- Thyristor Control Function Set, Model 9069-3
- HVDC Transmission System Control Function Set, Model 9069-7

- SVC Control Function Set, Model 9069-8
- STATCOM Control Function Set, Model 9069-B

Manual

Description	Manual number
Computer-Based Instruments for EMS (User Guide)	585219 (86718-E0)

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Computer-Based Instruments for EMS (User Guide) (585219 (86718-E0))

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- 2 Familiarization with the Oscilloscope
- 3 Familiarization with the Phasor Analyzer
- 4 Familiarization with the Harmonic Analyzer
- 5 Measuring Three-Phase Power Using the Metering Window

Additional Equipment Required to Perform the Exercises (Purchased separately)

Qty	Description	Model number
1	Personal Computer	579785 (8990-00) [19]
1	AC 24 V Wall Mount Power Supply	579696 (30004-20) [20]

Specifications

Parameter	Value
Insulated Voltage Inputs (4)	
Range (Low / High Scales)	-80 to +80 V / -800 to + 800 V (user-selectable through software)
Impedance (Low / High Scales)	326.6 kΩ / 3.25 MΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Insulated Current Inputs (4)	
Range (Low / High Scales)	-4 to +4 A / -40 to + 40 A (25 A rms)
Impedance (Low / High Scales)	5 mΩ / 50 mΩ
Bandwidth	DC to 65 kHz (-3 dB)
Accuracy	1% (dc to 10 kHz)
Insulation	800 V
Measurement Category	CAT II (283 V ac/400 V dc versus ground)
Analog Inputs (8)	
Voltage Range	-10 to +10 V
Impedance	› 10 MΩ
Bandwidth	DC to 125 kHz
Measured Parameters	User-selectable through software
Parameter-to-Voltage Ratio	User-determined through software
A/D Converter for Insulated and Analog Inputs (16)	
Type	Successive approximation
Resolution	12 bits
Integral Non-Linearity	≤ ±1.5 LSB

[19] Refer to the Computer Requirements in the System Specifications section of this datasheet if the computer is to be provided by the end-user. Only one computer is required per station. This model is available in multiple voltage- and frequency dependent variants. Contact a Festo representative to obtain the correct part number.

[20] Required if power is not supplied by the Power Supply, Model 8821-2. This model is available in multiple voltage- and frequency dependent variants. Contact a Festo representative to obtain the correct part number.

Parameter	Value
Differential Non-Linearity	≤ ±1 LSB
Maximum Sampling Rate	600 ksamples/s (one channel)
FIFO Buffer Size	16 ksamples
Analog Outputs (2)	
Voltage Range (2)	-10 to +10 V
Operational Load Impedance	› 600 Ω
D/A Converter for Analog Outputs (2)	
Type	Resistor string
Resolution	12 bits
Integral Non-Linearity	≤ ±8 LSB
Differential Non-Linearity	-0.5 to +0.7 LSB
Digital Inputs (3)	
Types	Encoder (2), synchronization (1)
Signal Level	0-5 V (TTL compatible)
Maximum Input Frequency	50 kHz
Impedance	5 kΩ
Digital Outputs (9)	
Types	Control (6 on a DB9 connector and 2 on 2 mm banana jacks), synchronization (1 on a DB9 connector)
Signal Level	0-5 V (TTL compatible)
Maximum Output Frequency	20 kHz (software-limited)
Impedance	200 Ω
Control Functions	
Activated Sets	Computer-Based Instrumentation Function, Model 9069-1
	Thyristor Control Function Set, Model 9069-3
	HVDC Transmission System Control Function Set, Model 9069-7
	SVC Control Function Set, Model 9069-8
	STATCOM Control Function Set, Model 9069-B
Computer I/O Interface	USB 2.0 full speed via type-B receptacle
Power Requirements	24 V - 0.4 A - 50/60 Hz
Accessories	
Included Accessories	2 m USB interconnection cable (1)
	24 V power cable (1)
	2 mm banana plug test leads (3)
	DB9 connector control cable (1)
Physical Characteristics	
Dimensions (H x W x D)	154 x 287 x 410 mm (6.1 x 11.3 x 16.1 in)
Net Weight	3.9 kg (8.6 lb)

Optional Equipment Description

SCADA for LVDAC-EMS (Optional) 8094377 (8973-00)

Education in electrical engineering at Festo Didactic is largely based on our unique electric power technology training platform, which combines hardware, software, and courseware to allow study of electrical energy.

At the heart of the systems are the data acquisition and control interface (DACI) and the four-quadrant dynamometer/power supply. When used in combination with LVDAC-EMS software program, students have access to a complete set of computer-based instruments to measure, observe, analyze, and control electrical and mechanical parameters of a workstation on their computers.

Our state-of-the-art training platform has just been enhanced through the integration of a new SCADA-EMS feature, a software program designed to run in combination with LVDAC-EMS. SCADA-EMS transforms LVDAC-EMS and the workstation's computer into a local workstation that can be monitored and controlled over a local network from a supervisory computer. Using the OPC Server protocol, SCADA-EMS enables users to design their own interface by calling the different applications running on the local workstations.

SCADA-EMS enhances LVDAC-EMS by adding several new features. You will be able to:

- Collect data from local workstations.

- Observe and control one or more stations from one or more supervisory stations.

- Remotely control several applications in your lab.

- Use a workstation in a different room to make real demonstrations over the network in your classroom without having to bring your workstation to class.

- Introduce students to the fundamentals of SCADA in a smart grid context.

- Recreate a complete grid with several different applications running.

The SCADA-EMS software program can be downloaded from our website. This locked version can be unlocked by a USB dongle. A dongle unlocks five workstations; order as many dongles as required.

Before ordering the dongles, please install:

- LVDAC-EMS (version 3.19 or later) on all your workstation computers.

- SCADA-EMS (1.01 or later) on the workstation computers you want to use to build up your SCADA application.

Contact your sales representative about order details and options.

LVDAC-EMS

The LVDAC-EMS software is a freeware which can be downloaded anytime from the Festo Didactic website (www.labvolt.com). The LVDAC-EMS software is a user-friendly tool that facilitates the use of the various functions which can be implemented with USB peripherals such as the Data Acquisition and Control Interface (DACI), LabVolt Series 9063, and the Four-Quadrant Dynamometer / Power Supply, LabVolt Series 8960.

The LVDAC-EMS software also includes a firmware update for the DACI. When a DACI is connected to a newer version of LVDAC-EMS, the user can easily update the module using a simple update wizard.

LVDAC-EMS Functions

The functions that are currently available for the DACI, Model 9063, are described below. All functions can be activated in any DACI by purchasing a license for that specific function and then performing the upgrade procedure on the DACI. New functions will be added to this datasheet as they become available.

Instrumentation Functions

The instrumentation functions of LVDAC-EMS replace a multitude of actual data acquisition devices (e.g., voltmeters, ammeters, oscilloscopes, synchroscopes) with a series of computer-based instruments that display the data measured by the DACI.

Features & Benefits

- Monitor and control several workstations from one (or more) supervisory computer(s)
- Use OPC server protocol to communicate between the different workstations

- Include your own pictures and schematics
- Introduce SCADA in existing EMS laboratories

Personal Computer (Optional) 579785 (8990-00)

The Personal Computer consists of a desktop computer running under Windows® 10. A monitor, keyboard, and mouse are included.

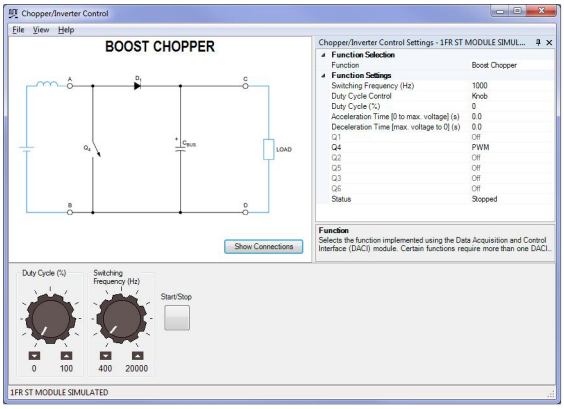
Specifications

Parameter	Value
Power Requirements	
Current	1.05 A
Service Installation	Standard single-phase ac outlet

Complete Function Set (Optional) 581451 (9069-00)

This Model activates all currently available control function sets for the Data Acquisition and Control Interface, Model 9063. See individual control functions sets, Models 9069-X, for more information on the included functions.

Chopper/Inverter Control Function Set (Optional) 581453 (9069-20)



The Chopper/Inverter Control Function Set enables the following choppers and inverters to be implemented using the Data Acquisition and Control Interface, the IGBT Chopper/Inverter and the Insulated DC-to-DC Converter:

- Buck Chopper (high-side switching)
- Buck Chopper (low-side switching)
- Buck/Boost Chopper
- Boost Chopper
- Four-Quadrant Chopper
- Buck Chopper with Feedback
- Boost Chopper with Feedback

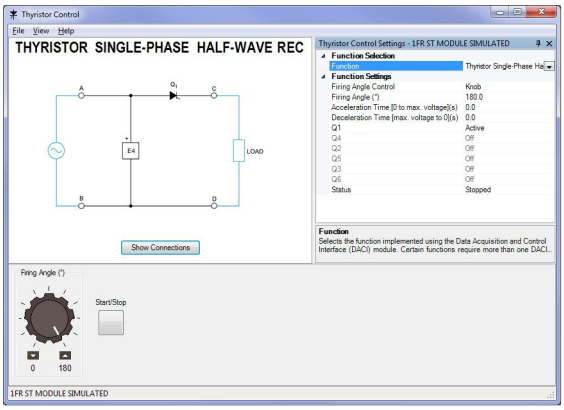
- Single-Phase, 180° Modulation Inverter
- Single-Phase PWM Inverter
- Three-Phase, 180° Modulation Inverter
- Three-Phase PWM Inverter
- Three-Phase Inverter (constant V/f ratio)
- Insulated DC-to-DC Converter
- Four-Quadrant DC Motor Drive without Current Control
- Four-Quadrant DC Motor Drive

Specifications

Parameter	Value
Control Functions	
Control Functions	Buck Chopper (high-side switching)
	Buck Chopper (low-side switching)
	Buck/Boost Chopper
	Boost Chopper
	Four-Quadrant Chopper
	Buck Chopper with Feedback
	Boost Chopper with Feedback
	Single-Phase, 180° Modulation Inverter
	Single-Phase PWM Inverter
	Three-Phase, 180° Modulation Inverter
	Three-Phase PWM Inverter
	Three-Phase PWM Inverter (constant V/f ratio)
	Insulated DC-to-DC Converter
	Four-Quadrant DC Motor Drive without Current Control
	Four-Quadrant DC Motor Drive
Buck Chopper (high-side switching), Buck Chopper (low-side switching), Buck/Boost Chopper, Boost Chopper, Four-Quadrant Chopper	
Switching Frequency	400 Hz to 20 kHz
Duty Cycle Control	Knob or analog input on the DACI
Duty Cycle	0-100%
Acceleration Time (0 to Max. Voltage)	0-100 s
Deceleration Time (Max. Voltage to 0)	0-100 s
IGBTs Q1 to Q6	PWM, on, off (certain IGBTs are unavailable depending on the selected chopper control function)
Buck Chopper with Feedback, Boost Chopper with Feedback	
Switching Frequency	2-20 kHz
Command	0-100%
Feedback Input	Voltage, current, speed, power, or low-power analog signal
Feedback Range (100% Value =)	10-400 V
Feedback Filter Cutoff Frequency	100-4900 Hz
Command Input	Knob or analog input on the DACI
Acceleration Time (0 to 100%)	0-100 s
Deceleration Time (100% to 0)	0-100 s
Single-Phase, 180° Modulation Inverter	
DC Bus	Unipolar or bipolar
Frequency	0-120 Hz
IGBTs Q1 to Q6	180° Modulation, on, or off (certain IGBTs are unavailable)
Single-Phase PWM Inverter	
DC Bus	Unipolar or bipolar
Switching Frequency	400 Hz to 20 kHz
Frequency	0-120 Hz
Peak Voltage	0-100% of dc bus
IGBTs Q1 to Q6	PWM, on, or off (certain IGBTs are unavailable)
Three-Phase, 180° Modulation Inverter	
Phase Sequence	Forward (1-2-3), reverse (1-3-2), or forward/reverse
Frequency	0-120 Hz
IGBTs Q1 to Q6	180° Modulation, on, or off
Three-Phase PWM Inverter	
Switching Frequency	400 Hz to 20 kHz
Phase Sequence	Forward (1-2-3), reverse (1-3-2), or forward/reverse
Frequency	0-120 Hz
Peak Voltage	0-117% of dc bus/2
Modulation Type	Sinusoidal pulse-width modulation or space vector
IGBTs Q1 to Q6	PWM, on, or off
Three-Phase PWM Inverter (Constant V/f Ratio)	
Switching Frequency	400 Hz to 20 kHz

Parameter	Value
Phase Sequence	Forward (1-2-3), reverse (1-3-2), or forward/reverse
Frequency	0-120°
Knee Peak Voltage	0-117% of dc bus voltage/2
Knee Frequency	1-120 Hz
Modulation Type	Sinusoidal pulse-width modulation or space vector
Acceleration Time (0 to Knee)	0-100 s
Deceleration Time (Knee to 0)	0-100 s
Insulated DC-to-DC Converter	
Duty Cycle	0-45%
Four-Quadrant DC Motor Drive with and without Current Control	
Switching Frequency	2-20 kHz
Speed Command Input	Knob or analog input on the DACI
Speed Command	-5000 r/min to 5000 r/min
Pulley Ratio	24:12 or 24:24
Acceleration Time (0 to Max. Speed)	0-100 s
Deceleration Time (Max. Speed to 0)	0-100 s
Current Feedback Range	4 A or 40 A (only available in current control)
Current Feedback Filter Cutoff Frequency	100-4900 Hz (only available in current control)
Current Command Limit	0-40 A (only available in current control)

Thyristor Control Function Set (Optional) 581454 (9069-30)



The Thyristor Control Function Set enables the following thyristor-based devices to be implemented using the Data Acquisition and Control Interface, and the Power Thyristors:

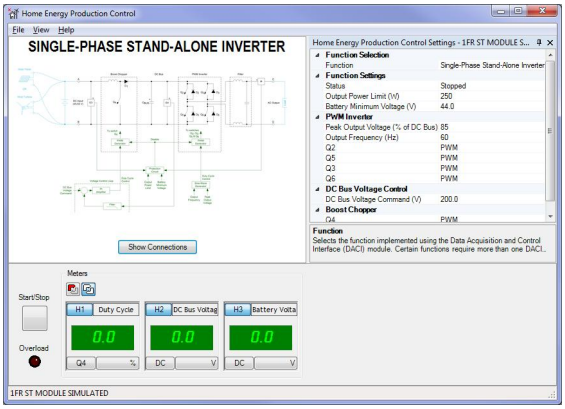
- Thyristor Single-Phase Half-Wave Rectifier
- Thyristor Single-Phase Bridge
- Thyristor Three-Phase Bridge
- Thyristor Three-Phase Bridge with Feedback
- Solid-State Relay
- Thyristor Single-Phase AC Power Control
- Thyristor Three-Phase AC Power Control
- Direct-On-Line Starter
- Soft Starter

Specifications

Parameter	Value
Control Functions	
Control Functions	Thyristor Single-Phase Half-Wave Rectifier
	Thyristor Single-Phase Bridge
	Thyristor Three-Phase Bridge
	Thyristor Three-Phase Bridge with Feedback
	Solid-State Relay
	Thyristor Single-Phase AC Power Control
	Thyristor Three-Phase AC Power Control
	Direct-On-Line Starter
	Soft Starter

Parameter	Value
Thyristor Single-Phase Half-Wave Rectifier, Thyristor Single-Phase Bridge, Thyristor Three-Phase Bridge	
Firing Angle Control	Knob or analog input on the DACI
Firing Angle	0-180°
Acceleration Time (0 to Max. Voltage)	0-100 s
Deceleration Time (Max. Voltage to 0)	0-100 s
Thyristors Q1 to Q6	Active, on, or off (certain thyristors are unavailable depending on the selected thyristor control function)
Thyristor Three-Phase Bridge with Feedback	
Command Input	On or off
Command	Knob or analog input on the DACI
Inverter Limit	100-180°
Arc-Cosine	On or off
Feedback Input	Voltage, rms voltage, current, speed, power, or low-power analog signal
Feedback Range (Voltage Input Only)	80-800 V
Current Feedback Range (Current Input Only)	0.4-4 A
Speed Feedback Range (Speed Input Only)	250-2500 r/min
Analog Feedback Range (Analog Input Only)	1-10 V
Power Feedback Range (Power Input Only)	32-3200 W
Feedback Filter Cutoff Frequency	10-180 Hz
Acceleration Time (0 to 100%)	0-100 s
Deceleration Time (100% to 0)	0-100 s
Thyristors Q1 to Q6	Active, on, or off
Solid-State Relay	
Zero-Voltage Switching	On or off
Relay Control	Open or close
Thyristors Q1 to Q6	Active, on, or off (certain thyristors are unavailable)
Thyristor Single-Phase AC Power Control	
Control Mode	Phase control, synchronous burst fire control, or asynchronous burst fire control
Firing Angle Control	Knob or analog input on the DACI
Firing Angle	0-180°
Thyristors Q1 to Q6	Active, on, or off (certain thyristors are unavailable)
Thyristor Three-Phase AC Power Control	
Load Configuration	3 wires star (3S), 3 wires delta (3D), 4 wires star (4S), or 6 wires delta (6D)
Control Mode	Phase control or synchronous burst fire control (certain control modes are unavailable depending on the selected thyristor control function)
Firing Angle Control	Knob or analog input on the DACI
Acceleration Time (0 to Max. Voltage)	0-100 s
Deceleration Time (Max. Voltage to 0)	0-100 s
Thyristors Q1 to Q6	Active, on, or off
Direct-On-Line Starter	
Motor Full-Load Current	0.4-2 A
Overload	On or off
Overload Class	5, 10, 15, 20, 25, 30, 35, or 40
Soft Starter	
Mode	Soft Start or current-limit start
Motor Full-Load Current	0.4-2 A
Initial Torque	15%, 25%, 35%, or 65% of LRT
Start Time	2-200 s
Kick-Start Time	0 s, 0.5 s, 1 s, or 1.5 s
Soft Stop	0, 1, 2, or 3 times the start time
Overload	On or off
Overload Class	5, 10, 15, 20, 25, 30, 35, or 40

Home Energy Production Control Function Set (Optional) 581455 (9069-40)



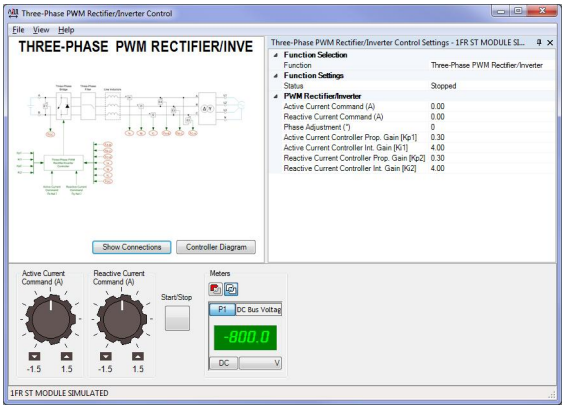
The Home Energy Production Control Function Set enables the following devices required for home energy production to be implemented using the Data Acquisition and Control Interface, the IGBT Chopper/Inverter, and the Insulated DC-to-DC Converter:

- Single-Phase Stand-Alone Inverter
- Single-Phase Grid-Tied Inverter
- Solar Power Inverter (LF Transformer)
- Solar/Wind Power Inverter (HF Transformer)

Specifications

Parameter	Value
Control Functions	
Control Functions	Single-Phase Stand-Alone Inverter
	Single-Phase Grid-Tied Inverter
	Single-Phase Grid-Tied Inverter (LF Transformer)
	Solar/Wind Power Inverter (HF Transformer)
Single-Phase Stand-Alone Inverter Function	
Output Power Limit	50-250 W
Battery Minimum Voltage	35-55 V
PWM Inverter Peak Output Voltage	50-95% of dc bus voltage
PWM Inverter Output Frequency	50 or 60 Hz
DC Bus Voltage Command	100-400 V
Single-Phase Grid-Tied Inverter Function	
Active Current Command	-1 to 1 A
Reactive Current Command	-1 to 1 A
DC Bus Voltage Command	100-400 V
Solar Power Inverter (LF Transformer)	
MPP Tracker	On or off
Active Current Command	-10 A to 10 A (only available when the MPP Tracker parameter is switched to Off)
Reactive Current Command	-10 A to 10 A
Solar/Wind Power Inverter (HF Transformer)	
MPP Tracker Type	Solar panel or wind turbine

Three-Phase PWM Rectifier/Inverter Control Function Set (Optional) 581456 (9069-50)



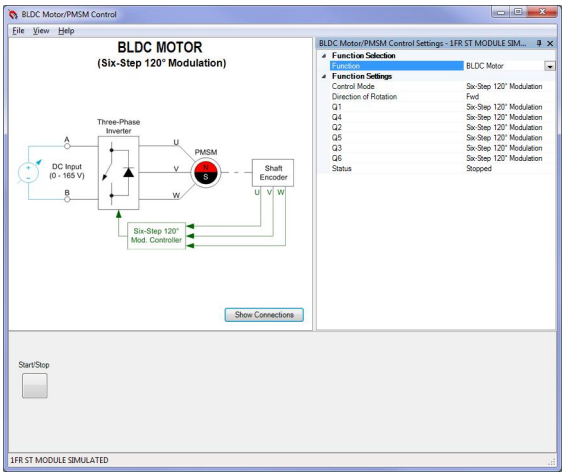
The Three-Phase PWM Rectifier/Inverter Control Function Set enables the following three-phase PWM rectifiers/ inverters to be implemented using the DACI and the IGBT Chopper/Inverter:

- Three-Phase PWM Rectifier/Inverter
- PWM Rectifier/Inverter with Buck/Boost Chopper

Specifications

Parameter	Value
Control Functions	
Control Functions	Three-Phase PWM Rectifier/Inverter
	PWM Rectifier/Inverter with Buck/Boost Chopper
Three-Phase PWM Rectifier/Inverter	
Active Current Command	-1.5 A to 1.5 A
Reactive Current Command	-1.5 A to 1.5 A
Phase Adjustment	-90° to 90°
PWM Rectifier/Inverter with Buck/Boost Chopper	
Reactive Current Command	-1.5 A to 1.5 A
Phase Adjustment	-90° to 90°
DC Bus Voltage Command	150-250 V
Buck/Boost Chopper Duty Cycle	10-40%

BLDC Motor/PMSM Control Function Set (Optional) 581457 (9069-60)



The BLDC Motor/PMSM Control Function Set enables the following control types for brushless dc (BLDC) motors and permanent-magnet synchronous machines (PMSM) to be implemented using a Data Acquisition and Control Interface, and a IGBT Chopper/Inverter, or using two Data Acquisition and Control Interface, and two IGBT Chopper/Inverter:

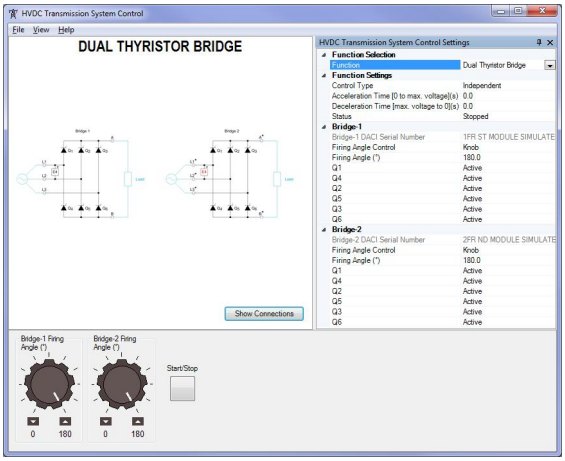
- Three-Phase, Six-Step 120° Modulation Inverter
- Brushless DC Motor
- Permanent Magnet Synchronous Motor Drive
- Wind Turbine with Permanent Magnet Synchronous Generator

Specifications

Parameter	Value
Control Modes	
Control Modes	Three-Phase, Six-Step 120° Modulation Inverter
	Brushless DC Motor

Parameter	Value
	Permanent Magnet Synchronous Motor Drive
	Wind Turbine with Permanent Magnet Synchronous Generator
Three-Phase, Six-Step 120° Modulation Inverter	
Phase Sequence	Forward (1-2-3) or reverse (1-3-2)
Frequency	0-400 Hz
IGBTs Q1 to Q6	Six-step 120° modulation, on, or off
Brushless DC Motor	
Control Mode	Six-step 120° modulation or low-side six-step PWM
Direction of Rotation	Forward or reverse
Permanent Magnet Synchronous Motor Drive	
Control Mode	Constant V/f ratio or vector control
Switching Frequency	400 Hz to 20 kHz
Direction of Rotation	Forward or reverse
Frequency	0-300 Hz
Knee Peak Voltage	0-100% of dc bus voltage/2
Knee Frequency	1-300 Hz
Low-Speed Boost Voltage	0-25% of dc bus voltage/2
Modulation Type	Sinusoidal pulse-width modulation or space vector
Acceleration Time (0 to Knee)	0-100 s
Deceleration Time (Knee to 0)	0-100 s
Wind Turbine with Permanent Magnet Synchronous Generator - First Module (BLDC Motor/PMSM Control)	
Switching Frequency	400 Hz to 20 kHz
Direction of Rotation	Forward or reverse
MPP Tracker	On or off
Vector Control Direct Current Command	0-5 A
Vector Control Quadrature Current Limit	0-3.5 A
Wind Turbine with Permanent Magnet Synchronous Generator - Second Module (PWM Rectifier/Inverter Control)	
DC Bus Voltage Command	150-250 V
PWM Rectifier/Inverter Reactive Current Command	-1.5 A to 1.5 A
PWM Rectifier/Inverter Phase Adjustment	-90° to 90°

High-Voltage DC (HVDC) Transmission System Control Function Set (Optional) 579790 (9069-70)



The High-Voltage DC (HVDC) Transmission System Control Function Set enables the following devices required for the study of HVDCs to be implemented using two Data Acquisition and Control Interface, and two Power Thyristors:

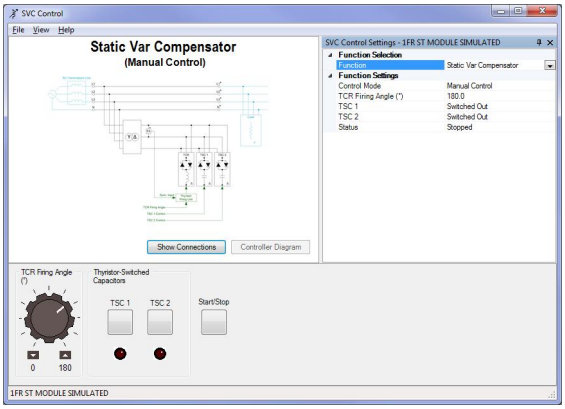
- Dual Thyristor Bridge
- Monopolar HVDC Transmission System
- 12-Pulse Converter

Specifications

Parameter	Value
Control Functions	
Control Functions	Dual Thyristor Bridge
	Monopolar HVDC Transmission System

Parameter	Value
	12-Pulse Converter
Dual Thyristor Bridge	
Control Type	Independent, common (α,α), or common (α,ß)
Acceleration Time (0 to Max. Voltage)	0-100 s
Deceleration Time (Max. Voltage to 0)	0-100 s
Firing Angle Control (for Each Bridge)	Knob or analog input on the DACI
Firing Angle (for Each Bridge)	0-180°
Monopolar HVDC Transmission System	
Control Type	Independent, linked (rectifier = bridge 1), or linked (rectifier = bridge 2)
Command Input (for Each Bridge)	Knob or analog input on the DACI
Current Command (for Each Bridge)	0-2 A
Inverter Limit (for Each Bridge)	90-180°
Arc-Cosine (for Each Bridge)	On of off
Feedback Filter Cutoff Frequency (for Each Bridge)	10-180 Hz
12-Pulse Converter	
Firing Angle	0-180°
Acceleration Time (0 to Max. Voltage)	0-100 s
Deceleration Time (Max. Voltage to 0)	0-100 s

Static Var Compensator (SVC) Control Function Set (Optional) 581458 (9069-80)



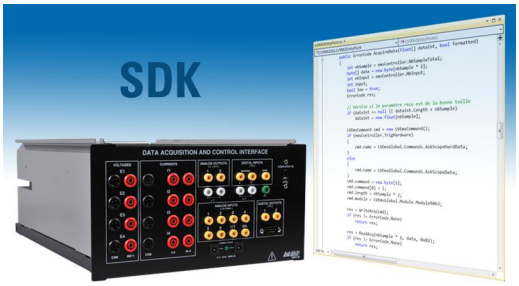
The Static Var Compensator (SVC) Control Function Set enables the following devices required for the study of SVCs to be implemented using the Data Acquisition and Control Interface, and the Power Thyristors:

- Static Var Compensator (Manual Control)
- Static Var Compensator (Automatic Voltage Control)
- Static Var Compensator (Automatic Reactive Power Control)

Specifications

Parameter	Value
Control Modes	
Control Modes	Manual control
	Automatic voltage control
	Automatic reactive power control
Manual Control	
TCR Firing Angle	0-180°
TSC 1 and TSC 2	Switched in or switched out
Automatic Voltage Control	
Line Voltage Command	160-440 V
Automatic Reactive Power Control	
Phase Adjustment	-90° to 90°

Software Development Kit (SDK) (Optional)
581459 (9069-90)



The DACI SDK (Software Development Kit) offers the possibility to control various inputs and outputs of the Data Acquisition and Control Interface using third-party rapid prototyping software like Mathworks® MATLAB, National Instruments® LabVIEW, Microsoft Visual Studio and other programming tools that support Microsoft® .NET Framework 4.0. The SDK gives users the possibility to build their own advanced functions using the Data Acquisition and Control Interface.

The SDK includes the following:

- DLL files for communication with the DACI

- Documentation related to the functions

- MATLAB (2010 or later), LabVIEW (2009 or later) and Visual Studio C# (2012 or later) example programs

- Binaries from the C# example. This application can be used to verify that your PC configuration is compatible with the SDK.

The following functions are available using the SDK:

- Acquisition through the voltage and current inputs

- Acquisition through the encoder inputs

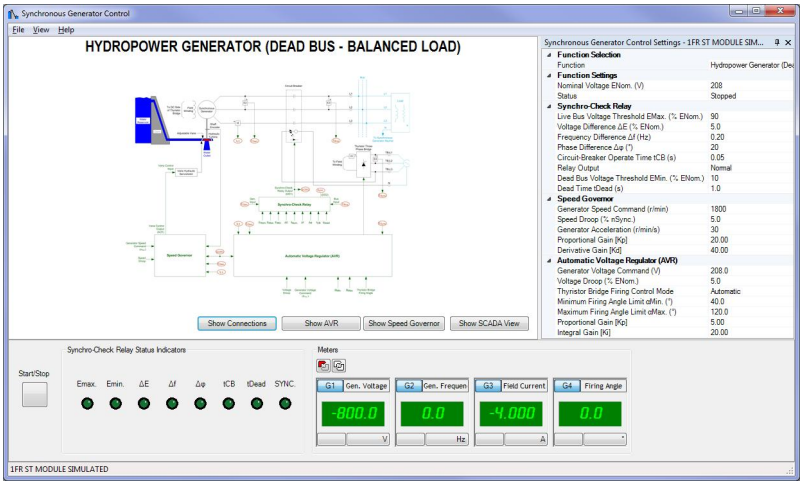
- Acquisition through the analog inputs

- Control of the digital outputs

- Control of the analog outputs

Important Notice: One DACI SDK (Software Development Kit) must be ordered for each Data Acquisition and Control Interface to unlock the SDK features.

Synchronous Generator Control Function Set (Optional)
579788 (9069-A0)



The Synchronous Generator Control Function Set enables the control of synchronous generators using different prime movers (emulated using the Four-Quadrant Dynamometer/Power Supply, and different control types for each prime mover. The function set allows the following prime movers and control types to be implemented using the Data Acquisition and Control Interface, and the Power Thyristors:

- Hydropower Generator (Dead Bus - Balanced Load)

- Hydropower Generator (Infinite Bus)

- Hydropower Generator (Balanced Infinite Bus)

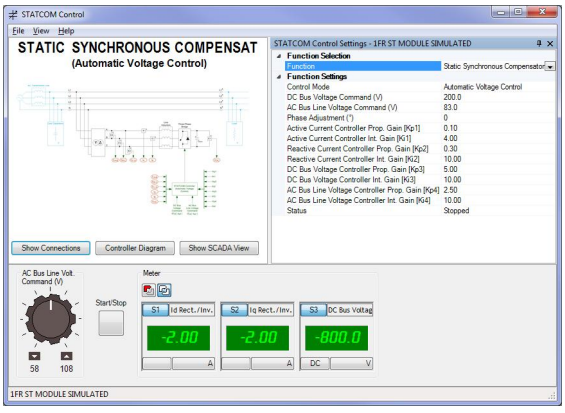
- Hydropower Generator (Generator Paralleling - Balanced Bus)

- Generator (Microgrid)

Specifications

Parameter	Value
Control Functions	
Control Functions	Hydropower generator (dead bus - balanced load)
	Hydropower generator (infinite bus)
	Hydropower generator (balanced infinite bus)
	Hydropower generator (gen. paralleling - balanced bus)
	Generator (Microgrid)
Controller Features	Each function of the Synchronous Generator Control Function Set comprises a synchro-check relay, a speed governor, and an automatic voltage regulator.
Synchro-Check Relay	
Live Bus Voltage Threshold	50-100 V
Voltage Difference	2-40 V
Frequency Difference	0.02-2 Hz
Phase Difference	5-50°
Circuit-Breaker Operate Time	0.05-0.25 s
Relay Output	Normal, high, or low
Dead Bus Voltage Threshold	10-80% of nominal voltage
Dead Time	0.1-20 s
Speed Governor	
Speed Command	0-2000 r/min
Speed Droop	0-10%
Generator Acceleration	10-100 r/min/s
Automatic Voltage Regulator (AVR)	
Generator Voltage Command	0-440 V
Voltage Droop	0-10%
Thyristor Bridge Firing Control Mode	Automatic or manual
Minimum Firing Angle Limit	40-120°
Maximum Firing Angle Limit	120°

Static Synchronous Compensator (STATCOM) Control Function Set (Optional) 581460 (9069-B0)



The Static Synchronous Compensator (STATCOM) Control Function Set enables the following devices required for the study of STATCOMs to be implemented using the Data Acquisition and Control Interface, and the IGBT Chopper/ Inverter:

- Static Synchronous Compensator (Automatic Voltage Control)

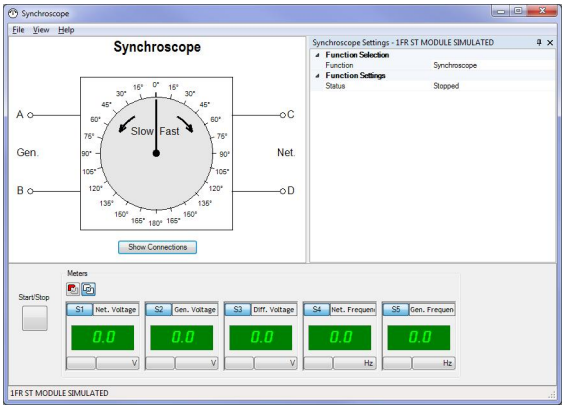
- Static Synchronous Compensator (Automatic Reactive Power Control)

Specifications

Parameter	Value
Control Modes	
Control Modes	Automatic Voltage Control
	Automatic Reactive Power Control
Automatic Voltage Control	

Parameter	Value
DC Bus Voltage Command	150-250 V
AC Bus Line Voltage Command	58-108 V
Phase Adjustment	-90° to 90°
Automatic Reactive Power Control	
DC Bus Voltage Command	150-250 V
Phase Adjustment	-90 to 90°

Synchroscope Function (Optional) 579789 (9069-C0)

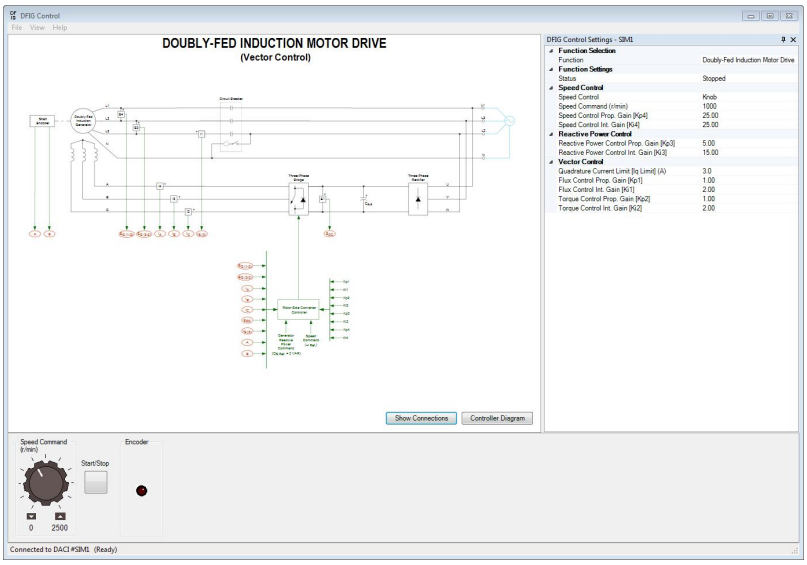


The Synchroscope Function is used for the synchronization of synchronous generators. This function emulates the operation of an actual synchroscope by showing on-screen the dial indicating the phase angle difference between the generator voltage and the network voltage. In addition, the Synchroscope Function includes meters displaying various parameters important to generator synchronization (e.g., network voltage and frequency, generator voltage and frequency, voltage difference).

Specifications

Parameter	Value

Doubly-Fed Induction Generator (DFIG) Control Function Set (Optional) 587056 (9069-D0)



The Doubly-Fed Induction Generator (DFIG) Control Function Set enables the following devices required for the study of DFIGs to be implemented using the Data Acquisition and Control Interface, Model 9063, the IGBT Chopper/Inverter, Model 8837-B, and the Rectifier and Filtering Capacitors, Model 8842-A:

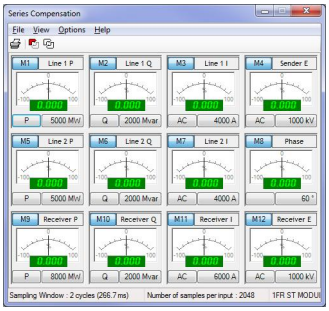
Doubly-Fed Induction Generator (DFIG) Control

Specifications

Parameter	Value
Speed Control	
Speed Control	Knob, AI-1 (0 to 10 V)
Speed Command	0-2500 r/min
Speed Control Prop. Gain	0.01-100

Parameter	Value
Speed Control Int. Gain	0-200
Reactive Power Control	
Reactive Power Control Prop. Gain	0.01-100
Reactive Power Control Int. Gain	0-200
Vector Control	
Quadrature Current Limit	0-3 A
Flux Control Prop. Gain	0.01-100
Flux Control Int. Gain	0-200
Torque Control Prop. Gain	0.01-100
Torque Control Int. Gain	0-200

Power Line Series Compensation Function Set (Optional) 581461 (9069-S0)



The Power Line Series Compensation Function Set enables the Series Compensation function in LVDAC-EMS.

Additional Equipment Required to Perform the Exercises (Purchased separately)

Qty	Description	Model number
1	Power Line Series Compensation Demonstrator (Add-on to EMS)	586477 (8362-A0)

AC 24 V Wall Mount Power Supply (Optional) 579696 (30004-20)

This 24 V AC Power Supply is used specifically to power specific components from our learning systems, such as the Data Acquisition and Control Interface and the protection mechanism of our electrical machines.

Specifications

Parameter	Value
Power Requirements	
Maximum Current	TBE
AC Power Network Installation	220 V – 50/60 Hz, must include live, neutral, and ground wires
Power Outputs	
Fixed, Single-Phase AC	24 V – 2,5 A

AC 24 V Wall Mount Power Supply (Optional) 579698 (30004-2A)

The 24 V AC Power Supply is used to power specific modules of the Electric Power Technology Training Systems, such as the Data Acquisition and Control Interface, the IGBT Chopper/Inverter, and the Power Thyristors.

Specifications

Parameter	Value
Power Requirements	
Maximum Current	TBE
AC Power Network Installation	220 V – 50/60 Hz, must include live, neutral, and ground wires
Power Outputs	
Fixed, Single-Phase AC	24 V – 2,5 A

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.

Festo Didactic SE

Rechbergstrasse 3
73770 Denkendorf
Germany

P. +49(0)711/3467-0
F. +49(0)711/347-54-88500

Festo Didactic Inc.

607 Industrial Way West
Eatontown, NJ 07724
United States

P. +1-732-938-2000
F. +1-732-774-8573

Festo Didactic Ltée/Ltd

675 rue du Carbone
Québec QC G2N 2K7
Canada

P. +1-418-849-1000
F. +1-418-849-1666

www.labvolt.com

www.festo-didactic.com