

Pre-packaged Dual DECS-200 Excitation System Reduces Engineering and Installation Time and Increases Reliability

The flexibility of digital control provides solutions to obsolete excitation systems by providing increased machine capability range at reasonable cost. In this application note, the Redundant DECS-200 pre-packaged retrofit solution is discussed for use on small to medium size synchronous machines having either brush or brushless type rotating exciters. The Redundant DECS-200 offers the advantage of two digital controllers that communicate via parallel ports to maintain the generator output voltage via the field of the exciter. The redundant controllers offer the means to use the second controller as a voltage regulator or an independent manual control. The pre-packaged system can be supplied as panels for installation into an existing excitation cabinet or the panel can be supplied in its own NEMA 1 enclosure.

The Redundant DECS-200 package is intended for those applications where an independent manual control may have otherwise been required, or simply the need to have increased reliability in the excitation system at an affordable cost. The DECS-200 pre-packaged excitation system offers the ability to automate plant controls and meet the directives from various agencies for performance, model simulations/testing and functions dictated by such agencies as NERC, and MAPP that are requiring certification for generators connected to the public power grid.

Offers Effective Features to Meet Agency Requirements

Ease and convenience are key words when replacement of the original excitation package becomes necessary. The DECS-200 system meets the requirement of a full-featured excitation system equipped with all functions needed to provide reliable operation of the generator but where exceptional performance, typical of a two-quadrant control excitation system, is not required. For smaller machines, less than 40 MVA where fast dynamic performance is a lesser issue, but full excitation capability is needed to safeguard the generator, the DECS-200 system is the system of choice, offering an economical solution for equipment upgrade.

Today's demands are much different than in the past when the minimum requirement was to regulate generator voltage. Today, it is not so simple, since regulatory agencies are requiring model information of the excitation system and performance data of the generator and excitation system. Such data will include voltage step responses, and dynamic performance of the excitation

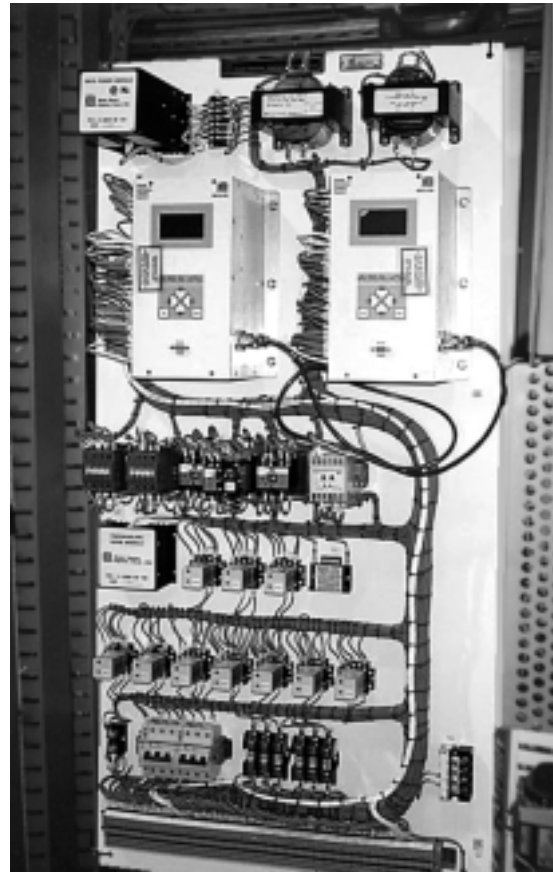


Figure 1: Packaged excitation system with dual DECS-200 Digital Excitation Control Systems

limiters both open circuited and when parallel to the electric power system. Additionally, performance testing may need to be repeated every two to three years.

The power system has become very complex and the need to understand the behavior of the generator and excitation system has become important to predict its performance. At the same time, unscheduled shutdown is unacceptable and therefore, increased reliability becomes vital.

Basler Electric offers a retrofit solution that through commissioning software tools, aids the end user in addressing the various concerns of connecting to the utility to safeguard the generator, replacing the obsolete excitation system, and having the capabilities to streamline test and capturing data for diagnostics.

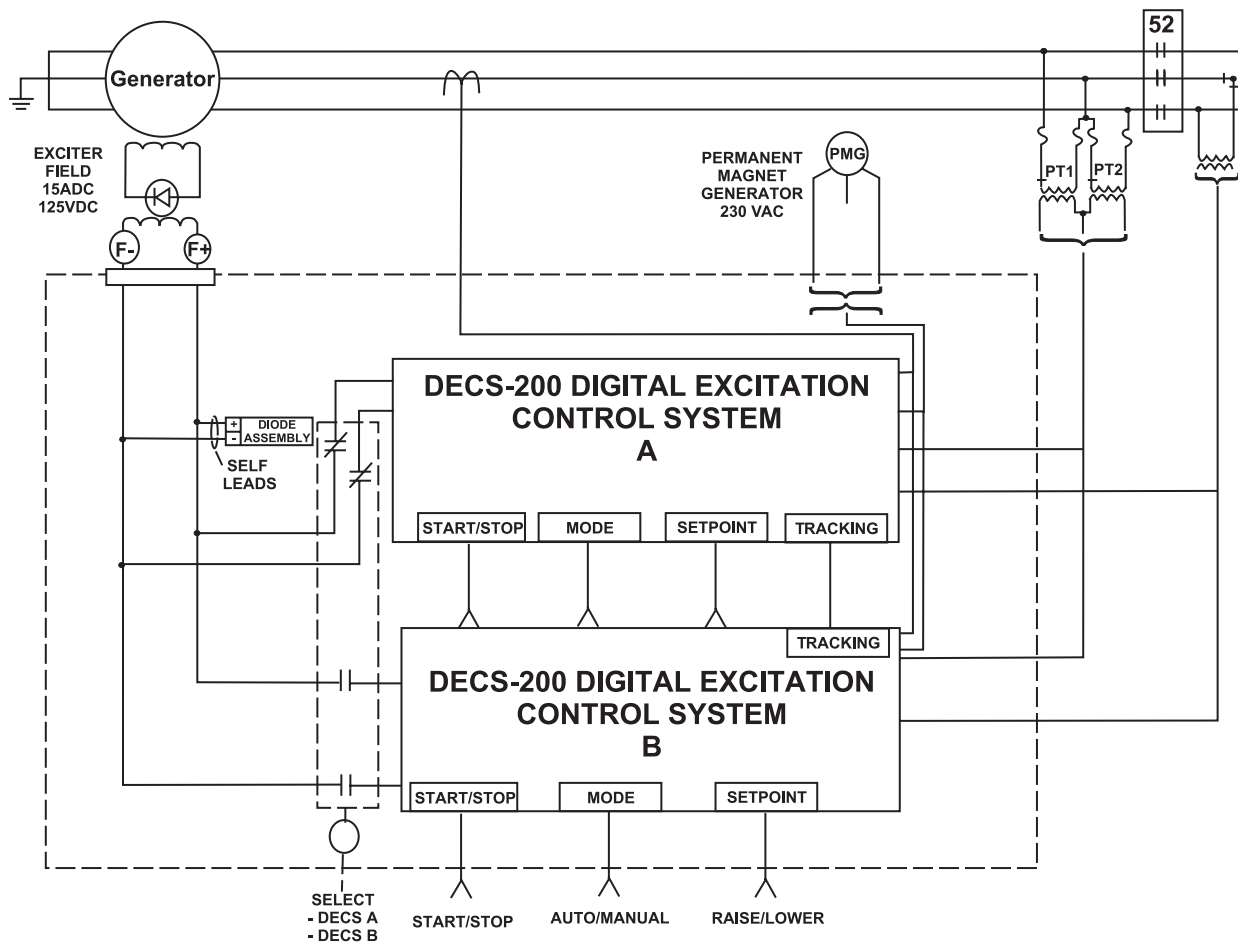


Figure 2: Simplified system interconnection drawing for the DECS-200 Pan 3

The Packaged Excitation System

Basler Electric has engineered a pre-packaged excitation system with redundant DECS-200 controllers and control relays mounted on a pan chassis capable of being installed in an existing enclosure (see Figure 2 and 5). It is also possible to have the dual excitation system mounted in a freestanding NEMA 1 type enclosure. The prepackaged design reduces engineering and installation time and is tested as a complete system at the factory to eliminate problems associated with individual components that are installed and wired at the job site. This also can reduce commissioning time by not having to troubleshoot and track down wiring errors.

Input Voltage Range / Field Output Capacity

The DECS-200 has a wide range of input voltages and frequencies and a robust internal power stage capable of delivering 15 Adc continuously to the shunt field of the rotary exciter. This diversity allows a single model of the DECS-200 to be applied to a vast array of generators including those that have a permanent magnet generator as the AC input power source as well as those being shunt fed from the generator output terminals. Applying either a single or three phase AC input voltage between the ranges of 56 –277 Vac and 50-

400 Hz determines the DC nominal output voltage of the DECS-200 that is rated 32, 63 and 125 Vdc with single quadrant field power control.

Digital Control

Digital control makes setting up DECS-200 and commissioning the system fast and convenient with the BESTCOMS software that is included (See Figure 3). Because of digital settings, there are no potentiometers to calibrate setpoints, no setpoint drifting and no potentiometers to get dirty and fail. Functions of the digital control include:

- ¼% Regulation Accuracy for precise control
- PID stability network for optimizing system response
- Underfrequency or V/Hz Ratio Limiter
- Softstart Voltage Buildup to prevent generator overshoot
- Paralleling Provisions for reactive droop or line drop compensation
- Setpoint Preposition for all 4 operating modes
- VAR/PF Control
- Minimum Excitation Limiter to prevent pole slip
- Maximum Excitation Limiter (on-line and off line settings) to prevent rotor overheating

- Voltage Matching to match generator voltage to bus voltage before synchronizing
- Field Current Regulator
- Internal Tracking for bumpless transfer between operating modes

Functional Operation

Each of the two DECS-200 in the dual excitation system has four control modes that include automatic voltage regulator, field current regulator (manual), VAR and Power Factor control. The three inactive operating modes automatically track the output level of the active mode for bumpless transfer between operating modes. The backup regulator of the dual system is designed to track the output level of the primary regulator. In the unlikely event of a primary regulator failure, the system is designed to automatically transfer to the backup unit thereby providing maximum assurance that the generator will stay on line. Transfer is executed via a watchdog circuit that monitors the microprocessor and power supply.

Automatic tracking between DECS (A) and DECS (B) and vice versa is provided, allowing bumpless manual transfer to either controller. Normal operating mode of the primary DECS-200 will be AVR mode, should a loss of voltage sensing occur, the system will transfer to FCR-manual mode and raise/lower control will affect manual mode setpoint only until the problem has been resolved.

Voltage matching will be provided to allow automatic voltage matching between the generator and the connecting utility bus. Voltage matching will be enabled in AVR mode only.

Contact status is provided for:

- DECS A or DECS B operating
- FCR mode active
- Limiting Active
- Protection Active
- On/Off Status
- Extended field overcurrent for machine trip
- Watchdog failure alarm

External Switch Interface is provided for:

- DECS A to DECS B Transfer
- On/Off
- FCR Reset to AVR mode
- Alarm/Fault reset
- Raise/Lower Control

Local/Remote Control and Communications

Digital technology makes local and remote control capability and communication simple. Local control, setup and monitoring can be accomplished by two means:

- 1) Using the backlit LCD and advanced menu driven, password protected, HMI keypad; or



Figure 3: BESTCOMS settings screens allow the user to type in settings values for fast and easy commissioning.

- 2) Using Basler's free Windows®-based, password protected, BESTCOMS software with a PC connected to a standard DB-9, RS 232 COM port.

Remote control is accomplished by using:

- 1) Control room switches and breaker contact inputs; or
- 2) Remote control and data acquisition through a RS-485 COM port that supports the open Modbus™ protocol so all data registers and operating instructions can be accessed.

Protective Functions

The inherent protective functions of the DECS-200 provide supplemental fault protection and also may be used as backup to primary protection relays:

- Generator Over and Under Voltage
- Field Overvoltage and Overcurrent
- Watchdog Timer (DECS failed)
- Loss of Voltage Sensing (can be programmed to automatically transfer to FCR mode (manual))
- Extended Over Excitation Relay for alarm or tripping generator (external to DECS-200 and incorporated into pan chassis assembly)

Brushless Exciter Diode Failure Detection Offers Unique Monitoring of Diode Ring

For brushless exciter applications, the DECS-200 can be programmed via the BESTCOMS software to monitor the rotating exciter diodes' condition. The DECS system can provide surveillance of the brushless exciter diode ring for either a shorted or open diode condition. Early detection can limit damage of the exciter and excitation system if otherwise left undetected.

Power System Diagnostic Tools

Digital technology also makes troubleshooting events or disturbances "after the fact" simpler with the DECS-200 by reconstructing the exact timing of contact input/output changes of state, system operation changes and

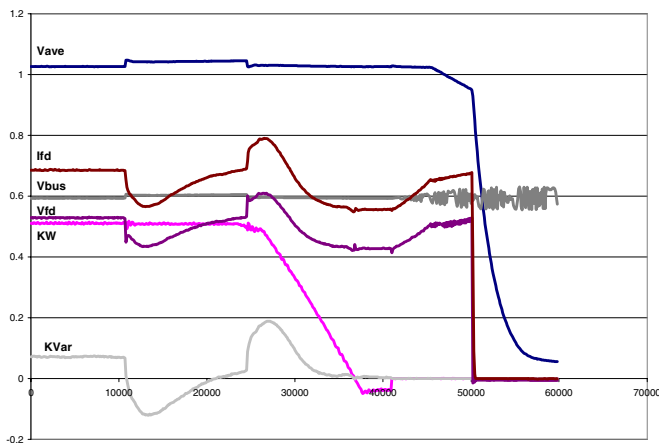


Figure 4: Oscillographic records like those shown above aid in troubleshooting system disturbances.

alarm conditions. An example of an event record is shown in Figure 4. In this event, it is documented that there was an abrupt increase in the system bus voltage noted by Vave and Vbus. The DECS-200 responds appropriately by decreasing field voltage and current (Vfd and Ifd). When the bus voltage abruptly changes back to a nominal value, the DECS responds appropriately again to increase field voltage and current to maintain appropriate Kvar levels. The graph also shows that the turbine/generator was tripped off as seen by KW, Vave, Vfd and Ifd collapsing to zero. This investigation lead to the discovery of incorrect setting of a protective relay that tripped the generator. Volatile memory can store 127 event sequences that can be retrieved using the BESTCOMS software. The DECS-200 can also store up to 8 oscillographic records of up to 6 monitored parameters with pre-trigger and post-trigger data. Standard COMTRADE software or Basler BESTVIEW allows viewing of the oscillographic records.

Where agency requirements dictate the need to provide data of unit performance such as excitation limiters operation, and voltage step responses, the oscillography offers a convenient tool to record and store records of performance testing at time of commissioning and offering comparison of data later when unit performance needs to be verified based upon an agency's requirement to periodically recheck data. The data can be set to trigger from a magnitude quantity or automatically during a voltage step change.

Dual Control Power Input Sources

The redundant DECS-200 modules accept simultaneous control power input voltages of 120 Vac and 125 Vdc from plant power sources so loss of one source will not cause the regulator to lose control. If both control power sources are lost, the dedicated watchdog circuit output of the backup DECS-200 is designated to trip an 86 generator lockout relay. There are also provisions to convert the 120 Vac control power to dc in parallel with the 125 Vdc control power for redundant control power to the on-board sequencing relays.

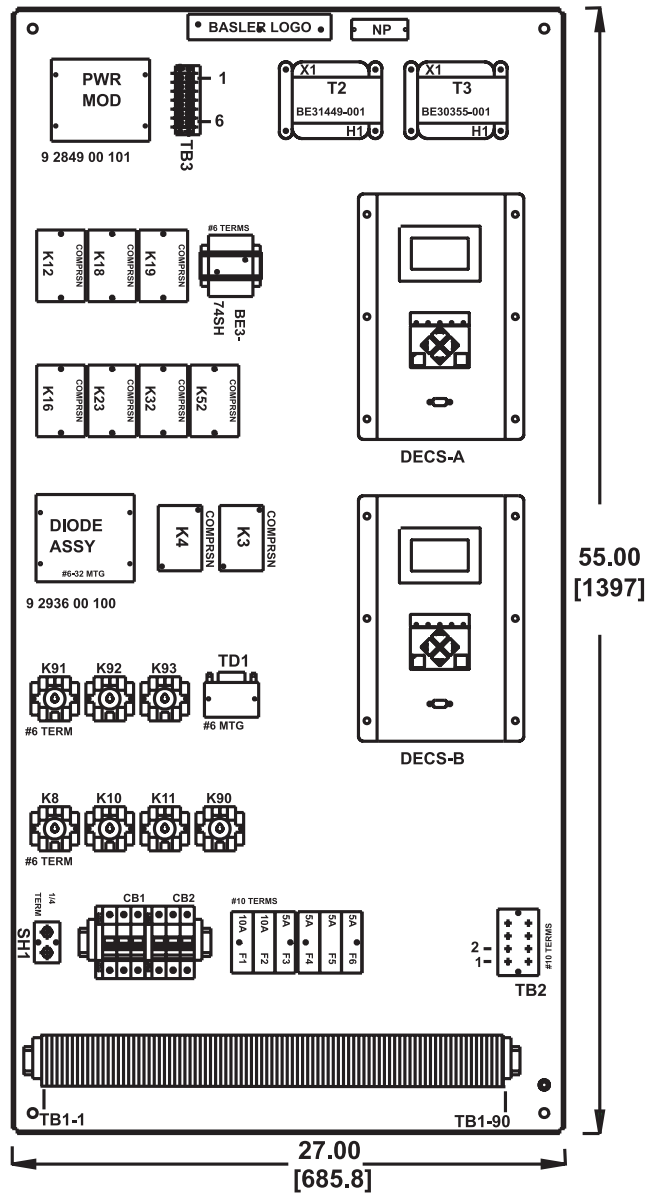


Figure 5: Outline drawing of DECS-200 Pan 3, a retrofit solution that features redundant regulators and control relays mounted on a pan chassis capable of being installed in an existing enclosure.

Installation and Commissioning

The pre-packaged excitation system provides faster factory lead time, installation and commissioning time. For further information on this product, visit the download section of our website at www.basler.com to access product documentation. To discuss your specific application or turnkey installation, consult Basler's experienced Application Specialists at the factory at (618) 654-2341.