

INSTRUCTION MANUAL

FOR

GENERATOR EXCITATION SYSTEM

Model: DECS-300-N, 125-22 kW

Part Number: 9386500100

 **Basler Electric**

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SECTION 1 • GENERAL INFORMATION

GENERAL DESCRIPTION

The excitation system is designed for operation with a three-phase, synchronous generator that has a full-load requirement of 65 Adc at 125 Vdc.

Excitation system components are housed in a single enclosure (cubicle). The free-standing cubicle is constructed from 11 gauge, cold-rolled steel and is finished in a light-gray, baked enamel or powder coating. Hinged panels (doors) at the front of the cubicle provide easy access to the cubicle interior.

EXCITATION SYSTEM COMPONENTS

Table 1-1 lists the system components, their location, and the designations used in the system drawings.

Table 1-1. Excitation System Components

Component	Front Panel	Cubicle Interior	Mounted Remotely
Auto/FCR Switch			CS2
Close/Trip Switch			CS1
Common Alarm Indicator	L5		
Crowbar Fired Indicator	L4		
DC Millivolt Sensing Relay		BE3-74SH	
DECS Select Switch			CS4
DECS-A Active Indicator	L1		
DECS-B Active Indicator	L2		
Digital Excitation Control System	DECS-A DECS-B		
Extended Overexcitation Indicator	L3		
Field Ground Test Sequencer		FGTS	
Firing Circuit Chassis		IFM-A, IFM-B	
Ground Fault Relay	64F		
Ground Fault Test Switch	S6		CS6
Isolation Module		IM-A, IM-B	
Multi-Bridge Interface		MBI	
Power Module		9284900101	
Power Supply		PS1, PS2	
Power System Stabilizer	PSS-100		
Programmable Logic Controller		PLC	
PSS Enable/Disable Switch		S7	CS7
Raise/Lower Switch			CS3
Rectifier Chassis		RECT-A RECT-B	
Reset to Normal Switch	S5		CS5
RS-232/RS-485 Converter		9348300016	

Component	Front Panel	Cubicle Interior	Mounted Remotely
Shaft Suppression Module		9199800100	
Test Switch	TS-1		
Thermostat		THRMST1 THRMST2	
Transducers		XD1, XD2	

OUTPUT CONTACTS

Table 1-2 lists the output contacts that are provided for customer use. Refer to the system interconnection drawings for terminal assignments and contact configurations.

Table 1-2. Output Contacts

Output Contact Function	Source Device
64F Exciter Field Ground Fault	64F
64F Exciter Field Ground Relay Power Off	64F
AC Shutdown Contactor Off Position Indication	K41X2
AC Shutdown Contactor On Position Indication	K41X1, K41X2
Active DECS and PLC Failed	K16, 18, 19, 71
CB1 Auxiliary Switch Position Indication	CB1
Common Alarm Indication	K24
Crowbar Fired	K45
DECS-300 Failed to Build Up	DECS-A DECS-B
DECS-300 General Limiting Function Active	DECS-A DECS-B
DECS-A Active Indication	K16
DECS-A and DECS-B Failed	K18, K19
DECS-A Failed Indication	K18
DECS-B Active Indication	K16
DECS-B Failed Indication	K19
Exciter in AVR Mode Indication	K15
Exciter in FCR Mode Indication	K15
Exciter Off Indication	K12
Exciter On Indication	K12
Extended overexcitation Indication	K32
Loss of Primary Sensing Voltage	K60X
PLC Failed Indication	K71
PSS Alarm Indication	PSS-100
PSS Failure Indication	PSS-100
RECT-A Enabled	K50

Output Contact Function	Source Device
RECT-A Overtemperature	K53
RECT-A Redundant Fan On	K43
RECT-B Enabled	K51
RECT-B Overtemperature	K54
RECT-B Redundant Fan On	K44
Rectifier System Critical Alarm	K49
Rectifier System Non-critical Alarm	K48
Transferred DECS on Protective Trip	K61

SPECIFICATIONS

Excitation system physical and electrical specifications are provided in the following paragraphs.

Control Cubicle Specifications

Overall Dimensions

Height: 84.00 in (2,133 mm)
Width: 72.00 in (1,828 mm)
Depth: 39.81 in (1,011 mm)

Total Weight: 1,700 lb (771.80 kg)

Power Inputs: 120 Vac, 3-phase, 144 Aac
120 Vac, 15 Aac minimum
125 Vdc, 10 Adc

Power Output: 125 Vdc, 176 Adc, 22 kW

Power Dissipation: 1,500 W

Operating Temperature: 122°F (50°C) maximum ambient

SECTION 2 • FUNCTIONAL DESCRIPTION

CONTROLS

The following paragraphs describe the function of the remotely located controls and the controls located on the control cubicle front panel.

Auto/FCR Switch (CS2). This switch places the excitation system in either the Auto or Field Current Regulation (Manual) operating mode.

Placing CS2 in the Auto position energizes AVR Select Relay K92, which applies an Auto input to DECS-A and DECS-B.

Placing CS2 in the FCR position energizes FCR Select Relay K93, which applies an FCR input to DECS-A and DECS-B.

Close/Trip Switch (CS1). This switch enables and disables the excitation system.

Placing CS1 in the Close position energizes Start Select Relay K90. K90 enables DECS-A and DECS-B by applying a Start input to both DECS-300 units. When DECS-A is enabled, the DECS-A On output closes and energizes DECS-A On Auxiliary Relay K57. When DECS-B is enabled, the DECS-B On output closes and energizes DECS-B On Auxiliary Relay K58. K57 applies a DECS-A On input to the PLC and K58 applies a DECS-B On input to the PLC. If DECS-A is selected as the active DECS-300 (selected by PLC default logic or DECS Select Switch CS4), the contacts of K57 energize System Off/On Relay K12. If DECS-B is selected as the active DECS-300 (selected by CS4), the contacts of K58 energize K12. When energized, K12 performs the following actions.

- Closes the Exciter On Indication output contacts
- Enables Crowbar Fired Lockout Relay K45
- Applies operating power to the Ground Fault Relay (64F)
- Removes the Crowbar input from Rectifier Chassis (RECT-A and RECT-B)
- Removes the Block input from Firing Circuit Chassis IFM-A and IFM-B
- Energizes (closes) AC Shutdown Contactor K3

When energized, K3 applies three-phase operating power to the excitation system and energizes AC Shutdown Contactor Auxiliary Relay #1 (K41X1) and #2 (K41X2). K41X1 and K41X2 close the AC Shutdown Contactor On Position Indication output contacts.

Placing CS1 in the Trip position energizes Stop Select Relay K91. K91 disables DECS-A and DECS-B by applying a Stop input to both DECS-300 units. When DECS-A is disabled, the DECS-A On output opens and de-energizes K57. When DECS-B is disabled, the DECS-B On output opens and de-energizes K58. K57 removes the DECS-A On input from the PLC and K58 removes the DECS-B On input from the PLC. If DECS-A is active, K57 de-energizes K12. If DECS-B is active, K58 de-energizes K12. When de-energized, K12 performs the following actions.

- Closes the Exciter Off Indication output contacts
- Disables K45
- Removes operating power from the 64F relay
- Applies a Crowbar input to RECT-A and RECT-B
- Applies a Block input to IFM-A and IFM-B
- De-energizes (opens) K3

When de-energized, K3 removes three-phase operating power from the excitation system and de-energizes K41X1 and K41X2. K41X1 and K41X2 close the AC Shutdown Contactor Off Position Indication output contacts.

DECS Select Switch (CS4). This switch selects which DECS-300 controls excitation.

Placing CS4 in the DECS-A position applies a DECS-A Selected input to the PLC. The PLC DECS-B Active output opens and de-energizes DECS-B Active Relay K16 and DECS-B Active Auxiliary Relay K16X.

When de-energized, K16X performs the following actions.

- Enables DECS-A to energize Active DECS in FCR Mode Relay K15 when DECS-A is operating in FCR mode
- Lights DECS-A Active indicator L1

When de-energized, K16 performs the following actions.

- Closes the DECS-A Active Indication output contacts
- Connects the DECS-A Control output to Firing Circuit Chassis IFM-A and IFM-B
- Enables the contacts of DECS-A On Auxiliary Relay K57 to energize System Off/On Relay K12 when DECS-A is enabled
- Applies a Selected as Secondary DECS input to DECS-B

Placing CS4 in the DECS-B position applies a DECS-B Selected input to the PLC. The PLC DECS-B Active output closes and energizes K16 and K16X.

When energized, K16X performs the following actions.

- Enables DECS-B to energize K15 when DECS-B is operating in FCR mode
- Lights DECS-B Active indicator L2

When energized, K16 performs the following actions.

- Closes the DECS-B Active Indication output contacts
- Connects the DECS-B Control output to IFM-B and IFM-B
- Enables the contacts of DECS-B On Auxiliary Relay K58 to energize K12 when DECS-B is enabled

Applies a Selected as Secondary DECS input to DECS-A

Ground Fault Test Switch (S6, CS6). This switch initiates a test for field ground faults by reversing the test voltage connections from the output of the Ground Fault Relay (64F) to the field winding of the field.

PSS Enable/Disable Switch (S7, CS7). When closed, this switch enables the Power System Stabilizer (PSS-100). The PSS-100 is disabled when S7/CS7 is opened.

Raise/Lower Switch (CS3). This switch lowers and raises the generator voltage when the active DECS-300 is operating in the AVR, FCR, Var, or Power Factor modes. Placing CS3 in the Raise position energizes Raise Select Relay K10, which applies a Raise input to DECS-A and DECS-B. Placing CS3 in the Lower position energizes Lower Select Relay K11, which applies a Lower input to DECS-A and DECS-B.

Reset to Normal Switch (S5, CS5). Operating S5 or CS5 energizes Reset Relay K8. When energized, K8 applies a Reset input to DECS-A, DECS-B, the Power System Stabilizer (PSS-100), and the PLC.

Test Switch (TS-1). During testing and maintenance, the test switch is used to isolate DECS-A, DECS-B, and the Power System Stabilizer (PSS-100) from the sensing voltage and current. When placed in the test position, TS-1 automatically places a short-circuit across the output of the current sensing transformers.

Thermostat (THRMST1, THRMST2, THRMST3). Each thermostat controls a 500 watt strip heater and sets and regulates the minimum ambient temperature of the exciter cubicle. During times of equipment inactivity, the thermostats and strip heaters prevent condensation from forming within the control cubicle. THRMST1 and STRIP HTR1 control the temperature of the exciter cubicle left-hand compartment, THRMST2 and STRIP HTR2 control the temperature of the center compartment, and THRMST3 and STRIP HTR3 control the temperature of the right-hand compartment. Each thermostat has a setting range of 40 to 85 degrees Fahrenheit.

DEVICES

The following paragraphs describe the function of each device in the excitation system.

DC Millivolt Sensing Relay (BE3-74SD). The DC Millivolt Sensing Relay functions as an Overexcitation Relay. When field current increases above the adjustable overexcitation setpoint, the relay trips and energizes Extended Overexcitation Relay K32 through the time delay of timing module TD2. K32 closes the Extended Overexcitation Indication output contacts, lights Extended Overexcitation Indicator L3, and applies a Common Alarm input to the PLC.

For a detailed description of the DC Millivolt Sensing Relay, refer to Basler publication 9320800990.

Digital Excitation Control System (DECS-A, DECS-B). DECS-A and DECS-B provide dc excitation to the exciter field. Power levels to the field are controlled to regulate the generator output voltage to within $\pm 0.25\%$ of the regulation setpoint. DECS-A and DECS-B features include:

- Underexcitation and overexcitation limiting
- Field overvoltage and overcurrent protection

- Generator undervoltage and overvoltage protection
- Auto voltage regulation, field current regulation, var, and power factor modes of operation
- User-friendly BESTCOMS communication software

For a detailed description of the Digital Excitation Control System, refer to Basler publication 9310300990. BESTCOMS software is provided with the DECS-300 instruction manual.

Field Ground Test Sequencer (FGTS). The Field Ground Test Sequencer connects the Ground Fault Relay (64F) to the field for the purpose of ground fault testing. Testing can be initiated either manually or automatically. Ground Fault Test Switch S6 or CS6 are operated to initiate a test manually. The programmable timer of the FGTS can be set to automatically initiate testing at a user specified time of day.

For a detailed description of the Field Ground Test Sequencer, refer to Basler publication 9322401991.

Firing Circuit Chassis (IFM-A, IFM-B). IFM-A (primary) and IFM-B (backup) control the output of Rectifier Chassis RECT-A and RECT-B by modulating the phase angle of the SCR firing pulses. The active Firing Circuit Chassis receives an analog control signal from the active DECS-300.

IFM-A uses 420 hertz operating power supplied by a PMG. IFM-B uses 60 hertz operating power supplied by a backup source. Changeover from IFM-A to IFM-B requires manually changing the operating power and firing pulse connections of the Firing Circuit Chassis.

For a detailed description of the Firing Circuit Chassis, refer to Basler publication 9324100990.

Ground Fault Relay (64F). The Ground Fault Relay works in conjunction with the Field Ground Test Sequencer (FGTS) to monitor the field circuit for ground faults. When a field ground is detected, the Field Ground Fault Signal output contacts close.

For a detailed description of the Ground Fault Relay, refer to ABB publication IB 7.1.1.7-8.

Isolation Module (IM-A, IM-B). The Isolation Modules provide DECS-A and DECS-B with electrically isolated field voltage and current signals. Isolation Module field current sensing is supplied by current shunt SH1. Field voltage sensing is obtained directly from the field.

For a detailed description of the Isolation Module, refer to Basler publication 9310300990.

Multi-Bridge Interface Assembly (MBI). The Multi-Bridge Interface Assembly distributes the SCR gate pulses from the active Firing Circuit Chassis (IFM-A or IFM-A) to each Rectifier Chassis (RECT-A and RECT-B). The MBI reads failure annunciation signals from each Rectifier Chassis and indicates problems by lighting circuit board-mounted LEDs.

For a detailed description of the Multi-Bridge Interface Assembly, refer to Basler publication 9262100991.

Power Module (9 2849 00 101). The Power Module provides and conditions 125 Vdc operating power for DECS-A, DECS-B, and the system relays.

Power Supply (PS1, PS2). Redundant power supplies provide 24 Vdc operating power for the PLC inputs. PS1 receives 120 Vac operating power from transformer T2. PS2 uses 125 Vdc control power.

Power System Stabilizer (PSS-100). The Power System Stabilizer modulates the excitation system to provide supplementary damping for low frequency power oscillations. PSS-100 features include:

- Speed and power measurement
- Integrated test facility and data acquisition for ease of testing and commissioning
- Accurate, drift-free settings
- Extensive self-monitoring features
- User-friendly BESTCOMS communication software

For a detailed description of the Power System Stabilizer, refer to Basler publication 9318600990. BESTCOMS software is provided with the PSS-100 instruction manual.

Programmable Logic Controller (PLC). The PLC assembly includes an I/O base, processor adapter, communication adapters, and a power supply.

At system power-up, the PLC selects which DECS-300 is active. During system operation, the PLC monitors contact outputs from DECS-A and DECS-B, controls transfers from one DECS-300 to another, and operates hardware outputs to indicate system status.

For detailed information about using the PLC, refer to Schneider Automation publication 870 USE 002 00 (I/O base), 870 USE 101 10 (processor adapter), 870 USE 103 00 (communication adapter), and 8440CT0001 (power supply). All PLC publications are supplied as Adobe Acrobat (PDF) files on a CD-

ROM as part number 9374507012. Basler drawing 9376804001 contains a ladder diagram and programming notes that pertain to the PLC used in this excitation system.

Rectifier Chassis (RECT-A, RECT-B). Each Rectifier Chassis consists of a three-phase, full-converter bridge that supplies dc power to the field. Rectifier Chassis output is controlled by trigger pulses generated by the active Firing Circuit Chassis (IFM-A or IFM-B) and distributed through the Multi-Bridge Interface (MBI).

For a detailed description of the Rectifier Chassis, refer to Basler Publication 9261400894.

RS-232/RS-485 Converter (9348300016). The RS-232/RS-485 Converter adapts data received from a user-supplied RS-232 communication interface for use with the RS-485 communication interface of DECS-A and DECS-B.

Shaft Suppression Module (9199800100). The Shaft Suppression Module is connected in parallel with the field circuit. The module prevents bearing deterioration caused by capacitive coupling resulting from power rectifier switching noise and RF interference.

Transducers (XD1, XD2). The transducers convert a monitored voltage to a milliamperes-level signal for use with external meters.

Transducer XD1 supplies a signal to terminals TB1-30 (-) and 31(+) that is proportional to the level of field current monitored at current shunt SH2.

Transducer XD2 supplies a signal to terminals TB1-28 (-) and 29 (+) that is proportional to the field voltage.

For a detailed description of transducer XD1, refer to Moore Industries publication 148-701-00. For a detailed description of transducer XD2, refer to Moore Industries publication 146-701-00.

INDICATORS

Excitation system indicators include indicator lights and output contacts. The following paragraphs describe the function of each indicator. Refer to the system interconnection diagram for output contact terminal assignments.

64F Exciter Field Ground Fault Output Contacts (64F). These contacts close when the Ground Fault Relay detects a ground fault in the field circuit.

64F Exciter Field Ground Relay Power Off Output Contacts (64F). These contacts open when operating power is applied to the Ground Fault relay. When operating power is removed from the 64F relay, the contacts close.

AC Shutdown Contactor Off Position Indication Output Contacts (K41X2). These contacts close when the excitation system is disabled and AC Shutdown Contactor K3 is de-energized (open).

AC Shutdown Contactor On Position Indication Output Contacts (K41X1, K41X2). These contacts close when the excitation system is enabled and AC Shutdown Contactor K3 is energized (closed).

Active DECS and PLC Failed Output Contacts (K16, K18, K19, K71). These contacts close if either of the following conditions exist.

- A PLC failure and DECS-A failure occurs while DECS-A is serving as the primary DECS-300
- A PLC failure and DECS-B failure occurs while DECS-B is serving as the primary DECS-300

CB1 Auxiliary Switch Position Indication Output Contacts (CB1). These contacts indicate the state (open or closed) of circuit breaker CB1.

Common Alarm Indication Output Contacts (K24). These contacts close when the Common Alarm Relay is energized by any of the following conditions.

- DECS-A or DECS-B detect field overcurrent, field overvoltage, generator overvoltage, generator undervoltage, loss of sensing, overexcitation limiting, underexcitation limiting, or underfrequency
- An internal PLC failure occurs
- The PLC Common Alarm input is energized due to extended overexcitation, redundant rectifier chassis fan on, rectifier chassis overtemperature, rectifier chassis critical or non-critical failure, or the rectifier chassis crowbar circuit energizing
- Power System Stabilizer (PSS-100) programmable output OUT6 closes
- The PLC detects an I/O module error or a failure of DECS-A or DECS-B
- The DC Millivolt Sensing Relay (BE3-74SD) trips and initiates a DECS-300 transfer

Common Alarm Indicator (L5). This red indicator lights during the same conditions that causes the Common Alarm Indication output contacts to close.

Crowbar Fired Indicator (L4). This red indicator latches on when a voltage transient is induced into the generator field and the Rectifier Chassis (RECT-A or RECT-B) crowbar circuit fires. L4 will not light when the crowbar circuit fires during normal shutdown. L4 is turned off by operating Reset to Normal Switch S5 or CS5.

Crowbar Fired Output Contacts (K45). These output contacts latch closed when a voltage transient is induced into the generator field and the Rectifier Chassis (RECT-A or RECT-B) crowbar circuit fires. These contacts will not close when the crowbar circuit fires during normal shutdown. K45 is released by operating Reset to Normal Switch S5 or CS5.

DECS-300 Failed to Build Up Output Contacts (DECS-A, DECS-B). These contacts close if the generator output voltage fails to increase to the level of the active DECS-300 Field Flash Dropout Level setting by the time the active DECS-300 Maximum Field Flash Time setting expires.

DECS-300 General Limiting Function Active Output Contacts (DECS-A, DECS-B). These contacts close when the active DECS-300 is limiting overexcitation, limiting underexcitation, detects under-frequency, or the DECS-300 setpoint is above or below the setpoint limit.

DECS-A Active Indicator (L1). This green indicator lights when DECS-A is acting as the primary DECS-300.

DECS-A Active Indication Output Contacts (K16). These contacts close when DECS-A is acting as the primary DECS-300.

DECS-A Failed Indication Output Contacts (K18). These contacts close when a DECS-A failure occurs.

DECS-B Active Indicator (L2). This green indicator lights when DECS-B is acting as the primary DECS-

DECS-B Active Indication Output Contacts (K16). These contacts close when DECS-B is acting as the primary DECS-300.

DECS-B Failed Indication Output Contacts (K19). These contacts close when a DECS-B failure occurs.

Exciter in AVR Mode Indication Output Contacts (K15). These contacts close when the excitation system is operating in Automatic Voltage Regulation mode.

Exciter in FCR Mode Indication Output Contacts (K15). These contacts close when the excitation system is operating in Field Current Regulation (Manual) mode.

Exciter Off Indication Output Contacts (K12). These contacts close when the excitation system is stopped.

Exciter On Indication Output Contacts (K12). These contacts close when the excitation system is started.

Extended Overexcitation Indication Output Contacts (K32). These contacts latch closed when either of the following conditions exist.

- DECS-A or DECS-B detect field overcurrent and timing module TD1 times out
- The DC Millivolt Sensing Relay (BE3-74SD) detects field overexcitation and timing module TD2 times out

Extended Overexcitation Indicator (L3). This red indicator latches on during the same conditions that cause the Extended Overexcitation Indication output contacts to close.

Loss of Primary Sensing Voltage Output Contacts (K60X). These contacts close when the user-supplied voltage balance (60) relay trips due to a loss of sensing voltage.

PLC Failed Indication Output Contacts (K71). These contacts close when an internal PLC failure causes the PLC Failed output of the PLC to open and de-energize PLC Failed Relay K71.

PSS Alarm Indication Output Contacts (PSS-100). This output (OUT 4) must be programmed by the user and may be configured to annunciate a variety of functions. Refer to Basler Publication 9318600990 for information about programming PSS-100 functions.

PSS Failure Indication Output Contacts (PSS-100). This programmable set of contacts annunciates an internal Power System Stabilizer failure. This output must be programmed by the user and may be

configured to annunciate a variety of functions. Refer to Basler Publication 9318600990 for information about programming PSS-100 functions.

RECT-A Enabled Output Contacts (K50). These contacts close when Rectifier Chassis RECT-A is supplying excitation power to the field.

RECT-A Overtemperature Output Contacts (K53). These contacts close when the temperature of Rectifier Chassis RECT-A reaches approximately 222°F (106°C). Chassis temperature at this level is indicative of failed cooling fans.

RECT-A Redundant Fan On Output Contacts (K43). These contacts close when the temperature of Rectifier Chassis RECT-A reaches approximately 212°F (100°C) and the redundant cooling fans energize.

RECT-B Enabled Output Contacts (K51). These contacts close when Rectifier Chassis RECT-B is supplying excitation power to the field.

RECT-B Overtemperature Output Contacts (K54). These contacts close when the temperature of Rectifier Chassis RECT-B reaches approximately 222°F (106°C). Chassis temperature at this level is indicative of failed cooling fans.

RECT-B Redundant Fan On Output Contacts (K44). These contacts close when the temperature of Rectifier Chassis RECT-B reaches approximately 212°F (100°C) and the redundant cooling fans energize.

Rectifier System Critical Alarm Output Contacts (K49). These contacts close when more than one failure on a particular rectifier chassis (either RECT-A or RECT-B) causes the rectifier chassis to shut down. Conditions that cause annunciation of a rectifier chassis failure can be selected through the shutdown enable switches of the Multi-Bridge interface (MBI). Refer to Basler publication 9262100991 for information about selecting rectifier chassis failure annunciations.

Rectifier System Non-Critical Alarm Output Contacts (K48). These contacts close upon detection of a single failure on a particular rectifier chassis (either RECT-A or RECT-B). Additional failures on the same rectifier chassis will close the Rectifier System Critical Alarm output contacts and disable the affected rectifier chassis. Conditions that cause annunciation of a rectifier chassis failure can be selected through the shutdown enable switches of the Multi-Bridge Interface (MBI). Refer to Basler publication 9262100991 for information about selecting rectifier chassis failure annunciations.

Transferred DECS on Protective Trip Output Contacts (K61). These contacts close when either of the following conditions occur.

- DECS-A or DECS-B detect field overcurrent and the DC Millivolt Sensing Relay (BE3-74SD) detects overexcitation.
- A user-supplied contact input is detected at terminals TB1-52 and 53.