NEW MULTI-PROCESSOR DIGITAL EXCITATION SYSTEM

ECS2100

OVERVIEW

浩鑫企業有限公司
ARITH COMPANY LTD.
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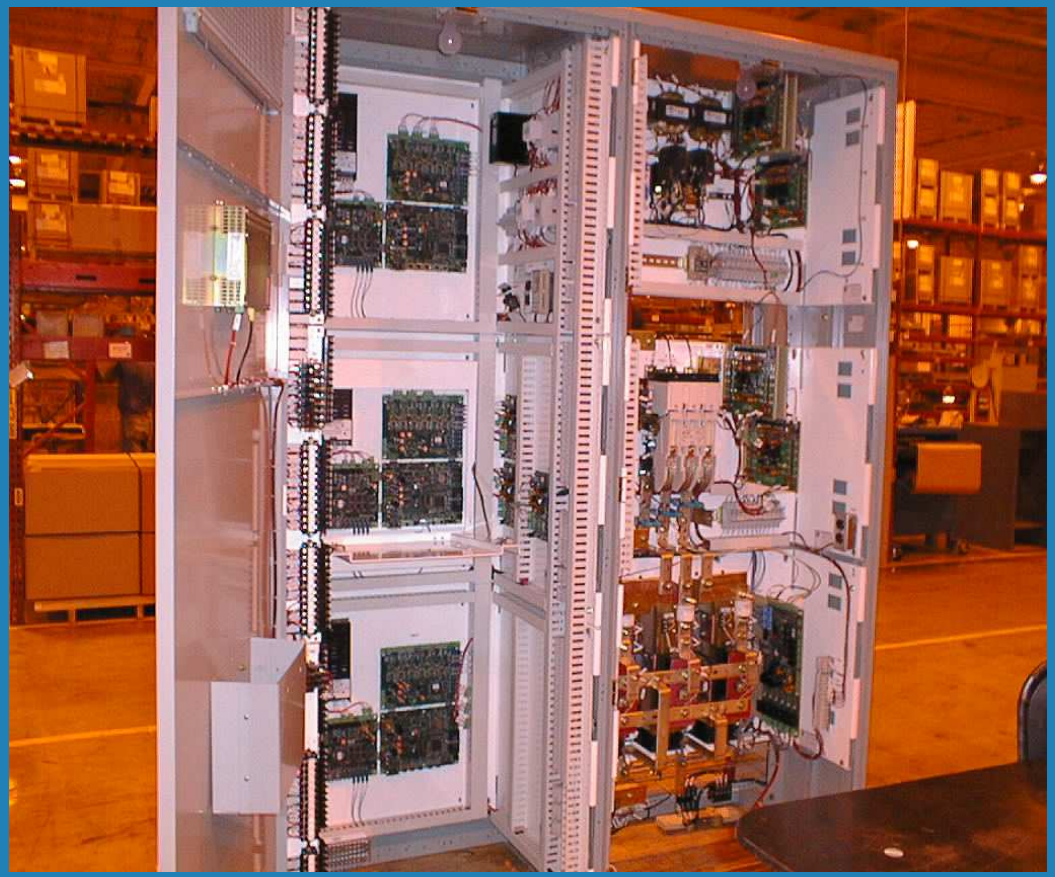
Digital Excitation System



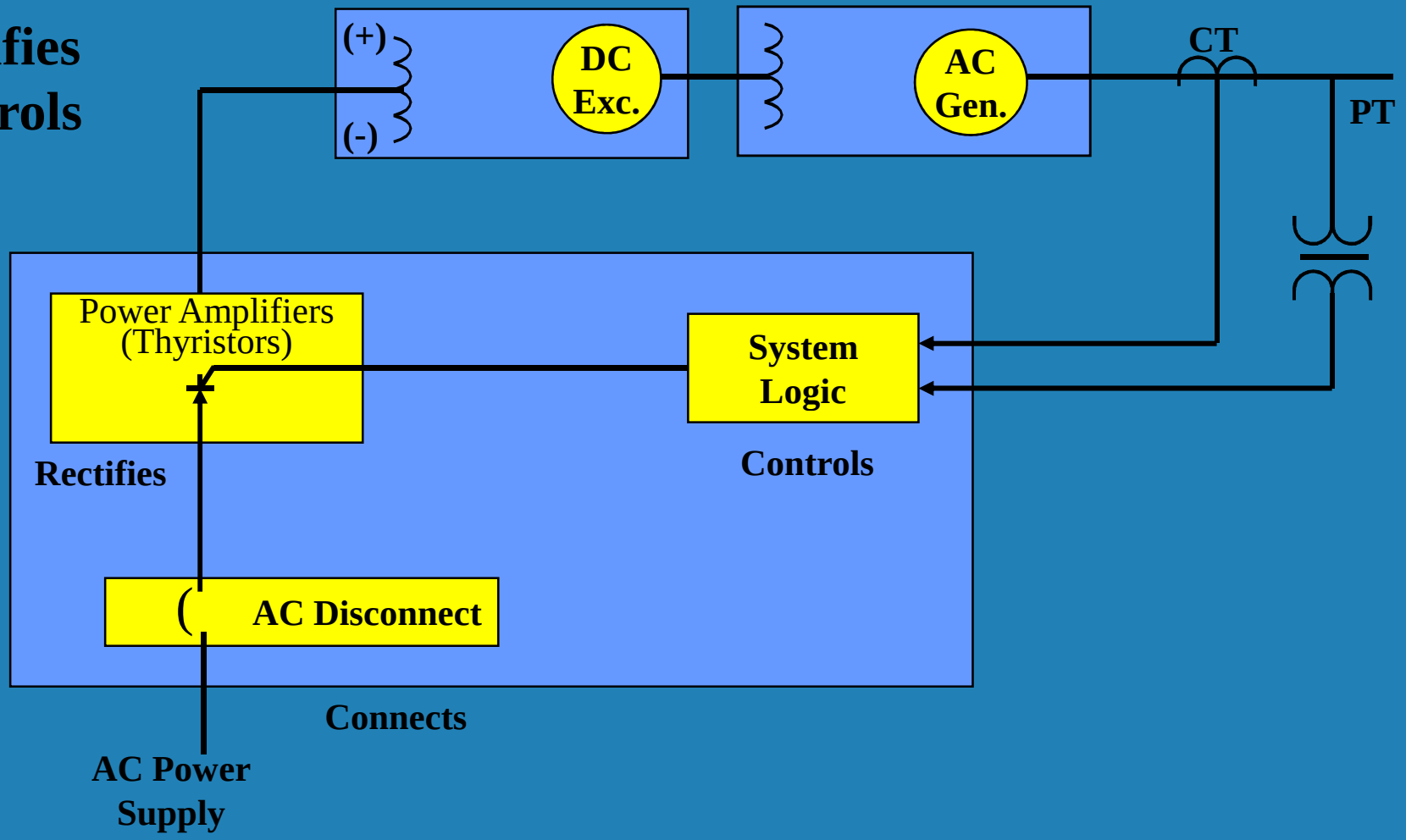
Logic Structure Power Structure

Primary Function - Supply Field Current

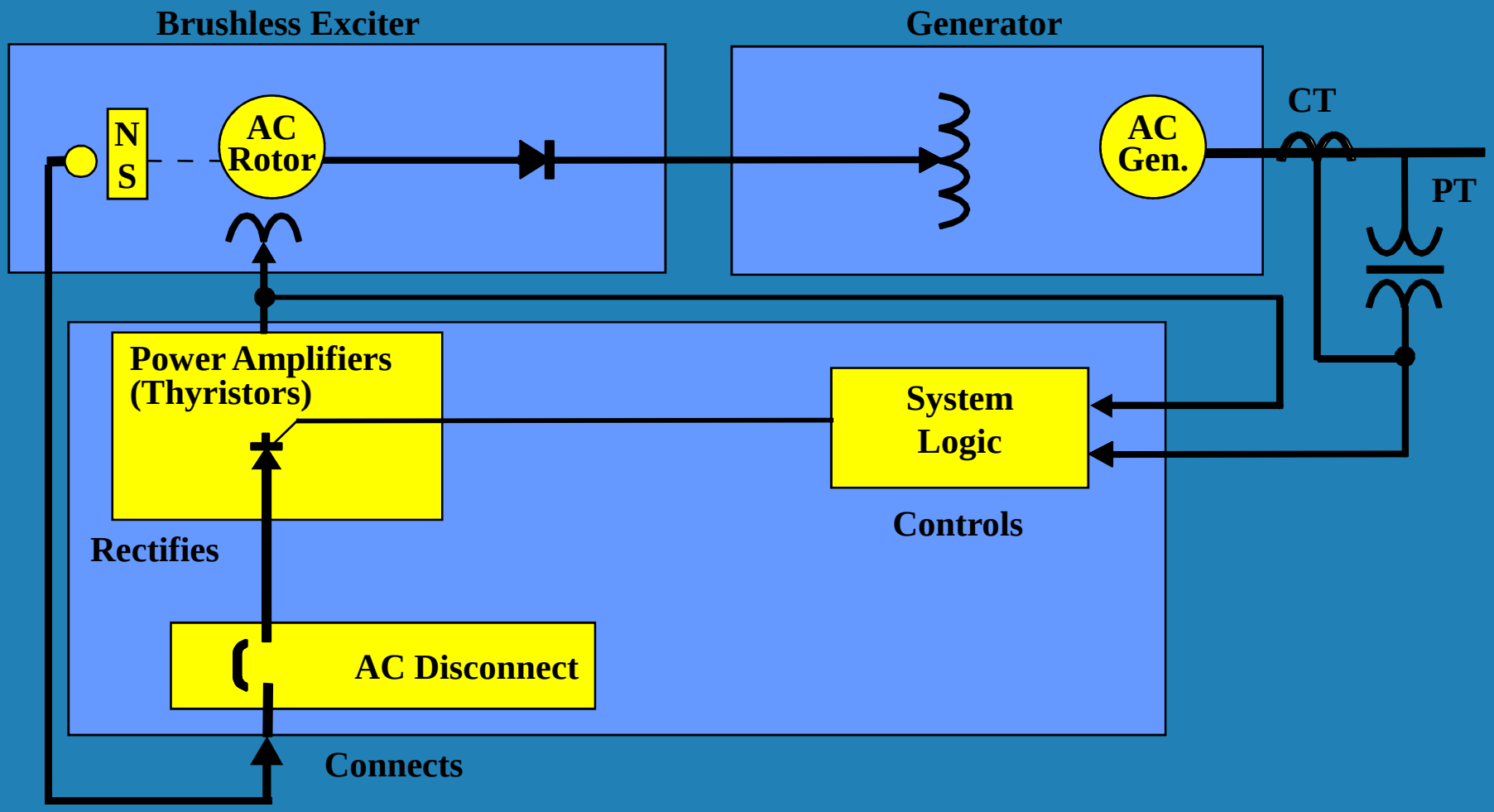
- Voltage Regulators provide field current
  - *To the field of main exciter*
- Brushless Exciter Regulators provide field current
  - *To the field of brushless exciter*
- Static Excitation provide field current
  - *Directly to Rotor of Generator*

Voltage Regulator

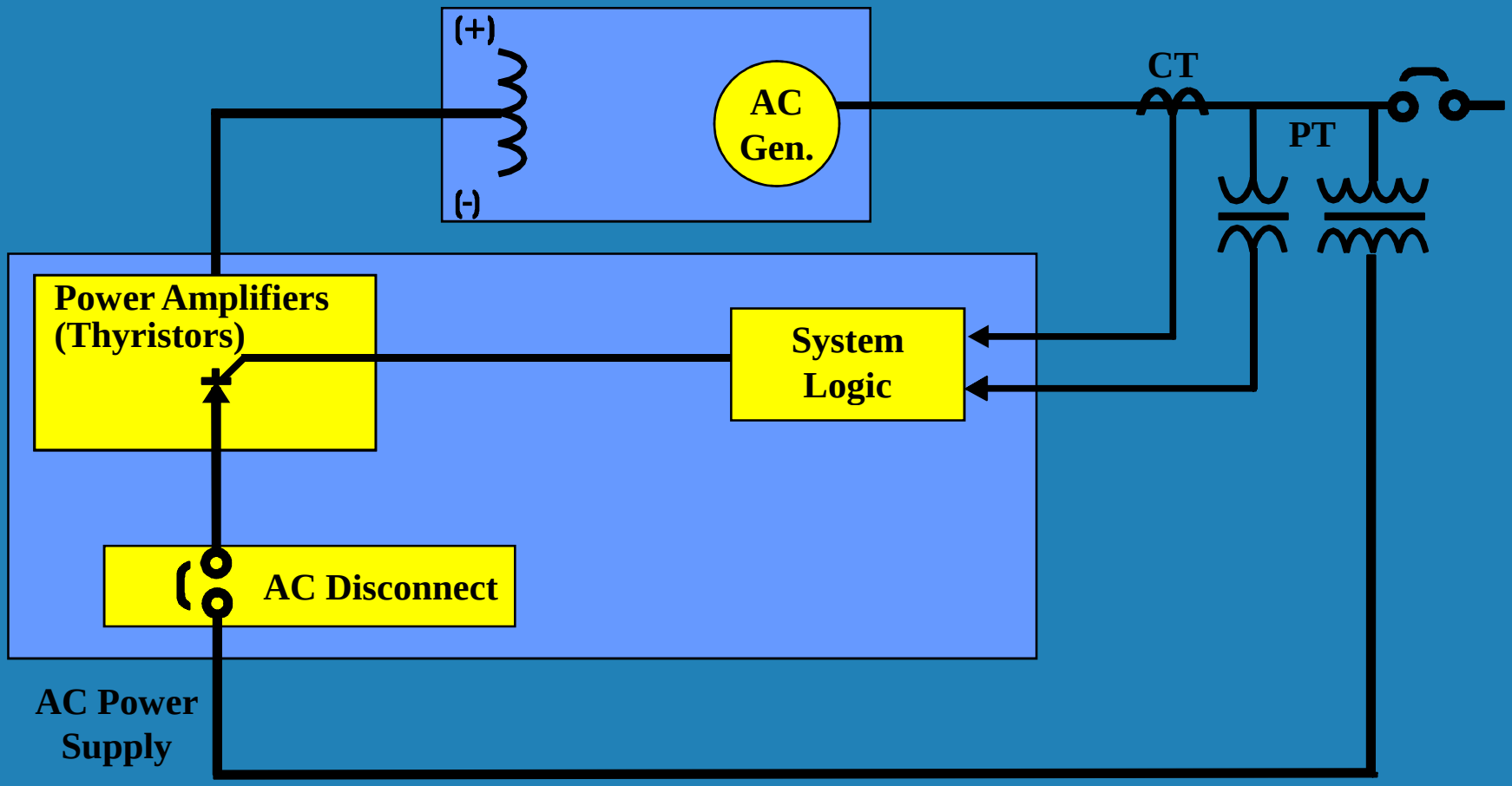
- **Connects**
- **Rectifies**
- **Controls**



Brushless Exciter System



Static Exciter



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Typical Static Exciters

Logic Power Breaker Auxiliary

Dual Channel Logic

Drawout Type Power Drawer

Drawout Air Circuit Breaker

Single Channel Logic with Fixed Mounted Bridge

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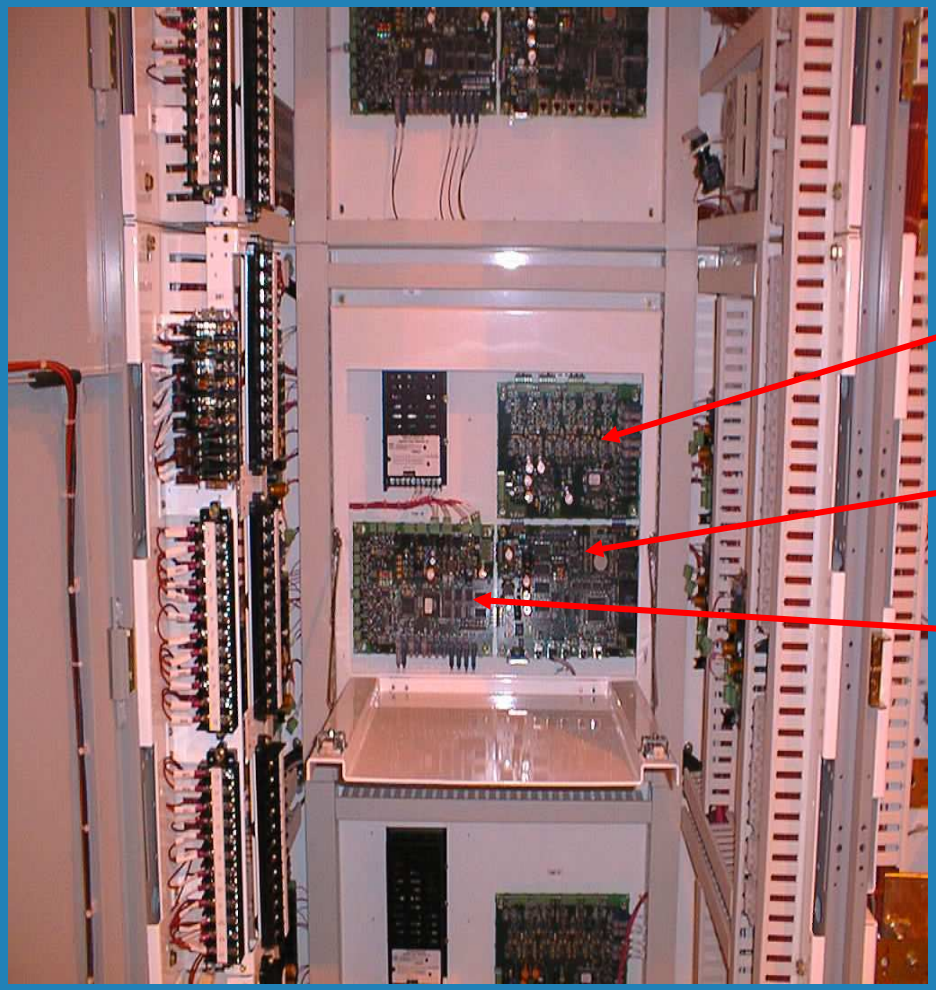
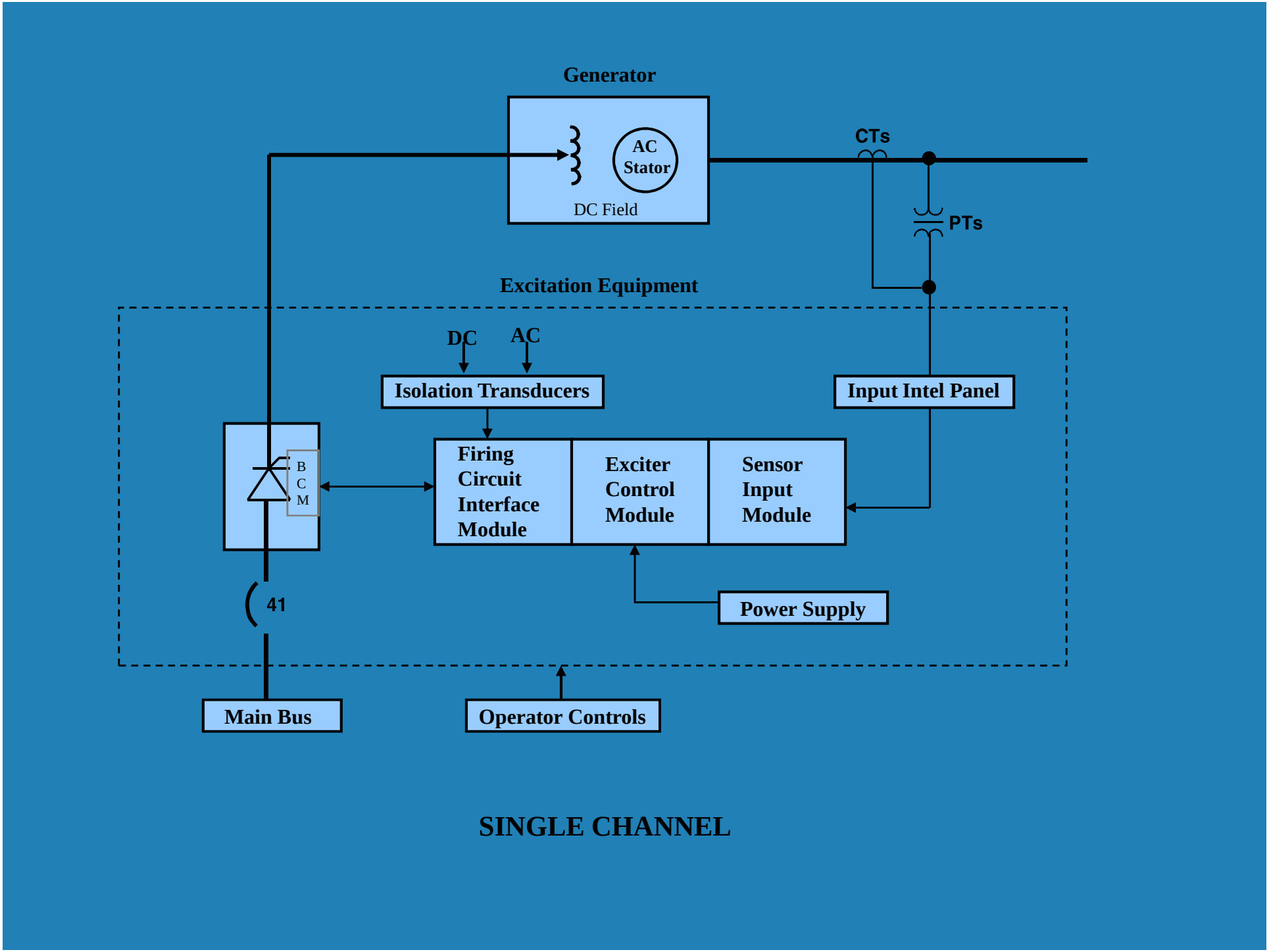
Single Channel View



- SIM Module
- **Sensor Input Module**
- ECM Module
- **Exciter Control Module**
- FCIM Module
- **Firing Circuit Interface Module**

Single Control Channel

- Field Isolation Module
  - One For Generator (Static) or Exciter Field
- AC Line Isolation
- Sensor Input Module
- Exciter Control Module
- Firing Circuit Interface Module
- Bridge Control Module
- Input/Output Modules
  - Zero to Three Analog
  - One to Three Digital



SINGLE CHANNEL

Sensor Input Module

- Provides Digitized Signals for Control Module
  - Generator Line Voltage
  - Generator Line Currents
- Communicates I/O to/from Exciter Control Module
  - Digital I/O (Fiber Optics)
  - Analog I/O (Fiber Optics)
- Direct Connection to Exciter Control Module

Exciter Control Module

- Feedback Control
- Sequence (Ladder Logic) Control
- Communication In/Out of Regulator
- Firing Control
- *Utilizes Multiple Microprocessors*

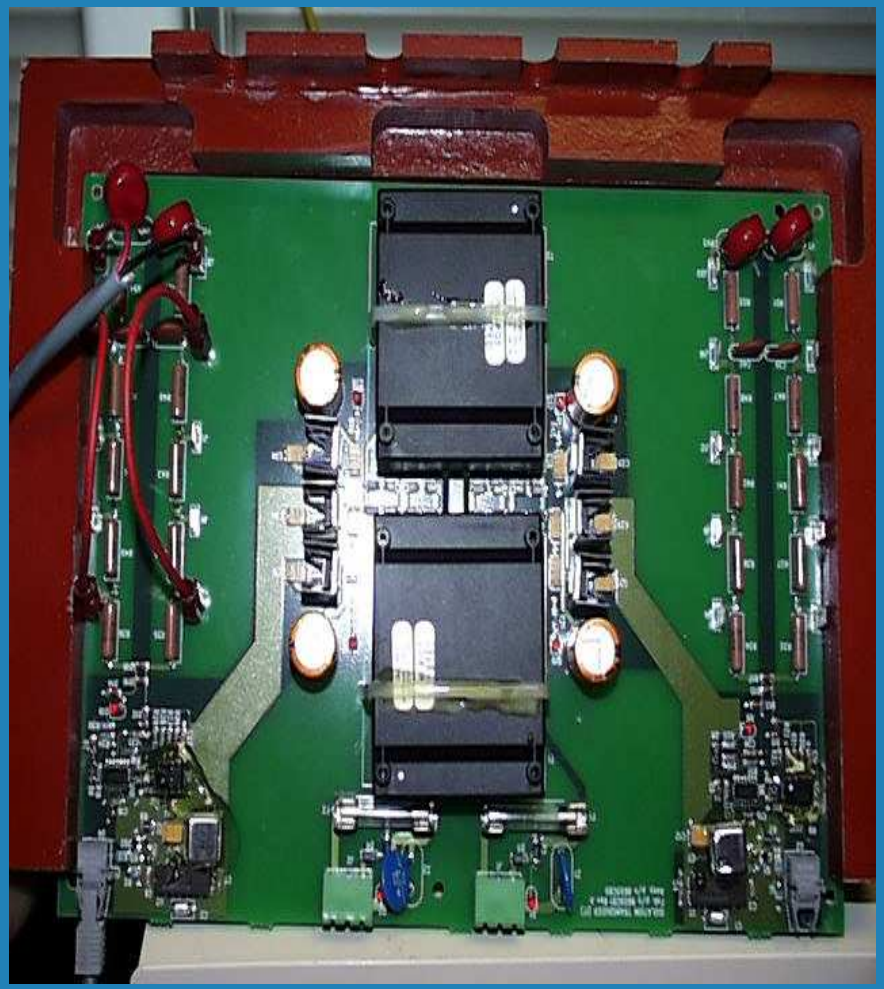
Firing Circuit Interface Module

- Receives Excitation Level From ECM
- Communicates to Thyristor Bridges
  - Via Fiber Optics
- Supervises Bridges
  - Timing of Thyristor Gate Pulses
- Monitors Bridges
  - Bridge Temperature
  - Thyristor Conduction

Bridge Control Module

- One BCM per Bridge
- Generates Thyristor Firing Pulses
- Determines Bridge Current
- Detects Thyristor Firing
  - (Conduction Monitor)
- Detects
  - Heatsink Temperature
  - Air Temperature at Bridge

Isolation Transducer



- Common Transducer
  - Provides Digitized Signal via Voltage Control Oscillator VCO
  - Isolation via Fiber Optics
- Field Isolation
  - Detects Field Voltage up to 2000 VDC
  - Detects Field Current From MV Shunt
- Line Isolation
  - Detects Bridge AC Input Voltage
  - Timing Information for SCR Firing

Input/Output Modules

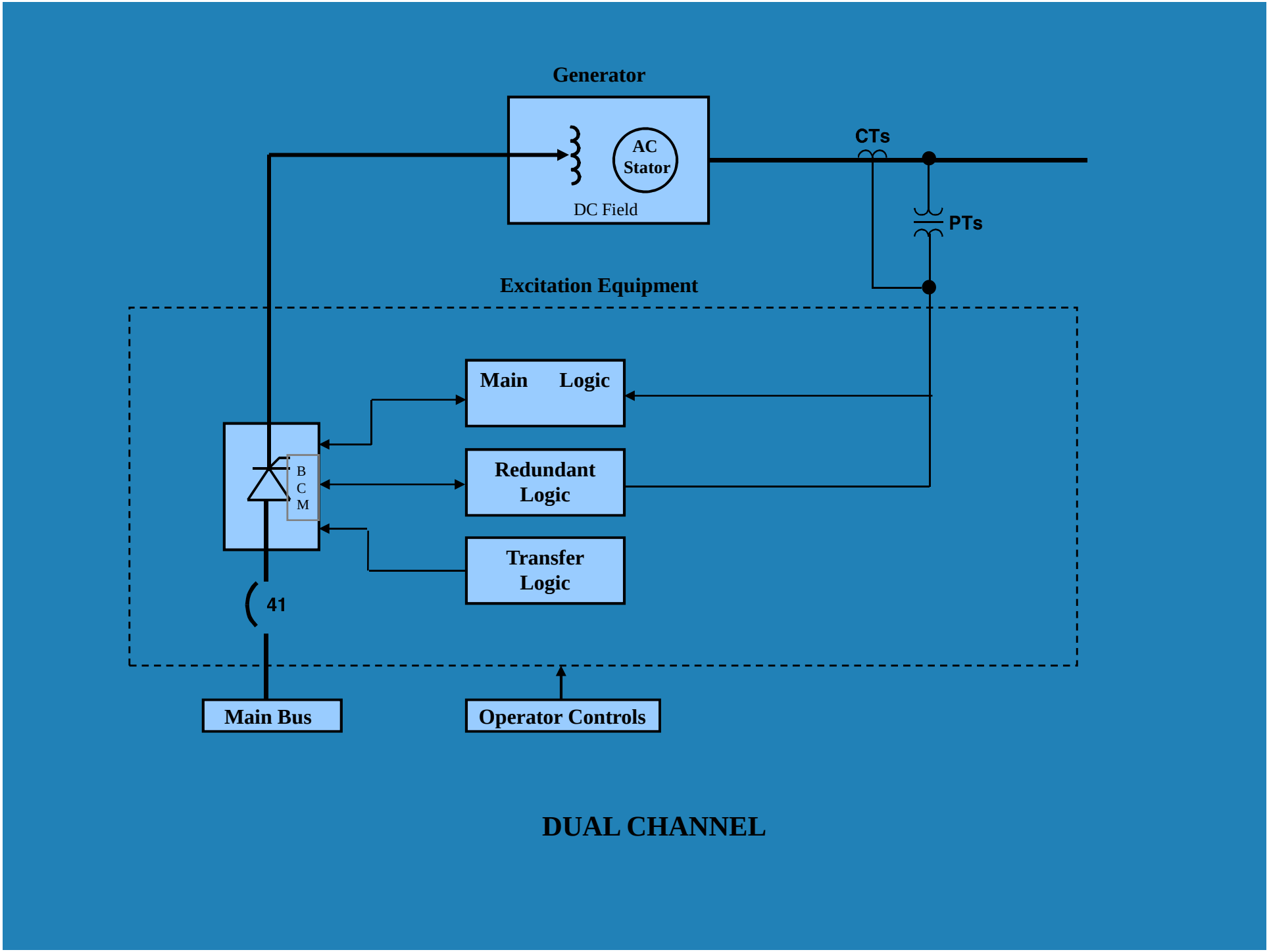
- Analog I/O
  - A/D Converters
  - D/A Converters
  - RTD Transducers
- Digital I/O
  - Relay Contact State Sensing
  - Dry Relay Contacts
- Fiber Optic Communication

Analog I/O

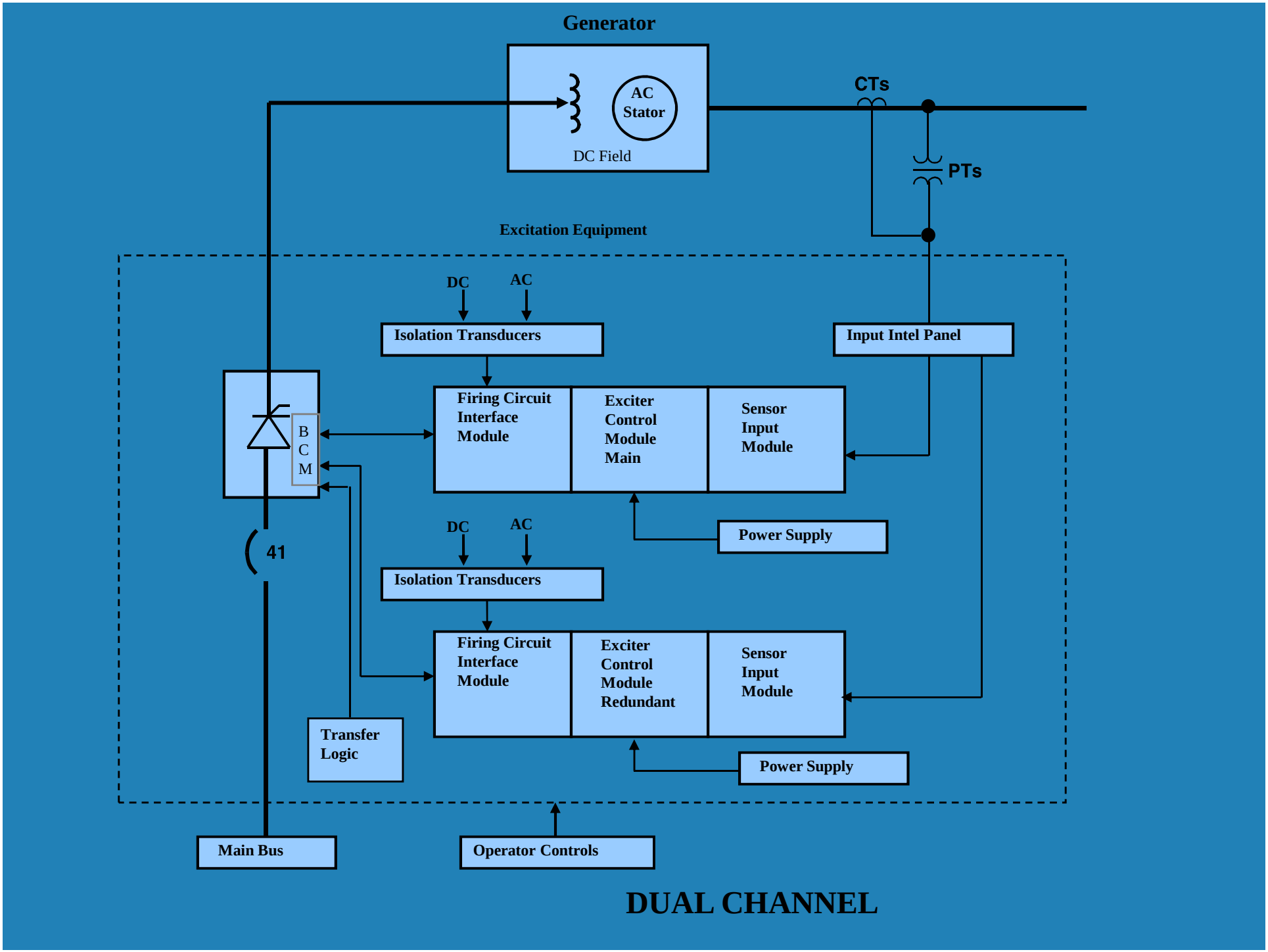
- Configurable I/0
  - 4-20ma
  - +\- 10 Volts
- Building Blocks
  - One RTD (In)
  - Two Analog (In)
  - Four Analog (Out)
- Up To Three Blocks

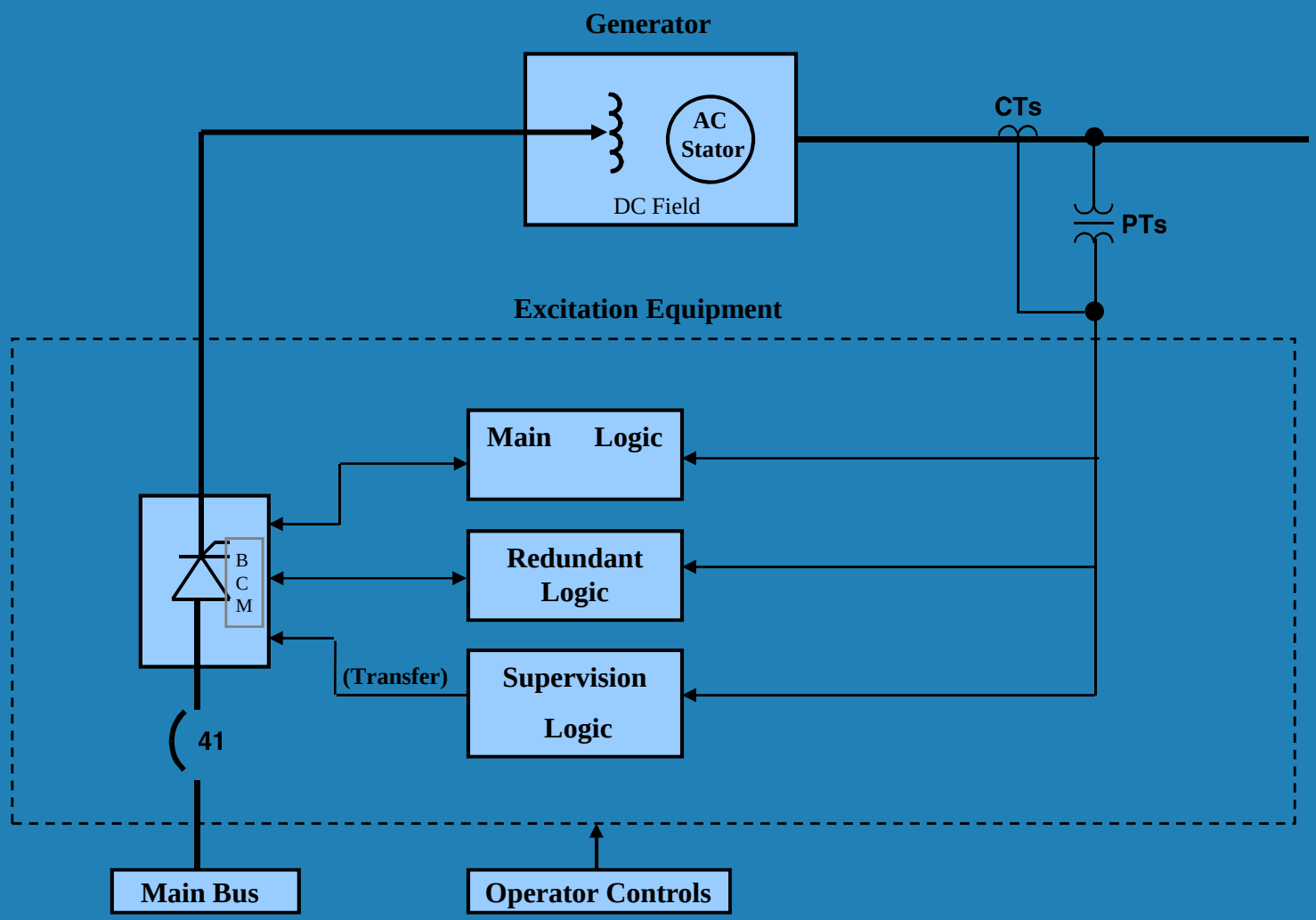
Digital I/O

- Configurable Inputs
  - +24 Volts DC
  - +125 Volts DC
- Dry Relay Contact Outputs
- Building Blocks
  - Twelve Inputs
  - Eight Outputs
- Up To Three Blocks

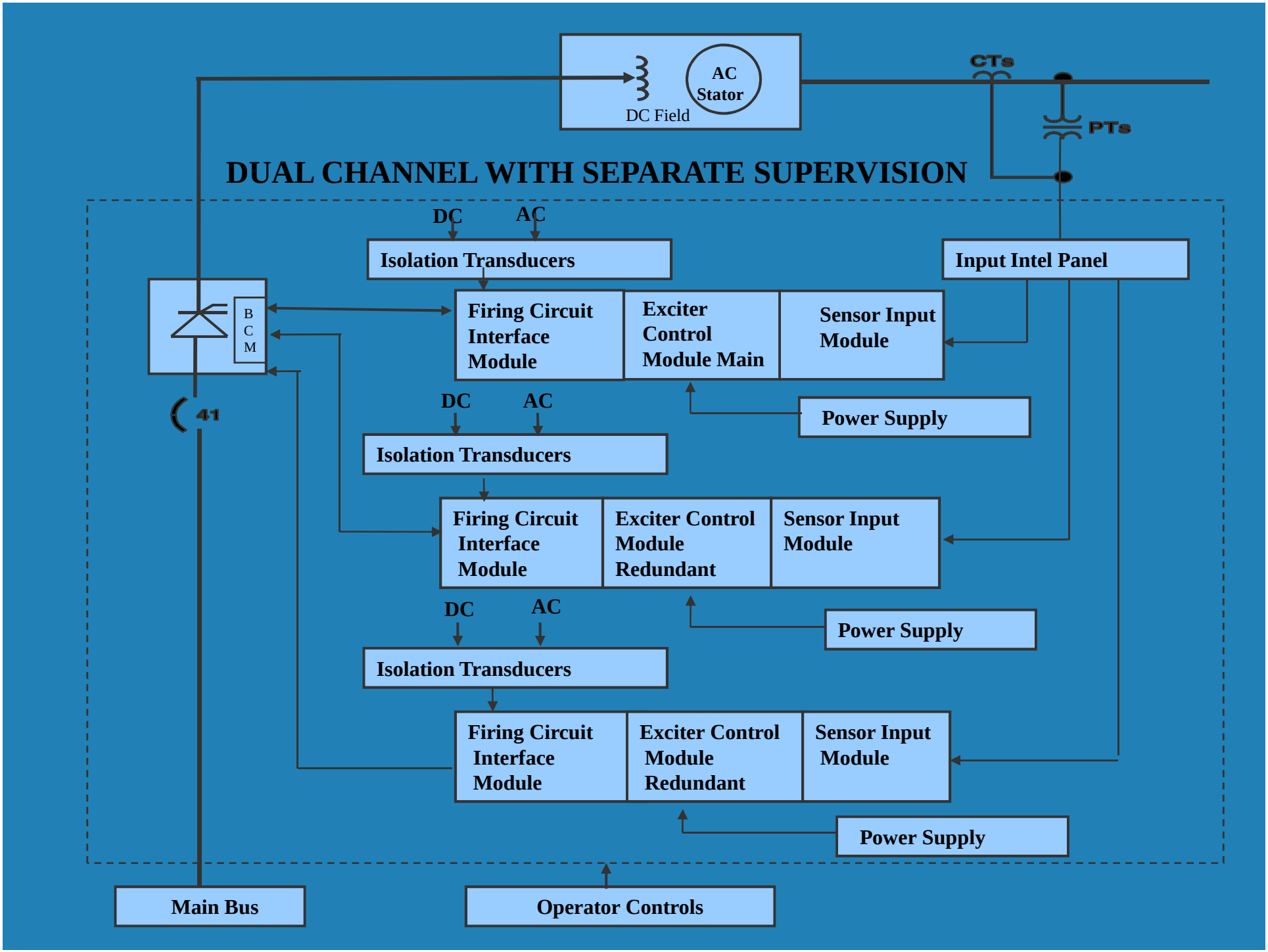


DUAL CHANNEL


Generator
AC Stator
DC Field
CTs
PTs
Excitation Equipment
DC
AC
Isolation Transducers
Input Intel Panel
Firing Circuit Interface Module
Exciter Control Module Main
Sensor Input Module
B C M
41
Power Supply
DC
AC
Isolation Transducers
Firing Circuit Interface Module
Exciter Control Module Redundant
Sensor Input Module
Transfer Logic
Power Supply
Main Bus
Operator Controls
DUAL CHANNEL



DUAL CHANNEL WITH SEPARATE SUPERVISION


AC
Stator
DC Field
CTs
PTs
DUAL CHANNEL WITH SEPARATE SUPERVISION
DC
AC
Isolation Transducers
Input Intel Panel
B
C
M
41
Firing Circuit
Interface
Module
Exciter
Control
Module Main
Sensor Input
Module
Power Supply
DC
AC
Isolation Transducers
Firing Circuit
Interface
Module
Exciter Control
Module
Redundant
Sensor Input
Module
Power Supply
DC
AC
Isolation Transducers
Firing Circuit
Interface
Module
Exciter Control
Module
Redundant
Sensor Input
Module
Power Supply
Main Bus
Operator Controls

Hardworking Software

- Automatic Voltage Regulator
- Manual Regulator
- Power Factor/Var Control/Regulation
- Limiters
- Protection
- Power System Stabilizer

Hardworking Software

- Sequence Control via ECM
- Configurable Software
- Replaces Discrete Relays/Timers
- Modify Without Changing Wires
  - *Controller Configuration Tool*

Active Current Balance

- Optional patented algorithm that facilitates current balance between parallel bridges
- Average current in each thyristor calculated using positive and negative shunt and conduction monitors on each AC phase
- Firing is periodically inhibited for thyristors carrying more than intended average current

Communication Via ECM

- One RS232 Port
  - DB 9 for Configuration Tool
  - RJ11 for Modem
- Two RS485 Ports - RJ45
- One Ethernet Port
  - RJ45 for Twisted Pair or
  - DB15 for AUI Interface
    - Coax or Fiber Optic

Flexible Interface Alternatives

- RS232 - Configuration Tool/Modem
- RS485 - Modbus Protocol
  - Operator Interface or Process Control Interface
- Ethernet
  - Process Control Interface
- Remote Mounted I/O Module
  - Connected by Fiber Optics
- Hard Wired to Digital/Analog I/O Modules
  - Interface To Switches, Meters, Lights
- Single Cable Connection to Control Room

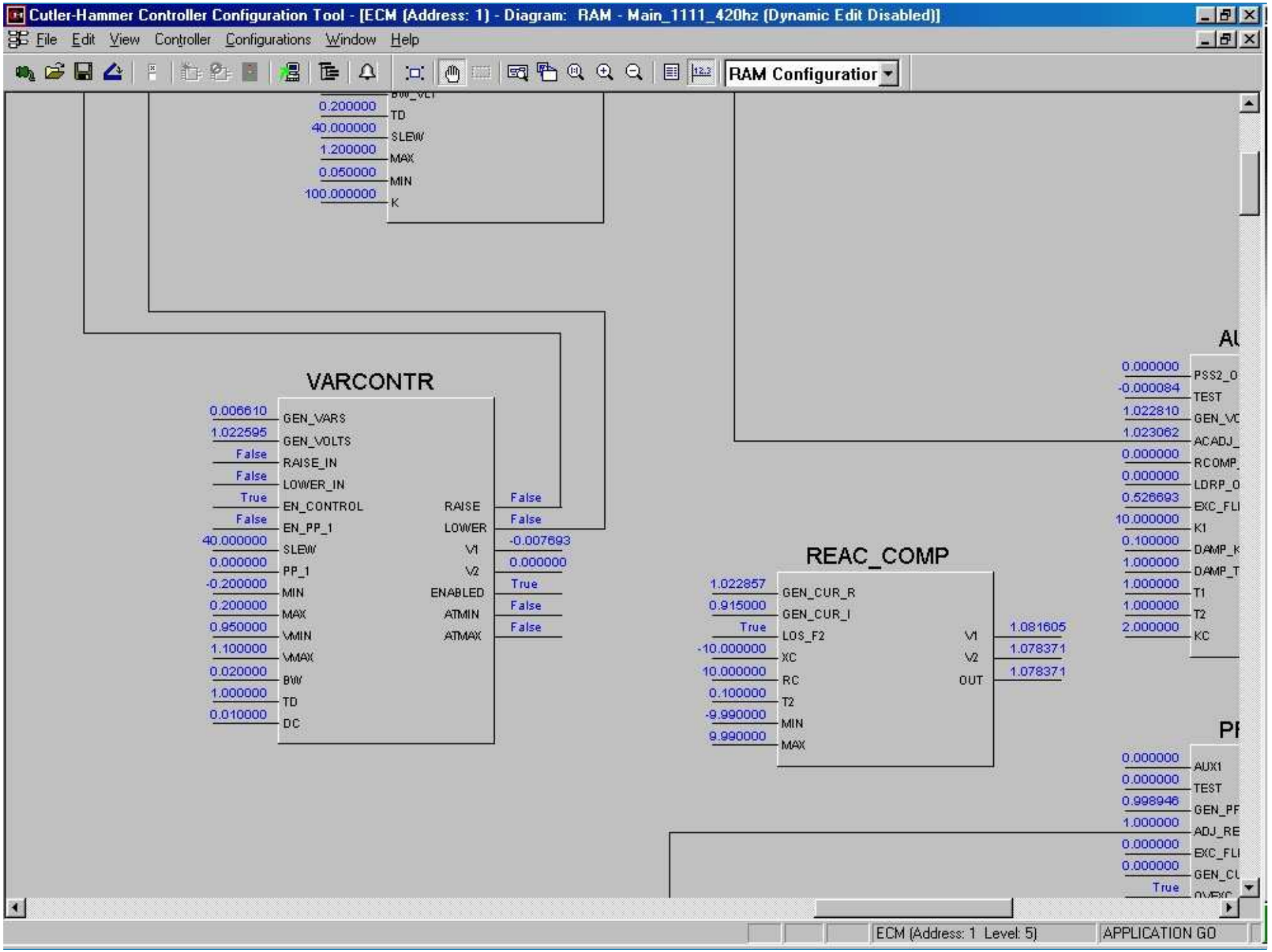
Operator Interface Panel

Local & Remote Installation via Single Cable

PanelMate 1700 Series

Controller Configuration Tool

- Software used to configure, monitor, maintain, and debug excitation system
- Three security levels with passwords provide different access privileges
  - View only
  - View and tune settings
  - Configuration management


Cutler-Hammer Controller Configuration Tool - [ECM (Address: 1) - Diagram: RAM - Main_1111_420hz (Dynamic Edit Disabled)]
File Edit View Controller Configurations Window Help
RAM Configuratior
0.200000 TD
40.000000 SLEW
1.200000 MAX
0.050000 MIN
100.000000 K
VARCONTR
0.006610 GEN_VARS
1.022595 GEN_VOLTS
False RAISE_IN
False LOWER_IN
True EN_CONTROL
False EN_PP_1
40.000000 SLEW
0.000000 PP_1
-0.200000 MIN
0.200000 MAX
0.950000 VMIN
1.100000 VMAX
0.020000 BW
1.000000 TD
0.010000 DC
RAISE False
LOWER False
V1 -0.007693
V2 0.000000
ENABLED True
ATMIN False
ATMAX False
REAC_COMP
1.022857 GEN_CUR_R
0.915000 GEN_CUR_I
True LOS_F2
-10.000000 XC
10.000000 RC
0.100000 T2
-9.990000 MIN
9.990000 MAX
V1 1.081605
V2 1.078371
OUT 1.078371
Al
0.000000 PSS2_O
-0.000084 TEST
1.022810 GEN_VC
1.023062 ACADJ_
0.000000 RCOMP_
0.000000 LDRP_O
0.526693 EXC_FLI
10.000000 K1
0.100000 DAMP_K
1.000000 DAMP_T
1.000000 T1
1.000000 T2
2.000000 KC
PI
0.000000 AUX1
0.000000 TEST
0.998946 GEN_PF
1.000000 ADJ_RE
0.000000 EXC_FLI
0.000000 GEN_CU
True
ECM (Address: 1 Level: 5)
APPLICATION GO

Automatic Voltage Regulator

- +/- .2% Regulation
  - 40-110% Rated Generator Voltage
- 20 to 72 Hertz Range of Operation
- Excitation System Stabilizer
- Transient Gain Reductions
- Current Compensation
- Adjusters
- Line Drop Compensation

Manual Regulation

- +/-.5% Regulation
  - 30% No Load to125% Rated Load
- Field Current or Field Voltage

Volts Per Hertz Limiter

- Provides protection from overheating due to off-frequency operation at excessive voltage levels
- Volts per Hertz limiter operates using an inverse curve rather than instantaneous or fixed time delay
- Independent online and offline settings are available

Overvoltage Limiter

- Protects the machine from sustained high terminal voltage levels
- Automatic phase back signal provided after a fixed time delay

Under Excitation Limiters

- Two separate limiters
  - Minimum Excitation Limiter (MEL) utilizes five-segment piecewise linear curve representing steady state stability limit
  - Under Excitation Limiter (UEL) coordinates with non-circular generator capability curve
- Dynamic adjustment of pickup based upon hydrogen pressure and cooling air temperature

Over Excitation Limiter

- Limits the magnitude and duration of excessive field voltage or current
- Inverse time characteristic with cool down characteristic curve
- Dynamic adjustment of pickup based upon hydrogen pressure and cooling air temperature

Generator Current Limiter

- Limits generator line current below a desired threshold
- Dynamic adjustment of pickup based upon hydrogen pressure
- Bi-directional output allows limiter to raise or lower excitation depending upon whether system is underexcited or overexcited

Instantaneous Field Current Limiter

- Limits field current below a desired threshold
- Independent online and offline settings are available

Power System Stabilizers

- Provides means of damping system oscillations
- Three separate power system stabilizer algorithms available
  - Delta frequency
  - Dual input integral of accelerating power
  - Dual input accelerating power
- Analog input provided for optional external power system stabilizer

Var / Power Factor Controllers

- Used to maintain average reactive power or power factor at a preset value
- Terminal voltage supervision of var and power factor controllers
- Var and power factor controllers available in both automatic and manual voltage regulation modes

Diagnostic Capabilities

- Online instruction leaflets and context sensitive help screens
- Integrated transient event recorder
- Internal data logger
- Online field ground detector
- Integral field temperature monitor
- Thyristor bridge temperature monitor

ECS2100

Locate Back Forward Refresh Home Print Options

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- ECM BLOCKS
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  - ACVLTADJ
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  - AUTO_REG
  - BRDG_CUR
  - CROSS_CUR
  - DC_EXCITER
  - DIGRIN1
  - DIGRIN2
  - DIGRIN3
  - DIGRIN4
  - DIGROUT1
  - DIGROUT2
  - DIGROUT3
  - DIGROUT4
  - FCIM_INP
  - FCIM_OUT
  - GEN_CUR
  - HXL_P
  - INST_CUR
  - LINE_DROP
  - LOS_SENS
  - MANADJ
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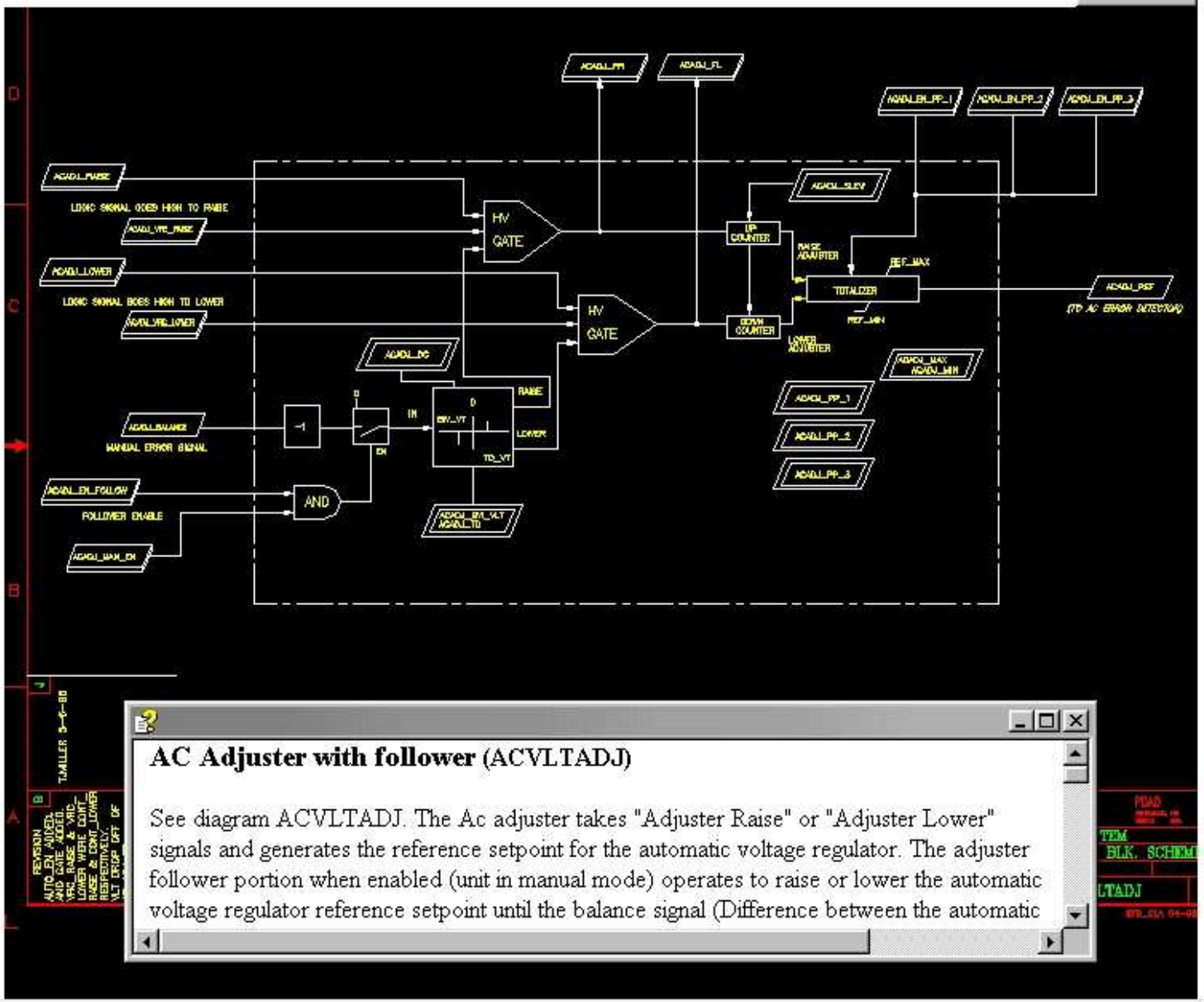
  - MEL_P
  - NOISE_GEN
  - OCPA
  - OEL_P
  - OFF_LINE
  - ON_LINE
  - OVL_P
  - PFCONTR
  - PF_REG
  - PLNT_MOD
  - PLNT_ID
  - PMIN

ACVLTADJ

Find in CCTool

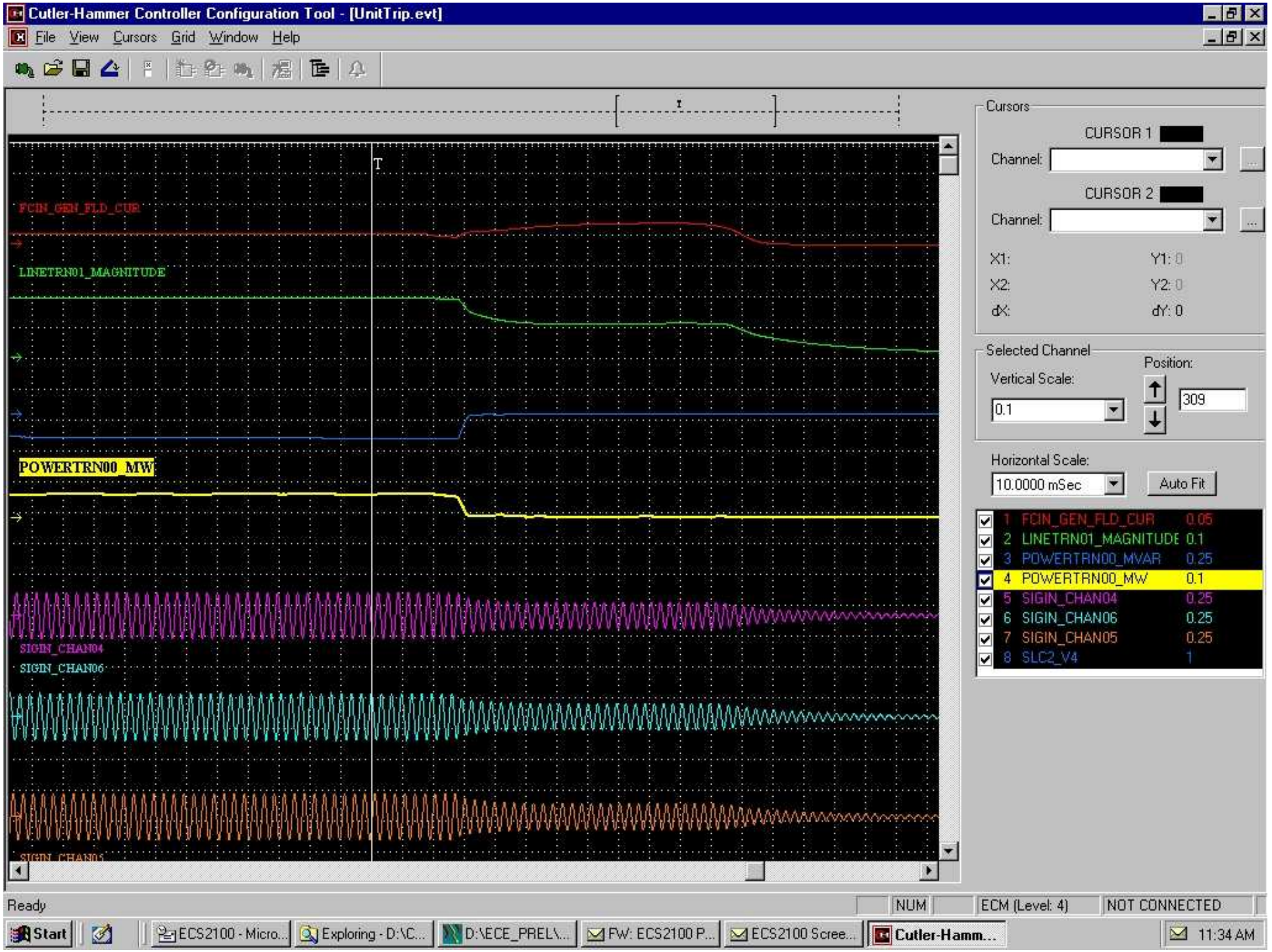


AC Adjuster with follower (ACVLTADJ)

See diagram ACVLTADJ. The Ac adjuster takes "Adjuster Raise" or "Adjuster Lower" signals and generates the reference setpoint for the automatic voltage regulator. The adjuster follower portion when enabled (unit in manual mode) operates to raise or lower the automatic voltage regulator reference setpoint until the balance signal (Difference between the automatic

Transient Event Recorder

- Four separate configurable recorders with 100,000 total data point capacity
- Each recorder individually configurable (number of channels, channel data, number of data points, number of pre-trigger data points, trigger data, sample rate)
- Data can be displayed on PC user interface or can be exported to spreadsheet


Cutler-Hammer Controller Configuration Tool - [UnitTrip.evt]
File View Cursors Grid Window Help
T
FCIN_GEN_FLD_CUR
LINETRN01_MAGNITUDE
POWERTRN00_MW
SIGIN_CHAN04
SIGIN_CHAN06
SIGIN_CHAN05
Cursors
CURSOR 1
Channel:
CURSOR 2
Channel:
X1:
Y1: 0
X2:
Y2: 0
dX:
dY: 0
Selected Channel
Vertical Scale:
0.1
Position:
309
Horizontal Scale:
10.0000 mSec
Auto Fit
1 FCIN_GEN_FLD_CUR 0.05
2 LINETRN01_MAGNITUDE 0.1
3 POWERTRN00_MVAR 0.25
4 POWERTRN00_MW 0.1
5 SIGIN_CHAN04 0.25
6 SIGIN_CHAN06 0.25
7 SIGIN_CHAN05 0.25
8 SLC2_V4 1
Ready
NUM
ECM (Level: 4)
NOT CONNECTED
Start
ECS2100 - Micro...
Exploring - D:\C...
D:\ECE_PREL\...
FW: ECS2100 P...
ECS2100 Scree...
Cutler-Hamm...
11:34 AM

Data Logger

- Twelve channel data logger with 25,000 total data points
- Circular data buffer with oldest data overwritten when buffer has been filled
- Data can be displayed on PC user interface or can be exported to spreadsheet

Alarm Log

- Time and date stamped log of all alarms
- Last 2000 alarms stored locally
- Log may be periodically uploaded to database on personal computer

BRIDGE 0 Alarms				
CONDUCTION SENSOR AP	Alarm			
CONDUCTION SENSOR AN	Alarm			
CONDUCTION SENSOR BP	Alarm			
CONDUCTION SENSOR BN	Alarm			
CONDUCTION SENSOR CP	Alarm			
CONDUCTION SENSOR CN	Alarm			
BRIDGE 1 Alarms				
CONDUCTION SENSOR AP	Alarm			
CONDUCTION SENSOR AN	Alarm			
CONDUCTION SENSOR BP	Alarm			
CONDUCTION SENSOR BN	Alarm			
CONDUCTION SENSOR CP	Alarm			
CONDUCTION SENSOR CN	Alarm			