

Excitation Control for a Synchronous Generator

Team Three Phase

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Project Summary

Goals

- ▶ The goal of this project is to establish a working excitation control system for the synchronous generator in the BEL Power Lab.
- ▶ Three Phase will also develop a condensed manual for quick operation of said control system and an informative document on the theory or operation for the system.

Design Choices

- ▶ Build, Assemble, or Purchase
 - ▶ Chose to Purchase

- ▶ Basler, Reivax, or ABB
 - ▶ Chose ABB

Project Summary

Features	ABB Unitrol-1020	Basler DECS-250	Reivax RTX Energy DRV01
Maximum Input Voltage	300 Vac	277 Vac	220 Vac
Exciter Output	Up to 20 Adc	Up to 15 Adc Up to 125 Vdc	Up to 20 Adc
Short Term Overload	Up to 40 Adc 10 seconds	Up to 300 Vdc Up to 30 Adc 10 seconds	Up to 40 Adc 30 seconds
VR accuracy	±0.20%	±0.25%	±0.10%
Digital I/O	12 Inputs 8 Outputs	16 Inputs 11 Outputs	29 Inputs 15 Outputs
PT	3 PT inputs: 0 to 300 V	3 PT inputs: 0 to 200 V	3 PT Inputs: 0 to 200 V
CT	1 CT input: 1 or 5 A	3 CT inputs: 1 or 5 A	3 CT Inputs: 5 A
Operating Temperature	-40 to 70 °C	-40 to 70 °C	0 to 70 °C
Size	6.69" x 11.89" x 6.69"	8.08" x 8.62" x 12"	11.8" x 23.6" x 31.5"
Cost	Between \$5,000 and \$6,000	Between \$4,000 and \$5,000	Between \$20,000 and \$30,000

Information

- ▶ ABB Ship Date: 3/9/2015
- ▶ Estimated Arrival Date: 3/12/2015

System Components

- ▶ Variable Frequency Drive (VFD)
- ▶ Induction Machine
- ▶ Synchronous Generator
- ▶ Generator Circuit Breaker (GCB)
- ▶ Static Exciter (Unitrol-1020)
 - ▶ Current Transformer for armature current sensing

External Capacitor

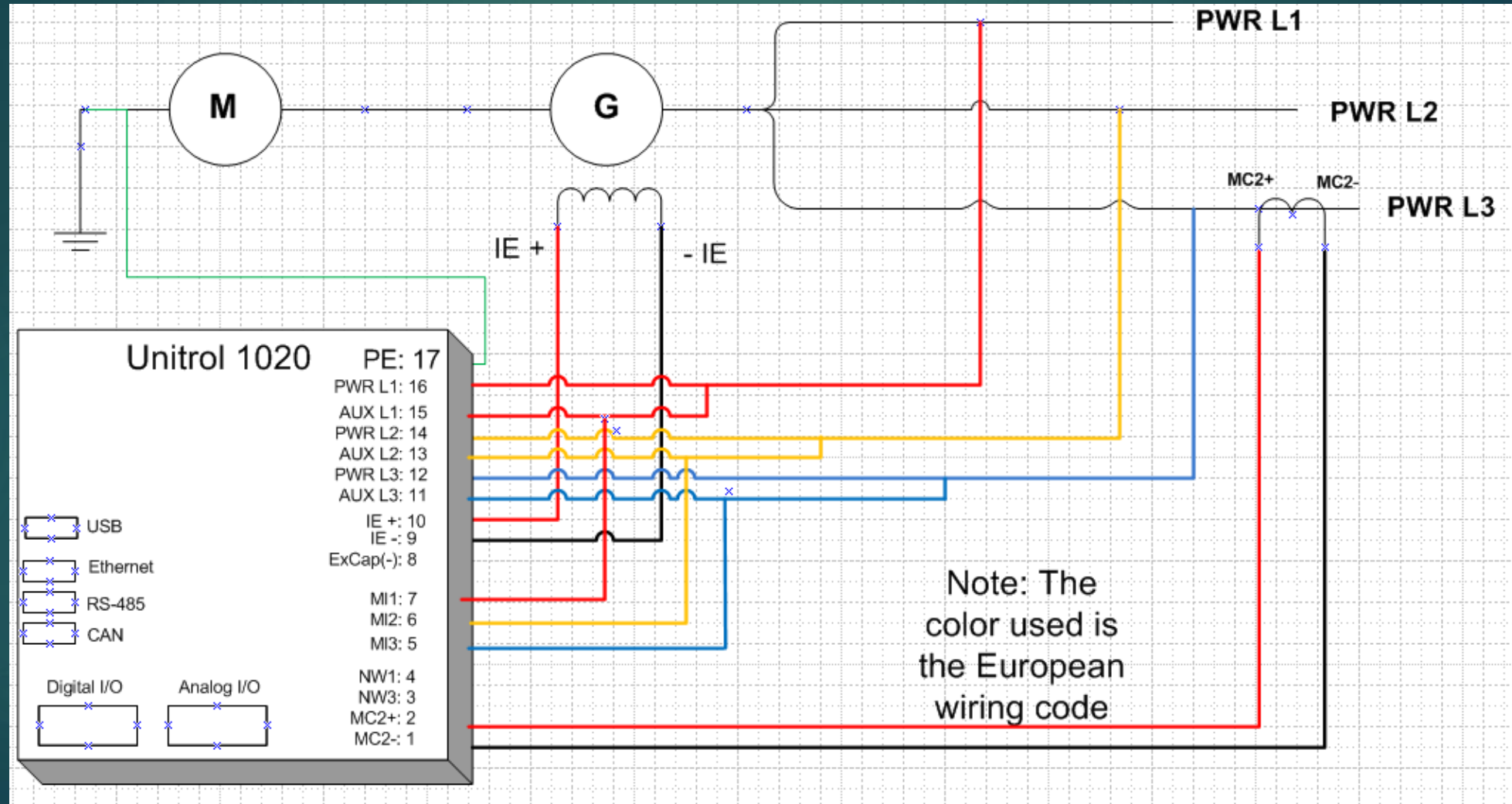
Operational Lifetime Chart for UNITROL 1020

Light Grey: No external capacitor needed
 Dark Grey: External capacitor needed
 No operation possible

Excitation Current Supply	<5A	5A to 8A	8A to 10A	10A to 15A	15A to 20A	Ambient Temperature
1 phase input	Light Grey	Light Grey	Light Grey	Light Grey	Dark Grey	<30°C
	Light Grey	Light Grey	Light Grey	Dark Grey	Dark Grey	30° to 40°C
	Light Grey	Light Grey	Light Grey	Dark Grey	Dark Grey	40° to 55°C
	Light Grey	Light Grey	Dark Grey	No operation possible	No operation possible	55° to 70°C
3 phase or DC input	Light Grey	Light Grey	Light Grey	Light Grey	Light Grey	<30°C
	Light Grey	Light Grey	Light Grey	Light Grey	Light Grey	30° to 40°C
	Light Grey	Light Grey	Light Grey	Light Grey	Dark Grey	40° to 55°C
	Light Grey	Light Grey	Light Grey	No operation possible	No operation possible	55° to 70°C

This table is an excerpt from page 80 of the ABB users manual. This table shows the need for an external capacitor for a given current and temperature range.

Connection Diagram



Testing Plans

- ▶ Offline tests
 - ▶ Manual Control Mode Verification
 - ▶ Over/Under excitation protection
- ▶ Online tests
 - ▶ Automatic Voltage Regulation Verification
 - ▶ Fault Ride Through

Projected Expenses

Component	Price
ABB Unitrol-1020	\$4,000.00
(Projected) Lab Cart	\$90.00
(Projected) Cables	\$30.00
(Projected) Connecters	\$20.00
(Projected) Expo Poster	\$100.00
Total	\$4,240.00

- ▶ The funds allocated to this project total \$6,000.00.

Schedule

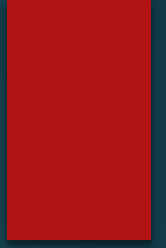
Important dates

Task	Date
Design Review	February 17
Snapshot 3	March 11
Receive Exciter	March 12
Engineering Design Expo	May 1

Important Deadlines

Task	Date
Final Draft: Operation Manual	February 25
Finish Commissioning	March 20
Final Draft: Training Guide	March 12
Final Draft: Test Procedure	March 20
Finish RTDS Testing	March 28
Finish Functionality Testing	April 1
Order Expo Poster	April 17

Closing



Questions?