



## DECS-400 Digital Excitation Control System

The DECS-400 Digital Excitation Control System is a microprocessor-based controller that provides excitation control, flexible logic control, and optional power system stabilization for synchronous machines in an integrated package. The controller provides an analog output to control the firing of external bridge(s) and monitors machine parameters to control, limit, and protect the synchronous machine from operating beyond its capability limitations.

The optional Power System Stabilizer is an IEEE-type PSS2A, dual input, "integral of accelerating power" stabilizer that provides supplementary damping for low-frequency local mode, inter area, and inter unit power system oscillations.

Setup and initial operation are facilitated by Basler Electric's user-friendly BESTCOMS PC software that incorporates real time monitoring test analysis, flexible oscillography, trending, and expanded testing capabilities, including means for performing frequency response tests with a graphic display of results.

## FEATURES

- Microprocessor-based design
- Four Control Modes, with autotracking between modes
  - Automatic Voltage Regulation (AVR)
  - Field Current Regulation (FCR)
  - Power Factor (PF)
  - Var Control
- 0.20% Voltage Regulation Accuracy
- Two pre-position set points for each mode
- Two Programmable Analog Outputs
- Setup from Front Panel HMI or by PC
- 40 Standard Stability Settings
- Customizable Stability Setting with two PID setting groups
- Reactive Droop, Line Drop Compensation
- Voltage Soft-Start Buildup
- Real Time Metering for 19 Generator Parameters
- Voltage Matching
- Autotracking with Optional Backup DECS-400
- Flexible Remote Set point Control
  - Contact inputs
  - Proportional Analog input,  $\pm 10$  Vdc or 4-20 mA
  - Digital Communications
    - Local RS-232, ASCII, Modem Capabilities
    - RS-485, Modbus™ (continued on page 2)

## WINDOWS® SOFTWARE

Interface for setting and communicating with Basler products

Request BESTCOMS-DECS400 (Microsoft Windows® 95, 98, 2000, Me or XP)

## ADDITIONAL INFORMATION

**INSTRUCTION MANUAL** Request Publication 9369700990

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- Built-in limiting functions
  - Overexcitation Limiters - Summing Point or Takeover Type
  - Underexcitation Limiters - 5 point user programmable or internally generated, summing point or takeover
  - Dual Slope Voltz/Hz Ratio or Underfrequency Limiter
  - Stator Current Limiter (single phase or three phase)
- Built-in Protective Functions
  - Field Overvoltage and Overcurrent
  - Generator Undervoltage and Overvoltage
  - Loss of Sensing Voltage
  - Loss of Field (40Q)
  - Field Overtemperature (for main field)
  - Dual Slope Volts/Hertz (24)
  - Exciter Diode Failure (for brushless exciters)
  - Generator Frequency Less than 10 Hz
- Optional Integral Power System Stabilizer
  - Dual input, integral of accelerating power (IEEE PSS2A)
  - Customer selectable speed-only sensing
  - Two wattmeter power measurement
  - Optional Frequency Based Operation
  - Generator or Motor control modes
- IIRG Time synchronization
- Sixteen Contact inputs - 10 user-programmable
- Eight Contact Outputs - 6 user-programmable
- Metering - Two 4-20mA meter drivers, customer programmable
- Four Communication Ports
- Data Logging, Sequence of Events Recording, Trending, real time monitoring test analysis, and built-in frequency response test capabilities
- UL Recognized, CSA certified, CE Compliant

## DESCRIPTION

The DECS-400 Digital Excitation Control System is a microprocessor-based controller that offers excitation control, logic control, and optional power system stabilization in an integrated package. The DECS-400 controls field excitation by providing an analog signal used to control the firing (output) of an external power bridge. The DECS-400 monitors generator or motor parameters and acts to control, limit, and protect the machine from operating outside its capability. The optional, onboard power system stabilizer is an IEEE-defined PSS2A, dual-input, "integral of accelerating power" stabilizer that provides supplementary damping for local mode, inter-unit and inter-area power system oscillations.

Integral programmable logic provides excitation system control and annunciation based on DECS-400 contact inputs, operating mode status, excitation system parameters and user-defined programming. Setup and initial operation are facilitated by Basler Electric's user-friendly BESTCOMS PC software that incorporates a test mode, flexible oscillography, and a graphic display of PSS test results.

The DECS-400 is designed for use with Basler's Interface Firing Module (IFM) and semiconverter or full converter power bridges. However, it will work equally well with any power bridge with a firing circuit that is compatible with the control signal output of the DECS-400.

## APPLICATION

The DECS-400 is a digital excitation control system with optional Power System Stabilizer function that is used as the primary controller in voltage regulator or main field excitation systems applied on a broad range of synchronous generators or motors. The DECS-400 controls the generator output voltage, Var output or power factor by adjusting the output of a semiconverter or full converter rectifier bridge that supplies DC power to the main or exciter field of the generator. Because of its high level of flexibility and reliability, the DECS-400 is suitable for use in single or dual controller systems on virtually any synchronous machine. The DECS-400 is at the heart of custom Basler Electric excitation systems that typically include the digital controller, supplementary protective and control devices, a power potential transformer and associated AC breaker or contactor, and a power rectifier section, assembled in suitable NEMA 1 excitation and power potential transformer enclosures.

## SPECIFICATIONS

DECS-400 electrical and physical specifications are listed in the following paragraphs.

### Operating Power

DECS-400 L:	24/48Vdc nominal (16-60Vdc), Burden=30W.
DECS-400 C:	120Vac nominal (85-132Vac, 50 or 60Hz), Burden=50VA. 125Vdc nominal (90-150Vdc), Burden=30W.

### Generator Voltage Sensing

- Single-phase or three-phase line voltage, two ranges:
- 100V/50Hz nominal (85-127Vac), 120V/60Hz nominal (94-153V)
  - 200V/50Hz nominal (170-254Vac), 240V/60Hz nominal (187-305V)

### Bus Voltage Sensing

- Single-phase line voltage, two ranges:
- 100V/50Hz nominal (85-127V), 120V/60Hz (94-153V)
  - 200V/50Hz nominal (170-254V), 240V/60Hz (187-305V)

## SPECIFICATIONS, continued

**Generator Current Sensing** Single or three phases; separate cross-current compensation input. 1 A ac or 5 A ac nominal.

**Sensing Burden** Voltage: <1 VA per phase. Current: <1 VA. Parallel Compensation: <1VA.

**Field Voltage and Current** Field current and voltage values are provided by the Isolation Module.

**Isolation Module** Power +5 Vdc,  $\pm 12$  Vdc from DECS-400.  
Five field voltage sensing ranges: 63 Vdc, 125 Vdc, 250 Vdc, 375 Vdc, and 625 Vdc  
Output: 0.9-9.1 Vdc (5.0 Vdc = zero field volts)  
Two nominal shunt ranges: 50 mVdc and 100 mVdc  
Output: 2.0-9.5 Vdc (2.0 Vdc = zero field current)

### Contact Inputs

Sixteen contact inputs accept dry switch/relay contacts or open-collector outputs from a PLC. There are six fixed-function contact inputs and 10 programmable contact inputs. Interrogation Voltage: 12 Vdc.

#### Fixed Function Inputs

- AVR\*
- FCR\*
- Lower\*\*
- Raise\*\*
- Start\*
- Stop\*

\*Functions activated by a momentary input. \*\*Functions active only when corresponding contact input is active.

#### Programmable Inputs

Any of the 10 programmable inputs can be programmed with the following functions.

- 2nd PID settings
- Pre-Position
- Reactive Droop Compensation Enable
- PSS Enable
- PSS Motor Pump/Generator Mode
- PSS Parameters Set Selection
- Phase Rotation
- Unit/Parallel Operation (52 L/M)
- Var/Power Factor Enable (52 J/K)
- Secondary Enable
- Reactive Differential Compensation Enable
- 2nd Pre-Position

### Accessory Input (Remote Set Point Control)

Analog input for remote set point control. Select one of two configurations:  $\pm 10$  Vdc or 4-20 mA dc.

### Control Outputs

Isolated analog output for set point control. Output drives external Firing Circuit/Rectifier Bridge. Select one of three configurations:  $\pm 10$  Vdc, 0-10 Vdc, or 4-20 milliamperes dc

### Meter Drivers

Two programmable 4 to 20 mA analog meter drivers. Meter side isolated from DECS-400. Programmable to meter field voltage or current, generator voltage or current, bus voltage, generator or bus frequency, active power, reactive power, apparent power, power factor, field temperature, tracking error, position indication and PSS parameters.

### Contact Outputs

Two dedicated contact outputs and six programmable contact outputs.

Make 30 A for 0.2 seconds per IEEE C37.90; Carry 7 A continuous. Break (Resistive or Inductive) 0.3 A at 120 Vdc or 250 Vdc (L/R = 0.04 maximum)

#### Dedicated Outputs

- Watchdog
- On/Off

#### Programmable Outputs (All programmed through integrated logic.)

- DECS-400 Status
- Active Alarms
- Active Limiter Functions
- Active Protective Functions

### Communication Ports

**COM 0** RS-232 front panel female DB-9, 1200-19200 Baud, 8N1 Full Duplex, ASCII commands  
**COM 1** RS-485 rear panel screw terminals, 4800-19200 Baud, 8N1 Half Duplex, ASCII commands  
**COM 2** RS-485 rear panel screw terminals, 4800-19200 Baud, 8N2 Half Duplex, Modbus™ protocol  
**J1** FCC Part 68 approved modem, rear panel RJ-11

SPECIFICATIONS, continued

IRIG-B Time Sync

Standard: 200-98, Format B002, Demodulated (dc level-shifted digital signal)

Regulation Accuracy

- AVR Mode Voltage regulation  $\pm 0.2\%$  over the load range, at rated power factor and constant generator frequency. Steady state stability is  $\pm 0.1\%$  at constant load and frequency. Temperature Stability  $\pm 0.5\%$  between 0 to 50°C at constant load and frequency. Response Time <1 cycle.
- FCR Mode Field Current Regulation is  $\pm 1\%$  of the nominal value for 10% of the rectifier bridge input voltage change or 20% of the field resistance change. Otherwise,  $\pm 5.0\%$ .
- VAR Control Mode Reactive Power Regulation is  $\pm 2.0\%$  of the nominal VA rating at the rated frequency.
- PF Control Mode  $\pm 0.02$  Power Factor for the real power between 10 and 100% at rated frequency. (e.g. set point PF = 0.8, PF regulation is between 0.78 and 0.82)

Metering Accuracy

- |                            |   |                                 |               |
|----------------------------|---|---------------------------------|---------------|
| Generator and Bus Voltage: | $\pm 1.0\%$   | Generator and Bus Frequency:    | $\pm 0.1$ Hz  |
| Generator Line Current:    | $\pm 1.0\%$   | Power Factor:                   | $\pm 0.02$ PF |
| Field Current and Voltage: | $\pm 2.0\%$   | Aux. Voltage and Current Input: | $\pm 1.0\%$   |
| Generator Power:           | Apparent Power (VA) $\pm 2.0\%$ ; Active Power (W) $\pm 2.0\%$ ; Reactive Power (var) $\pm 2.0\%$ |                                 |               |

Power System Stabilizer (PSS)

- Operating Mode: Generator or Motor, ABC or ACB phase sequence
- Sensing Configuration: Power and Speed or Speed only
- Power Measurement: 2 wattmeter method
- Frequency Range: Responds to power oscillations from 0.1 to 5 Hz. Low-pass and high-pass filtering prevents unwanted PSS action outside this range.

**Soft Start** Two sets of soft start settings are available when operating in AVR or FCR mode. Bias level is adjustable from 0-90% in 1% increments; time to reach nominal value is adjustable from 1-7,200 s in 1 s increments.

**Sequence of Events Recording** Events are time- and date-stamped and stored in volatile memory. 127 event capacity, 50 ms scan interval. SER can be triggered by input/output status changes, alarms, or system operating status changes.

**Data Logging (Oscillography)** Stores 6 records, with up to 6 variables per record. Sampling rate: 600 data points per record, pre-trigger adjustable from 0 to 599 data points. Record interval adjustable from 4 ms to 10 s.

**Trending** Stores 1 record, with up to 6 variables per record. Sampling rate is 1200 data points per record, with total record duration adjustable from 1 hour to 30 days.

**Paralleling/Line Drop Compensation** Can use either reactive droop or reactive differential (cross-current) compensation. Droop adjustable from 0% to 30% in 0.1% increments. Parallel compensation burden is less than 1 VA. Negative droop settings provide line drop compensation. Adjustable from -30% to 0% in 0.1% increments.

Limiters

**Underfrequency Compensation** Choice: Underfrequency compensation with slope adjustable from 0 to 3.00 PU in .01 PU increments and knee frequency between 15 and 90 Hz, or Volts/Hertz ratio limiter with slope adjustable from 0 to 3.0 PU in 0.1 PU increments. Provisions for two levels of protection, with duration of high V/Hz limit adjustable in the range of 0 to 10 s.

**Overexcitation** On-line and off-line limiters provided, each a choice between summing point and takeover type controllers. Dual settings groups. Provisions to scale settings for both type limiters based on an auxiliary analog

## SPECIFICATIONS, continued

input (by others) representing air temperature, hydrogen pressure, etc. Includes a cooldown feature to prohibit repeated high forcing level operation that could be damaging to the rotor.

*Summing Point Type OEL* Limiter response time is less than three cycles.

- On-Line
  - Level One – Highest current level (instantaneous) set point adjustable from 0 to 11,999Adc in 0.1% increments of the rated field current. Limiting occurs for a time period ranging from 0 to 60 seconds, settable in 1 second increments.
  - Level Two – Medium current level set point adjustable from 0 to 11,999Adc in 0.1% increments of the rated field current. Limiting occurs for a time period ranging from 0 to 120 seconds, settable in 1 second increments.
  - Level Three – Lowest current level set point adjustable from 0 to 11,999Adc in 0.1% increments of the rated field current. Limiting occurs indefinitely.
- Off-Line
  - Level One – Highest current level set point adjustable from 0 to 11,999Adc in 0.1% increments of the rated field current. Limiting occurs for a time period ranging from 0 to 60 seconds, settable in 1 second increments.
  - Level Two – Lowest current level set point adjustable from 0 to 11,999Adc in 0.1% increments of the rated field current. Limiting occurs indefinitely.

*Takeover Type OEL* The Takeover OEL uses an I<sup>2</sup>t characteristic. Limiter response time is less than three cycles.

- On-Line
  - High Level – High current level (instantaneous) set point is adjustable from 0 to 11,999 Adc in 0.1 Adc increments.
  - Low Level – Low current set point is adjustable from 0 to 11,999 Adc in 0.1 Adc increments. Limiting occurs indefinitely.
  - Time Dial – This setting determines the inverse time curve selected.
- Off-Line
  - High Level – High current level (instantaneous) set point is adjustable from 0 to 11,999 Adc in 0.1 Adc increments.
  - Low Level – Low current set point is adjustable from 0 to 11,999 Adc in 0.1 Adc increments. Limiting occurs indefinitely.
  - Time Dial – This setting determines the inverse time curve selected.

*Underexcitation* Customer selectable summing point type of takeover type limiter. The UEL curve can be selected either by specifying acceptable reactive power level at zero active power output, or by entering a five point UEL characteristic. Dual settings groups available. UEL limiter adjusts characteristics with changes in terminal voltage.

*Stator Current* Single or three phase stator current limiter, adjustable between 100% and 300% of nominal generator output current. Includes a two-step limiter with a definite time delay for the higher limit level, adjustable between 0 and 60 s. Summing point type limiter with PI control loop.

### Protection Functions

- Field Overvoltage* Range 1 to 2000 Vdc, time delay 0.2 to 30 s, dual setting groups
- Field Overcurrent* Range from 0.1 to 9,999 Adc, time delay 0.1 to 20 s, dual setting groups
- Generator Undervoltage* Range from 0 to 34,500 Vac, time delay 0.5 to 60 s, dual setting groups
- Generator Overvoltage* Range from 0 to 34,500 Vac, time delay 0.1 to 60 s, dual setting groups
- Loss of Sensing Voltage* Pickup level 0 to 100% with balanced or unbalanced conditions; time delay 0 to 30s
- Generator Frequency* <10 Hertz
- Loss of Field (40Q)* Range 0 to 3000 Mvar, time delay 0 to 9.9 s
- Field Overtemperature* Calculated from field voltage and current. Setting range from 0 to 572°C, time delay from 0.1 to 60s
- Volts per Hertz (24)* Range from 0.5 to 6 V/Hz, integrating reset range 0 to 9.9 V/Hz
- Exciter Diode Failure* Shorted and/or Open; Exciter to Stator Poles Ratio less than or equal to 10, generator frequency range 40 to 70 Hz (for brushless exciter applications)



SPECIFICATIONS, continued

Type Tests

Shock:	IEC 60255-21-2	Vibration:	IEC 60255-21-1
Humidity:	IEC 68-1, IEC 68-2-28	Dielectric Strength:	IEEE 421.3
Transients:	IEEE C37.90.1-1989	Impulse:	IEC 60255-5
Surge Withstand Capability:	IEEE C37.90.1-1989	Radio Frequency Interference:	IEEE C37.90.2
Electrostatic Discharge:	IEEE C37.90.3 Draft 2.3		

Agencies

UL recognition, CSA certification, and CE compliance: Pending

Environment

Operating Temperature: -40 to 60°C (-40 to 140°F)  
Storage Temperature: -40 to 85°C (-40 to 185°F)

Physical

Weight: 6.1 kg (13.5 lb)  
Size: See Figure 1 on page 8 for DECS-400 dimensions.

FEATURES/FUNCTIONS

Voltage Regulation

The DECS-400 regulates the generator RMS voltage to within 0.20% from no-load to full-load, utilizing digital signal processing and precise regulation algorithms developed by Basler Electric, using the experience gained over longer than a decade of manufacturing tens of thousands of digital voltage regulators.

Output

The DECS-400 supplies an isolated output signal of 4-20 mA, 0-10 Vdc, or ±10Vdc to the firing or control circuits of external power stages. The dc current produced by the power stages provides excitation to the field of the generator or the exciter. The DECS-400 can control virtually any bridge capable of accepting these signals, that is suitable for use on synchronous generators/motors.

Stability

The DECS-400 utilizes proportional (P), integral (I) and derivative (D) stability control. DECS-400 has preprogrammed stability (PID) settings for both main field (20 settings) and exciter field (20 settings) applications. Thus, a suitable standard stability set is available for most machines and applications. The DECS-400 also provides an additional setting group that can be customized to provide optimum generator transient performance. Setup software includes a PID selection program to assist in choosing the correct PID settings. The DECS-400 also provides for customizing the stability and transient performance of the minimum and maximum Excitation Limiters, the VAR/PF controllers, and the stator current limiter, by providing additional stability adjustments.

Two PID Setting Groups

The DEC-400 provides for two sets of PID settings to optimize performance under two distinct operating conditions, such as with a Power System Stabilizer (PSS) in or out of service. A fast controller provides optimum transient performance with the PSS in service, while a slower controller can provide improved damping of first swing oscillations with the PSS off line.

Optional Power System Stabilizer

The DECS-400 may be purchased with an integral Power System Stabilizer function that duplicates the excellent performance of the Basler PSS-100 Power System Stabilizer without the complications of an additional control device. The PSS provides damping for local mode, inter-area and inter-unit oscillations in the 0.1 to 5.0 Hz range. The PSS incorporated in the DECS-400 is a dual-input, IEEE type PSS2A stabilizer that utilizes the "integral of accelerating power" algorithm. The PSS can also be programmed to respond to frequency only if required for unusual applications. Required inputs include three phase voltages and two or three phase line currents.

Underfrequency Limiter  
or V/Hz Ratio Limiter

DECS-400 includes a customer selectable choice of an Underfrequency Limiter or a V/Hz Ratio Limiter to avoid overfluxing the generator or other connected magnetic devices. The under-frequency limiter slope can be set at 0-3 PU Volts/Hz in .01 PU increments, and the frequency roll-off kneepoint can be set across a range of 15 to 90 Hz, in 0.1Hz increments, with fixed voltage above the knee frequency. The V/Hz Ratio Limiter regulates voltage based on a customer defined V/Hz slope

## FEATURES/FUNCTIONS, continued

adjustable between 0.0 and 3.0 PU, and includes two limiting levels to permit operation above the primary V/Hz range for a customer adjustable time limit to inhibit limiter response to transient frequency or voltage excursions.

### Soft-Start Voltage Buildup

The DECS-400 includes a voltage soft-start feature with a user-adjustable setting to control the rate at which the generator voltage is allowed to build up and to prevent voltage overshoot during start-up of the generator system. The soft-start feature is active in both AVR and FCR modes.

### Reactive Droop and Line Drop Compensation

The DECS-400 has provisions for paralleling two or more generators using reactive droop or for using reactive differential compensation with the addition of an external current transformer with secondary currents of 1 or 5A ac. The current input burden is less than 1VA, so existing metering CTs can be used. Inputting a negative value for droop provides Line Drop Compensation to offset line or transformer impedance drops and move the regulation point beyond the terminals of the machine.

### Set Point Control

DECS-400 includes means for external adjustment of the set point of the controlling mode of operation using raise/lower contact inputs or an auxiliary analog input of 4-20 mA or  $\pm 10$ Vdc. The active mode set point may also be adjusted using BESTCOMS Windows® based software in a PC connected to the RS-232 communication port, or using Modbus™ protocol (floating point) to communicate digitally using the RS-485 port. The traverse rates of all modes of operation are independently adjustable, so the operator can customize the rate of adjustment and "feel" to meet his/her needs.

### Dual Pre-position Inputs

DECS-400 provides the added flexibility of two customer-adjustable sets of predetermined operating points for each mode of operation. On startup and with the appropriate contact inputs to the DECS-400, the operating mode is driven to one of two preset operating or regulation levels, depending on the configuration of the system. This feature allows the DECS-400 to be configured for multiple system and application needs.

### Field Current Regulation Operating Mode

DECS-400 provides a manual channel of operation called Field Current Regulation (FCR) Mode. In this mode, DECS-400 regulates the DC output current of the power bridge. It is not dependent on the generator

voltage sensing input to the DECS-400 and, therefore, provides backup excitation control when loss of sensing is detected. In FCR mode, the operator must manually vary field current to maintain nominal generator voltage as load varies.

### VAR/Power Factor Controller Operating Mode

DECS-400 has two additional control modes for use when the generator is operating in parallel with the utility power grid. In the VAR control mode, the DECS-400 can regulate the VAR output of the generator at an operator adjustable VAR setting or, in the Power Factor mode, it can control the VAR output of the generator to maintain a specific power factor as the kW load varies on the generator.

### Overexcitation Limiters

Overexcitation limiters monitor the field current output of the voltage regulator or static exciter and act to limit the field current to prevent field overheating. The Overexcitation Limiter (OEL) function includes a cooldown feature to avoid damage to the rotor caused by repeated high forcing. The OEL is active in all modes except FCR mode. In FCR mode, limiter action is optional. The DECS-400 provides a choice of two types of overexcitation limiters: Summing Point and Takeover. The output of the Summing Point type limiter is applied to the summing junction of the AVR control loop in addition to the AVR controller output, while the output of a takeover type limiter overrides the normal AVR output.

#### Summing Point Type OEL

Three OEL current levels are defined for on-line operation - high, medium, and low. The generator can operate continuously at the low OEL current level and for programmed times at the high and medium OEL current levels. Two OEL current levels are defined for off-line (main breaker open) operation - high and low. The generator can operate continuously at the low OEL current level and for a programmed time at the high OEL current level.

#### Takeover Type OEL

The Takeover-style Overexcitation Limiter, determines the field current level at which limiting occurs using an inverse time characteristic. Two current levels and a time dial setting are defined for the takeover-style OEL. Separate curves may be selected for on-line and off-line operation. If the system enters an overexcitation condition, the field current is limited and made to follow the selected curve. The selection of on-line or off-line OEL levels and curves is determined by an OEL option selection.

## FEATURES/FUNCTIONS, continued

### Minimum Excitation Limiter

The Minimum Excitation Limiter prevents the excitation being supplied to the field of the generator from dropping below safe operating levels. This prevents the machine from possibly slipping poles and damaging the machine. This action also limits the amount of VARs being absorbed by the machine, based on user-definable settings. An internally generated Under-excitation Limiting (UEL) curve based on a permissible VAR level at 0kW can be utilized, or a 5 point UEL curve can be created to match specific generator characteristics. UEL Limiter action is optional in FCR mode.

### Stator Current Limiter

The stator current limiter (SCL) senses the level of stator current and limits it to prevent stator overheating. The SCL operates in all modes except FCR. In FCR mode, the DECS-400 provides indication that a stator overcurrent condition exists, but limiter action is inhibited.

Two SCL current levels are provided: high and low. The generator can operate continuously at the low SCL level, but only for a programmed time at the high SCL level.

### Autotracking Between DECS-400 Operating Modes

DECS-400 is an intelligent device that can provide autotracking (autofollowing) of the controlling mode by the non-controlling modes. This allows the operator to initiate a controlled, bumpless transfer of the DECS-400 between operating modes with minimal disturbance to the power system. This feature can be used in conjunction with a set of protective relays to initiate a transfer to a backup mode of operation, such as FCR mode, upon the detection of a system failure or fault, such as loss of sensing.

### Autotracking between DECS-400 Units

The DECS-400 is also designed to automatically track a second DECS-400 unit using dedicated communication ports on the two units. A backup DECS-400 controller can be placed in service and programmed to track the control output of the primary DECS-400. In the unlikely event of a failure of the first DECS-400, protective relays can initiate a transfer of control from the first to the second DECS-400 with minimal system disturbance.

### Protective Functions

The protective functions built into the DECS-400 may be used as backup to the primary protection relays and can be assigned to up to six programmable output contacts via the PC software. The protection features offer fully adjustable tripping levels and time delays. The protective features are as follows:

- Generator Overvoltage\*
- Generator Undervoltage\*
- Field Overvoltage\*
- Field Overcurrent\*
- Field Overtemperature\*
- Loss of Field\*
- Loss of Voltage Sensing
- Microprocessor Watchdog
- Loss of Field Isolation Transducer
- Volts/Hertz Protection
- Exciter Diode Open (Brushless App.)
- Exciter Diode Shorted (Brushless App.)

The functions marked with an asterisk (\*) have dual setting groups.

### Integrated Logic

The DECS-400 utilizes integrated logic functionality in the form of multiplexors, AND gates, OR gates, NOT gates, and timer gates. Inputs to the logic are in the form of discrete information including switching inputs, system status data, protection status data, limiter status data, alarm status data, and PSS status data. The outputs of the logic module can be used to control the relay outputs as well as various other functions inside the DECS such as control functions (start/stop, mode select, etc.), protection functions (Field Overvoltage Enable, Field Overcurrent Enable, etc.), limiter functions (OEL enable, UEL enable, etc.), and PSS functions. BESTCOMS includes tools for customizing the system control logic for specific applications.

### Metering

The DECS-400 is provided with two programmable 4 to 20 mA analog meter drivers for the customer's use. The meter side is isolated from the DECS-400 circuitry. Either can be programmed to meter a broad range of generator and system parameters.

### Sequence of Events Recording (SER)

A sequence of event report (SER) is a very powerful tool for reconstructing the exact timing of an event or disturbance. The DECS-400 monitors its contact inputs and outputs for changes of state, system operation changes, and alarm conditions. If any of these events occurs, the DECS-400 will log that event with a date and time stamp using IRIG B and an internal clock with optional battery backup, allowing the user to analyze a chain of events with accurate information regarding the sequence in which they occurred. The DECS-400 can store 127 events in volatile memory, and those events are retrievable using BESTCOMS.

### Oscillography

The data recording feature can record up to six (6) oscillographic records stored in volatile memory. The user can select up to six (6) variables to be monitored when triggered by the DECS-400 BESTCOMS, a Logic Trigger, or a Level Trigger. Variables that can be selected are: generator voltage, current (single phase), frequency, kW, Power Factor, field voltage, and field current. The user can utilize the DECS-400 BESTCOMS to trigger and save a record of a voltage step response



## FEATURES/FUNCTIONS, continued

during commissioning. Once commissioned, a logic trigger or level trigger can be used to activate the data recorder to capture the occurrence for review at a later time. DECS-400 alarms can also be used to start the data recorder. When an alarm condition occurs, an oscillographic record can be stored. A level trigger will initiate a record to be saved when a variable exceeds a predetermined setting, such as when the exciter field current exceeds a predetermined setting.

The oscillographic records are recorded in accordance with the IEEE Standard Common Format for Transient Data Exchange (COMTRADE) or Log file format. Basler Electric provides BESTWAVE, a COMTRADE viewer, that allows the user to view the oscillography records saved by the DECS-400.

### Real Time Monitoring

The DECS-400 also provides for real time monitoring for any of the parameters available for oscillography. The real time monitoring screen will display two parameters at a time, and data can be stored in a file for later examination.

### Internal Testing Provisions

Using BESTCOMS, the operator can set up and run both frequency and step response tests to facilitate commissioning or to demonstrate system performance. The frequency response test has a frequency range from 0.1 to 10 Hz, and gain/phase information is generated in the form of a Bode plot. The DECS-400 also allows injection of test signals at various points in

the PSS/voltage regulation loop for a high level of testing flexibility.

### Communications

DECS-400 comes complete with Windows® based PC software designed to make the programming and customization of the DECS-400 easy and fast. The software includes a PID selection program that allows the user to select stability settings quickly and easily in a user-friendly format. The PC software has monitoring screens that allow the user to view all settings, metering screens for viewing all machine parameters, and control screens for remote control of the excitation system.

The rear-mounted RS-485 port supports Modbus™ (floating point) communications protocol. This is an open protocol with all registers and operating instructions available in the instruction manual, to make it simple for the user to develop custom communications software. A rear-mounted modem is also provided to facilitate access to DECS-400 settings and alarms from remote locations.

### Password Protection

All DECS-400 parameters are viewable via the front panel LCD display, the PC software, or via Modbus™ without the need of a password. If the user wishes to change a setting, the proper password must be entered to allow access to the parameter. Two levels of password protection exist, one for global access to all parameters and one for limited access to parameters normally associated with operator control.

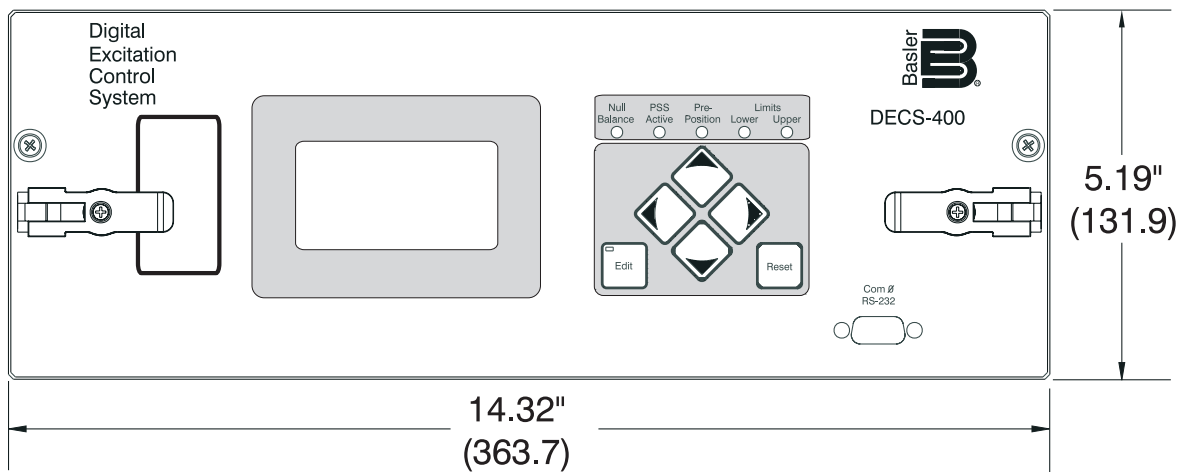


Figure 1 - Dimensions, Front view  
Depth: 11.14" (283.0mm)

CONNECTIONS

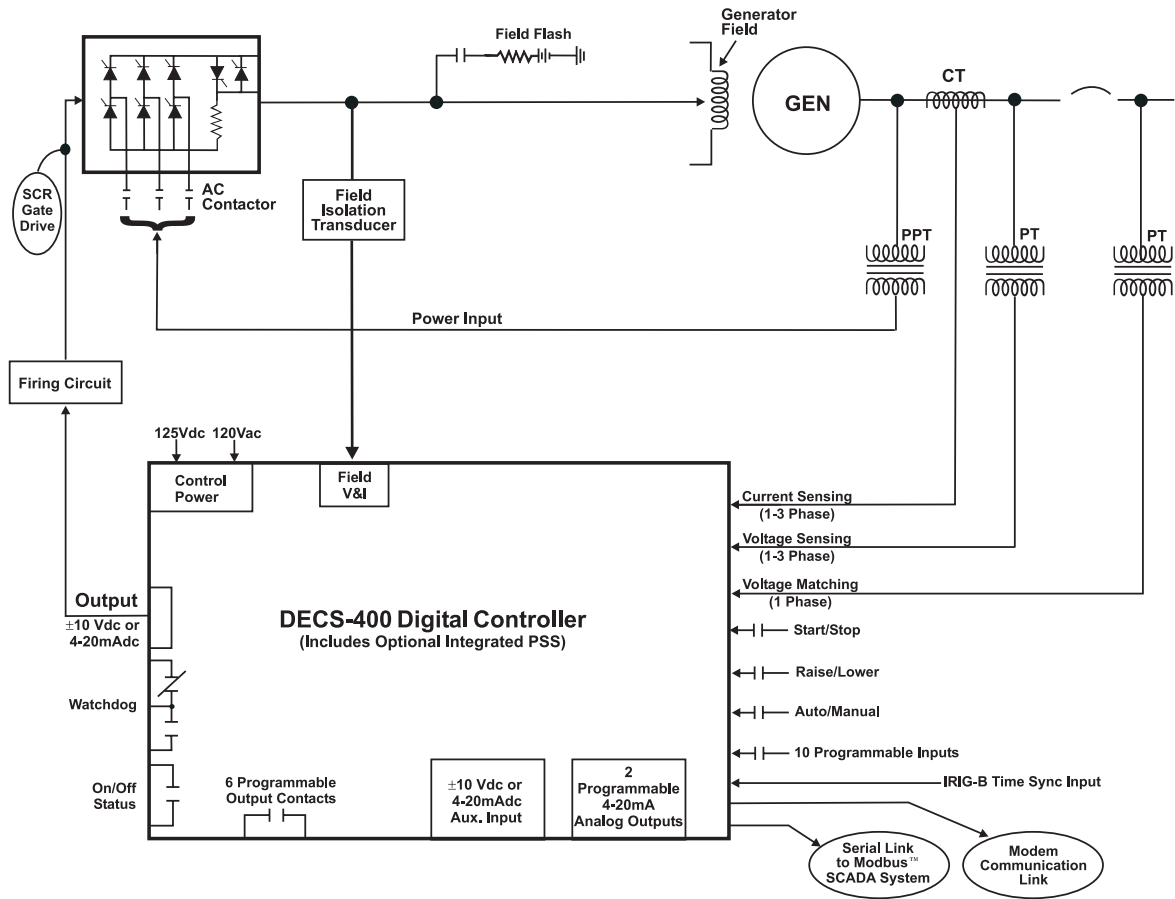
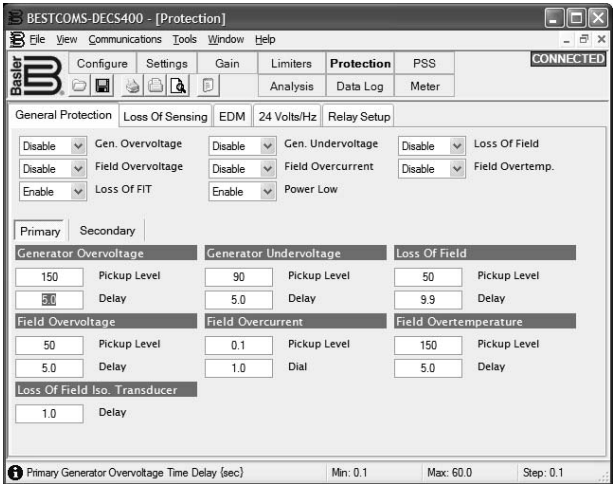


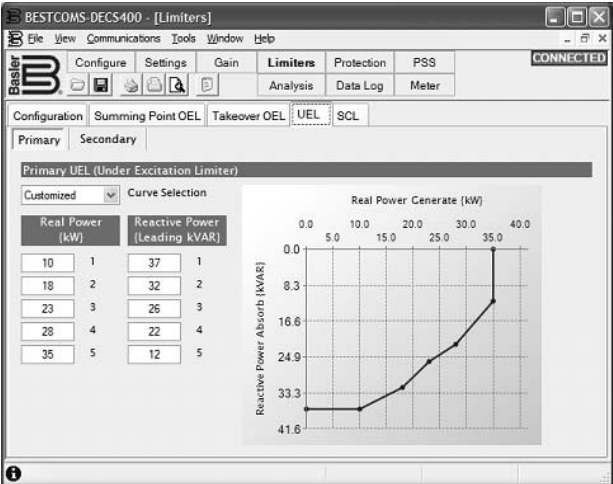
Figure 2 - Typical AC Connection Diagram

BESTCOMS SOFTWARE

The DECS-400 is supplied with BESTCOMS PC-based software to facilitate system setup and testing. As shown in the Protection screen, below left, choices are made using drop-down screens, and parameters are familiar. Reminders are also provided at the bottom of the screen for input units and available parameter range. Tabs identify general functions, and related functions are on adjacent pages. As shown on the Underexcitation Limiter Screen, below right, graphics are also used to help visualize input parameters.

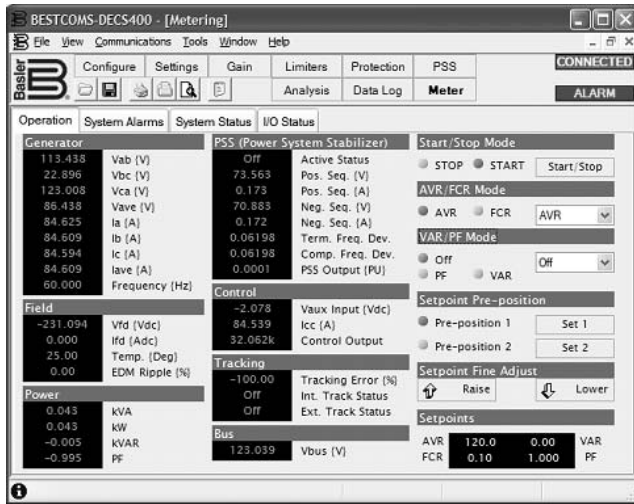


Protection

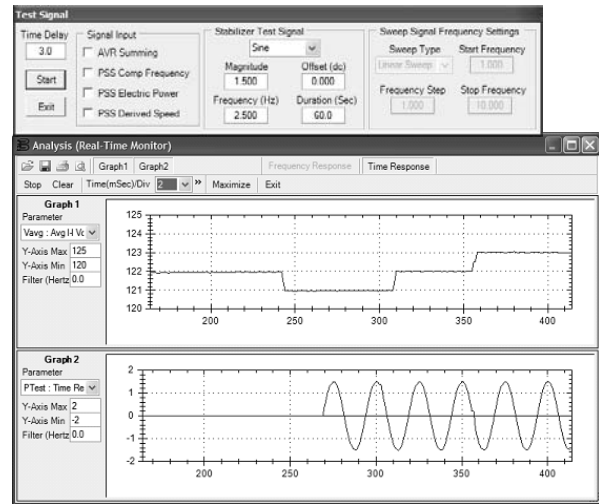


Underexcitation Limiter

## BESTCOMS SOFTWARE, continued



Metering

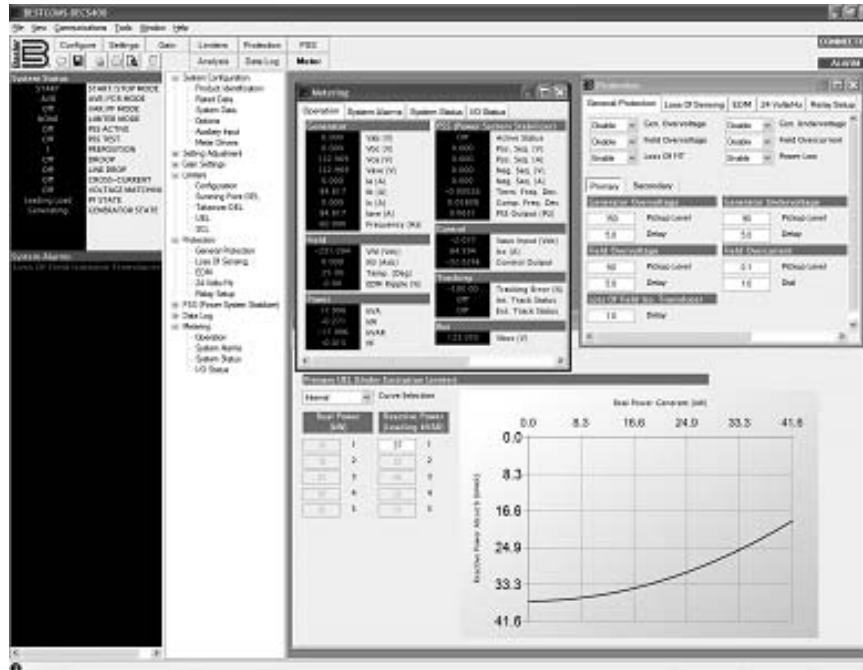


Real Time Monitoring

As shown in the metering screen, above left, a broad range of machine and system parameters can be displayed, along with key system status information, such as operating status, operating mode, and key parameter set points. Adjustments to the current operating mode set point can also be made from this screen.

On-line PSS and AVR testing can also be performed using screens such as the Test Signal screen, which can initiate pre-programmed tests that may be monitored using the Real Time Monitoring function illustrated in the Analysis screen, above right.

BESTCOMS for the DECS-400 also incorporates greater "Windows" functionality, as shown in the screen shot below. The screen simultaneously displays the systems status and alarms window, other available systems screens using the familiar Explorer View, along with other screens, such as the metering display, the protection screen and the UEL settings screen shown. Multiple screens can be tiled, cascaded or otherwise manipulated using familiar Windows commands.



Example of Multiple Screen Capability

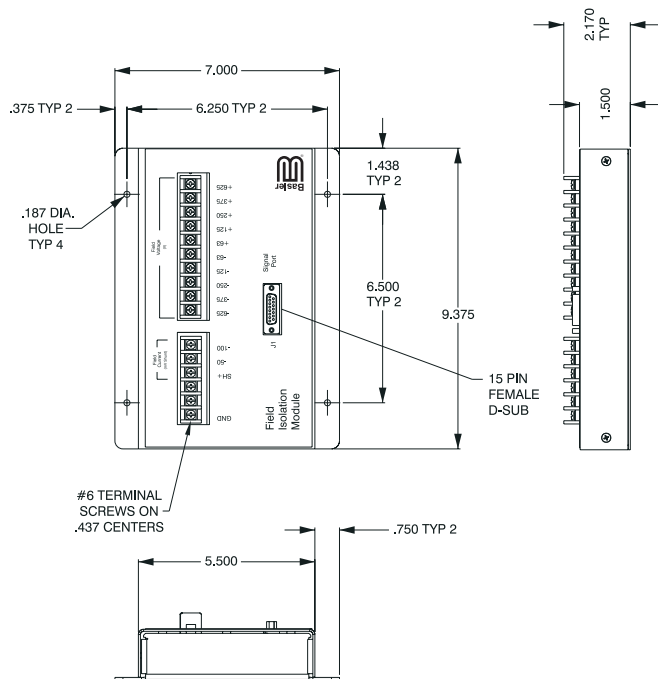


Figure 3 -Dimensions, Isolation Module  
P/N 9372900100

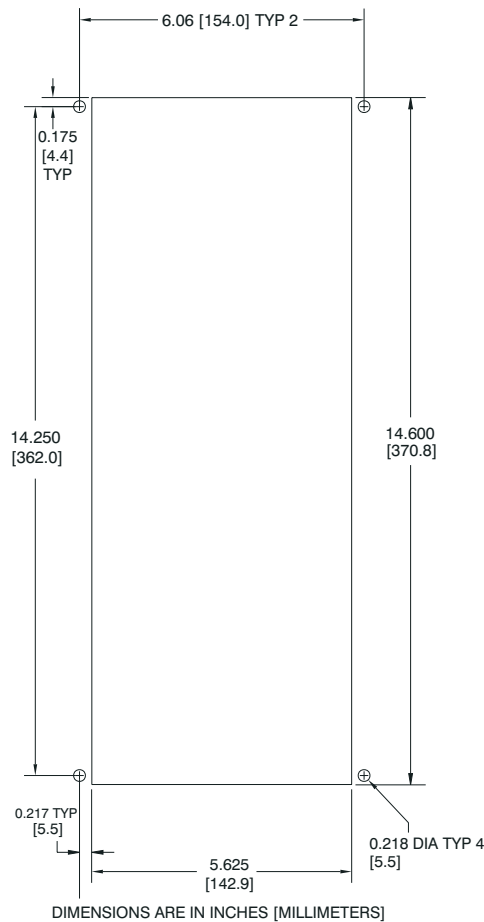
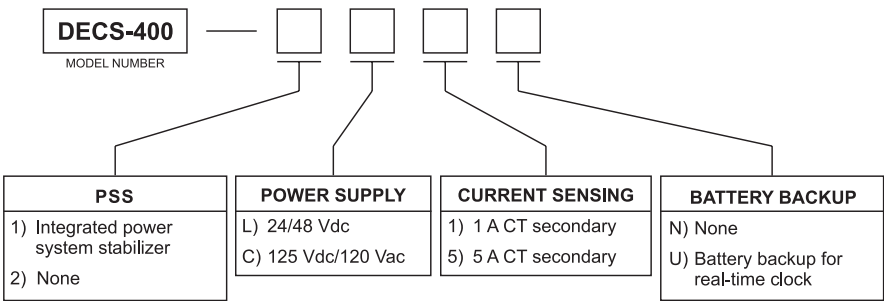


Figure 4 - Front Panel Cutout Dimensions,  
front panel mounting bracket

HOW TO ORDER



ACCESSORY

- Front panel mounting bracket for DECS-300 retrofit applications, Basler P/N 9369707009.

