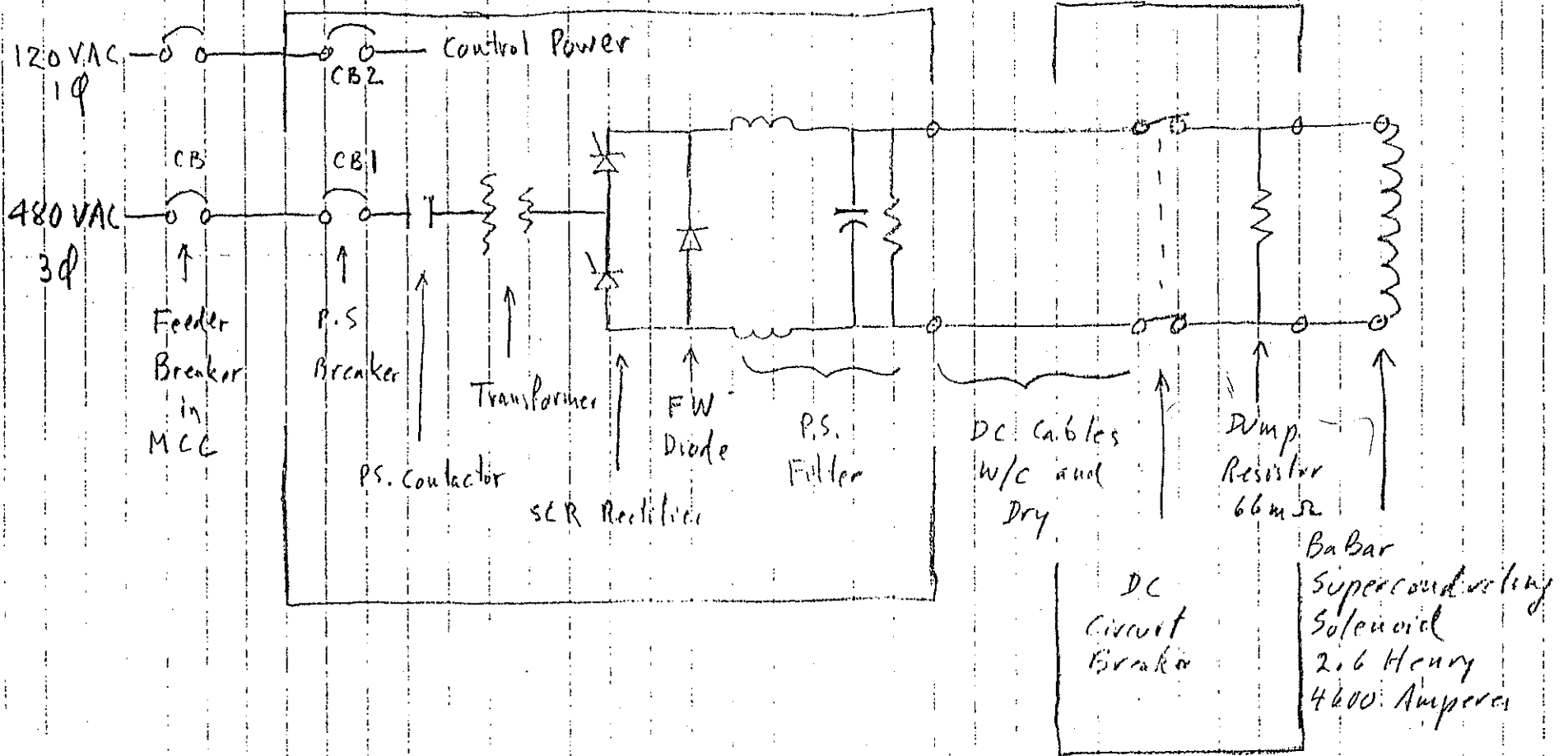


Power Supply in Building 625



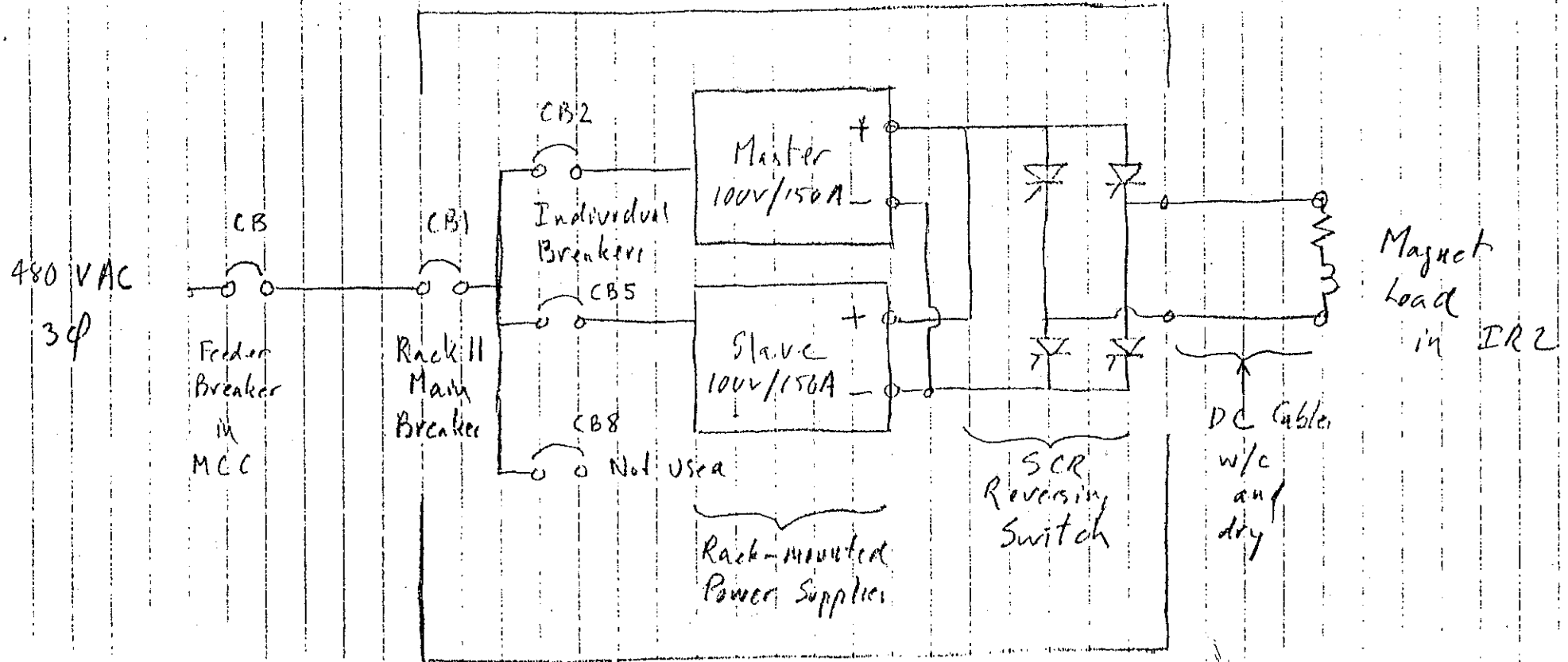
BaBar Solenoid Power Supply

0-20 VDC

0-8000 ADC

Operating Current = 4600 ADC

Rack II in Building 625



Ba Bar Bucking Coil Power Supply

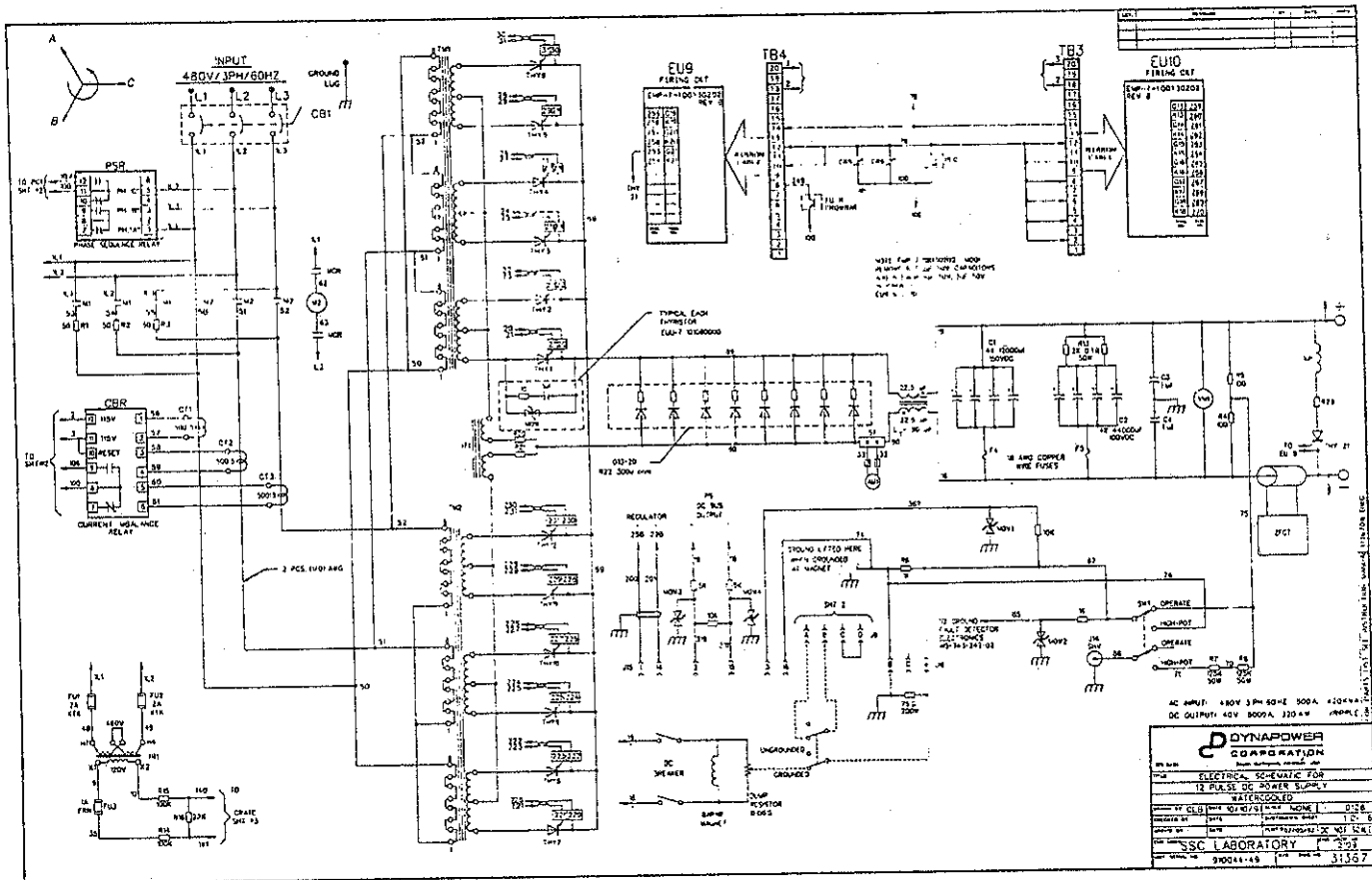
0 - 100 V DC
0 - 300 A DC

Operating Current = 300 A DC

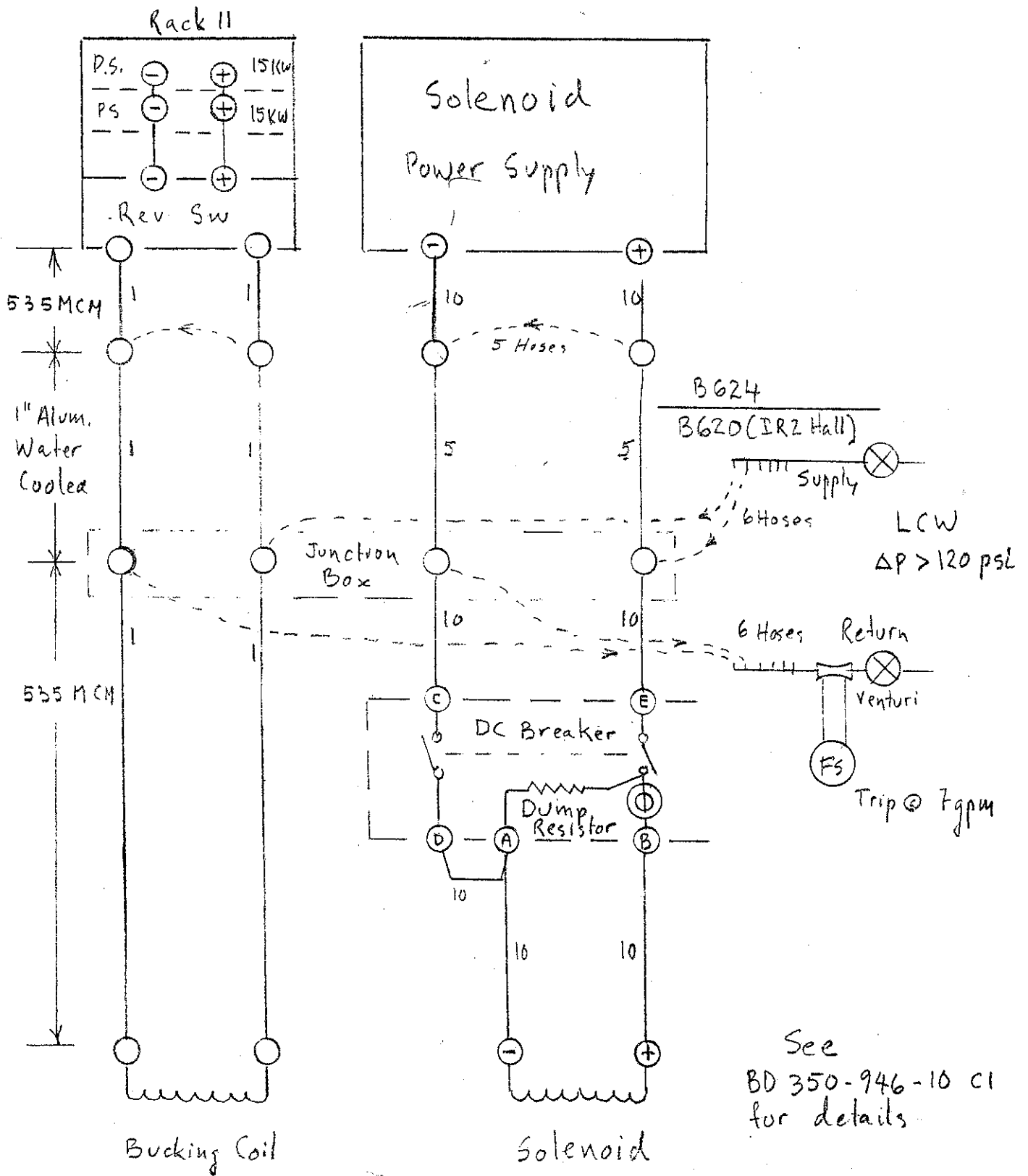
Solenoid Power Supply Specifications

Manufacturer	Dynapower
Maximum rating:	40 VoltsDC, 8000 Amperes, 320 KW Reconnectable transformer primary for 10, 20 or 40 Volts DC output (20 Volt connection used for BaBar)
Input power:	480 Volts AC, 3 phase for power 120 Volts AC, 1 phase for controls
Rectifier Transformers:	Two transformers, one Delta primary, one Wye primary 6 phase star connected secondary windings
Rectifier:	Two 6-phase SCR stars, connected in parallel through an interphase transformer
Freewheeling Diodes:	8 in parallel, at input to filter
Filter:	L (iron core) and C (electrolytic bank)
Cooling:	Water (LCW, about 6 GPM)

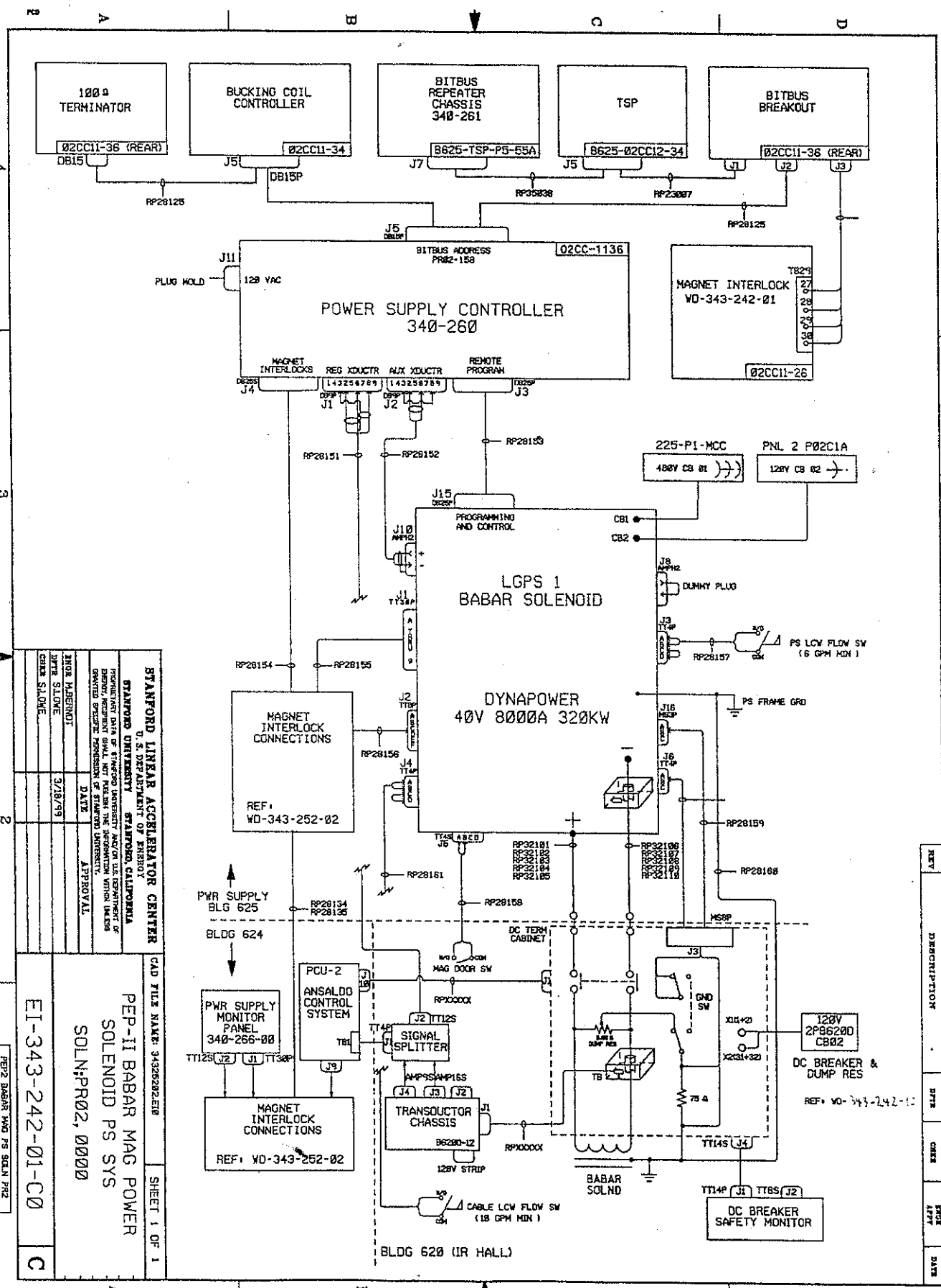
Solenoid Power Supply



DYNAPOWER CORPORATION
ELECTRICAL SCHEMATIC FOR
12 CLASS DC POWER SUPPLY
WATERCOOLED
REV. 2
DESIGNED BY [REDACTED]
DRAWN BY [REDACTED]
CHECKED BY [REDACTED]
APPROVED BY [REDACTED]
DATE: 11-13-67
DYNAPOWER CORPORATION
31567



**BaBar Solenoid & Bucking Coil
 DC Cable Plant**



STANFORD LINEAR ACCELERATOR CENTER
 U. S. DEPARTMENT OF ENERGY
 STANFORD UNIVERSITY STANFORD, CALIFORNIA

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ANNO MADERNDI	DATE	APPROVAL
GENE SLOANE	3/18/93	

CAD FILE NAME: 3432622EIB

PEP-II BABAR MAG POWER SOLENOID PS SYS
 SOLN:PR02, 0000

EI-343-242-01-C0

PEP-II BABAR MAG PS SOLN PR02

SHEET 1 OF 1

REV#	DESCRIPTION	DATE	BY

BaBar Solenoid

External Power Supply Interlocks

Connected directly into the Power Supply:

- J3 Power Supply LCW Flow Switch in Building 625.
External Interlocks #1 Cable #RP28157
- J4 DC Cable LCW Flow Switch in IR Hall West wall.
External Interlock #2 Cable #RP28161
- J6 Ground Switch on Dump Resistor in IR Hall.
Switch is opened to check magnet insulation resistance.
Switch must be closed (magnet grounded) to run.
External Interlock #3 Cable #xxxx
- J2 Remote OFF push button in Building 624 (Cryogenic Controls).
External Interlock #4 Cable RP 28156 and
Trunk Line RP28135
- J5 Interlock to insure Magnet Doors are closed and Magnet Plugs are inserted.
This interlock bypasses PLC500 and acts directly on Main Contactor.
Cable #xxxx

Connected into Power Supply Controller Chassis 340-260

- Mag Fault 0 DC Breaker open
- Mag Fault 1 Interlocks from Cryogenic Control System
- Mag Fault 2 Ramp Down
(Note: Since SCP controls do not provide for a "Ramp Down" Subroutine,
this command from the magnet protection system will turn off the power supply
instead of ramping down the current.
- Mag Fault 3 Not used
- Regulating Transductor (J1) "Magnet only" current transductor installed inside Dump Resistor Box,
with Transductor Driver chassis in Rack 12 on top of magnet
- Auxiliary Transductor (J2) Interlock bypassed with jumper in plug J2.
The Auxiliary transductor is the transductor inside the power supply.
This transductor measures the power supply current (magnet + dump).
The interlock from this Transductor is part of the internal power supply
interlock system controlled by the power supply PLC500

**BaBar Magnet
Power Supplies**

BITBUS
PANEL

UPDATE
PANEL
3-MAR
13:27:59

HELP

RETURN
BABARI
OX

INDEX
PANEL

Power Supplies

Access
Procedure

Button
Macro

PRINT
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Text
MCCIMGN

Sole-
noid

Buckng
Coil

Degaus

Multi-
Step
Ramp

Control Functions

BaBar Ramp Functions

Enter
BDES

RAMP
TIME
minutes
2.50

Setup
Ramp

Start
BaBar
Ramp

Hold
BaBar
Ramp

Turn
Off
LGPS

Turn
On
LGPS

TurnON
Revrse
Polarity

Ansaldo
Ctl Sys
Status:

Ramp
Stop
YES

Ramp
Down
YES

Contrl
Lock
OK

DC
Breakr.
OPEN

Remote
Intlk
Reset

CHECK
MAGNET
STATUS

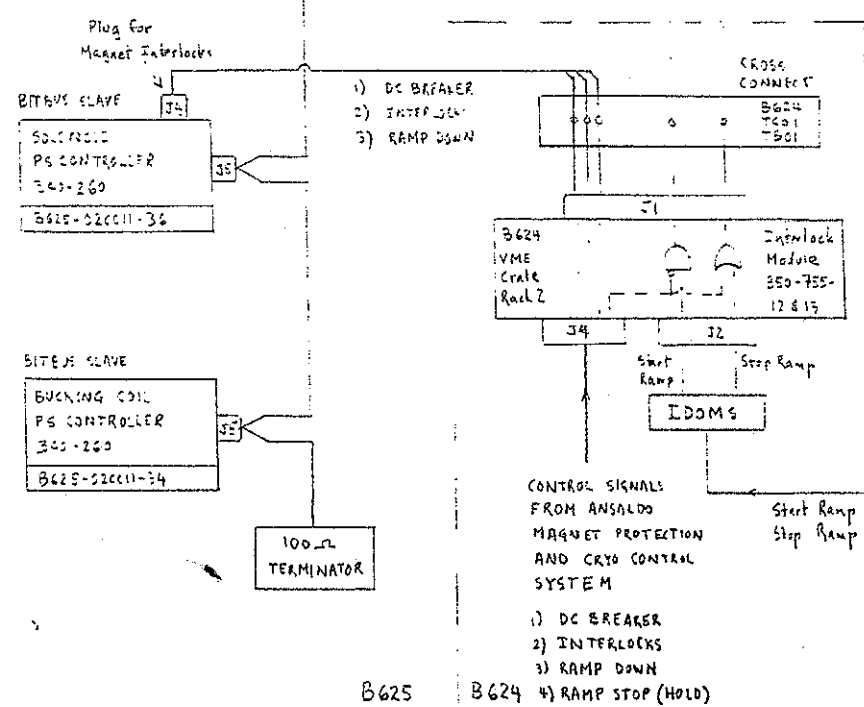
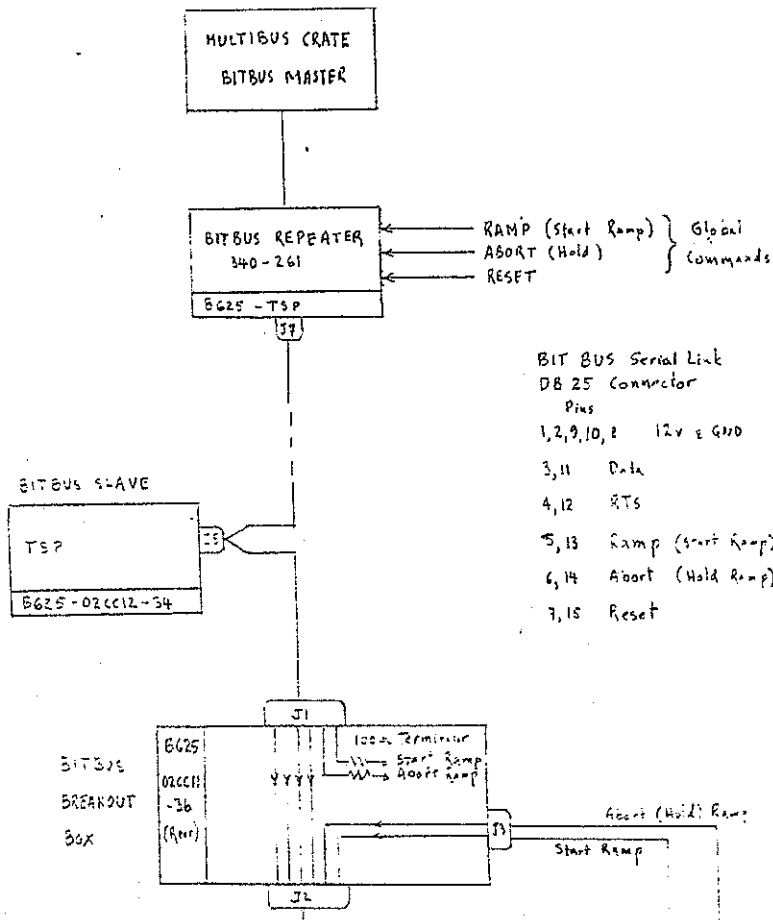
ALL
MAGNET

DISPLY
ALL
UNITS

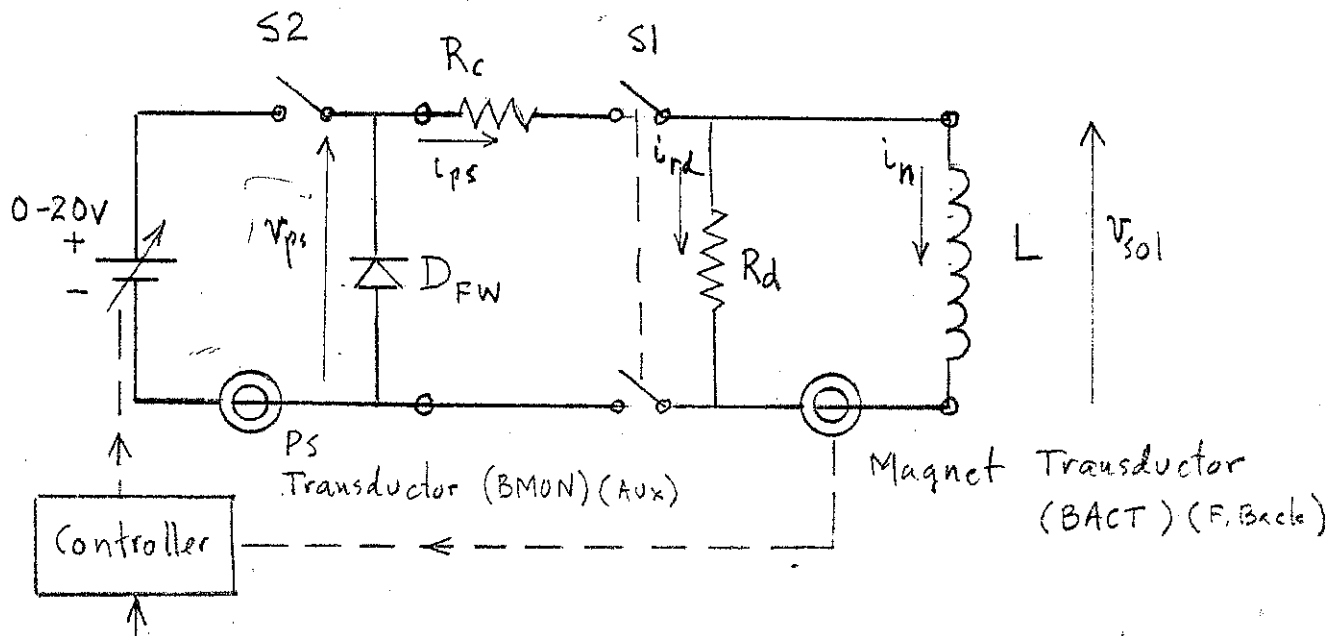
DISPLY
SINGLE
UNIT

MAGNET
ADJUST
KNOB 0

MAGNET
DIAG
PANEL



B625 B624 4) RAMP STOP (HOLD)



1 Current Setpoint (ramp) from SCP BaBar panel (LGPS-1)
0-4600 Amp

Simplified BaBar Solenoid and Power Supply Circuit

L = 2.58 Henries Superconducting Solenoid inductance
Rd = 68 milliohms Dump Resistor (air cooled)
Rc = 1.25 milliohms DC cable resistance

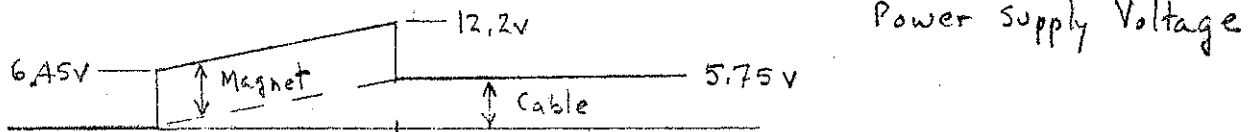
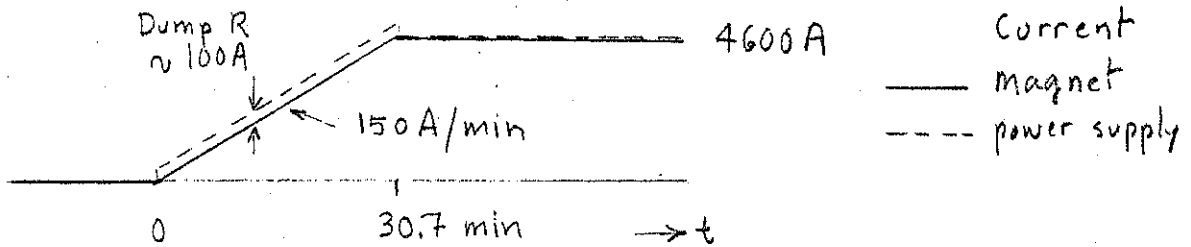
S1 DC Breaker (2-pole) for Solenoid Dump
S2 Fictitious switch to simulate "turning power supply off".
Dfw Freewheeling Diodes
In Current in Solenoid
Ird Current in Dump Resistor
Ips Current from power supply
Vsol Voltage across Solenoid terminals
Vps Power supply terminal voltage

In normal operation:

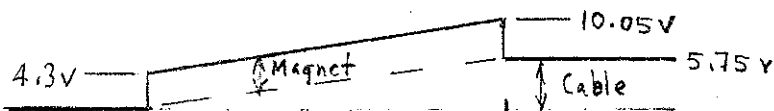
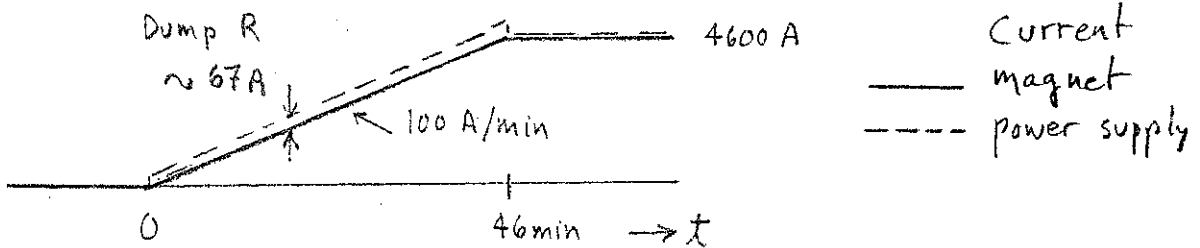
- Power supply is in V mode (voltage regulated).
- Power supply Transducer is not in control loop.
- Magnet Transducer is in control loop, and is used for both current feedback and magnet current measurement.
- S1 and S2 are closed for normal operation.
- S1 (DC Breaker) is opened to initiate a "Fast Dump".
- Opening S2 starts a slow current decay, (approximately exponential decay, with 34 minute time constant)

$$e_{p.s.} = i_{\text{magnet}} \times R_{\text{cable}} + L_{\text{magnet}} \frac{di_{\text{mag}}}{dt}$$

- a) During a current ramp, $L \frac{di}{dt} = \text{constant}$
- b) If $e_{p.s.}$ is constant, $\frac{di}{dt}$ changes exponentially with time constant given by L/R
- c) As long as there is a current in the power supply, the p.s. output voltage can be controlled between
- 0.7 Volts (FW Diode Voltage)
- and
- + 20.0 Volts (Max p.s. output)

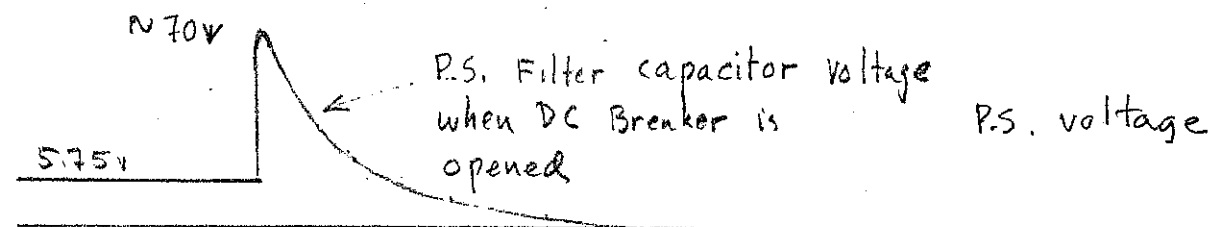
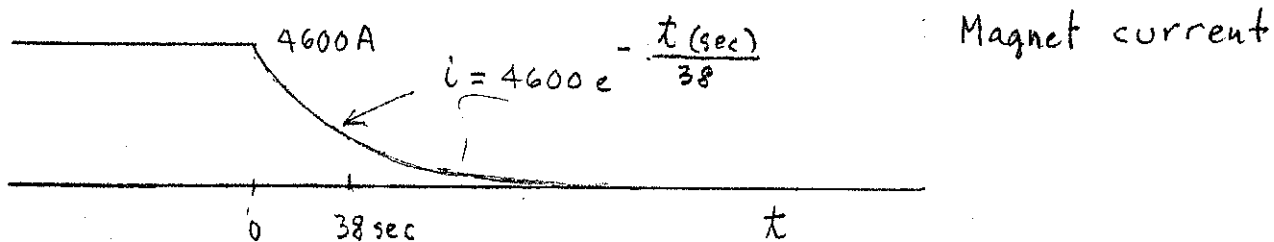


a) Current & P.S. Voltage @ 150 Amp/min



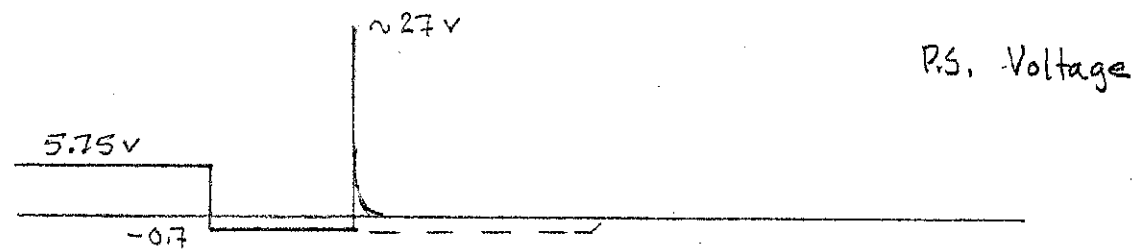
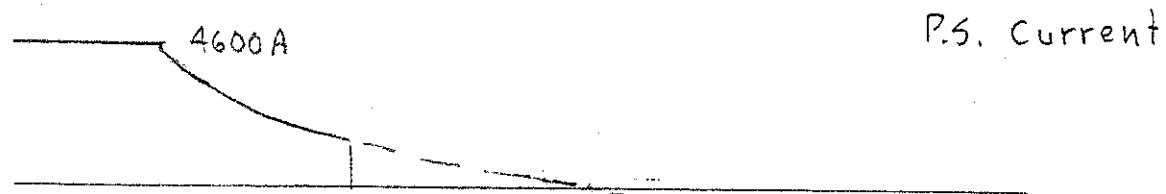
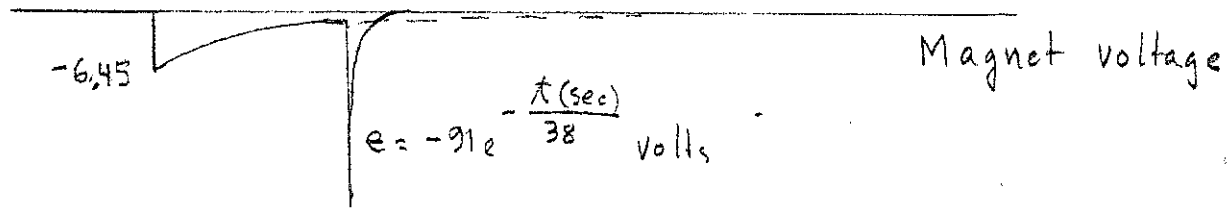
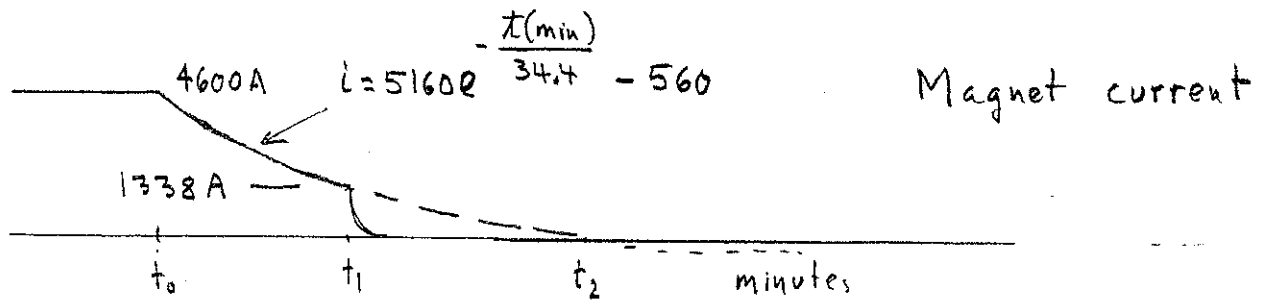
b) Current & P.S. Voltage @ 100 A/min

Solenoid
Magnet Charging



- DC Breaker opened @ 4600 A.
PS contactor opened at the same time
- PS Filter Capacitor discharges through permanently connected 200 Ω bleeder with 35 sec time constant
- There is considerable liquid helium boil-off, and recovery of cryo system may take 1-2 hours.

Solenoid Magnet Fast Dump/Discharge (Magnet Quench)

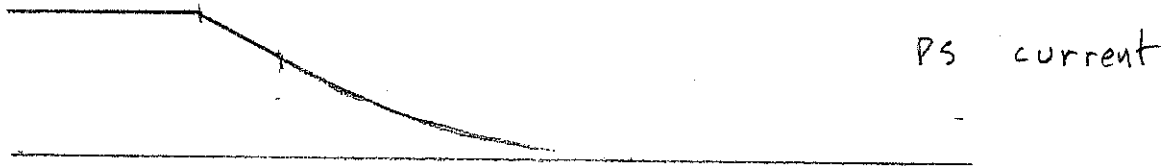
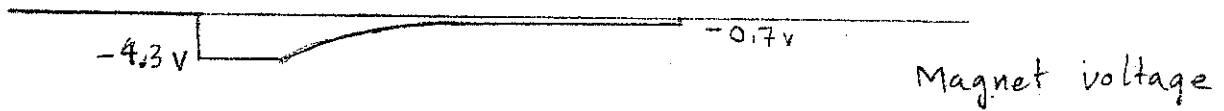
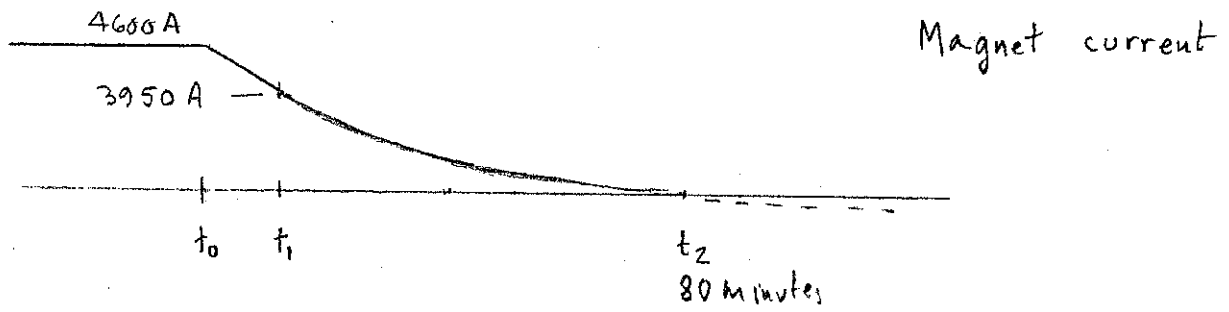


t_0 - P.S. contactor opens

t_1 - DC Breaker opens @ 34.4 min, when magnet current has reached an acceptable low limit (500 to 2000 A).

t_2 - Approximate time for current to reach zero if DC breaker is not opened (~ 76 min)

Solenoid Magnet Slow Discharge, followed by a Fast Dump



- t_0 - start of linear ramp down @ 100 A/min
- t_1 - current decay stops being linear after about 6-10 min
- t_2 - Approximate time for current to reach zero if DC breaker is not opened (> 80 min)

Solenoid Magnet Slow Discharge, rate limited

Bucking Coil Power Supply System Specifications

Power Supplies

Manufacturer Electronic Measurements Inc

Rating (each p.s.): 100 Volts DC, 150 Amperes, 15 KW
480 Volts AC 3 phase input

Specification: PS-340-250-01

Type: Off-line Switcher
Rack mounted

Configuration: 2 supplies in parallel (master/slave)
300 Amperes total current

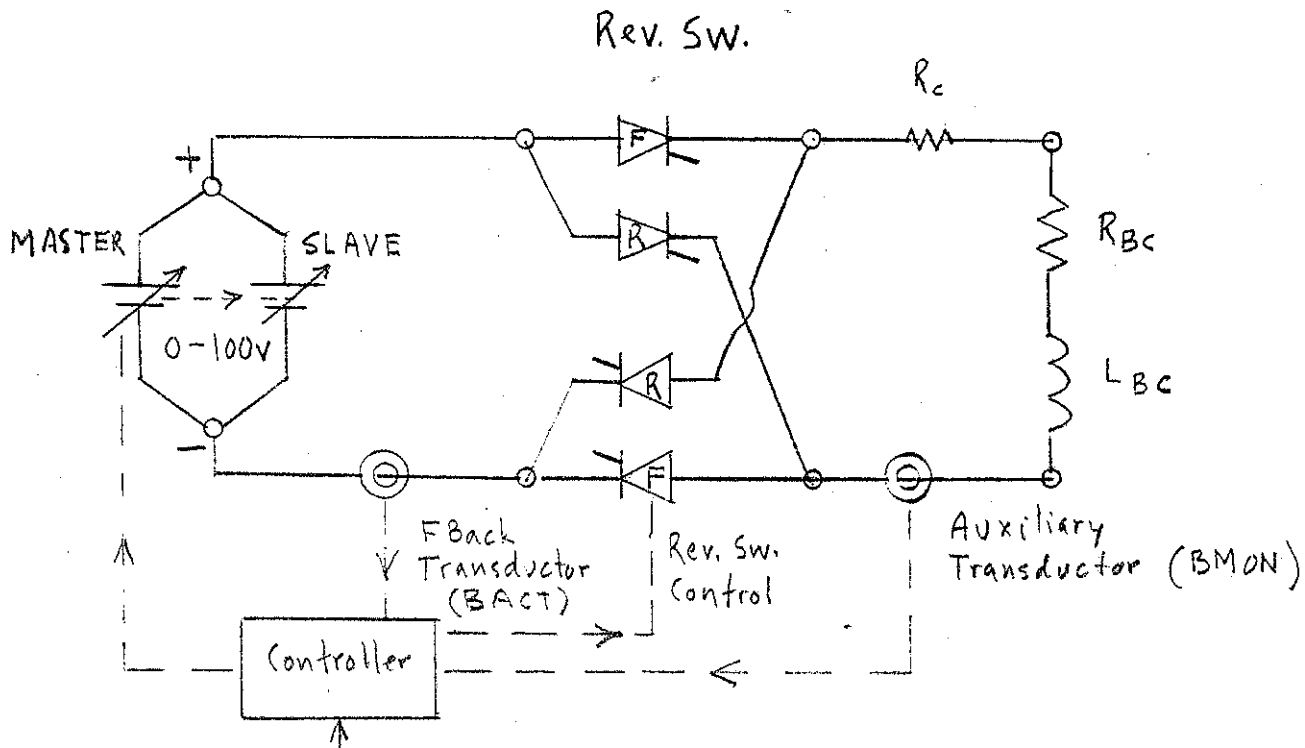
Cooling: Air (internal fans)

Location: Building 625, Rack CC11

Reversing Switch

Type: 4 SCR bridge

Cooling: LCW, ~1.0 gpm, ~30 psi
Protected with Klixon temperature switch



Current Setpoint (ramp) from SCP BaBar panel (LGPS-2)
 0 to +/- 300 Amp

Simplified BaBar Bucking Coil Power Supply Circuit

$L_{bc} = 0.66$ milliHenries	Bucking Coil inductance in air
$R_{bc} = 0.30$ Ohms	Bucking Coil resistance
$R_c = 6.4$ milliohms	DC cable resistance
$I_n = +200$ Amperes	Normal operating current
$I_dg = +/-300$ Amperes	Degaussing current in Solenoid

Notes:

- a) Reversing Switch is used only for Degaussing DIRC Standoff Box.
- b) Solenoid and Bucking Coil ramp "up" together, and will track each other.
- c) Solenoid and Bucking Coil do not track when running "down": Solenoid decays exponentially. Bucking coil runs down under control.

BaBar Bucking Coil External Power Supply Interlocks

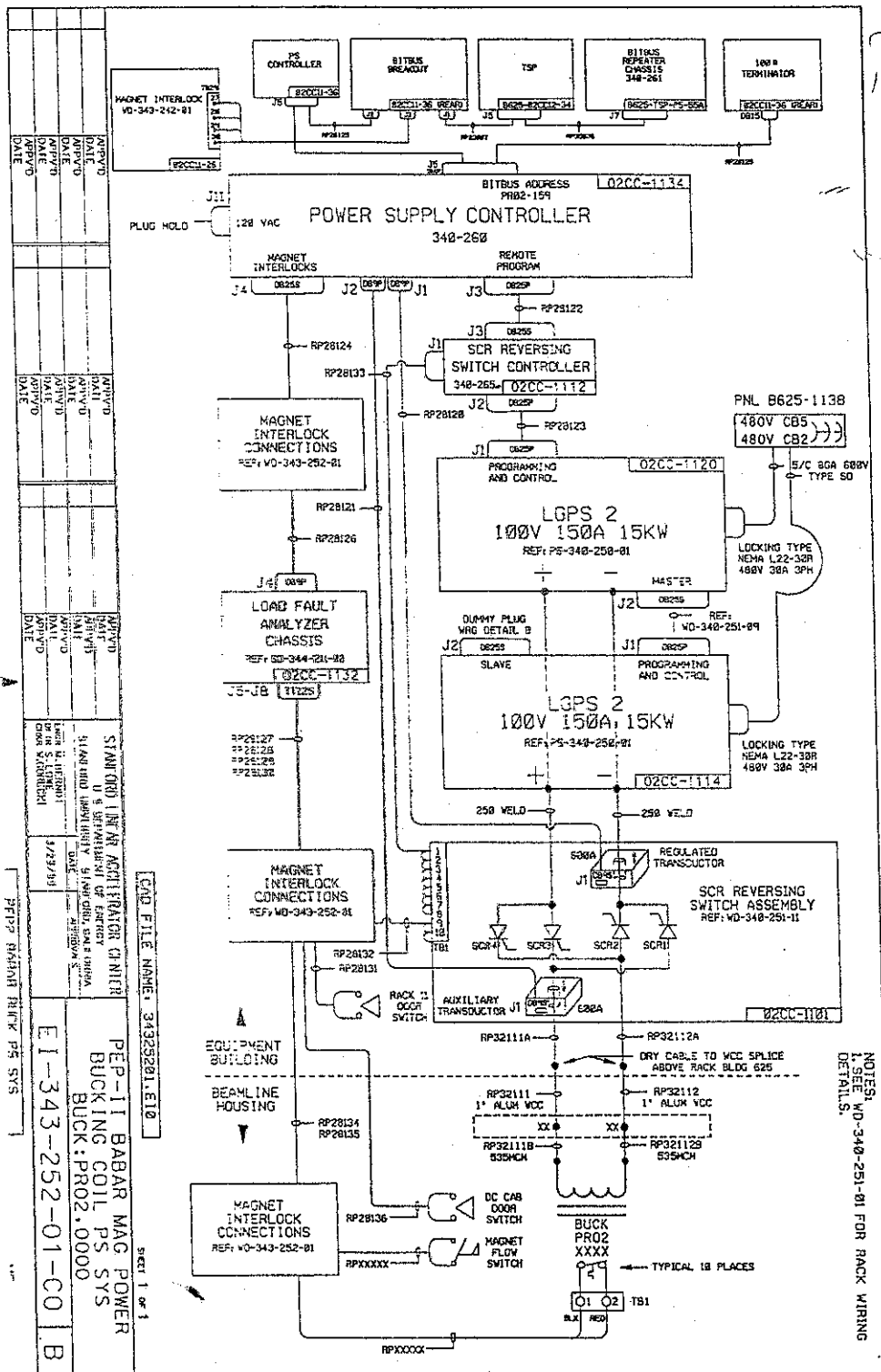
Connected directly into the Power Supply:

Nothing

Connected into the Power Supply Controller Chassis 340-260

Mag Fault 0	Klixons and LCW Flow Switch, using a Load Fault Analyzer Chassis 344-211: 10 Klixons on the Bucking Coil (IR Hall) 2 Klixons on the Reversing Switch (B625, Rack 11) 1 LCW flow switch for the Bucking Coil (IR Hall West wall) 1 Door switch on DC Cable Link Box (IR Hall West wall)
Mag Fault 1	Rack 11 rear cabinet door
Mag Fault 2	Not used
Mag Fault 3	Not used
Regulating Transducer (J1)	Transducer ahead of Reversing Switch
Auxiliary Transducer (J2)	Transducer at output of Reversing Switch

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DATE	APPROVED	DATE	APPROVED	DATE	APPROVED

CAD FILE NAME: 34329201.E10
SHEET 1 OF 1
PEP-II BABAR MAG POWER
BUCKING COIL PS SYS
BUCK:PRO2.0000
E1-343-252-01-C0 B
STANFORD UNIVERSITY
DEPARTMENT OF ENERGY
SLAC
SANTA BARBARA, CALIF. 93192
DATE: 3/29/93
BY: H. HARRIS
CHK: M. HARRIS

NOTES:
1. SEE WD-340-251-01 FOR RACK WIRING DETAILS.