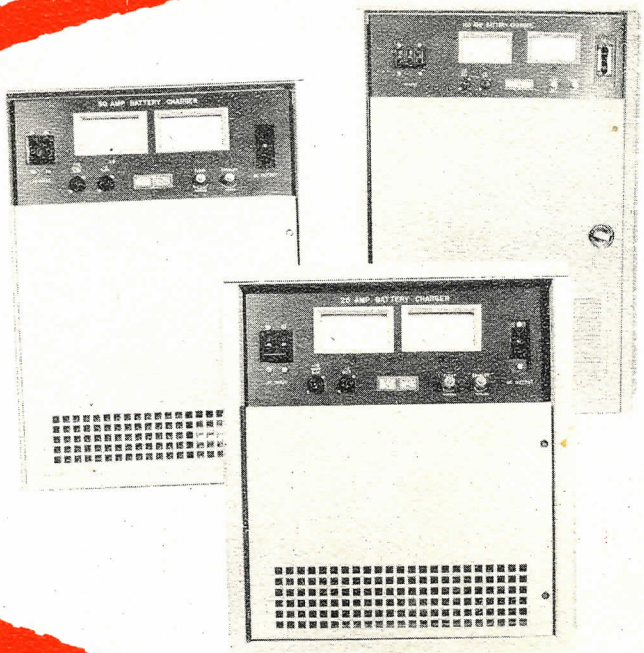
CONTROLLED FERRORESONANT BATTERY CHARGERS

3616AE
3616
3617AE ⇦
3617 ⇦
3618AE
3618



INSTRUCTION MANUAL

NORTH ELECTRIC COMPANY
ELECTRONETICS DIVISION
GALION, OHIO 44833 / PHONE (419) 468-8100
A United Telecommunications Company

INSTRUCTION MANUAL
FOR
PEC 3616AE
PEC 3616
PEC 3617AE
PEC 3617
PEC 3618AE
PEC 3618

NORTH ELECTRIC COMPANY
ELECTRONETICS DIVISION
GALION, OHIO 44833
TELEPHONE: 419/468-8100

8500050

TABLE OF CONTENTS

SPECIFICATION

1.1 General: The PEC 3616AE, 3616, 3617, 3618 are designed to float or equalize telephone lead acid batteries.

1.2 Output Ratings

1.2.1 Voltage: A switch selects float or equalize modes of operation and adjust potentiometers are provided to make adjustment for separate voltages.

A. Float adjust: 48 to 54 VDC.

B. Equalize Adjust: 0 to 7 VDC above float (not to exceed total output).

C. Total output: 48 to 57 VDC.

D. Maximum output 48 to 58 VDC (for end cell charging).

1.2.2 Regulation

A. Output voltage will remain within ± 1/2% for all A.C. input and output load conditions.

1.2.3 Output Noise: (Measured on battery with an AH rating of four (4) times the charger's rated output).

A. Voice Band: Maximum of 32 dbrn, C-message weighting.

B. Wide Band: Maximum of 200 MV peak to peak (10 Hz to 14 MHz).

1.2.4 Output Current

PEC 3616AE	PEC 3616	PEC 3617	PEC 3618
25 Amps	30 Amps	50 Amps	100 Amps

1.3 Input Ratings

1.3.1 Voltage: Nominal 105/240 volts, single phase, 57 to 63 Hz with taps provided for input voltage of 105, 120, 210, and 240 VAC with a variation of ± 10% from nominal tap voltage.

1.3.2 Input Data:

A. At 50.00 D.C. Volt Output

PEC 3616AE (48 V @ 25 A)

Voltage & Tap	Load	A.C. Amperes	Watts	VA	VAR	Efficiency
120	No Load	1.80	110	---	---	----
	Half Load	6.76	780	811	223	80.3%
	Full Load	13.00	1470	1570	551	85.4%
240	No Load	1.50	140	---	---	----
	Half Load	3.38	780	812	226	80.3%
	Full Load	6.55	1470	1572	557	84.6%

PEC 3616 (48 V @ 30 A)

Voltage & Tap	Load	A.C. Amperes	Watts	VA	VAR	Efficiency
120	No Load	2.00	120	---	---	----
	Half Load	7.88	920	946	220	81.7%
	Full Load	16.80	1752	2016	997	85.9%
240	No Load	1.60	145	---	---	----
	Half Load	3.94	920	946	220	81.1%
	Full Load	8.40	1752	2016	997	85.9%

PEC 3617 (48 V @ 50 A)

Voltage & Tap	Load	A.C. Amperes	Watts	VA	VAR	Efficiency
120	No Load	3.55	150	---	---	----
	Half Load	12.9	1500	1548	348	84.0%
	Full Load	26.0	2900	3120	1151	86.8%
240	No Load	3.80	120	---	---	----
	Half Load	6.49	1500	1558	421	84.0%
	Full Load	13.00	2900	3120	1151	86.8%

PEC 3618 (48 V @ 100 A)

Voltage & Tap	Load	A.C. Amperes	Watts	VA	VAR	Efficiency
120	No Load	10.00	220	---	---	----
	Half Load	24.0	2880	3000	840	85.9%
	Full Load	52.0	5610	6240	2733	89.8%
240	No Load	5.0	230	---	---	----
	Half Load	12.5	2880	3000	840	85.9%
	Full Load	26.0	5610	6240	2733	89.8%

B. Breaker current rating on low/high voltage taps.

Input Voltage	PEC 3616AE	PEC 3616	PEC 3617	PEC 3618
105/120 210/240	24.0 Amp 12.0 Amp	24.0 Amp 12.0 Amp	50.0 25.0	100.0 50.0

1.3.3 Noise Level (TIF*)

A.

Input Voltage	PEC 3616AE	PEC 3616	PEC 3617	PEC 3618
99-132 187-257	139 85	140 85	200 100	450 225

* Values are typical measurements at 50.0 VDC and full load output with nominal A.C. input. TIF is an IT product measurement.

1.4 Standard Features:

1.4.1 Rectification System: Controlled ferroresonant with silicon diode rectification.

1.4.2 Input Protection: A double pole circuit breaker capable of carrying input current has the poles in series with A.C. input line on the high volt taps and the same poles are paralleled with the input line for low volt taps.

1.4.3 Output Protection:

A. Current limiting: Output current is limited to 110% of full rated output.

B. Short circuit: D.C. output current is limited when current limiting fails by an output circuit breaker (CB2).

C. Overvoltage: Charger will shutdown if output voltage reaches 56.00 VDC (factory setting).

1.4.4 Remote Voltage Sensing: Sense leads may be connected to batteries for optimum regulation.

1.4.5 Alarm Indication:

A. Any time the charger is shut down due to an abnormal condition a signal will be sent to office, and RFA/CFA alarm lamp will light.

B. When the charger is under a low current condition (factory set .5 amp) RFA/CFA lamp will light.

1.4.6 Positive or Negative Load Sharing: A circuit is provided so that charger can proportionally share load with the largest charger in string within ±5%.

1.4.7 Current Walk-In: Upon initial turn on of charger the output current will gradually increase to output load.

1.4.8 Meters:

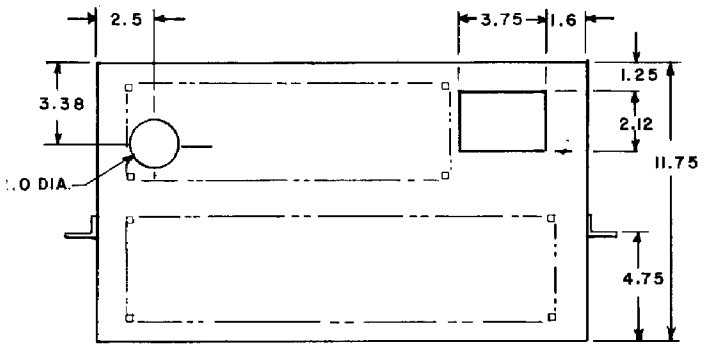
A. Output volt and ammeter is within ± 2% accuracy full scale.

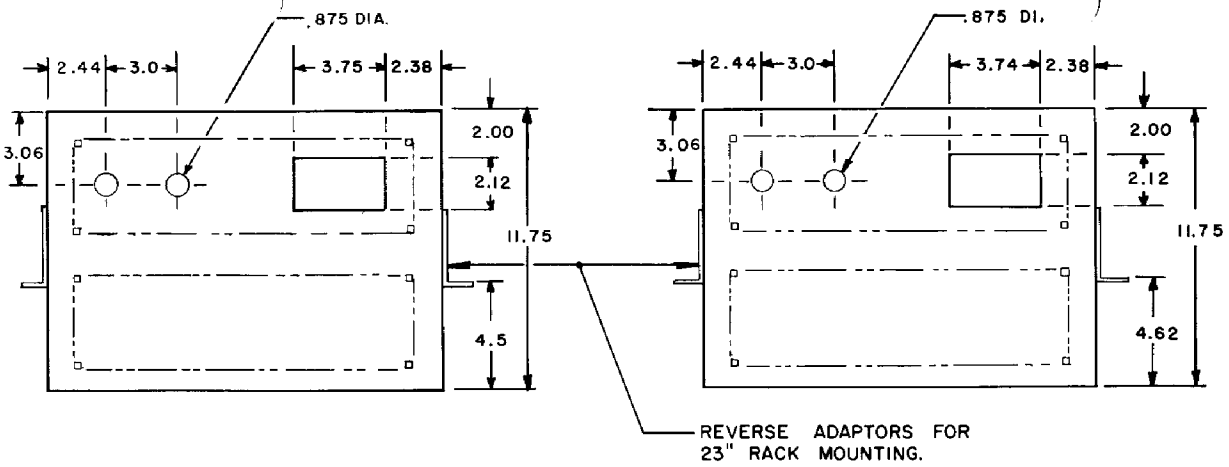
1.4.9 Mounting: Charger can be mounted in either a 19 or 23" rack.

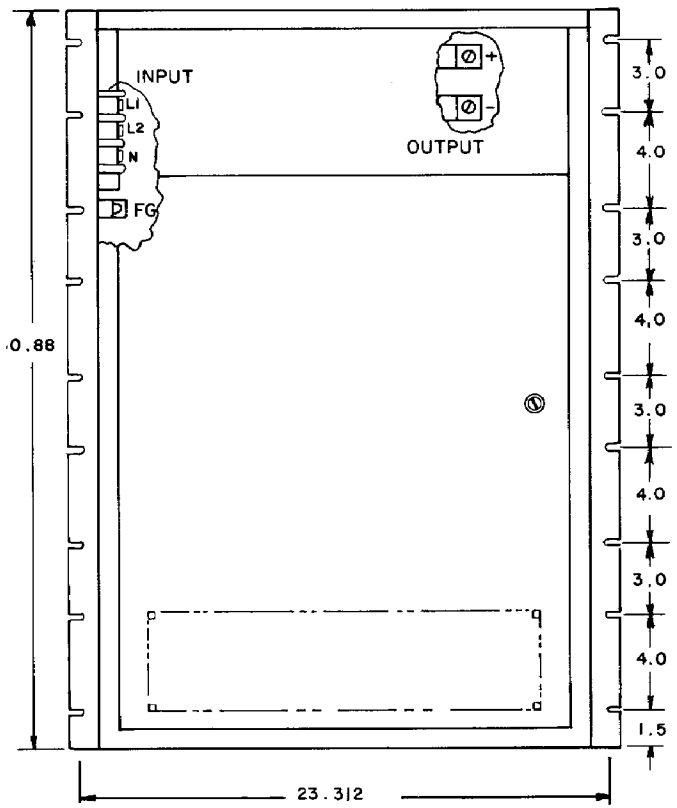
1.5 Environmental Ratings:

1.5.1 Operating ambient 0°C to 50°C.

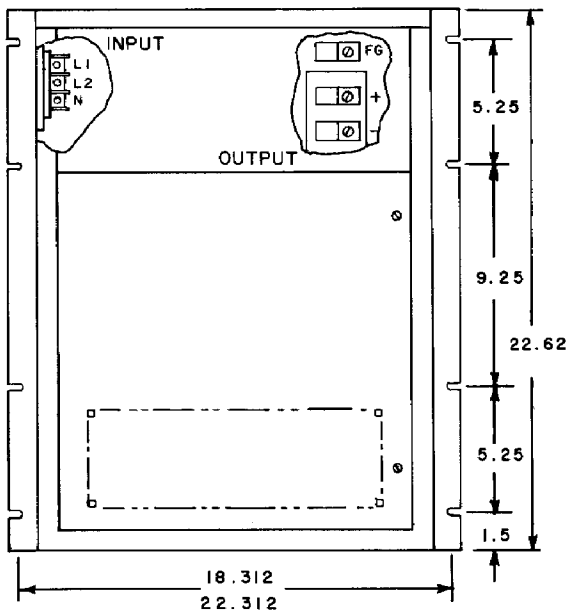
1.5.2 Storage ambient -40°C to +85°C.



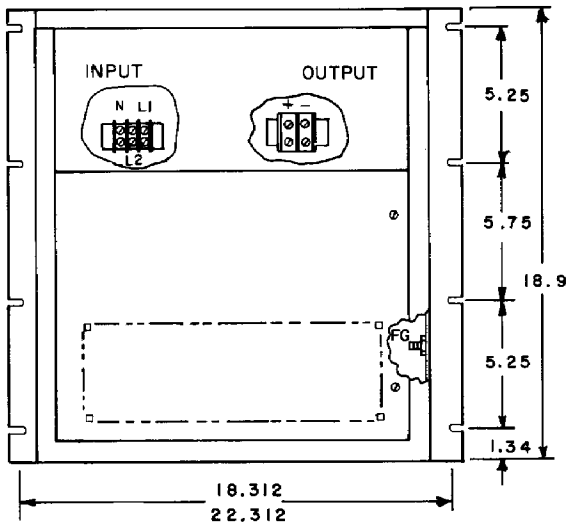




100. AMP



50. AMP



25. & 30. AMP

850050	
EC LEVEL	REL DATE

OUTLINE DRAWING
25, 30, 50, 100 AMP
BATTERY CHARGERS

M. TWEDDLE 6-20-75

4383384

1. GENERAL DESCRIPTION

This manual covers the installation and operation of the following controlled ferroresonant battery chargers.

PEC 3616AE to charge 23 to 26 cell @ 25 amps
PEC 3616 to charge 23 to 26 cells @ 30 amps
PEC 3617 to charge 23 to 26 cells @ 50 amps
PEC 3618 to charge 23 to 26 cells @ 100 amps

The chargers provide a regulated 48 to 58 VDC at rated load from an A.C. power source, and is designed for positive ground operation. The input power requirements are: single phase 60 Hz + 3 Hz, 99 to 132 VAC, or 187 to 257 VAC. (Suitable taps are provided for any input voltage within the above limits.

2. INSTALLATION INSTRUCTIONS

Mounting Data

2.01 25, 30, 50 A chargers can be mounted in either a 19 or 23" rack. 100 A charger can be mounted in 23" rack only. Allow minimum of 3" space at top and bottom of chargers for ventilation.

A.C. Input

2.02 The A.C. input lead entrance can be made through the top of unit or the top left as viewed from front. The input terminal block is located directly below this opening. (Ref. input strapping and wire gauge chart for proper strapping and wire size).

CAUTION:

CB1 MUST BE IN THE OFF POSITION BEFORE CONNECTING A.C. INPUT.

INPUT ADJUST CHART

INPUT VOLTAGE	INPUT VOLTAGE CONNECTIONS	WIRING CONNECTIONS			T.B. STRAPPING CONNECTIONS
		WIRE / NO	FROM	TO	
105	TB1 – L1 & N	W – 2 W – 1	TB1 – N CB1 – 2 – LOAD	TB2 – 6 TB2 – 4	TB2 5 & 6 TB1 – L1 & L2
120	TB1 – L1 & N	W – 2 W – 1	TB1 – N CB1 – 2 – LOAD	TB2 – 2 TB2 – 4	TB2 2 & 3 TB1 – L1 & L2
210 *	TB1 – L1 & L2	W – 2 W – 1	TB1 – N CB1 – 2 – LOAD	TB2 – 2 TB2 – 6	TB2 4 & 5
240 *	TB1 – L1 & L2	W – 2 W – 1	TB1 – N CB1 – 2 – LOAD	TB2 – 6 TB2 – 2	TB2 3 & 4

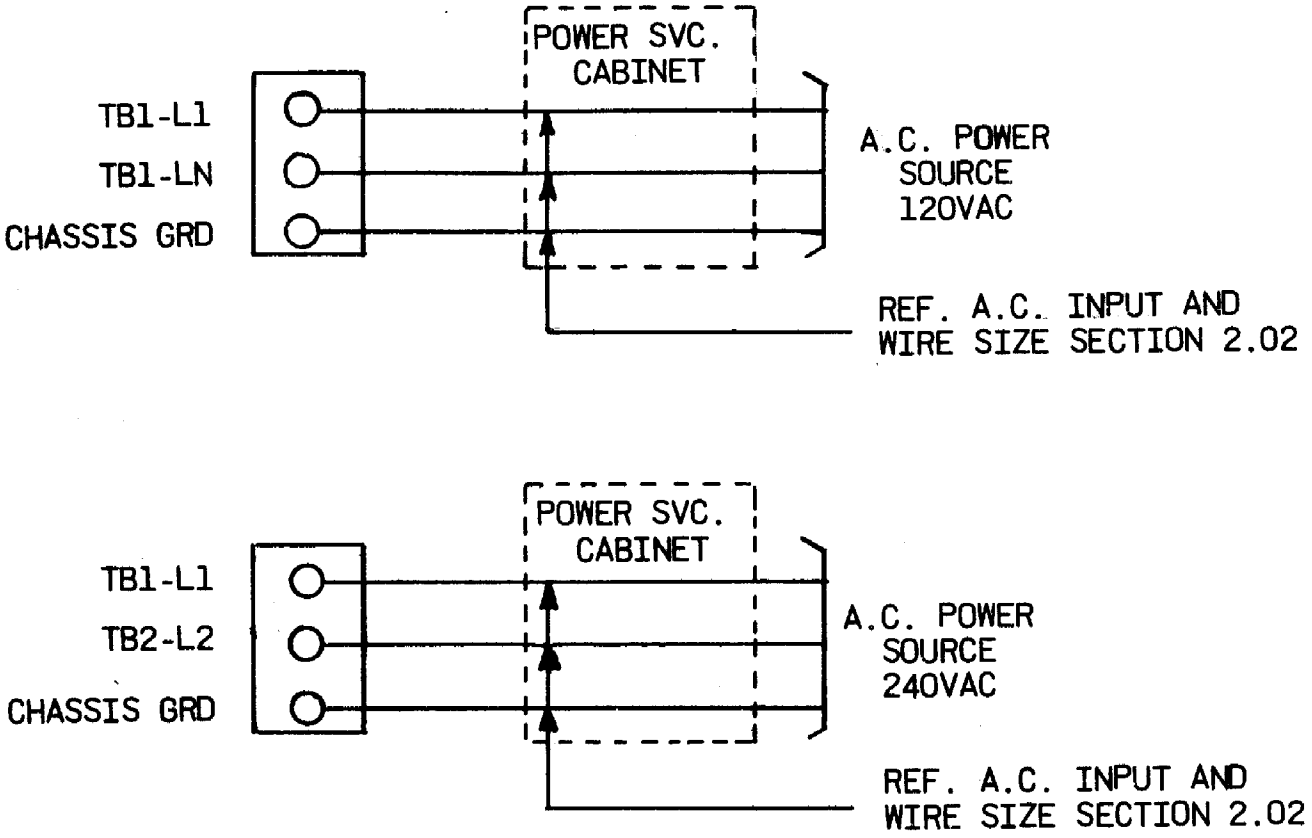
* TB1 L1 & L2 STRAP REMOVED FOR 210/240 INPUT

CONNECTIONS

MODEL	OUTPUT CAP	INPUT						OUTPUT		
		RECM. WIRE		RECM. FUSING		FRAME GROUND	LUG RANGE	WIRE SIZE		LUG RANGE
		110/120V	220/240V	110/220V	220/240V			50'	100'	
PEC 3616AE	25A	#10	#14	30A	15A	#10	#22 THRU #10 GA	#6	#4	#18 THRU #4 GA
PEC 3616	30A	#10	#14	30A	15A	#10	#22 THRU #10 GA	#6	#4	#18 THRU #4 GA
PEC 3617	50A	#6	#10	50A	25A	#10	#18 THRU #4 GA	#4	#2	1/0 THRU #14 GA
PEC 3618	100A	#2	#6	100A	50A	#8	1/0 THRU #14GA	#1/0	#1/0	350 MCM THRU #6 GA

NOTE: AC WIRING IS PER NATIONAL ELECTRICAL CODE
DC WIRING IS BASED ON A ONE (1) VOLT LOOP DROP OR LESS

INSTALLER'S CONNECTIONS "A.C. INPUT"



D.C. Output

2.03 The D.C. output lead entrance can be made through top of unit or top right of cabinet as viewed from front, the output connection is located just opposite output cable entrance and are clearly labeled + (Battery +) and - (battery -).

Recommended D.C. Output Wire Size

PEC 3616AE	PEC 3616	PEC 3617	PEC 3618
10 Ga.	10 Ga.	6 Ga.	2 Ga.

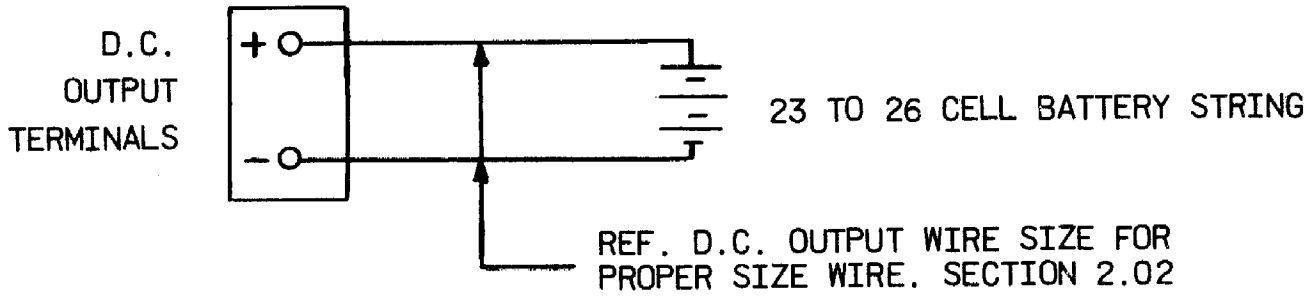
NOTE:

RECOMMENDED D.C. OUTPUT WIRE SIZE IN FIGURE WITH REMOTE SENSING AND 2 VOLT LEAD DROP.

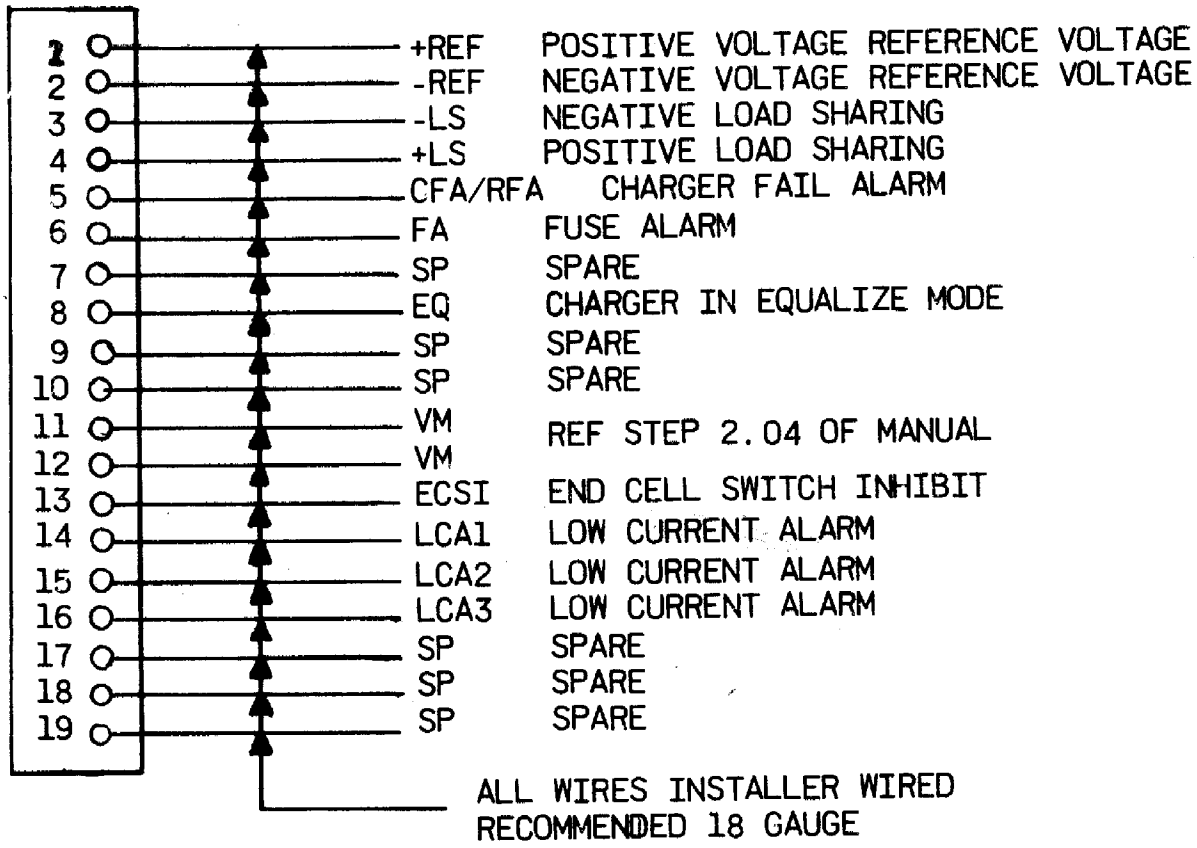
The chargers are factory shipped for local sense, if remote sense is desired a pair of 18 Ga. twisted wires can be ran from TB6-1 to + battery and TB6-2 to - battery. "This configuration is desired for optimum regulation at the batteries".

CAUTION MUST BE OBSERVED AS NOT TO REVERSE THE POLARITY OF SENSE LEADS WHEN MAKING CONNECTIONS.

INSTALLER'S CONNECTION "D.C. OUTPUT"



TB-6 CONTROL AND ALARM LEADS



Control and Alarm Lead Connections

2.04 The control and alarm lead entrance is through the same opening as the D.C. OUTPUT LEADS. The office disconnect block is located in the top center of unit. Solder or screw type connecting terminals are used for attaching the leads, connect the control and alarm leads as follows:

TB6-1 + REF

For remote sense connect to (+) of battery.

TB6-2 - REF

For remote sense connect to (-) of battery.

NOTE:

WHEN CHARGER CONTROL PANEL IS USED THE SENSE LEADS WILL TERMINATE AT CHARGER CONTROL PANEL.

CAUTION:

POLARITY OF SENSE LEADS ARE CRITICAL. MAKE CONNECTIONS CAREFULLY TO ASSURE THAT POLARITY IS CORRECT.

TB6-3 -LS

To provide proportional sharing of current on each charger with negative load sharing. Connect TB6-3 of all chargers together.

TB6-4 +LS

To provide proportional sharing of current on each charger with positive load sharing. Connect TB6-4 of all chargers together.

TB6-5 CFA/RFA

If for any reason the charger should shut down and lock out due to overloads or component failure, a ground (Gnd.) signal will be extended on CFA/RFA office disconnect TB6-5 and RFA lamp on charger will light.

TB6-6 FA

If a fuse or circuit breaker opens a ground signal will be extended to office on TB6-6.

TB6-8 EQ

A ground signal is provided on TB6-8 when float-equalize switch (S1) is pressed to place charger in an equalize mode.

TB6-11 & 12 Metering

When the charger is OFF the voltmeter (M1) will read zero. If reading on (M1) is desired strap TB6-11 to TB6-12.

TB6-14, 15, 16 LCA

When the output current falls below a preset low current value (factory set .5 amps) RFA lamp lights and a circuit is completed between TB6-14 & 15. When the charger is carrying in excess of .5 amps (factory setting) a circuit is completed between TB6-15 & 16.

Installation Check (Before Putting into Operation)

2.05 After installation and before the charger is initally turned ON, the following procedure should be adhered to:

(a) Check input adjust chart (section 2.02) for proper input strapping and voltage.

(b) Determine how many cells the charger will be charging. (23 to 26 cells),

(c) Recheck input, output, and control connections for tightness to avoid unwanted voltage losses.

Initial Turn-On

2.06 After the installer connections are made and checked for correctness and tightness the charger can be turned on.

Place CB2 in the "On" position, if the charger is equipped with TB6 11 & 12 strap together M1 will read battery voltage. (If TB6 11 & 12 is not strapped together M1 will read zero).

Turn CB1 on, at this time A.C. is applied to the charger and it will start picking up the load. If charger is placed on batteries that are discharged or new, the charger may go into a constant current mode which will let the charger set at constant current and voltage at something less than 50 VDC. As the batteries charge up the output current will drop off and the voltage will pick up to normal output voltage.

After this sequence of events and the batteries are at a normal current now the output voltage can be set to determine plant voltage.

Adjust float adjust pot located on front panel clockwise (CW) to raise output voltage or counterclockwise (CCW) to lower output voltage to desired setting.

Press (S1) equalize switch, equalize lamp will light placing charger in equalize condition. Adjust equalize adjust pot clockwise (CW) to increase equalize voltage or counterclockwise (CCW) to lower equalize voltage to desired setting. After these settings are obtained the charger should be returned to float condition unless an equalize of the batteries is desired.

3. CONTROL POTENTIOMETER SETTINGS

All control potentiometers are factory set and should not be adjusted unless trouble is suspected in one or a circuit pack has been changed out. If adjustment is needed to be made the following procedure should be adhered to:

Current Limit Setting

3.01 R123 maximum current limit rheostat has been factory adjusted to limit the output current at 110% of full rated output current. If setting is to be changed or checked and the load on the charger is not greater than the desired current limit setting an artificial load should be used to insure the amount of load exceeds the desired output current limit setting.

To decrease the current limit setting turn adjustment shaft of potentiometer R-123 on P/C card counterclockwise until the output current drops to the desired limit.

To increase the current limit setting, turn adjustment shaft of potentiometer R-123 clockwise until the output current rises to the desired limit.

CAUTION:

DO NOT ADJUST THE CURRENT OUTPUT LIMIT TO A VALUE GREATER THAN 110% OF RATED OUTPUT CURRENT.

Low Current Setting

3.02 To readjust low current setting if factory adjustment of .5 amperes is unsatisfactory; proceed as follows:

increase load box resistance to desired set point. Set R146 on P/C card so that LC relay operates and lights RFA/CFA lamp when M2 reading decreases to desired low current setting.

High Voltage Alarm

3.03 Readjust the high voltage alarm control rheostat R166 on P/C card to maximum counterclockwise (CCW) position. Push float-equalize switch (S1) placing charger in equalize mode.

Place the plant voltmeter or volt/ohm meter across output of charger, adjust both float adjust and equalize potentiometer until the desired high voltage setting is obtained.

Adjust R166 clockwise (CW) until the charger shuts down. This setting will be the high voltage shut down of the charger.

NOTE:

THERE IS A SLIGHT TIME DELAY IN THE HIGH VOLTAGE ALARM CIRCUIT SO R166 MUST BE ADJUSTED SLOWLY.

CAUTION:

HIGH VOLTAGE ALARM SHOULD NOT BE SET HIGHER THAN 56.00 VDC.

Whenever the charger sensing voltage increases to a level of the high voltage alarm set point, HVA relay will operate. A -48 V is then applied to CB1 trip coil which will trip the input circuit breaker (CB1) shutting down the charger.

Raise and lower charger output several times to insure correct high voltage setting.

NOTE:

FLOAT AND EQUALIZE VOLTAGE SHOULD BE RESET AFTER HVA SETTING IS MADE. (REF. STEP 2.06).

Proportional Load Sharing

3.04 The following procedure should be adhered to in setting the load sharing. The load sharing circuit allows approximately proportional load sharing between the chargers. Positive load sharing references the load sharing circuit to the + sense (+REF lead). The float or equalize voltage of the charger should be set as close as possible. After setting the float or equalize voltage on all of the chargers (and connecting the load share lead between each of the chargers) minor adjustments can be made by turning rheostat R140 a few turns CW or CCW.

If the load difference is fairly large the following procedure should be taken in order to check the adjustment of R140. Connect the positive lead of a voltmeter to the + sense and the negative lead to TB6-4 on plant disconnect. The voltage should read approximately the value on the following table:

% Load	Voltage
0	10 V
25%	8 V
50%	6 V
75%	4 V
100%	2 V

If the voltage difference for a certain load is fairly large or is not present at all;the following steps should be taken to set the positive load sharing. Trip CB1 to the off position, remove batteries from the output of chargers.

If two or more chargers are used in paralleled shut off all chargers except charger one and set R140 on CP1 until the voltage reads

10 volts on voltmeter with charger one at no load turn charger one off, turn charger two on, and Adjust it if necessary to the same voltage reading as on charger one. Set the remaining chargers in this manner by having only one on at a time. After all chargers are set, plant can be returned to normal conditions. Use below (A) formula to check for proper proportional load sharing on each charger.

The following example does not pertain to any special telephone office and should be used only as a sample for setting both positive and negative load sharing.

(A) $$I_c = \frac{I_{cr}}{I_r} \times I_p$$

I_{cr} = Rated current of charger in question
I_c - Current of addition or questionable charger when load sharing
I_r - Total rated current of all chargers in parallel
I_p - Total plant current or load
Charger - 50 amp charger added to existing plant
Charger - 100 amp charger
Charger - 200 amp charger

(EXAMPLE)
Total plant current is 315 amps. Full load capacity of all paralleled chargers = 50 A + 100 A + 200 A = 350 A. Current output of 50 amp (added) charger is:

$$I_c = \frac{50\ A}{350\ A} \times 315\ A$$

I_c = 45 amps (50 amp charger will be carrying 45 amps). R140 potentiometer should be adjusted to conform.

Negative load sharing references the load sharing circuit to the - sense (-REF) lead. The float or equalize voltage of the charger should be set as close as possible. After setting the float or equalize voltage on all of the chargers (and connecting the load share lead between each of the chargers) the offset voltage must be determined. The offset voltage shall be defined as the voltage on the load share lead at no load. To measure connect voltmeter between TB6-3 and the - sense. To increase the voltage, adjust R138 (on CP1) in the CW direction. It should be between .5 to 3 volts. Set the new chargers to the offset voltage found on the old chargers or select a new value for all of the chargers (suggested range 1 to 3 volts). At this point all of the chargers should approximately share the load. Minor adjustments can be made by turning rheostat R140 a few turns CW or CCW. (It was factory set).

If the load difference is fairly large place a voltmeter + lead on TB6-3 and the negative lead on the - sense. The voltage (VLS + V offset) should read approximately the value on the following table:

% Load	(VLS + V Offset) Volts	Remarks
0	0 V + V Offset	Not Affected By R140
25	2 V + V Offset	V Offset is set with R138
50	4 V + V Offset	
75	6 V + V Offset	
100	8 V + V Offset	

If voltage is different than above table, trip CB1 to the off position, and remove batteries from output of chargers. Adjust R140 on CP1 to complete (CW) clockwise position. Return charger #1 to on and place a voltmeter across TB6-3 and minus sense, the voltage on voltmeter should read two (2) volts with charger at no load condition. If this voltage is not set at two (2) volts, R138 on CP1 can be adjusted until two (2) volts is present on voltmeter. If two or more chargers are paralleled in a string shut off remaining chargers and set charger one to two (2) volts. Turn charger two on and adjust it if necessary to the same voltage reading as on charger one. Balance the remaining chargers in this manner by having only one at a time.

After the set point on the charger has been set at two (2) volts, batteries can

be connected to output of chargers and returned to line. R140 on CP1 can be adjusted on each charger to get the proper proportional load sharing.

Use below formula (A) to check for proper proportional load sharing on each charger.

The following example does not pertain to any special telephone office and should be used only as a sample for setting both positive and negative load sharing.

$$(A) \quad I_c = \frac{I_{cr}}{I_r} \times I_p$$

I_{cr} - Rated current of charger in question
I_c - Current of addition of questionable charger
I_r - Total current of all chargers in parallel
I_p - Total plant current
Charger - 50 amp charger added to existing plant
Charger - 100 amp charger
Charger - 200 amp charger

Total plant current is 315 amps.
Full load capacity of all paralleled chargers = 50 A + 100 A + 200 A = 350 A
Current output of 50 amps (added) charger is:

$$I_c = \frac{50\ A}{350\ A} \times 315\ A$$

(EXAMPLE)
I_c = 45 amps (50 amp charger will be carrying 45 amps). R140 potentiometer should be adjusted to conform.

4. MAINTENANCE AND TROUBLE SHOOTING

Introduction

4.01 The chargers consist of a main power circuit controlled through a semiconductor regulating circuit whose error input is through the sense leads of the main unit and whose power input is from T1 transformer. In addition, a signal from the current circuit is introduced into the regulating circuit for the purpose of current limitation. The output of the regulating circuit is introduced into SCR firing circuits, which control the SCR's in the main power output. In the maintenance of solid state equipment, trouble must be localized in an orderly way. This is difficult in the case of a circuit having this feedback loop arrangement because trouble anywhere in the loop will give fault operation of other parts of the loop which may be trouble free.

When any kind of trouble is encountered, it is necessary first to decide whether to locate the trouble with the equipment operating or de-energized. This charger has been designed to make components accessible for testing with the power connected. All parts with over 150 volts to ground have been covered. Trouble is easier to find if the equipment can be fully energized, but if it is of a nature that causes excessive output from the equipment, it will be necessary to take the initial steps with the system de-energized, energizing it in sub-divisions for short periods only, while electrical measurements are taken. Also operation for more than a few minutes at a time while trouble exists, even though the output may not be excessive, may result in overheating of some components. It is essential, when testing, to be on the alert for the need for quickly shutting down the charger at any time until the trouble is localized and cleared.

The control rheostats, potentiometer, and switches should be replaced if they become defective in any respect.

The Maintenance and Trouble Shooting Guide is prepared for the aid of North Electric charger users to regain the service of the charger in a minimum amount of time.

4.02 Charger adjustments section are included for the aid of resetting the charger after component replacement or if adjustments are made for any reason.

The trouble shooting guide will aid in locating trouble that may occur within the North Electric charger.

Maintenance

4.03 The North Electric Charger is a controlled ferroresonant circuit design, consequently its operation is almost completely trouble free. Once the charger is put ito operation, periodic adjustments of control pots are not necessary. However, periodic maintenance of the battery charger is necessary to insure continued troublefree operation of the rectifier. Dirt build up; heating of various electrical and mechanical components and aging combine to cause the possible degrading of performance and loss of maximum life expectancy. The frequency of maintenance inspections may vary from one installation to another, but we recommend maximum interval of 1 year on the rectifying diodes and printed circuit card.

4.04 Maintenance procedures should be performed during the period of least demand upon the rectifier unless back up chargers or motor generators are available to pick up the load.

4.05 Circuit breaker (CB2) should be turned OFF in order to remove battery from the heat sinks of the rectifying diodes. As an extra precaution, check filter capacitors C2-C3 to be sure the voltage is bled down. Check the pigtail leads and the stud nuts on the heat sinks of CR1 & 2 for tightness.

Maintenance and Trouble Shooting Techniques

4.06 The charger is constructed such that when maintenance and troubleshooting becomes necessary it is easily achieved.

4.07 It is recommended that the "circuit breaker" (CB2 to be turned OFF when troubleshooting becomes necessary).

4.08 Charger has hinged door for easy access to all components.

4.09 With the charger door open; all components of the charger are easily accessible.

4.10 All of the control components are located on component board (CP1) which may be removed by removing the quick disconnect plugs.

CAUTION:

WHEN REPLACING COMPONENTS ON THE BOARD, USE CAUTION SO AS NOT TO DAMAGE ANY CIRCUIT CONDUCTORS.

If lans are damaged in any manner they may be bridged by soldering a piece of solid wire across the damaged portion of the circuit lans.

Trouble Shooting Guide

4.11 When trouble occurs thoroughly inspect the following before going to internal components.

4.12 Plant Control Disconnect should be disconnected so proper alarm signals can be checked from charger. Refer to Fig. 2 page 18 of manual.

4.13 See that the proper A.C. input voltage is applied to A.C. input terminals. Reference Installer's Connection sheet.

4.14 See that CB1 and CB2 (are tripped) return to "ON".

4.15 Check that CP1 card is securely placed in charger.

4.16 See that charger load is properly connected, (G) + Battery, (F) Battery.

4.17 Check that charger sensing is correctly connected.

4.18 Check that charger control lead connections are correct; refer to section 2.03.

4.19 See that an overload condition does not exist on charger output terminals. (Charger will current limit and protect itself if over load is present).

If conditions 4.11 thru 4.19 have been checked satisfactorily, then the following waveshapes should be checked.

CAUTION:

IT IS EXTREMELY IMPORTANT TO ISOLATE GROUND FROM ELECTRICAL TESTING INSTRUMENTS USED IN TROUBLESHOOTING BY ATTACHING AN ADAPTOR PLUG TO THE INSTRUMENT BEFORE CONNECTING TO THE CHARGER.

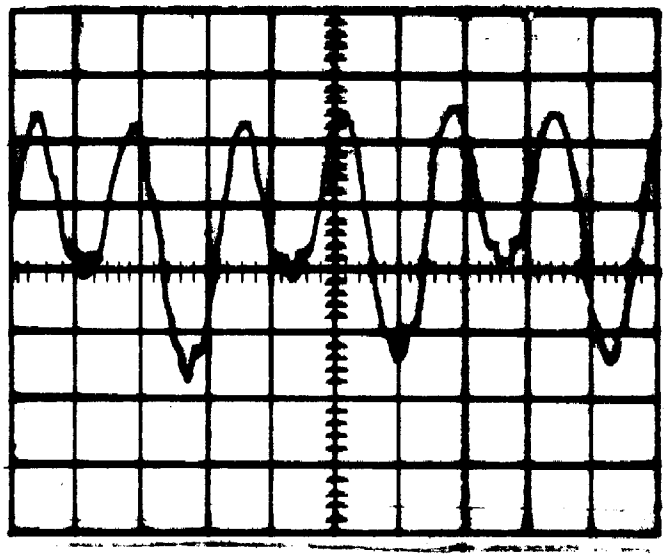


Fig. 2 V -20 MV/CM
H - 5 MS/CM
Connect positive (+) lead of scope to (+) positive output of charger and negative (-) lead to negative output of charger.

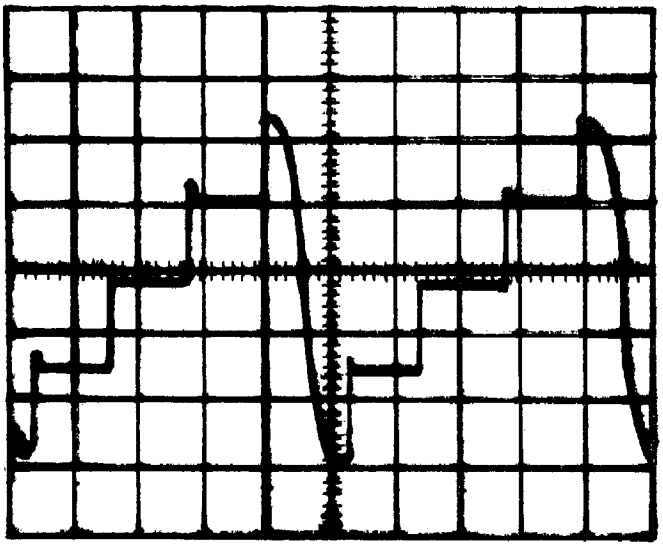


Fig. 2

V - 200 V/CM
H - 1 MS Uncalibrated/CM
Connect negative (-) lead of scope to cathode (+) of Q1 and positive lead to anode (+) of Q1. Above photo should be observed if waveshape does not look approximately like Fig. 2 proceed to next fig.

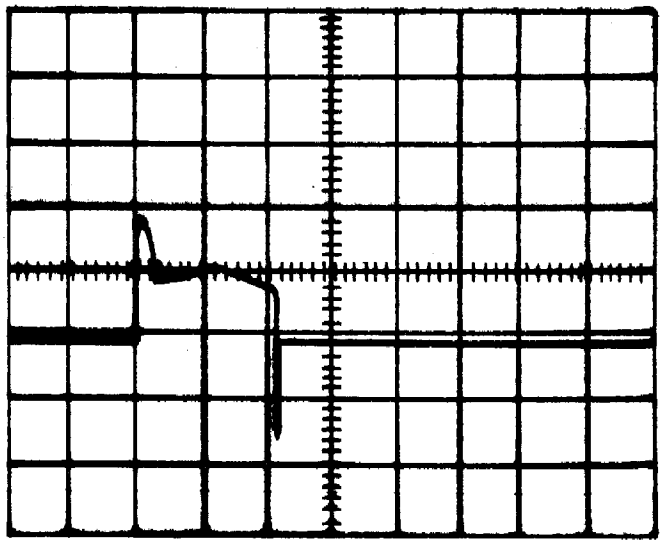


Fig. 3

1 - 1 V/CM
H - 2 MS/CM
Connect negative (-)lead of scope to cathode (+) of Q1 and positive lead to Q1 gate. Waveshape should look like Fig. 3. Check Q2 in same manner. If gate pulse across Q1 & Q2 appears as in Fig. 3 and Fig. 2 does not look proper it is an indication that Q1 or Q2 is defective. Replace with (2) NEC 3371732's. If Fig. 3 is not present it is an indication CP1 is defective, replace with spare.

5. SERVICE AND REPLACEMENT PARTS ORDERING

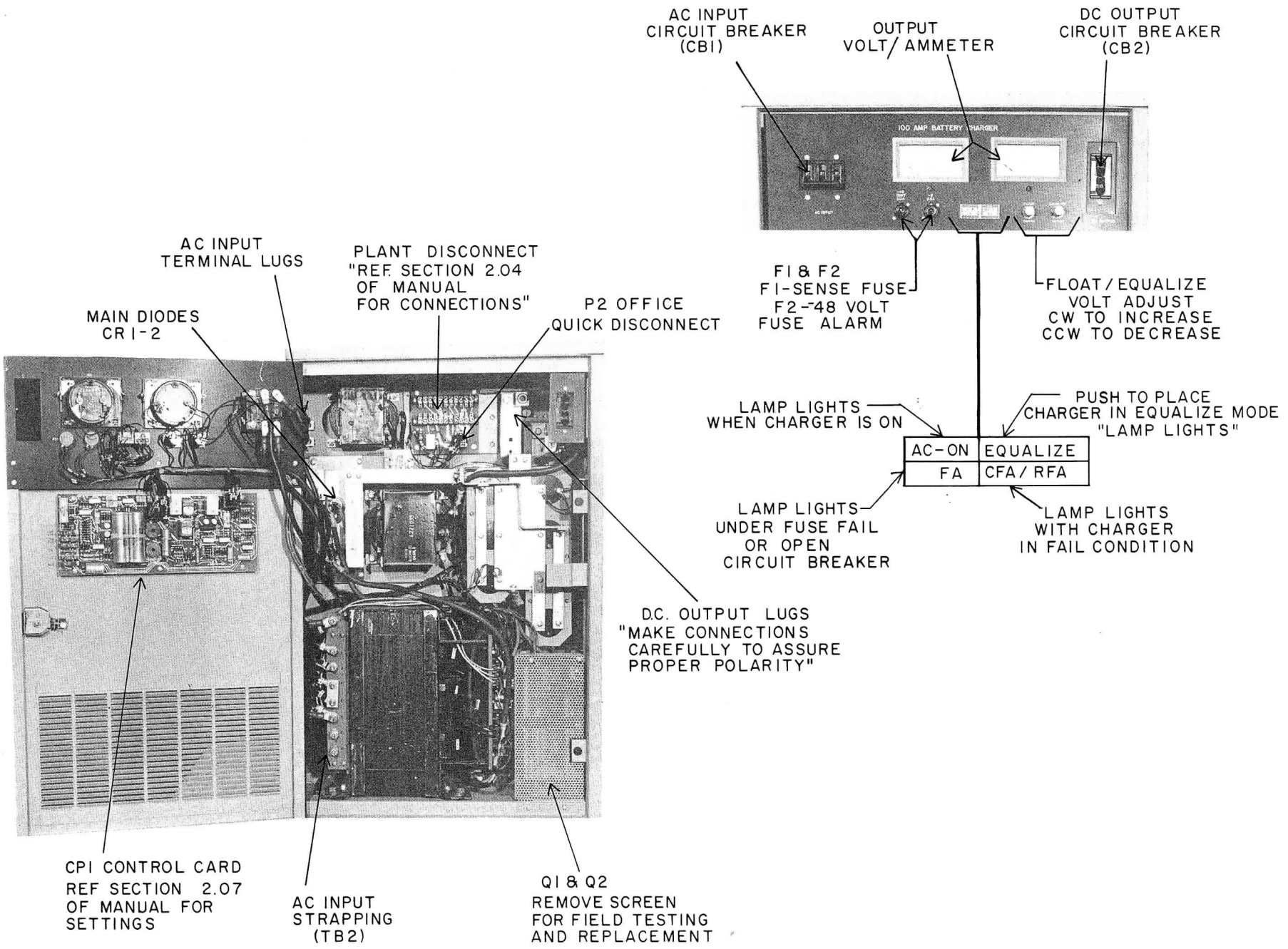
5.01 If for any reason further assistance is needed on any North Electric power equipment, complete engineering facilities and field service groups are available in Galion, Ohio, to assist you in any way possible.

Field Service - - - Call 419-468-8100 and ask for POWER FIELD SERVICE.

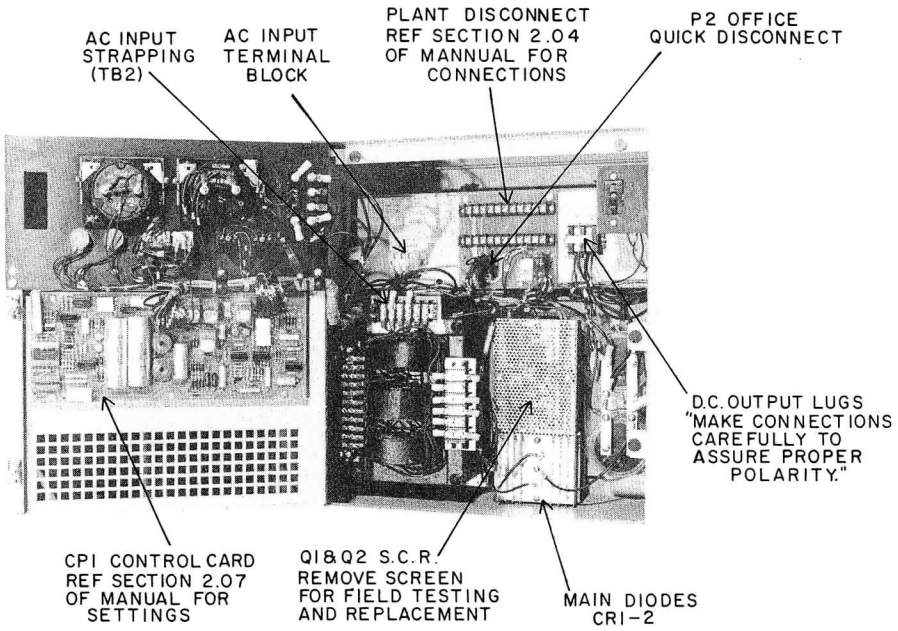
Recommended Spare Parts

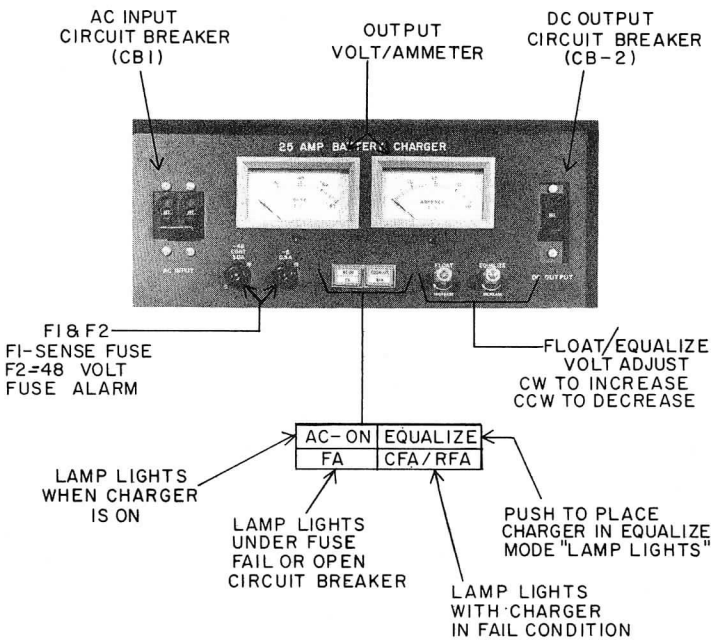
Circuit Pack	North Electric P/N	Recommended Qty. per Office
CP1 - Control and Relay Card	6201068	1

Fuse	Manufacturer	Size	Manufacturer Part No.	NECO P/N	Recommended Qty. per Office
F1	Bussmann	.5 A	70 G	3150605	10
F2	Bussman	3 A	70 C	3150610	10
Lamps					
DS1-DS4	Chicago Minature Lamp Co.		CM-327-LSV	3220054	10
Semiconductors (PEC 3616AE-3616)					
CR1-CR2	General Electric		IN-1185RA	3371370	4
	Transitron		IN-1185RA	3371370	4
	Motorola		IN-1185RA	3371370	4
Q1-Q2	General Electric		C147N	3371732	4
Semiconductors (PEC 3617)					
CR1-CR2	International Rectifier		70HR20	3371431	4
	Motorola		SR2975R	3371431	4
Q1-Q2	National Electronics		NL-C152	3371749	4
	Motorola		MCR152-80	3371749	4
	General Electric		C152	3371749	4
Semiconductors (PEC 3618)					
CR1-CR2	General Electric		IN-3263R	3371750	4
	Westinghouse		IN-3263R	3371750	4
	International Rectifier		IN-3263R	3371750	4
Q1-Q2	General Electric		C147N	3371732	4

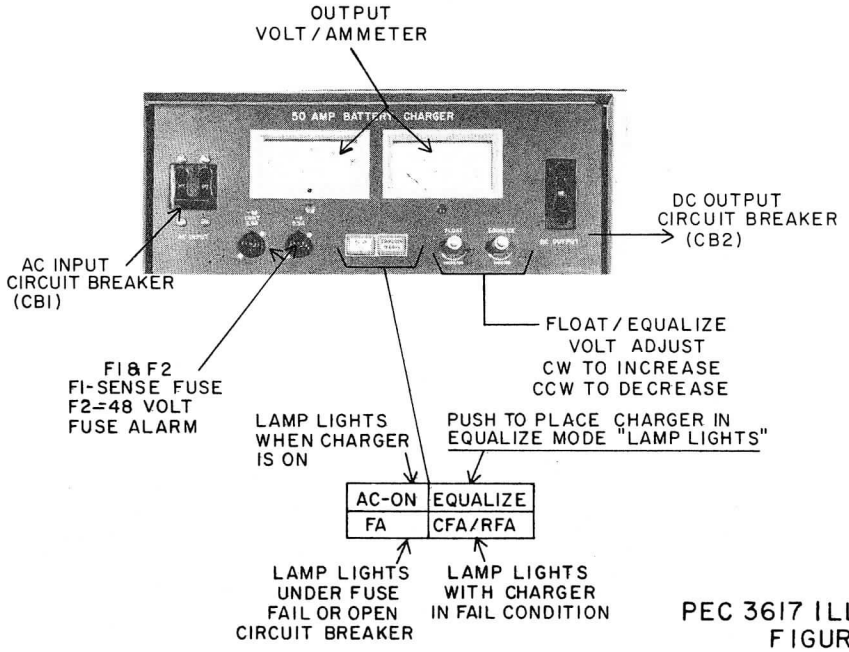


PEC 3618 ILLUSTRATION FIGURES

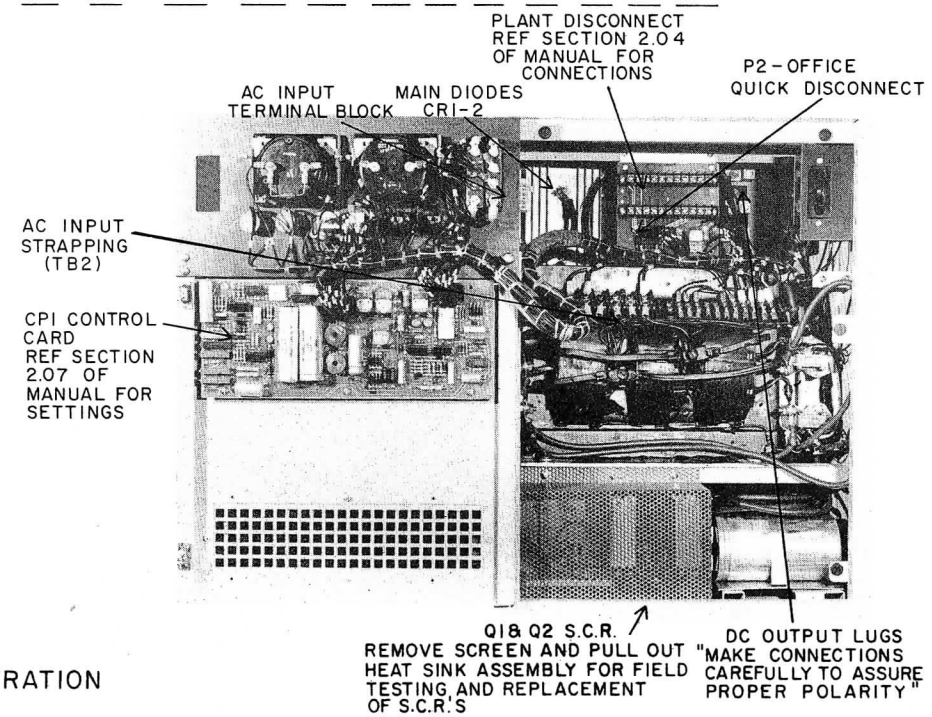




PEC 3616/AE ILLUSTRATIONS
FIGURES



PEC 3617 ILLUSTRATION
FIGURES



FIELD ASSISTANCE FOR SEMICONDUCTOR TESTING

1.0 GENERAL

North Electric power equipment is designed using semiconductor components. Most control and SCR gating circuits are made of semiconductor components which have been designed on pluggable printed circuit boards. These printed circuit boards may be easily removed from their sockets for trouble shooting and/or return to North Electric Co. for repair.

All equipment malfunctions are classified as either Sudden Component Failure or Performance.

A. Sudden component failure:

1. A blown fuse, or tripped circuit breaker.
2. Low or no output voltage.
3. High output voltage.
4. No control of output voltage.

B. Performance Failure

1. Incorrect installation.
2. Unit applications not adhered to.
3. Over loading of equipment (power).
4. Over-rating of unit capabilities
5. Loose connection of unit terminals.

Due to the complexity of North Electric power, design of telephone power equipment and the rigid test applications needed for making a complete test of semiconductors, the following explanation figures have been constructed as an aid to field personnel.

NOTE:

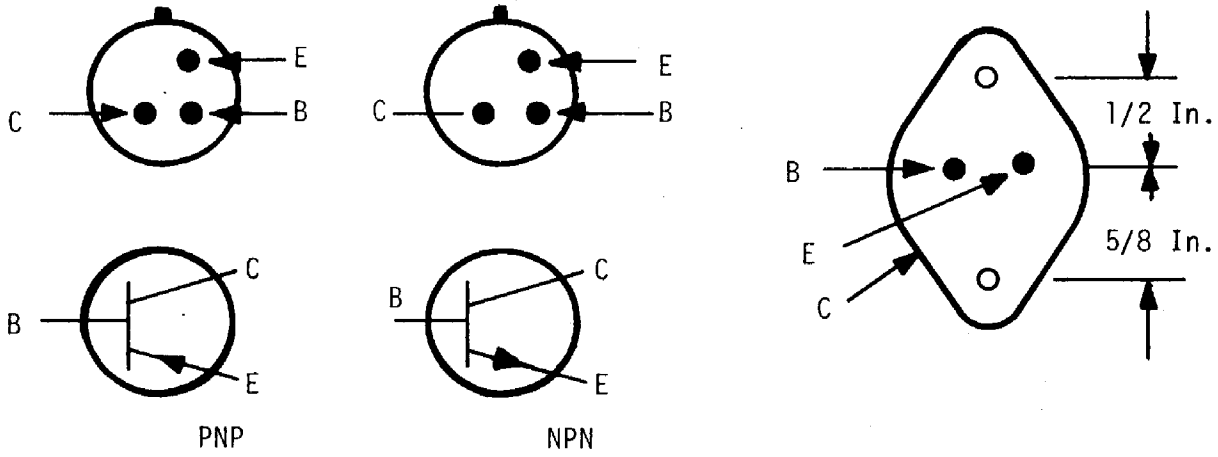
IN EACH SEMICONDUCTOR TEST, IT IS ESSENTIAL THAT THE POLARITY OF THE OHM METER BE DETERMINED BEFORE MAKING CHECKS!

2.0 TRANSISTORS

The following test is for PNP transistors. To test NPN type transistors reverse the ohm meter leads.

Figure 1 shows the transistor pin locations and the electrical symbols for both PNP and NPN transistors.

FIGURE 1



Select the polarity of the ohmmeter leads and connect the positive (+) lead to the emitter (E) and the negative (-) lead to the collector (C). The resistance reading should be between 100 and 50 K ohms.

NOTE:

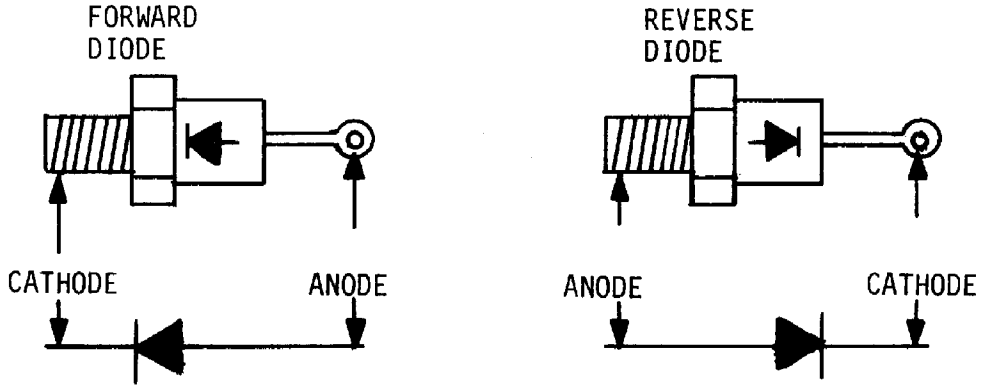
THE ACTUAL READING IN OHMS IS NOT SIGNIFICANT.

With the ohmmeter still connected, short the base (B) to the collector (C). The value of resistance should decrease. Then short the base (B) to the emitter (E). The value of resistance should now increase.

3.0 DIODES

Figure 2 is a mechanical and electrical figure showing both a POSITIVE and NEGATIVE DIODE.

FIGURE 2

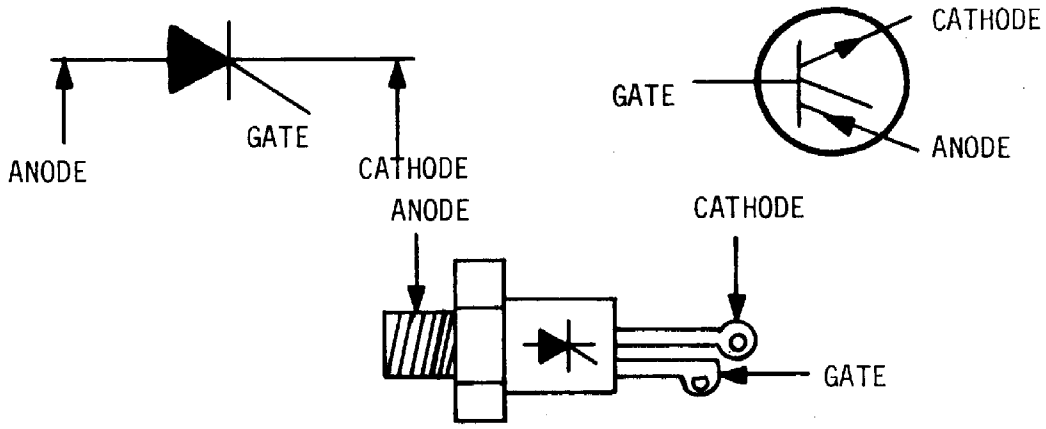


Determine the polarity of the ohmmeter leads and connect the positive (+) lead to the cathode (+) and the negative (-) lead to the anode (-). The value of the resistance should be 1 meg-ohm minimum. Now reverse the ohmmeter leads and the value of resistance shall be 10 - 50 ohms.

4.0 SILICON CONTROLLED RECTIFIERS (SCR's)

Figure 3 will show the circuit symbol and outline of a SCR. Either symbol may be used.

FIGURE 3



Determine the polarity of the ohmmeter leads and connect the positive (+) lead to the cathode (+) and the negative (-) to the anode (-). The value of resistance should be 1 meg-ohm minimum. Now reverse the meter leads and the value of resistance should be 1 meg-ohm minimum.

With the meter still connected negative (-) to cathode (+), positive (+) to anode (-), short the gate to the anode (-). The value of resistance should decrease to less than 1 K ohms.

DWG ISSUE	EC LEVEL	DATE	DWG	APVD
1	8500050		R.T.	5/21/75
2	8513408			
3	8513434			8-8-75 BEA

SHEET INDEX

			ISSUE NO.			
	SHEET INDEX	A1	1	2	3	A1
FS1	POWER SECTION	B1	1	1	1	B1
FS2	BIAS POWER	B2	1	1	1	B2
FS3	REGULATOR	B3	1	2	3	B3
FS4	HIGH VOLTAGE, LOW CURRENT DET.	B4	1	1	3	B4
FS5	RELAY & ALARM	B5	1	2	3	B5
	APP. FIG. FOR FS1 &FS2	C1	1	2	3	C1
	APP. FIG. FOR FS3	C2	1	2	3	C2
	APP. FIG. FOR FS4 & 5	C3	1	2	2	C3
	CAD 1	G1	1	1	1	G1

SUPPORTING INFORMATION

ISSUE A, B, C, ETC IS PRELIMINARY ISSUE. FINAL RELEASE WILL BE ISSUE 1 AND ALL FUTURE ISSUE CHANGES WILL BE DONE IN NORMAL FASHION

1. WHEN CHANGES ARE MADE IN THIS DRAWING, ONLY THOSE SHEETS AFFECTED WILL BE REISSUED
2. THIS SHEET INDEX WILL BE REISSUED AND BROUGHT UP TO DATE EACH TIME ANY SHEET OF THE DRAWING IS REISSUED, OR A NEW SHEET IS ADDED
3. THE ISSUE NUMBER ASSIGNED TO A CHANGED OR NEW SHEET WILL BE THE SAME ISSUE NUMBER AS THAT OF THE SHEET INDEX
4. SHEETS THAT ARE NOT CHANGED WILL RETAIN THEIR EXISTING ISSUE NUMBER
5. THE LAST ISSUE NUMBER OF THE SHEET INDEX IS RECOGNIZED AS THE LATEST ISSUE NUMBER OF THE DRAWING AS A WHOLE

CIRCUIT NOTES

101. FUSING:

A. FOR INTERNAL FUSE LIST SEE APP. FIG. FS5

102

FEATURES OR OPTION	APP. FIG. & WRG.	
OPTIONAL 105/120, 210/240VAC INPUT NOTE	FS1	
POSITIVE LOAD SHARING	FS3	Y
NEGATIVE LOAD SHARING	FS3	Z
OPTIONAL OUTPUT		

103. RECORD OF FIGURES, WIRING, AND APPARATUS CHANGES

104. INPUT ADJUST CHART

INPUT VOLTAGE	INPUT VOLTAGE CONNECTIONS	WIRING CONNECTIONS			T.B. STRAPPING CONNECTIONS
		WIRE NO.	FROM	TO	
105	TB1: L1 & N	W2 W1	TB1-N CB1-2 LOAD	TB2-6 TB2-4	TB2: 5&6 TB1-L1&L2
120	TB1: L1 & N	W2 W1	TB1-N CB1-2 LOAD	TB2-2 TB2-4	TB2: 2&3 TB1-L1&L2
210*	TB1: L1 & L2	W2 W1	TB1-N CB1-2 LOAD	TB2-2 TB2-6	TB2: 4&5
240*	TB1: L1 & L2	W2 W1	TB1-N CB1-2 LOAD	TB2-6 TB2-2	TB2: 3&4

* NOTE: TB1-L1&L2 STRAP MUST BE REMOVED FOR 210/240 INPUT

301. UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES IN OHMS CAPACITANCE VALUES IN MICROFARADS

302. INPUT WIRED FOR 240VAC

303. FACTORY SET VDC
HI VOLTAGE ALM.
56VDC

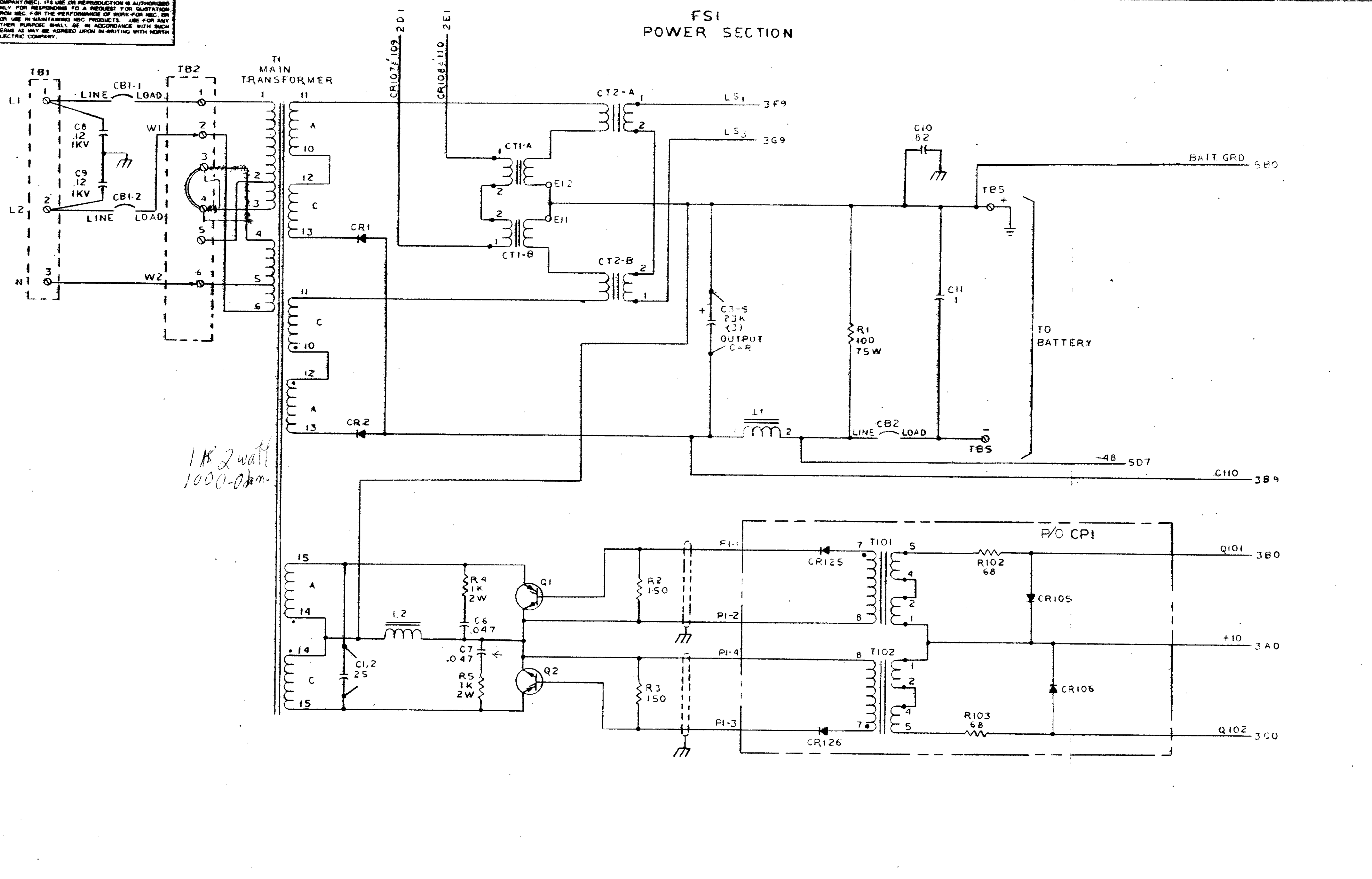
304. FACTORY SET AMP DC
LOW CURRENT ALM
0.5 AMPS

1

PEC 3617
50A BATT. CHARGER
SD 4392324 A1
NORTH ELECTRIC COMPANY
GALION, OHIO
D

FORM 500.77

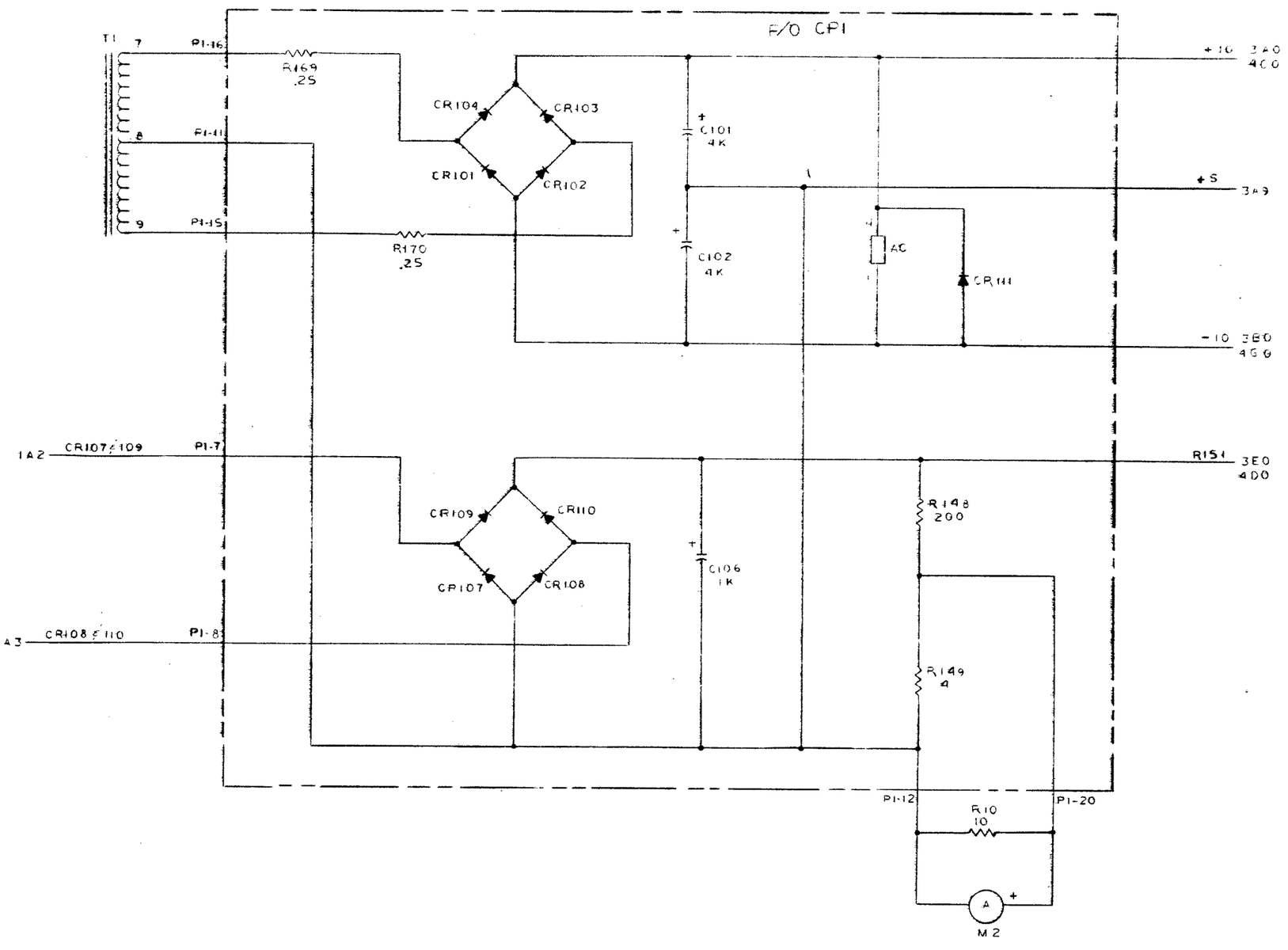
FS1 POWER SECTION



FEC-3617	SD-4392324-B1
50A BATT. CHARGER	
NORTH ELECTRIC COMPANY GALION, OHIO	D

SHT 1 ISSUE

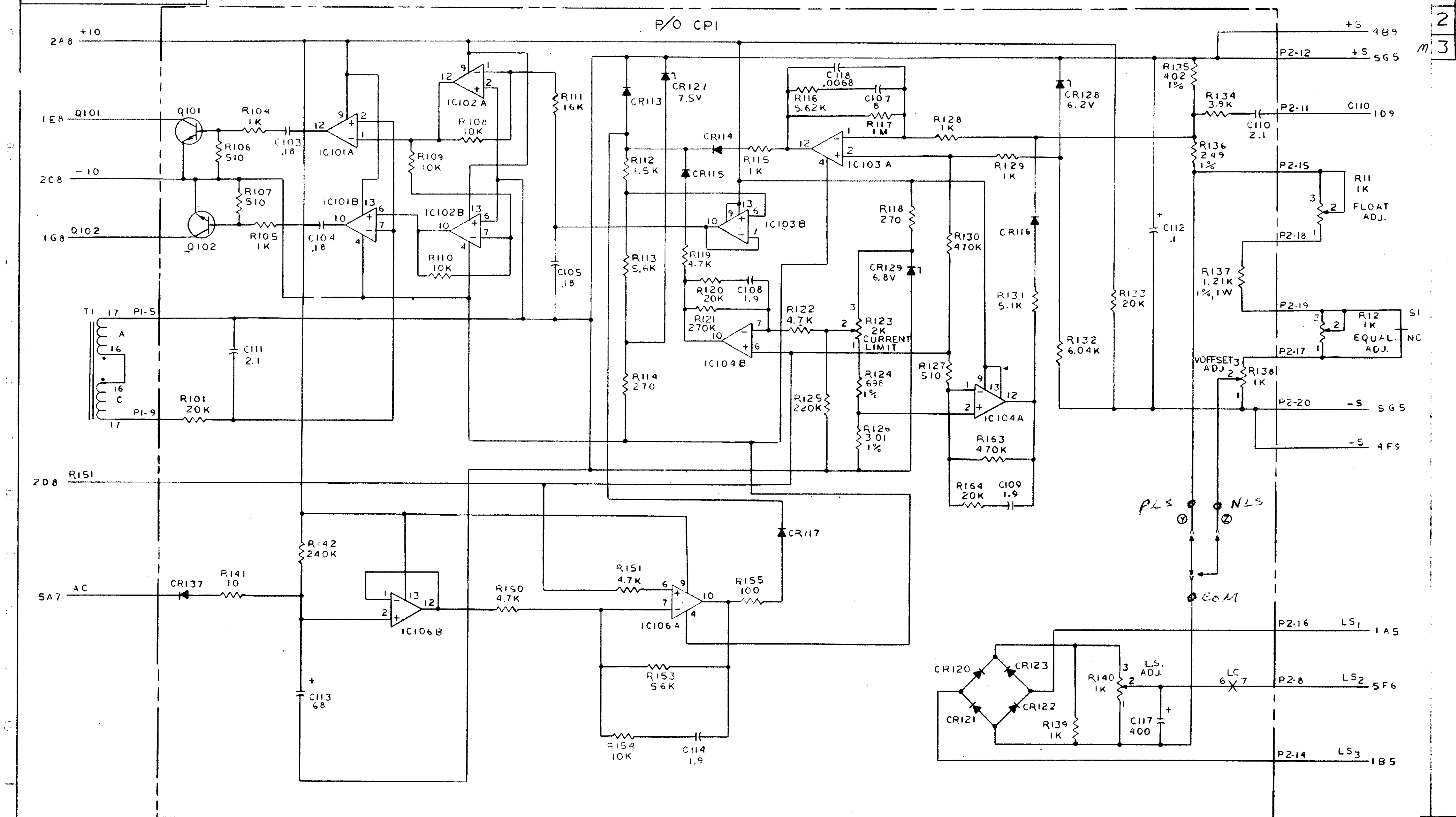
FS2
BIAS POWER



PEC-3617	
50A BATT. CHARGER	SD-4392324-B2
NORTH ELECTRIC COMPANY	D

1

FS3 REGULATOR



PEC 3617 50A BATT. CHARGER	SD 4392324-B3
NORTH ELECTRIC COMPANY GALION, OHIO	D

FS4
HIGH VOLTAGE, LOW CURRENT DET.

SHT	ISSUE
1	10 30 74
3	8 22 75

P/O CP1

+10 2A8

R143 510

R151 2D8

R152 4.7K

CR118

LC 4 1

R144 2.7K

R145 1.5K

IC107 2 9 13 1 12 4

CR133 5.1V

R157 3.9K

Q103

R158 1K

CR134 6.2V

C115 .1

3 2 1 R146 500

R156 1M

2C8 −10

+S 3A9

R160 1K

C116 47

R165 620 1%, 1W

CR130 6.2V

IC105A 13 2 12 1 4

R166 2K 1 2 3

CR131 10V

Q104

R161 1K

R162 43K

R159 3K 2W

CR132 10V

IC105-B 10 9 6 7

R167 3.9K 2%, 1W

R168 3.6K 1W

4 HVA 1

CR119

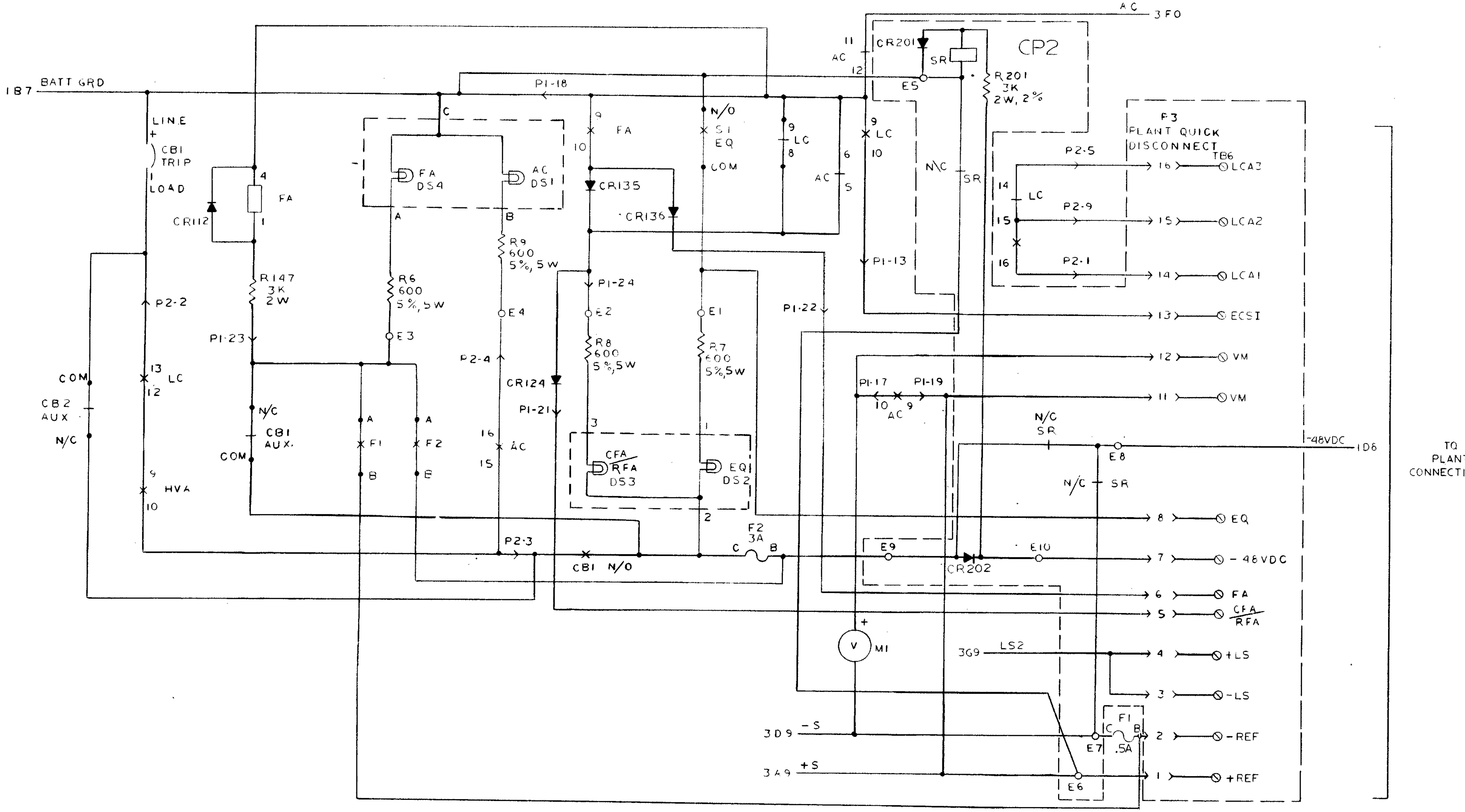
−S 3E9

PEC-3617 50A BATT. CHARGER	SD-4392324-B4
NORTH ELECTRIC COMPANY GALION, OHIO	D

3

FORM 508.22

FS5
RELAY & ALARM



PEC-3617	
50A BATT. CHARGER	SD 4392324-B5
NORTH ELECTRIC COMPANY GALION, OHIO	D

SHT 3

SHT	ISSUE
1	10/30/74
2	11/15 DW
3	8/13/75 DW

APPARATUS FOR FS1

CAPACITORS

DESIG	LOC	CODE
C1,2	1F2	304 1930 25MFD AT 660VAC
C3,4,5	1C5	304 2384 23 MFD AT 75VDC
C6,7	1F3	304 1937 .047MFD AT 1600VDC
C8,9	1B0	304 1839 .12 MFD AT 1K VDC
C10	1B6	304 1463 .82 MFD AT 200VDC
C11	1C6	054 2228 1 MFD AT 200VDC

CHOKE

DESIG	LOC	CODE
L1	1D5	622 1056
L2	1F2	622 1073

CKT. BREAKER

DESIG	LOC	CODE
CB1	1A1	305 0669
CB2	1D6	305 0669

DIODE

DESIG	LOC	CODE
CR1	1B2	337 1431 IR 704R20
CR2	1D2	

RESISTOR

DESIG	LOC	CODE			
R1	1C6	340 4500	100Ω		75W
R2,3	1F4	340 6653	150Ω	5%	1/2W
R4,5	1E3	340 6846	1KΩ	5%	2W

SCR, DIODE

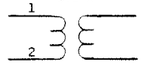
DESIG	LOC	CODE
Q1	1E3	337 1732 C152N
Q2	1F3	

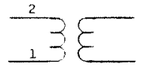
TRANSFORMERS

(601 2790)

CURRENT

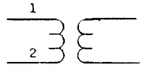
CT1-A

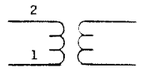




CT1-B

CT2-A





CT2-B

DESIG	CT1
TERM	LOC
1 A 2	1B3
1 B 2	1B3

DESIG	CT2-A & B
TERM	LOC
1 A 2	1A4
1 B 2	1C4

P/O MAIN FERRO

611 4853

DESIG	T1
TERM	LOC
1	1A1
2	1B2
3	1B2
4	1B2
5	1C1
6	1C1
10 A 11	1B2 1A2
12 C 13	1B2 1B2
10 C 11	1C2 1C2
12 A 13	1D2 1D2
14 A 15	1F2 1E2
14 C 15	1F2 1F2

P/O CP1 COMPONENT LIST 620 1068

DESIG	LOC	CODE
DIODE		
CR105 CR106 CR125 CR126	1E7 1F7 1E5 1G5	058 6256 400V
RES.		
R102 R103	1E7 1G7	340 6646 68Ω 2% 1/2W
TRANSFORMER		
T101 T102	1E6 1F6	050 0259 (PULSE)

APPARATUS FOR FS2

METER

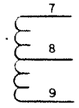
DESIG	LOC	CODE
M2	2G5	327 0321 (AMPMETER)

RESISTOR

DESIG	LOC	CODE
R10	2G6	340 6626 10Ω 2% 1/2W

P/O MAIN FERRO

(611 4853)



DESIG	T1
TERM	LOC
7	2A1
8	2B1
9	2B1

P/O CP1 COMPONENT LIST 620 1068

DESIG	LOC	CODE
RELAY		
AC	2C5	339 0646
CAPACITORS		
C101	2B4	304 1845 4000MFD AT 20VDC
C102	2C4	
C106	2E4	304 1478 1000MFD AT 10V
DIODE		
CR101-104 CR107-110 CR111	2B3 2E3 2C6	058 6256 400V
RESISTOR		
R148	2D6	340 4378 200Ω 1% 1W
R149	2F6	340 4376 3Ω 1% 1W
R169 R170	2A2 2C3	340 5343 .25Ω 1% 3W

PEC 3617
50A BATT. CHARGER

SD 439-2324-C1

NORTH ELECTRIC COMPANY
GALION, OHIO

D

FORM 800.77

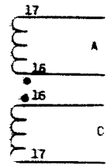
APPARATUS FOR FS3

POTENTIOMETER

DESIG	LOC	CODE			
R11	3B9]	341 0887	1KΩ	5%	W
R12	3D9]				

P/O MAIN FERRO

612 4853



DESIG	T1
TERM	LOC
16 A 17	300
16 C 17	300

P/O COMPONENT LIST 620 1068

DESIG	LOC	CODE			
CAPACITORS					
C103	3B1]				
C104	3C1]	054 2219	0.18MFD AT 200VDC	10%	
C105	3C3				
C107	3A5	304 1291	8MFD AT 30VDC		
C108	3C5]	304 1904	1.9MFD AT 20VDC		
C109	3E6]				
C110	3B8]	953 9460	2.1MFD	5%	100VDC
C111	3D1]				
C112	3C8	053 8287	0.1MFD AT 100VDC		
C113	3G2	304 1442	68MFD AT 20VDC		
C114	3G4	304 1904	1.9MFD AT 20VDC		
C117	3G7	304 1807	400MFD AT 15VDC		
C118	3A5	304 0992	0.0068MFD AT 100VDC		
DIODES					
CR113	3B4]				
CR114	3B4				
CR115	3C4				
CR116	3C7				
CR117	3E5	058 6256	400V		
CR120	]				
CR121	3G6				
CR122					
CR123	]				
POTENTIOMETER					
R123	3C5	341 0861	2KΩ	5%	1W
R138	3D8]	341 0520	1KΩ	5%	1W
R140	3G7]				

DESIG	LOC	CODE
REGULATORS		
IC101A	3B2]	
IC101B	3C2	
IC102A	3A3	
IC102B	3C3	
IC103A	3B5	
IC103B	3C5	061 7930 (A747
IC104A	3C6	
IC104B	3D5	
IC106A	3F4	
IC106B	3F2]	
RESISTORS		
R101	3D1	340 6684 20KΩ 2% 1/2W
R104	3B2]	
R105	3C1]	340 6661 1KΩ 2% 1/2W
R106	3B1]	
R107	3B1]	340 6613 510Ω 2% 1/2W
R108	3B3	
R109	3B2]	340 6677 10KΩ 2% 1/2W
R110	3C2]	
R111	3B3	340 6682 16KΩ 2% 1/2W
R112	3B4	340 6621 1.5KΩ 2% 1/2W
R113	3C4	340 6673 5.6KΩ 2% 1/2W
R114	3D4	340 6612 270Ω 2% 1/2W
R115	3B5	340 6661 1KΩ 2% 1/2W
R116	3A5	340 5958 5.62KΩ 2% 1/2W
R117	3B5	340 6725 1MΩ 2% 1/2W
R118	3C6	340 6612 270Ω 2% 1/2W
R119	3C4	340 6672 4.7KΩ 2% 1/2W
R120	3C4	340 6684 20KΩ 2% 1/2W
R121	3C4	340 6711 270KΩ 2% 1/2W
R122	3D5	340 6677 4.7KΩ 2% 1/2W
R124	3D5	340 6734 698Ω 1% 1/2W
R125	3D5	340 6709 220KΩ 2% 1/2W
R126	3B6	340 4376 3Ω 1% 1W
R127	3D6	340 6613 510Ω 2% 1/2W
R128	3B6]	340 6661 1KΩ 2% 1/2W
R129	3B6]	
R130	3C6	340 6717 470KΩ 2% 1/2W
R131	3C7	340 6605 5.1KΩ 2% 1/2W
R132	3D7	340 4339 6.04KΩ 1% 1/2W
R133	3C7	340 6684 20KΩ 2% 1/2W
R134	3B8	340 6618 3.9KΩ 2% 1/2W
R135	3A8	340 6731 402Ω 1% 1/2W
R136	3B8	340 6809 249Ω 1% 1/2W
R137	3C8	340 4343 1210Ω 1% 1W
R139	3D7	340 6651 1KΩ 2% 1/2W
R141	3F1	340 6626 10Ω 2% 1/2W
R142	3E1	340 6710 240KΩ 2% 1/2W
R150	3F3	
R151	3F4]	340 6672 4.7KΩ 2% 1/2W
R153	3G4	340 6695 56KΩ 2% 1/2W
R154	3G4	340 6677 10KΩ 2% 1/2W
R155	3F5	340 6608 100Ω 2% 1/2W
R163	3E6	340 6717 470KΩ 2% 1/2W
R164	3E6	340 6684 20KΩ 2% 1/2W

DESIG	LOC	CODE		
TRANSISTOR				
Q101	3B1]	370 0162	2N1893	
Q102	3C1]			
ZENERS				
CR127	3A4	337 1764	1N755A	7.5VDC
CR128	3A7	337 1253	1N825	6.2VDC
CR129	3C6	337 1355	1N754A	6.8VDC

PEC 3617
50A BATT CHARGER
SD 439324-C2
NORTH ELECTRIC COMPANY
GALION, OHIO

SHT / ISSUE: 1, 2

APPARATUS FOR FS4

P/D CP1 COMPONENT LIST — 620 1068

DESIG	LOC	CODE			
RELAY					
HVA	4F5	339 0645			
LC	4C4	339 0646			
CAPACITORS					
C115	4F1	053 8287	.1MFD AT 100VDC		
C116	4B6	304 1280	47MFD AT 25VDC		
DIODE					
CR118	4C3	058 6256	400VDC		
CR119	4F5				
POTENTIOMETER					
R146	4F2	341 0062	500Ω	5%	1W
R166	4C7	341 0589	2KΩ	5%	1W
REGULATOR					
IC105A	4D7	061 7930	μA747	OP-AMP.	
IC105B	4E6				
IC107	4E2				
RESISTOR					
R143	4D1	340 6613	510Ω	2%	1/2W
R144	4E1	340 6668	2.7KΩ	2%	1/2W
R145	4E2	340 6621	1.5KΩ	2%	1/2W
R152	4D1	340 6672	4.7KΩ	2%	1/2W
R156	4F3	340 5725	1MΩ	2%	1/2W
R157	4E3	340 6618	3.9KΩ	2%	1/2W
R158	4F3	340 6661	1KΩ	2%	1/2W
R159	4E5	340 6857	3KΩ	2%	2W
R160	4B5	340 6661	1KΩ	2%	1/2W
R161	4E5	340 6661	1KΩ	2%	1/2W
R162	4D6	340 6692	43KΩ	2%	1/2W
R165	4B7	340 4391	620Ω	1%	1W
R167	4E7	340 4259	3.9KΩ	2%	1W
R168	4E8	340 4258	3.6KΩ	2%	1W
TRANSISTOR					
Q103	4E4	370 0162	2N1893		
Q104	4D5	370 0303	2N5322		
ZENERS					
CR130	4C8	337 1253	1N825	6.2VDC	
CR131	4D8	337 1490	1N758A	10VDC	
CR132	4E5				
CR133	4E3	337 1072	1N751A	5.1VDC	
CR134	4F1	337 1253	1N825	6.2VDC	

APPARATUS FS5

CAPACITOR

DESIG	LOC	CODE

FUSE

DESIG	LOC	CODE	
F1	5G6	315 0605	.5A
F2	5E6	315 0610	3A

LAMPS

DESIG	LOC	CODE
DS1-AC	5B3	322 0054
DS2-EQ	5E5	
DS3-RFA	5E4	
DS4-FA	5B3	

METER

DESIG	LOC	CODE
M1	5F6	327 0324 (VOLTMETER)

RESISTOR

DESIG	LOC	CODE			
R9	5C3	340 8028	600Ω	5%	5W
R6	5C3				
R7	5D6				
R8	5D4				

SWITCH

DESIG	LOC	CODE
S1	5B4	386 0562 EQUALIZE SWITCH

P/D CP1 COMPONENT LIST — 620 1068

DESIG	LOC	CODE			
RELAY					
FA	5C2	339 0645			
DIODE					
CR112	5C1	058 6256	400V		
CR124	5D2				
CR135	5B4				
CR136	5C4				
CR137	3F1				
RESISTOR					
R147	5C2	340 6857	3KΩ	2%	2W

CP2 COMPONENT LIST — 620 1225

DESIG	LOC	CODE			
RELAY					
SR	5A6	339 0646			
DIODE					
CR201	5A6	058 6256	400V		
CR202	5E6				
RESISTOR					
R201	5B6	340 6857	3KΩ	2%	2W

PEC-3617
50A BATT CHARGER

SD-4392324-C3

NORTH ELECTRIC COMPANY, GALION, OHIO — D

SHT. ISSUE 1 D

CAD 1

EXTERNAL CONNECTIONS TO RECTIFIER

PLANT CONTROL DISCONNECT

TO PLANT CONTROL CIRCUIT

1	+REF	1	E6	CP1-(P2-19)
2	-REF	2	E7	F1-B
3	-LS	3		CP1-(P2-8)
4	+LS	4		
5	CFA/RFA	5		CP1-(P1-21)
6	FA	6		CP1-(P1-22)
7	-48V	7	E10	CR202 (CATHODE)
8	N/A (SPARE)	8		
9	N/A (SPARE)	9		
10	N/A (SPARE	10		
11	VM	11		CP1-(P1-19)
12	VM	12		CP1-(P1-17)
13	LCA	13		CP1-(P1-13)
14	LCA1	14		CP1-(P2-1)
15	LCA2	15		CP1-(P2-9)
16	LCA3	16		CP1-(P2-5)
17	N/A (SPARE)	17		
18	N/A (SPARE)	18		
19	SPARE	19		
20	SPARE	20		
21	SPARE	21		
22	SPARE	22		
23	SPARE	23		

TO CHARGE DISCHARGE CIRCUIT (BATTERY)		C3 (+)
		CB2 LOAD
	TB1	
L1	1	CB1-1 (LINE)
SEE NOTE 104 FOR WIRING INSTRUCTIONS L2	2	CB1-2 (LINE)
N	3	TB2 (ADJUSTMENT)
CHASSIS GRD.		CHASSIS GRD

PEC-3617
50A BATT. CHARGER

SD 4392324-G1

NORTH ELECTRIC COMPANY
GALION, OHIO

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FORM 886.77