

INTRODUCTION

The Basler Electric SMC-150 Synchronous Motor Controller precisely and reliably controls the level of excitation power supplied to the field of a brushless-excited synchronous motor. Field excitation power is controlled and delivered by Basler's DECS-150 Digital Excitation Control System.

All SMC-150 components and connection terminals are mounted and wired on a single mounting plate intended for installation in a suitable enclosure.

This publication serves as an overview of the functions and capabilities of the SMC-150. System drawings and product documentation specific to the devices of the SMC-150 accompany this publication.

SAFETY

Warning!

Personal injury may result if contact is made with system components carrying high voltages. The circuit diagrams supplied with this document will disclose hazardous areas.

As with all electrical equipment, appropriate safety measures must be taken whenever dealing with the excitation equipment. High voltages are present at the equipment. The voltage magnitudes depend upon the characteristics of a particular system. Opening the power source connections does not completely remove the threat of high voltages. As long as the machine is physically connected to the system, the possibility of a safety hazard exists.

When working with the excitation control switchgear, every precaution must be taken to ensure that all high voltages are isolated and avoided. In addition to voltage at the power potential transformer (PPT), there may be other power sources connected to the equipment. These sources may include the user-supplied dc control power and the ac station power. Consider all connections to be live and dangerous until proven otherwise.

SPECIFICATIONS

Operating Power Input

Voltage Range

For full-load continuous field voltage of:

63 Vdc: 100 to 139 Vac or 125 Vdc
125 Vdc: 190 to 277 Vac 1-phase, 190 to 260 Vac 3-phase, or 250 Vdc

Frequency Range: dc, 50 to 500 Hz

Control Power Input

Nominal: 24 Vdc
Range: 19.2 to 26.4 Vdc

Sensing Inputs

Voltage

Range: 100 to 600 Vac, 50/60 Hz
Configuration: 1-phase or 3-phase, 3-wire

Current

Nominal: 1 or 5 Aac
Configuration: 1-phase or 3-phase plus cross-current compensation

Contact Outputs (DECS-150)

Make, break, and carry ratings (resistive):
Rating: 7.0 Adc at 24 Vdc/240 Vac

Temperature

Operating

Up to 7 Adc Output: 0 to 60°C (32 to 140°F)
Up to 10 Adc Output: 0 to 55°C (32 to 131°F)

Storage: -20 to 60°C (-4 to 140°F)

FCC Requirements

This product complies with FCC 47 CFR Part 15.

HANDLING AND MAINTENANCE

Careful handling and routine maintenance will promote SMC-150 longevity and preserve its performance. Basler Electric publication 9410100990, supplied with this document, provides guidelines for handling, installing, and maintaining the SMC-150.

EQUIPMENT OVERVIEW

SMC-150 features and options are defined and specified by a style number derived from the style chart shown in Figure 1. The features of the SMC-150's DECS-150 controller will vary according to the style number specified for the SMC-150.

Standard equipment elements include a DECS-150 Digital Excitation Control System, Inrush Current Reduction Module, ES-74S DC Millivolt Sensing Relay, ES-55 Power Factor Relay, control relay, metering shunt, circuit breakers, and user terminals.

MOUNTING CONFIGURATION

Components are mounted and wired on a mounting plate constructed from 11-gauge, galvanized steel. The mounting plate is intended for installation in a suitable enclosure. Mounting plate dimensions are shown in Figure 2 and on the system outline drawing.

Dimensions are shown in inches with millimeters in parenthesis.

TERMINAL CONFIGURATIONS

User connections to the SMC-150 are made with compression (screw) terminals which accommodate wire sizes up to 12 AWG or 2.5 mm². When wiring to the terminals, a wire insulation stripping length of 8 to 10 millimeters (0.315 to 0.394 inches) is recommended. When tightening the terminal screws, apply a torque no greater than 0.6 N•m or 5.3 in-lb.

SYSTEM ELEMENTS

Interconnected SMC-150 system elements work together to supply regulated excitation power to the field and protect the controlled equipment. All excitation system element connections are illustrated on the system schematic diagrams.

Digital Excitation Control System DECS-150

The DECS-150 supplies regulated excitation power to the machine exciter field. It also monitors parameters to control, limit, and protect the machine from operating beyond its capabilities.

Detailed information about DECS-150 operation is available in Basler publication 9492600990. The following paragraphs serve as an overview of DECS-150 functions.

Regulation

Digital signal processing and precise regulation algorithms enable the DECS-150 to accurately regulate the level of excitation. Motor parameters are monitored through user-supplied VTs and CTs. Sensing of field voltage and current is obtained directly from the field. Depending upon the regulation mode in use, the DECS-150 compares all or some of these monitored parameters with the operating setpoint and provides regulated excitation power to the field.

Multiple regulation modes enable the DECS-150 to accommodate a variety of machine applications and operating conditions.

Manual Mode

In Manual mode, the DECS-150 regulates the level of excitation power supplied to the field independently of all operating conditions. This makes Manual mode useful as a backup method of excitation control if a loss of sensing occurs.

In an SMC-150 system, Manual mode is configured for field current regulation (FCR). FCR is selected automatically at system startup or manually, by the operator, during normal operation. When operating in FCR mode, the DECS-150 regulates only the level of field current. The operator must manually vary the FCR setpoint in order to achieve the desired motor operating conditions.

Auto Mode

During the motor startup sequence, the DECS-150 is switched from FCR to Auto mode when the DECS-150 determines that the level of ac motor current has reached the nominal level. In Auto mode, the DECS-150 measures the real power into the motor and adjusts the field excitation to obtain the desired level of reactive power (and power factor).

Autotracking

The setpoint of the active control mode is automatically tracked (followed) by the inactive control modes. This feature enables the initiation of bumpless transfers between Auto and Manual mode and vice versa. For example, if a loss of sensing occurs while operating in Auto mode, the auto tracking function will minimize the disturbance that the transfer from Auto mode to Manual mode would cause.

Limiters

As delivered, the SMC-150 has no limiter functions preprogrammed. However, any of the DECS-150 limiters can be programmed by the user and assigned to any unused DECS-150 contact outputs. DECS-150 limiter functions include:

- Overexcitation
- Underexcitation
- Stator current
- Underfrequency
- Volts per hertz

Protection

DECS-150 protective functions may be implemented as backup to the primary protection relays used in an application. Each protection feature has an adjustable tripping level and time delay and can be assigned to one of the DECS-150 programmable contact outputs. DECS-150 protective functions include:

- Configurable protection
- Exciter diode monitor
- Field overcurrent
- Field overvoltage
- Motor overvoltage
- Motor undervoltage
- Loss of sensing voltage
- Low frequency
- Overfrequency
- Underfrequency

Operating Logic

In the SMC-150, the DECS-150 is preconfigured with operating logic that is tailored specifically to synchronous motor applications. If desired, this logic scheme can be customized by using the logic programming capabilities of BESTlogic™ Plus. The BESTlogic™ Plus chapter of Basler publication 9492600990 provides information about customizing DECS-150 logic.

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Event Reporting

DECS-150 reporting functions include sequence-of-events recording and data logging.

Sequence of Events

The sequence-of-events recorder monitors the internal and external status of the DECS-150. More than 400 data/status points are monitored and will trigger up to 63 events per record.

Data Logging

Up to four oscillography records are logged in nonvolatile memory using the COMTRADE format. Logging of records is triggered by status changes in up to six user-selected parameters.

Communication

The DECS-150 is equipped with three communication ports. Each port is dedicated to a specific function.

The front-panel, Type-B USB port is intended for local, short-term communication with a PC operating BESTCOMSPi^{us}® software. BESTCOMSPi^{us}® is a Windows-based application used to program and customize the DECS-150. BESTCOMSPi^{us}® also has metering screens for viewing machine and system parameters and control screens for control of the excitation system. An integrated PID calculator simplifies selection of stability settings.

Ethernet communication is provided through a copper (100Base-T) port. The Ethernet port uses the Modbus® TCP/IP protocol for communication of DECS-150 metering, annunciation, and control commands.

DC Millivolt Sensing Relay (ES-74S)

The ES-74S monitors the level of field current through metering shunt SH1 and functions as an over-excitation and underexcitation relay. The adjustable underexcitation setpoint is preset at 20% of the full-load excitation current rating. The adjustable over-excitation setpoint is preset at 110% of the full-load excitation current rating. A time delay setting of 5 seconds for both setpoints prevents nuisance tripping during transient disturbances. When an under-excitation or overexcitation condition is detected, the ES-74S trips and applies a 74S Trip status input to the DECS-150. It also closes the Motor Fault Alarm/Trip output contacts at system terminals T1-36 and 37.

Details about the ES-74S are provided in Basler publication 9500100994.

Power Factor Relay (ES-55)

The ES-55 protects the motor from damage during increased loading or decreased excitation conditions. A protective trip is initiated when the motor power factor decreases below the ES-55 setpoint for the duration of the prescribed time delay. The adjustable ES-55 setpoints are preset for 0.85 lagging power factor with a 2.5 second time delay. When a power factor fault condition is detected, the ES-55 trips and

applies a 55 Trip status input to the DECS-150. It also closes the Motor Fault Alarm/Trip output contacts at system terminals T1-36 and 37.

Details about the ES-55 are provided in Basler publication 9500100892.

Inrush Current Reduction Module (ICRM)

The onboard ICRM protects the DECS-150 from the excessive inrush current that is possible with a low-impedance power source.

Details about the ICRM are provided in Basler publication 9387900990.

Inputs and Outputs

SMC-150 inputs and outputs consist of power and sensing inputs, control inputs and outputs, the field power output, and communication ports. For input and output connections, refer to the appropriate schematic diagram provided with this publication.

Control Power

SMC-150 control power is supplied by an external 24 Vdc source and applied at system terminals TB1-6 (+) and 7 (-). This source powers the ES-74S relay and Start/Stop relay K1. Onboard circuit breaker CB2 protects the control power circuitry from overcurrent conditions.

Operating Power

SMC-150 operating power is supplied by an external PPT or the station bus and applied at system terminals TB1-3 (A), 4 (B), and 5 (C). Onboard circuit breaker CB1 protects the operating power circuit from overcurrent conditions.

Sensing Inputs

SMC-150 sensing voltage and sensing current are supplied by external PTs and CTs configured to supply three-phase motor sensing. The PTs and CTs must be sized appropriately for the application and compatibility with the SMC-150. The DECS-150 must be configured with the PT and CT ratings prior to commissioning. Basler publication 9492600990 provides information about configuring the DECS-150 sensing transformer ratings.

Voltage sensing is applied to the SMC-150 at terminals TB1-14 (A), 15 (B), and 16 (C). Current sensing is applied to the SMC-150 at terminals TB1-8 (A+), 9 (A-), 10 (B+), 11 (B-), 12 (C+), and 13 (C-). The SMC-150 is delivered with jumpers installed across the current sensing inputs. These jumpers must be removed after the user-installed CTs are installed and before the SMC-150 is placed into operation.

Field Output

To obtain optimum metering resolution of the field current, one of two field output ranges are specified to suit the application requirements. An excitation current range of 1 to 4 Adc is specified by SMC-150 style

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xxAxxx or an excitation current range of 4 to 10 Adc is specified by SMC-150 style xxBxxx.

Control Inputs

SMC-150 control inputs include contact inputs and analog inputs.

Contact Inputs

SMC-150 contact inputs are received from remotely-located control switches and contact inputs from external devices. Contact input functions and terminal assignments are summarized as follows.

- Alarm reset, TB1-19, 20
- External protection, TB1-34, 35
- Lower setpoint, TB1-23, 24
- Manual/Auto mode, TB1-27, 28
- Raise setpoint, TB1-21, 22
- Start/stop, TB1-17, 18
- Var/PF disable, TB1-25, 26

Analog Inputs

An analog control signal may be applied to the SMC-150 for auxiliary control of the DECS-150 regulation setpoint. One of two analog input types may be applied. A 4 to 20 mAdc control input is applied at SMC-150 terminals T1-29 (+) and 30 (-). A ± 10 Vdc control input is applied at SMC-150 terminals T1-32 (+) and 33 (-).

Control Outputs

SMC-150 control outputs consist of preprogrammed output contacts. All control output connections are made at the SMC-150 terminal blocks. Contact output functions are summarized as follows.

DECS-150 Watchdog Output Contacts

This set of SPDT contacts changes state to indicate a loss of DECS-150 operating power or a firmware execution problem. The DECS-150 Watchdog contacts are terminated at SMC-150 terminals TB1-38 (NO), 39 (common), and 40 (NC).

Motor Fault

This set of contacts closes to indicate motor fault detection by the DECS-150, ES-74S relay, or ES-55 relay. A user-supplied contact input applied at SMC-150 terminals TB1-34 and 35 will also close the Motor Fault output contacts.

The DECS-150 will close the Motor Fault output contacts when any one of the following conditions exist:

- Exciter diode failure
- Field overvoltage
- Loss of motor sensing
- Motor overvoltage or undervoltage

The ES-74S relay will close the Motor Fault output contacts when field overexcitation or underexcitation is detected.

The ES-55 relay will close the Motor Fault output contacts when the motor power factor decreases below the prescribed threshold.

The Motor Fault output contacts are terminated at SMC-150 terminals TB1-36 and 37.

Communication Provisions

All SMC-150 communication is handled by the DECS-150 and includes:

- A front-panel USB port intended for local, short-term communication with a PC operating BESTCOMSPi^{us}® software
- Ethernet (Modbus TCP/IP) communication through an RJ45 connection

STARTUP AND SHUTDOWN

SMC-150 startup is initiated through application of a start contact input at terminals TB1-17 and 18. Application of this input should coincide with the application of a motor start command. Startup cannot occur if the user-supplied lockout (86) device is tripped.

SMC-150 shutdown is initiated by removal of the start contact input. Shutdown also may be initiated by a trip of the user-supplied lockout (86) device.

CONNECTION KIT FOR CE COMPLIANCE

If CE compliance is required, the SMC-150 must be connected using a kit consisting of an ac line filter and ferrite choke. Order Basler part number 9576530100.

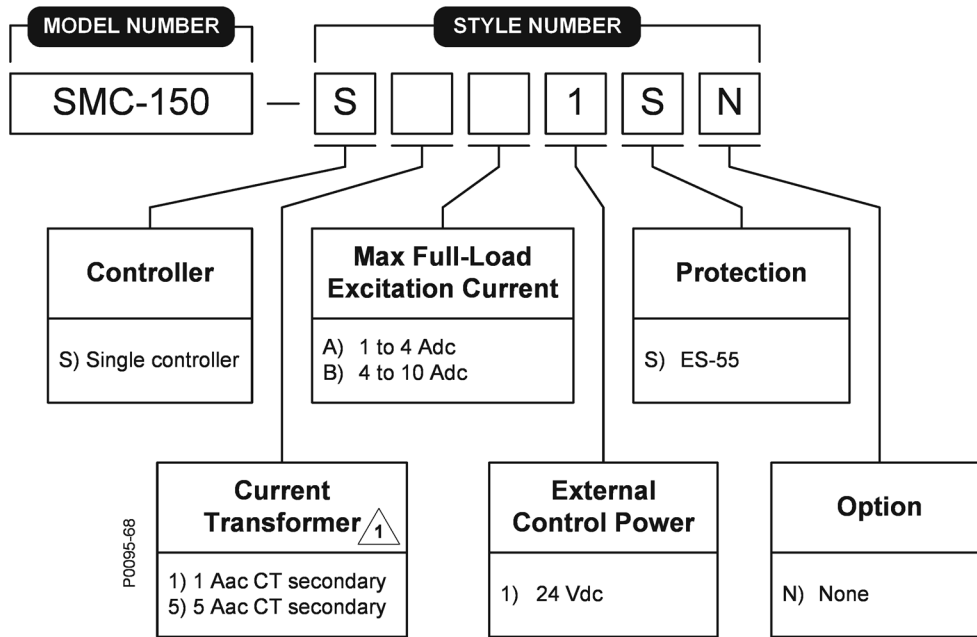
MAINTENANCE

Routine maintenance will promote excitation system longevity and preserve its performance. Basler publication 9410100990, supplied with the excitation system, provides guidelines for maintaining the equipment.

SPARE PARTS

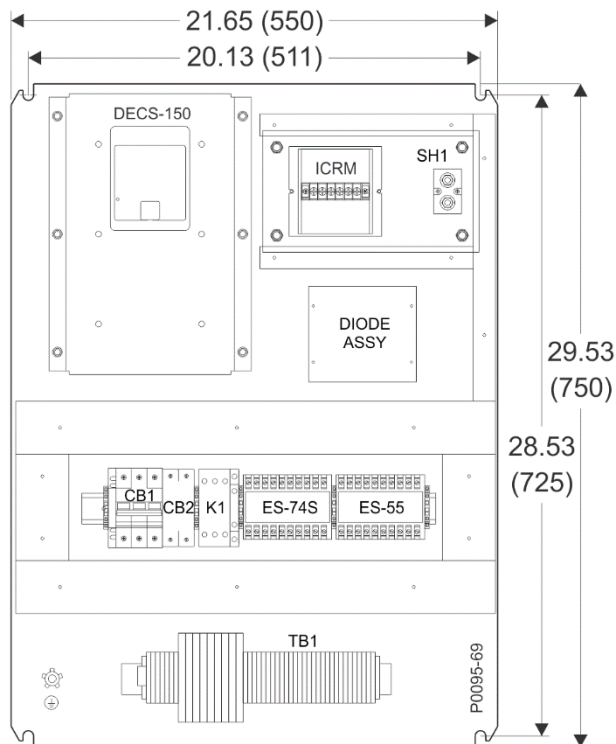
A reasonable stock of spare parts will minimize downtime in the event of an equipment malfunction. A list of recommended spare parts accompanies this publication.

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△ The DECS-150 controller will be automatically configured with the SMC-150 style selection made here.

Figure 1. SMC-150 Style Chart



Mounting notches (4): 0.47 (12)
 Maximum mounting depth: 5.12 (130)
 Approximate weight: 55 lb. (24.9 kg)

Figure 2. SMC-150 Mounting Dimensions

