POWER SYSTEMS
"LINEAGE"® 2000 RECTIFIER CIRCUIT
208/240/480 VOLT, 60HZ, 3 PHASE INPUT
24 OR 48 VOLT, 100 OR 200 AMPERE OUTPUT
J85503A&B

CHANGES

B Changes in Apparatus

B.1 Removed

C5 & C7 Capacitors, 97F5165AA6,35 GE Co - App Fig 6 & 8

C14 & C15 Capacitors, 97F5165AA6,35 GE Co - App Fig 11 & 13

C5,C7,C14 & C15 Capacitors; 97F5165AA6,35 GE Co - App Fig 12 & 14

Replaced by

C5 & C7 Capacitors 97F9250,35 GE Co - App Fig 6 & 8

C14 & C15 Capacitors, 97F9250,35 GE Co - App Fig 11 & 13

C5,C7,C14 & C15 Capacitors; 97F9250,35 GE Co - App Fig 12 & 14

D. Description of Changes

D.1 Information Note 303 has been changed to show Option ZU replacing Option ZG on a Class A basis. This change is only being applied to the J85503A (100A) rectifier.

D.2 Information Note 322 was added.

D.3 Capacitor changes were made (on a line out basis) as the 97F5165AA6, 35UF Capacitor has been discontinued by GE Co.

AT&T MICROELECTRONICS

POWER SYSTEMS
"LINEAGE" 2000 RECTIFIER CIRCUIT
208/240/480 VOLT, 60 Hz, 3 PHASE INPUT
24 OR 48 VOLT, 100 OR 200 AMPERE OUTPUT
J85503A AND B

CHANGES

B. Changes in Apparatus

B. 1 Added

CM2 Circuit Module, 208C, YC Option - App Fig 1

D. Description of Changes

D.1 Added a new CM2 - 208C Control Module (option YC) for use with the J85503B-1, L2, L16, List G (48V 200A) rectifier for battery-less operation. For all other applications for the J85503B rectifiers, the 208A Control Module (option YB) will still be used. Notes 302, 303, 310 and 318 were updated with this change.

D.2 Table A on sheet G1 was updated to show required connections of 200A rectifiers to a battery-less plant. Sheet Note 2 was added to Sheet G1.

D.3 Note 305 was revised to show correct taps for Option T (424V-508V line voltage range).

D.4 Option Index table was updated.

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J85503A AND B

CHANGES

B. Changes in Apparatus

B.1 Added

CR6 Diode D75N400B Mod 1 - App Fig 10, 16

CR7 Diode D75NR400B Mod 1 - App Fig 10, 16

Q1, Q2 Thyristor, Motorola MAC25A-10 - App Fig 1 - ZW Option

R3A.1, R3A.2, R3B, R3C, R3D Resistor KS-14603 L2AD, 430Ω - FS 1, App Fig 1 - ZV Option

R4A, R4B Resistor WP-90033 L1, 147Ω - FS 1, App Fig 11, 12, 13, 14 - ZY Option

B.2

Superseded	Superseded By
DS1, DS2 Diode 531D - FS 1, App Fig 1	DS1, DS2 Diode 531A - FS 1, App Fig 1
DS3 Diode 531E - FS 1, App Fig 1	DS3 Diode 531B - FS 1, App Fig 1
R6 Potentiometer, Bourns 3540S-701-102, 1 kΩ - FS 1, App Fig 1 - ZZ Option	R6 Potentiometer, Mepco/Copal M22S10, 1 kΩ - FS 1, App Fig 1 - YA Option

Superseded (Contd)	Superseded By (Contd)
R1 Resistor KS-8512 L8A, 200Ω - FS 1, App Fig 1 - ZX, V Options	R1 Resistor KS-8512 L13, 121Ω - FS 1, App Fig 1 - ZX, W Options

D. Description of Changes

D.1 New code D75N400B Mod 1 and See Note 1 have been added in App Fig 10 and 16 for diode CR6.

D.2 New code D75NR400B Mod 1 and See Note 1 have been added in App Fig 10 and 16 for diode CR7.

D.3 Sheet Note 1, regarding diodes CR6 and CR7, has been added on Sheet C4 on the drawing.

D.4 Motorola thyristor MAC25A-10 has been designated option ZW and added as an alternative for thyristors Q1 and Q2 in App Fig 1.

D.5 Resistors R3A through R3D for the filter capacitors have been designated option ZV and added in FS 1 and App Fig 1 on the drawing.

D.6 The R4A and R4B 147-ohm resistors (code WP-90033 L1) have been designated option ZY and added in FS 1 and, together with "See Note 8," in App Fig 11 through 14.

D.7 The code of light-emitting diodes DS1 and DS2 in App Fig 1 has been changed from 531D to 531A on a line-out basis.

D.8 The code of light-emitting diode DS3 in App Fig 1 has been changed from 531E to 531B on a line-out basis.

D.9 Potentiometer R6 has been changed by the addition of Mepco/Copal M22S10, designated option YA (AVAIL), and the Bourns 3540S-701-102 potentiometer has been designated option ZZ (DA).

D.10 Functional schematic FS 1 has been changed to show the CBA1 and CBA2 circuit breaker wire size to be 20 gauge.

D.11 Table A on the drawing has been changed by the removal of the reference to option ZA and by the addition of a reference to the 1125C inductor for use as L5 (options V and A) and as L4 (options W and A) in the 100-ampere rectifiers.

D.12 The remarks column for relay K1 in App Fig 5 through 14 has been changed by the addition of Sheet Note 7.

D.13 Sheet Note 7, regarding the preferred source for the K1 contactor used on the 200-ampere rectifiers, and Sheet Note 8, regarding resistors R4A and R4B, have been added on Sheet C3 on the drawing, and Sheet Note 6 has been corrected.

D.14 In Equipment Note 202, the L5 of KS-22247 has been changed to L4.

D.15 In Information Note 302, SPL has been removed from the output filter for 100-ampere output w/o end cell charging.

D.16 Information Note 303 has been changed by the addition of options ZV, ZY, YA, and YW [Available (AVAIL)] and by options ZX and ZZ [Discontinued Availability (DA)], and option D has been changed to Discontinued Availability (DA).

D.17 Information Note 308 has been changed by the addition of a table note regarding circuit breakers with the same ratings as the fuses.

D.18 Information Note 314 has been modified.

D.19 Information Note 320 has been completely changed.

D.20 The bay framework ground has been changed from 6 gauge wire to 4 gauge wire.

D.21 The Option Index table has been changed by the addition of options YA, ZV, ZW, ZX, ZY, and ZZ.

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J85503A&B

CHANGES

B. Changes in Apparatus

B.1

Superseded	Superseded By
R1 Resistor, KS-8512, L8A, 200, Option W - App Fig 1	R1 Resistor, KS-8512, L13, 121, Option W - App Fig 1
FA5 and FA6 Fuses, 70B, ZQ Option - FS1, App Fig 1	FA5 and FA6 Fuses, 70G, ZR Option - FS1, App Fig 1
CR2 to CR5 Diodes, KS-19404, L1 or 72HF20, IRC, Option ZK - App Fig 5 thru 8	CR2 to CR5 Diodes, KS-19404, L6B, Option ZL - App Fig 5 thru 8
CR2 to CR5 Diodes, 1N4047 or IN2057, Option ZK - App Fig 11 thru 14	CR2 to CR5 Diodes, WP-91147, L8BS, Option ZL - App Fig 11 thru 14
R10, R11 Resistors; WP-90033, L1, 100 ohms, Option ZM - App Fig 2	R10, R11 Resistors; KS-16311, L4F, 100 ohms, Option ZN - App Fig 2
R20 Resistor, KS-20616, L1A, 30.9K, Option ZM - App Fig 2	R20 Resistor, KS-16311, L4F, 30.9K, Option ZN - App Fig 2
R21 Resistor, KS-20616, L1A, 15K, Option ZM - App Fig 2	R21 Resistor, KS-16311, L4F, 15K, Option ZN - App Fig 2
R22 Resistor, KS-20616, L1A, 6.98K, Option ZM - App Fig 2	R22 Resistor, KS-16311, L4F, 6.98K, Option ZN - App Fig 2

T3 Transformer, 3245C, Option ZH - App Fig 11, 12	T3 Transformer, 3245F, Option ZU - App Fig 11, 12
T3 Transformer, 3245D, Option ZH - App Fig 13, 14	T3 Transformer, 3545G, Option ZU - App Fig 13, 14
P2 Connector, AMP 640456-8, Option ZO - App Fig 2	P2 Connector, AMP 102202-5, Option ZP - App Fig 2
P3 Connector, AMP 1-641126-4, Option ZO - App Fig 2	P3 Connector, AMP 1-102202-1, Option ZP - App Fig 2
P4 Connector, AMP 1-640456-5, Option ZO - App Fig 2	P4 Connector, AMP 1-102202-2, Option ZP - App Fig 2
P5 Connector, AMP 1-641126-2, Option ZO - App Fig 2	P5 Connector, AMP 102202-9, Option ZP - App Fig 2
J2 Connector, AMP 640440-8, Option ZO - App Fig 1	J2 Connector, AMP 102241-6, Option ZP - App Fig 1
J3 Connector, AMP 1-641190-4, Option ZO - App Fig 1	J3 Connector, AMP 1-102241-2 Option ZP - App Fig 1
J4 Connector, AMP 1-640440-5, Option ZO - App Fig 1	J4 Connector, AMP 1-102241-3, Option ZP - App Fig 1
J5 Connector, AMP 1-641190-2, Option ZO - App Fig 1	J5 Connector, AMP 1-102241-0, Option ZP - App Fig 1
J1B and J3A Connectors, AMP 1-640442-5, J, ZO Options - App Fig 3	J1B and J3A Connectors, AMP 1-640441-5, J, ZP Options - App Fig 3

B.2 Removed

CA3 Component Assembly, Option E - App Fig 4

D. Description of the Changes

D.1 The V+, V- fuses have been reduced from 2A to 1/2A. This will provide protection against damage in the rectifier when it is being operated improperly.

D.2 To improve the rectifier reliability under the EMP conditions, the CR2 to CR5 diodes have been changed.

D.3 To improve the accuracy of the CM3 Digital Meter, five resistors on CM1 option board have been changed.

D.4 To improve reliability, the P2 - P5 and J2 - J5 connectors have been changed on the 200-ampere rectifiers. The connectors designated with ZO option will remain STD for the 100-ampere rectifiers.

D.5 Added wire gauge for the W2 cable.

D.6 Note 303 updated for issue 5M.

D.7 To decrease the susceptability of the rectifier to RF fields, the shunt leads were shielded.

D.8 The R1 resistor was changed to more quickly discharge the output filter capacitors of the 48-volt rectifier.

D.9 Notes 312, 315 through 321 added, and Note 302 modified.

D.10 The CM3 Digital Meter was made standard for the 200-ampere rectifiers. The meter remains optional for the 100-ampere rectifiers.

D.11 The T3 local supply transformers were changed in the 200-ampere rectifiers.

D.12 E1 to E6 test points were added in the CM1 option board.

D.13 CAD3 was modified to increase the wire size of the 200A rectifier.

F. Changes in Description of Operation

F.1 In Section III, paragraph 3.01, add the following as the first sentence: "Only the 200-ampere rectifiers can be equipped for end cell (14 or 27 cells) charging by specifying option B."

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CHANGES

B. Changes in Apparatus

B.1 Removed	Replaced By
L3 Inductor, 1128A - App Fig 15 & 16	L3 Inductor, 1128C - App Fig 15&16, V Option L3 Inductor, 1128B - App Fig 16&15, W Option
L4 Inductor, 1128B, W Option - App Fig 16 L4 Inductor 1128A, V Option - App Fig 16	L4 Inductor, 1128C - App Fig 16
CR6 Diode 72HFR20 IR, W Option - App Fig 10 & 16	CR6 Diode WP91362, L2AR, W Option - App Fig 10 & 16
CR7 Diode, 72HF20 IR, W Option - App Fig 10 & 16	CR7 Diode, WP 91362, L2A, W Option - App Fig 10 & 16

D. Description of the Changes

D.1 To improve the output filtering of the 200-ampere rectifiers, the output inductors have been changed and their terminal designations have been added.

D.2 On the 200-ampere rectifiers the wiring from terminals 9, 10 of the T1, T2 transformers to the capacitors has been changed to 12 AWG.

D.3 The title was updated by addition of J85503B and LINEAGE® 2000.

D.4 The CR6 and CR7 diodes have been beefed up.

D.5 The sync leads of the T1, T2 transformers of the 200-ampere rectifiers have been shielded.

D.6 Note 205 has been modified.

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RECTIFIER CIRCUIT
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B. Changes in Apparatus

B.1 Superseded	Superseded By
CR2 thru CR5 Diodes, 72HF20, IR, Option P - App Fig 5 thru 8	CR2 thru CR5 Diodes, KS-19404, L1, Option G - App Fig 5 thru 8
K1 Relay, 425CXX106, Options ZB, S - App Fig 5, 6 K1 Relay, 425CXX107, Options ZB, Q - App Fig 5, 6	K1 Relay, ACC-330-8089C, Arrow-Hart, Option ZC - App Fig 5, 6
K1 Relay, 425CXX108, Option ZB - App Fig 7, 8	K1 Relay, ACC-330-8089D, Arrow-Hart, Option ZC - App Fig 7, 8
R16 & R18 Resistors, WP-90020,L1, 6.2K, ZD Option - App Fig 2 (CM1)	R16 & R18 Resistors, KS-20616,L1A 6.19K, ZE Option - App Fig 2 (CM1)
R20 Resistor, KS-20616,L1A 6.98, R Option - App Fig 2 (CM1)	R20 Resistor, KS-20616,L1A 30.9K, N Option - App Fig 2 (CM1)
R22 Resistor, KS-20616,. L1A 30.9K, N Option - App Fig 2 (CM1)	R22 Resistor, KS-20616, L1A 6.98K, R Option - App Fig 2 (CM1)
T3 Transformer, 3245A, ZG Option - App Fig 5, 6, 11, 12	T3 Transformer, 3245C, ZH Option - App Fig 5, 6, 11, 12

K1 Relay ACC-630-8060C, Arrow-Hart, Option ZI - App Fig 12	K1 Relay ACC 430-8076C, Arrow-Hart, Option ZJ - App Fig 12
T3 Transformer, 3245B, ZG Option - App Fig 7, 8, 13, 14	T3 Transformer, 3245D, ZH Option - App Fig 7, 8, 13, 14

B.2 Added

C6 & C8 Capacitors, WP-90004, L15, .022, ZF Option - App Fig 13, 14

D. Description of Changes

D.1 To improve balance of the circuit, resistors R16 and R18 were replaced with resistors of a tighter tolerance.

D.2 To reduce noise caused by diode turnoff, the CR2 through CR5 diodes have been changed in the 100-ampere rectifier.

D.3 Information Note 303 has been updated for issue 3B.

D.4 To reduce costs, the K1 line contactors have been replaced in 100-ampere rectifiers.

D.5 Sheet Note 5 was added to sheet C3.

D.6 Option Index was updated.

D.7 In CAD3, information for options F and N was changed.

D.8 Capacitors C6 and C8 were added to improve the noise immunity of triacs Q1 and Q2.

D.9 Transformers T3 (3245A, B) were replaced with UL approved transformers, 3245C and D.

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CHANGES

A. Changed and Added Functions

A.1 A shutdown without lockout is provided if the input power is unsatisfactory (CM2 - 208A, Series 3 and higher).

A.2 A shutdown with lockout is provided, after a 5-second delay, if the two transformers of the rectifier fail to share the load in a balanced manner (CM2 - 208A, Series 3 and higher).

B. Changes in Apparatus

B.1 Removed	Replaced By
K1 Relay, 2200EB230BA-6-9, Gould - App Fig 11	K1 Relay, ACC430-8070C Arrow-Hart - App Fig 11
K1 Relay, 2200EB430BA-6-9, Gould - App Fig 12	K1 Relay, ACC630-8030C, Arrow-Hart - App Fig 12
K1 Relay, 2200EB230VA-6-9, Gould - App Fig 13	K1 Relay, ACC430-8070D, Arrow-Hart - App Fig 13
K1 Relay, 2200EB430VA-6-9, Gould - App Fig 14	K1 Relay, ACC430-8070D, Arrow-Hart - App Fig 14
K3 Relay, KS-21401, L3, T Option - App Fig 1	K3 Relay, KUP3D5K24 Potter & Brumfield, T Option - App Fig 1

Q1 & Q2 Thyristors, SC260M2X357, GE, N, U Options - App Fig 1	Q1 & Q2 Thyristors, MAC25-10, Motorola, F, N, D Options - App Fig 1
C5 and C7 Capacitors, 97F3251, 50, GECo - App Fig 5, 7	C5 and C7 Capacitors, 97F5151AA6, 50, GECo - App Fig 5, 7
C5 and C7 Capacitors, 97F3136, 35, GECo - App Fig 6, 8	C5 and C7 Capacitors, 97F5165AA6, 35, GECo - App Fig 6, 8
C5 and C7 Capacitors, 97F3150, 50, GECo - App Fig 11, 13	C5 and C7 Capacitors, 97F5151AA6, 35, GECo - App Fig 11, 13
C14 and C15 Capacitors, 97F3136, 35,GECo - App Fig 11, 13	C14 and C15 Capacitors, 97F5165AA6, 35, GECo - App Fig 11, 13
C5, C7, C14, C15 Capacitors; 97F3209, 35, GECo - App Fig 12, 14	C5, C7, C14, C15 Capacitors; 97F5205AA6, 35, GECo - App Fig 12, 14
CR2, CR3, CR4, CR5 Diodes; KS-19404, L1 - App Fig 11 thru 14	CR2, CR3, CR4, CR5 Diodes; IN2057 or IN4047 - App Fig 11 thru 14
L1 and L2 Inductors, 1373A - App Fig 12, 14	L1 and L2 Inductors, 1373B - App Fig 12, 14
F1 Fuse, KS-19790, L3, 30A - App Fig 9, 10, 15, 16	F1 Fuse, KS-19780, L6, 30A - App Fig 9, 10, 15, 16
F2 Fuse, KS-19790, L3, 30A - W Option - App Fig 10	F2 Fuse, KS-19780, L6, 30A - App Fig 10
F3 Fuse, KS-19790, L3, 30A - W Option - App Fig 9, 10, 15, 16	F3 Fuse, KS-19780, L6, 30A - W Option - App Fig 9, 10, 15, 16
F4 Fuse, KS-19790, L3, 30A - V Option - App Fig 16	F4 Fuse, KS-19780, L6, 30A - V Option - App Fig 16
FA2 Fuse, 70G, W Option - App Fig 10	FA2 Fuse, 70G - App Fig 10

B2. Added

R2 Resistor, KS-20084, L9A, 16K,
Q, S Options - App Fig 1

R2 Resistor, KS-20084, L9A, 33K
T Option - App Fig 1

C2 Capacitor KS-20133, L114, V Option - App Fig 10

L5 Inductor, 1125C, Option V - App Fig 10

L4 Inductor, 1128B, Option W - App Fig 16

B.3 Removed

F4 Fuse, KS-19790, L3, 30A - App Fig 10

FA4 Fuse, 70G, V Option - App Fig 10

L4 Inductor, 1125C, V Option - App Fig 10

C4 Capacitor, KS-20133, L114, V Option - App Fig 10

L4 Inductor, 1128A, Option W - App Fig 16

D. Description of Changes

D.1 To improve efficiency, the K1 line contactors and CR2 to CR5 diodes have been changed in the 200 ampere rectifiers.

D.2 To reduce ripple at the output, the C5, C7, C14, and C15 capacitors have been changed, on a line-out basis, to capacitors of tighter tolerance.

D.3 The codes of the L1 and L2 inductors have been changed.

D.4 To reduce costs and improve manufacturability, the Q1 and Q2 thyristors have been changed on the 200-ampere rectifier.

D.5 Notes 4 and 5 have been added on Sheet C3.

D.6 Information Notes 304 and 308 have been modified.

D.7 To correct an instability problem on the 24V-100A rectifier with a SPL output filter, the output filter was rearranged by removing the C4 capacitor and the L4 inductor and adding the C2 capacitor and L5 inductor.

D.8 Information Note 302 revised by addition of 400 Ampere Output information.

D.9 The reference designations R20 and R21 were interchanged on the FS2 option board.

D.10 Relay K3 was replaced with a smaller, UL recognized relay.

D.11 Resistor R2 was added to provide loading for transformer T3 and thereby eliminating erractic action of the K1 line contactor when one input phase fails.

F. Changes in Description of Operation

F.1 Change paragraph 3.17 of SECTION III to read "(CM2- 208A, Series 3 and higher) Provides a shutdown without lockout and local (PH) and remote alarms

(a) if one input phase is lost

(b) if the line voltage drops to 70 percent of the nominal."

F.2 Change SECTION III to add "3.20 (CM2 - 208A, Series 3 and higher) Shuts down and locks out after a 5-second delay if an imbalance develops in operation of the rectifier so that the two transformers do not share the load equally."

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TABLE OF CONTENTS

SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This circuit charges and floats storage batteries by providing regulated dc power from an ac source.

1.02 The 3-phase, 2-transformer Scott-T connected ferroresonant rectifier converts an ac input voltage into a filtered and regulated dc output voltage of 24 or 48 volts of either polarity at any current between zero and the rated output current.

2. GENERAL DESCRIPTION OF OPERATION

RECTIFIER CIRCUIT

2.01 The Scott-T connected rectifier consists of two ferroresonant transformers, four rectifying diodes, dc filter capacitors, and a filter inductor. The dc output is obtained by paralleling the outputs of the transformers after the outputs pass through a full-wave rectifier. The output filter attenuates the ripple voltage to the required value.

FERROCONTROL CIRCUITS

2.02 The ferrocontrol circuit--one per ferroresonant transformer--consists of an ac capacitor, an ac inductor, a triac, a triac firing circuit, and an error amplifier which is common to both transformers. The switching action of the triac simulates saturation of the transformer at flux levels below magnetic saturation and thereby controls the output voltage of the transformer. The error amplifier senses the rectifier's output voltage and compares it to a reference. The difference between the output voltage and reference voltage is the error voltage. The error voltage is amplified and compared with a synchronizing signal obtained from the secondary winding of the transformer. The comparator output signal fires the triac sooner or later in the half cycle depending on the magnitude of the error voltage. The sensed output voltage is thereby regulated for changes in load, line voltage and frequency, and temperature.

AUXILIARY POWER SUPPLY

2.03 The auxiliary power supply consists of a conventional 3-phase transformer, rectifying diodes, filter capacitors, and series transistor regulators. It furnishes plus and minus 12 volts to power the control circuits and +27 volts to energize the relays for the alarm circuits.

PLUS AND MINUS 5 VOLT SUPPLIES

2.04 The plus and minus 5 volt supplies (derived from the regulated plus and minus 12 volt supplies) consist of positive and negative 3-terminal series voltage regulators and filter capacitors.

CURRENT LIMIT CIRCUIT

2.05 The current limit circuit limits the output of the rectifier under overcurrent conditions. This circuit consists of an operational amplifier, a zener diode, and a potentiometer. When the output current increases above a set limit, the operational amplifier overrides the voltage regulating error voltage (2.02) and decreases the output voltage of the rectifier.

WALK-IN CIRCUIT

2.06 This circuit consists of an RC network which controls the ramping-up of the rectifier after the power switch has been turned ON. The walk-in circuit is reset each time the K1 input contactor of the rectifier releases.

HIGH-VOLTAGE SHUTDOWN CIRCUIT

2.07 Two separate high-voltage shutdown circuits are provided. The first circuit, called selective, selectively accepts a high-voltage signal from the plant. The second circuit, called internal or back-up, senses the output voltage of the rectifier, and when this voltage exceeds the specified value, shuts the rectifier off. Operation of the selective high-voltage shutdown circuit depends on two conditions: first, that the rectifier is delivering at least five percent of its rated output current, and second, that the rectifier receives a high-voltage shutdown signal from the plant.

REMOTE SHUTDOWN CIRCUIT

2.08 This circuit consists of a relay and a current limiting resistor. The presence of the ground signal on the relay coil shuts the rectifier off and its absence allows the rectifier to restart.

PHASE MONITOR CIRCUIT

2.09 The phase monitor circuit issues an alarm when one of the ac input phase voltages has decreased 20 percent from the nominal value. If the C input phase is completely missing, the phase monitor circuit will issue an alarm. If either A or B phase is missing, the K1 input contactor will release and the rectifier will shut down. The phase monitor circuit monitors each phase separately by rectifying, filtering and attenuating the three secondary winding voltages of auxiliary transformer T3. Each secondary winding voltage is fed to a comparator and compared with the reference voltage. When any ac input phase voltage decreases to an unacceptable level, the output of the comparator activates the phase alarm.

UNBALANCE ALARM CIRCUIT

2.10 The unbalance alarm circuit issues an alarm if a severe unbalance develops, for example, if either triac becomes shorted. This circuit (one for each ferroresonant transformer) rectifies the secondary winding voltages from the ferroresonant transformers and filters them. Normally, the voltages across the filter capacitors are equal but opposite in polarities so that the net voltage across them is zero. When a triac shorts, the voltage difference between the capacitors cause the zeners to conduct current, which turns on an opto-isolator. The operation of the opto-isolator activates the phase monitor circuit.

FUSE ALARM CIRCUITS

2.11 Each capacitor in the output filter capacitor bank C1 to C8 is guarded by a main fuse and an alarm fuse. The internal V+ and V- are also guarded by alarm fuses. When either of the fuse alarm circuits operates, it activates the RFA relay, which shuts the rectifier down.

RESTART CIRCUIT

2.12 The restart circuit restarts the rectifier by means of an external signal. The restart circuit is a one-shot multivibrator that switches states when the restart signal is applied. The multivibrator output turns off the transistor that holds the RFA relay on. Then the rectifier restarts and stays on if the original cause of the shutdown has been cleared. The rectifier will try to restart once for each application of the external restart signal.

DIGITAL METER CIRCUIT

2.13 The CM3 digital meter circuit pack, J option, displays the rectifier's output current, output voltage, or battery voltage, selected by a 3-position switch.

CONTROL BOARD

2.14 The circuits listed below are located on the CM2 circuit pack, 20A Control

Board circuit module.

(a) Local power supplies

(b) Feedback regulator, ferrocontrol

(c) Walk-in circuit

(d) Current limit circuit

(e) High voltage shutdown circuits

(f) Remote shutdown circuit

(g) Restart circuit

(h) Phase monitor circuit

(i) Unbalance alarm circuit

(j) Fuse alarm circuit

(k) Isolated current measuring circuit

2.15 The FS2, CM1 Option Board serves as an interface between the CM2 and CM3 circuit packs and the cabinet-mounted components. It also contains certain optional components and all wiring straps of the rectifier. The CM1 Option Board is manufactured with all optional resistors and straps in place. Superfluous straps and resistors must be removed before the rectifier is placed in service.

SECTION II - DETAILED DESCRIPTION

1. RECTIFIER CIRCUIT

1.01 Ferroresonant transformers T1 and T2 isolate the output of the rectifier from the ac input source and provide the required voltage level at the output terminals. The primary windings of T1 and T2 are connected to the ac input source through make-contacts L1-T1, L2-T2, and L3-T3 of input contactor K1.

1.02 The primary windings of T1 and T2 are connected to the ac input source in a Scott-T configuration. The Scott-T configuration facilitates a balanced loading of a three-phase system by means of only two transformers. The T1 output winding is connected to CR2 and CR3, and the T2 output winding is connected to CR4 and CR5.

1.03 The parallel combined outputs of the full-wave, center-tap rectifiers are filtered by the L3 inductor and C1, C2, and C3 capacitors: This is the standard LC filter, Option A, for the normal telephone applications. If additional filtering is desired, the L4 inductor (ZA Option) can be ordered. With the C3 capacitor relocated to the C4 position, the ZA Option provides an LCLC filter.

1.04 The total output current passes through the R2 shunt which provides a signal for the output current meter. If the rectifier is not equipped with a meter, the output current can be measured with an external dc millivoltmeter connected to the shunt terminals. Bleeder resistor R1 discharges the output filter capacitors when the rectifier is turned off and disconnected from the battery.

1.05 Turning the S1 POWER switch ON applies power to the rectifier circuit. The switch closure operates the K2 and K3 (T option) relays from the +27V auxiliary supply on the CM2 circuit pack. The +27V supply is routed to terminal A of K2 relay through the S1 switch. Connector J2's terminal 9 connects to the ground of the +27V supply through break-contact 9-10 of the TR relay and break-contact 7-8 of the RFA2 relay on CM2. The CR1 diode on the CM1 Option Board suppresses the transient voltage across the coils of the K2 and K3 relays.

1.06 When K2 operates, its make-contacts 6 and 7 close and connect the ac input voltage across the coil of input contactor K1. When K1 operates, it connects the primary windings of transformers T1 and T2 to the ac input source through its make contacts L1-T1, L2-T2, and L3-T3. With the T option, the K3 relay connects the ac line to the coil of K1 in a similar manner.

1.07 The DS2 POWER light emitting diode (LED), in series with the R23 current limiting resistor on the FS2 Option Board, is in parallel with K2's coil. Therefore, the POWER light is on whenever the K1 contactor is closed and ac line voltage is applied to the primaries of the T1 and T2 transformers.

1.08 The S2 RECT TEST switch is used for checking the rectifier's ability to regulate. When the switch is moved to the NL position, the output of the rectifier should decrease. In the FL position, the output should increase.

1.09 The T3 transformer is the source of the rectifier's internal power supplies. The transformer also provides signals for the phase monitoring circuit of the rectifier. An unbalance in phase voltages results in lighting of the DS2 PH LED and in a closure on the PH lead on the J2A plant connector.

1.10 The 6-8 contacts of the K2 relay interrupt the power to the Digital Meter when the rectifier is off.

2. FERROCONTROL CIRCUITS

2.01 An ordinary ferroresonant transformer is capable of regulating its output voltage to a fixed value, thus compensating

for line and load variations. A controlled ferroresonant transformer provides a regulated output voltage that is controllable. Control is achieved by means of the ferrocontrol circuit.

2.02 The control circuit for the T1 ferroresonant transformer consists of capacitors C5 and 15, inductor L1, and triac Q1 (bidirectional thyristor). When Q1 turns on, L1 is paralleled with C5-C15. The resulting resonant discharge reverses the capacitor voltage. This action simulates saturation of the T1 transformer and thereby limits its output voltage. By varying the timing of Q1's gate pulses and therefore the timing of its turn-on, the T1 output voltage can be controlled. The gate pulses are generated in the CM2 circuit pack and controlled by the feedback amplifier.

2.03 The C2.1 capacitor and R1.1 resistor on CA1 component assembly form a snubber network across Q1 to reduce the rate of rise of voltage when Q1 turns off. The C1.1 capacitor suppresses noise at the gate of the triac. The C3.1 capacitor reduces RF emissions of the rectifier. The control circuit of the T2 transformer is exactly the same as that of T1.

2.04 Terminals 11 and 12 of the T1 and T2 transformers furnish a voltage used to synchronize the triac gate pulses with the voltage developed by the transformers. Terminals 13 and 14 of the transformers furnish a voltage used to develop an alarm signal if the two transformers are operating in an unbalanced mode, for example, as a result of a triac failure.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Ambient Temperature
Normal: 40 to 100°F
Short Term: 35° to 120°F
(Short term refers to a period of less than 72 consecutive hours and a total of less than 15 days in one year.)

1.02 Relative Humidity

10 percent through 90 percent, non condensing

1.03 Input Requirements

Phases: 3 phase, 3 wire, no neutral

Frequency: 57 through 63 Hertz

Line-to-Line voltage:

Nominal	Allowable Limits
208	194 through 220 Option S
240	212 through 254 Option D
480	424 through 508 Option T

Fusing and Wire Size:

Refer to Note 308 on SD-82605-01-02.

1.04 Output

The output voltage is adjustable as follows:

Option	Full Load	Max at No Load
W	43 to 56 volts	60 volts
Y	21.5 to 28 volts	30 volts

Voltage regulation is ±1/2 percent for line, load, and temperature changes.

1.05 Electrical Noise

Electrical noise, when measured at the terminals of a battery which has an ampere-hour capacity of four times the rectifier rating, is as follows:

Standard Filter, A Option	55 dbRNC
32 dbRNC Filter, ZA Option	32 dbRNC

1.06 Radio Frequency Interference

The rectifier meets FCC Part 15J requirements for class A equipment.

2. FUNCTIONAL DESIGNATIONS

2.01 Circuit Breaker

Designation	Meaning
CBA1	Output circuit breaker

2.02 Relays

Designation	Meaning
PH	Phase failure
RFA1, RFA2	Rectifier Failure; Shutdown and lock out of operation due to a high-voltage condition; a connector not mating properly, fuse has operated
K1	Contactor for supplying ac input power
K2, K3	Relays to operate main contactor
TR	Remote shutdown

2.03 Switches

Designation	Meaning
POWER	Main power switch OFF-ON
RECT TEST	No-Load, Full-Load regulation test switch
RECT V/AMPS/ BATT V	Output current, output voltage, and battery voltage selector.

3. FUNCTIONS

3.01 Charges and floats lead-acid batteries at 2.17 volts per cell with an up to 2-volt battery feeder loop drop, and with the following number of cells.

(a) 12 cells, Options V and K

(b) 13 or 14 cells, Option V

(c) 24 cells, Options W and M

(d) 25 or 27 cells, Option W

3.02 Provides for connections to a

(a) Conventional power plant

(b) LINEAGE™ 2000 MCS power plant

3.03 Provides for manually turning the rectifier on or off by operating the POWER switch.

3.04 Provides the POWER light to indicate that the K1 line contactor is closed and that the ac line is applied to the transformers. Provides for manually setting the output voltage by means of the OUTPUT VOLTS ADJ potentiometer.

3.05 Increases its output current gradually at turn-on.

3.06 Limits its output current

(a) inherently to approximately 125% of full load if the output is shorted.

(b) electronically to an adjustable 90 to 110% of full load.

3.07 Provides the RECT TEST switch for testing that the feedback regulator is working.

3.08 Provides the REG+, REG- test jacks for observing the output voltage at the point of regulation

3.09 Provides two levels of metering

(a) Digital meter, Option J, for measuring

(1) Output current at 2 percent initial accuracy

(2) Output voltage at 1 percent initial accuracy

(3) Battery voltage at 1 percent initial accuracy

(b) No meter provided. The output current is measured with an external millivoltmeter connected across the RJ shunt or read at the LINEAGE™ 2000 MCS display.

3.10 Transfers automatically to internal voltage sensing if an external sensing lead, R+ or R-, opens.

3.11 Shuts down and locks out on high voltage if

(a) the rectifier is delivering output current and receives a high-voltage shutdown signal from the plant. This is called the selective high-voltage shutdown.

(b) the output voltage increases to

(1) 29.9 volts, Options V & K

(2) 57.8 volts, Option V

(3) 59.9 volts, Options W & M

(4) 65.9 volts, Option W.

This is called the backup high-voltage shutdown.

3.12 Shuts down and locks out if a fuse fails.

3.13 Provides for shutting down the rectifier remotely.

3.14 Provides for restarting the rectifier remotely.

3.15 Provides for visual and remote indications of rectifier failure.

3.16 Provides isolation between the rectifier input and output.

3.17 Provides an output circuit breaker which closes its alarm terminals when the breaker has tripped.

3.18 Provides local (PM) and remote alarms

(a) if one of the input phases is lost

(b) if a triac fails.

3.19 Interfaces directly with both conventional and LINEAGE™ 2000 MCS battery plants.

4. CONNECTING CIRCUITS

4.01 Connecting circuit information can be found in the Equipment Design Requirements Practice (802 - Series) of the specific plant.

4.02 SD-82589-01 LINEAGE™ 2000 MCS Controller

SD-82603-01 LINEAGE™ 2000 Charge and Discharge Circuit.

5. TAKING EQUIPMENT OUT OF SERVICE

5.01 To take the rectifier out of service move the CBA1 circuit breaker to OFF, remove the ac input fuses, and disconnect the J2A connector.