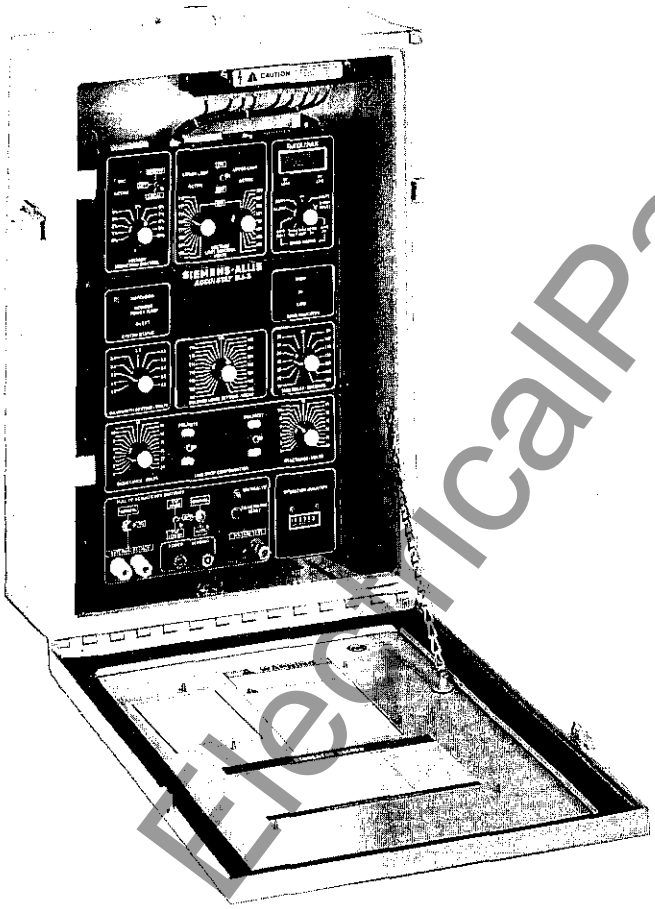
SIEMENS

Installation • Operation • Maintenance

Instructions



ACCU/STAT™ MJ-3,
MJ-2A, MJ-1A
REGULATOR CONTROL

21-115527-001
PR 4081-02

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INTRODUCTION

INTRODUCTION

The *Accu/Stat*™ MJ series are digital controls designed primarily for use with Type JFR, SFR and AFR step-voltage regulators. The *Accu/Stat* MJ-3T control is an adaptation of the *Accu/Stat* MJ-3 control incorporating additional features commonly desired on LTC transformer controls.

The *Accu/Stat* MJ-3 is similar in most operational respects to the earlier digital *Accu/Stat* MJ-1A and MJ-2A controls. Also, the *Accu/Stat* MJ-3 is electrically and mechanically interchangeable with previously supplied analog controls, the *Accu/Stat* IJ, SJ and particular UJ series.

The heart of the unit is an Intel 8022 microprocessor which includes an A/D input section to convert analog system information from the instrument transformers to a digital code which can be understood by the control processor. Digital information is then used to calculate voltage, current, and power factor. Calculated values are compared to the reference values which have been selected by operator settings on the control panel. Results of the comparison form the basis for output commands of the control.

Commonly requested accessory functions are conveniently added to the *Accu/Stat* MJ package as required:

- Reverse Power Flow capability. All controls will automatically recognize the existence of a system power reversal, but may require the addition of a supplemental relay in order to properly act upon it.
- Voltage Reduction Control. To automatically reduce the distribution system voltage by a preset percentage when remotely activated as via a SCADA command.
- Voltage Limit Control. To assure the output voltage at the regulator (or LTC) is not maintained beyond preset upper and lower limits.
- *DATA/PAK*™ Display. To provide local display of various present system parameters and information on the time-lagged excursion of these parameters. A coded display integral to the *DATA/PAK*™ display can identify situations which may require operator attention.

Accu/Stat MJ series controls are designed to operate at temperatures ranging from -40°C to +85°C (-40°F to +185°F) with accuracy levels exceeding ±0.5%. Transient overcurrent and overvoltage protection is afforded by fuses and metal oxide varistors.

WARNING

This equipment contains hazardous voltage. Personal injury due to electrical shock or property damage can result if safety instructions are not followed.

Only qualified personnel should work on this equipment after becoming thoroughly familiar with all warnings, safety notices, instructions and maintenance procedures contained herein. The successful and safe operation of this equipment is dependent upon proper handling, installation, operation and maintenance.

QUALIFIED PERSON

FOR THE PURPOSE OF THIS MANUAL AND PRODUCT LABELS, A QUALIFIED PERSON IS ONE WHO IS FAMILIAR WITH THE INSTALLATION, CONSTRUCTION AND OPERATION OF THE EQUIPMENT, AND THE HAZARDS INVOLVED. IN ADDITION, HE HAS THE FOLLOWING QUALIFICATIONS:

- Is trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.
- Is trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, etc., in accordance with established safety practices.
- Is trained in rendering first aid.

The successful field performance of the *Accu/Stat* MJ series controls depends as much on proper installation and maintenance as it does on good design and careful manufacture. Refer to these sections before performing any installation or maintenance.

The instructions included in this book are necessary for safe installation, maintenance and operation and to aid you in obtaining longer and more economical service from your regulator control. For proper installation and operation — resulting in better service and lower main-

tenance costs — this information should be distributed to your operators and engineers.

By carefully following these instructions, difficulties should be avoided. However, they are not intended to cover all details or variations that may be encountered in connection with the installation, operation and maintenance of this equipment.

Should additional information be desired, including replacement instruction books, contact your Siemens representative.

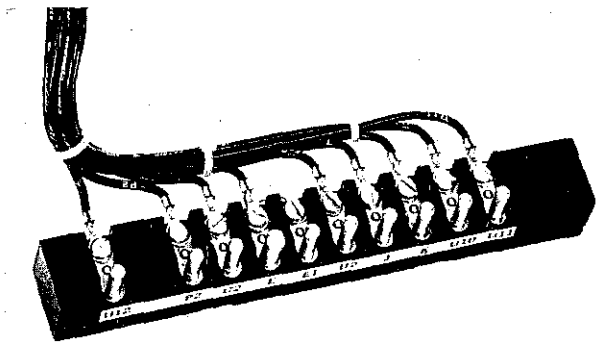
Distinctive signal words (DANGER, WARNING, CAUTION) are used in this instruction book to indicate degrees of hazard that may be encountered by the user. For the purpose of this manual and product labels these signal words are defined below.

DANGER Indicates death, severe personal injury or substantial property damage **will** result if proper precautions are not taken.

WARNING Indicates death, severe personal injury or substantial property damage **can** result if proper precautions are not taken.

CAUTION Indicates minor personal injury or property damage **could** result if proper precautions are not taken.

REPLACEMENT OF EARLIER CONTROLS WITH THE *ACCU/STAT* MJ CONTROL



The MJ control is directly interchangeable with previous types IJ-2, IJ-2A, SJ-3, SJ-4, SJ-5, SJ-6, UJ-5C, and UJ-5AC. It will mount in the original enclosure simply by swinging the control to be replaced outward on its hinges, removing and inserting of the MJ. If the original control has modifications such as Auxiliary VT, Auxiliary CT, Reverse Power Flow Detector, Voltage Limit Control, Voltage Reduction Control, or other accessories mounted in the enclosure, such must be removed to allow room for installing the MJ. The MJ may or may not have the needed accessory included in itself. If not, it will be necessary to remount the needed accessory in its own weatherproof enclosure and affix it to the side of the panel enclosure, or add it in kit form to the MJ.

Note 1: The control being replaced may incorporate a jumper between the P2 and U2 terminals on the female (stationary) portion of the polarized disconnect switch (PDS, or, jack plug). If, and only if, this jumper is present:

A. Remove the jumper.

B. Remove the P2 lead from the P2 screw terminal. Reconnect the P2 lead to the U2 screw terminal, leaving the P2 terminal vacant.

WARNING

Joining of P2 and U2 lines from the regulator will cause a direct short circuit of the two voltage sources.

Severe internal damage will occur.

Never connect the P2 and U2 leads to the same terminal.

Note 2: To replace panel types UA-23, UA-24, UA-25 (also type UJ-1 used on S/N's 9-0110-00159, 00163, and 00201) a special mounting adapter kit is required. To make use of this adapter kit, Cat. No. 1670, the MJ-3 must be installed complete with its enclosure.

Note 3: To replace panel types UJ-4 and UJ-5 with the MJ, replace the 10 pin male portion of the PDS of the MJ with the 7 pin male PDS from the older control. Tape up the three unused leads U10 (operation counter), U11 (drag hand reset), and U12 (***Neutralite***). Install a jumper wire from C1 to E on the female portion of the PDS.

Note 4: To replace controls other than those named, refer to the factory for special engineering instructions.

Note 5: Regardless of panel type being replaced, the MJ must be configured to operate with the particular regulator on which it is being installed.

FACEPLATE CONTROLS

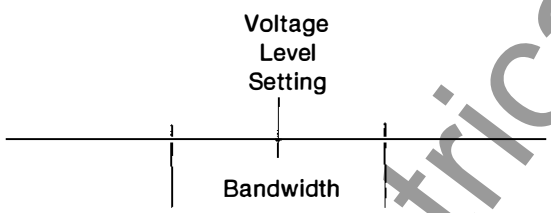
BASIC FUNCTIONS

Light Emitting Diode (LED) flashes at 6 Hz rate indicating proper operation of the microprocessor.

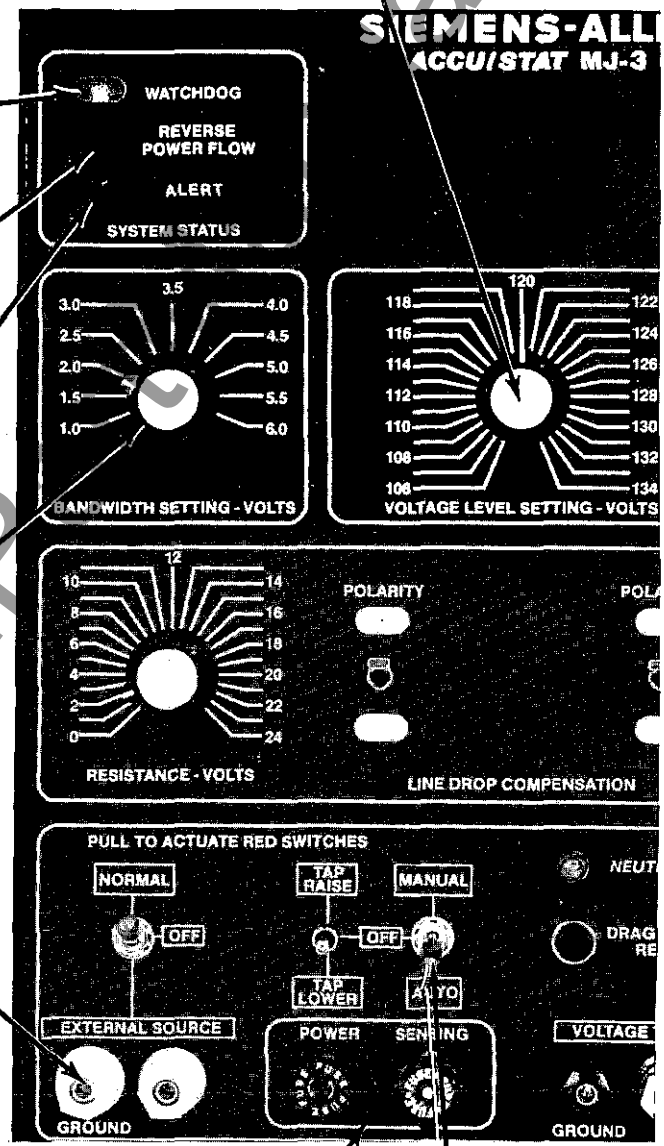
The control will automatically sense a condition of system power flow reversal, illuminating the LED.

When illuminated, indicates a condition which may require operator attention.

The voltage through which the control will remain "in" band. The voltage level setting is at the bandwidth center.



The Output voltage desired to be held by the regulator. When line drop compensation is used, the output voltage is the voltage at the load center.



The voltage source for the control is NORMAL (from the regulator's internal voltage supply) or EXTERNAL (from a properly polarized 120VAC source).

CAUTION

Improper external source connection will place 120V on the ground circuit.

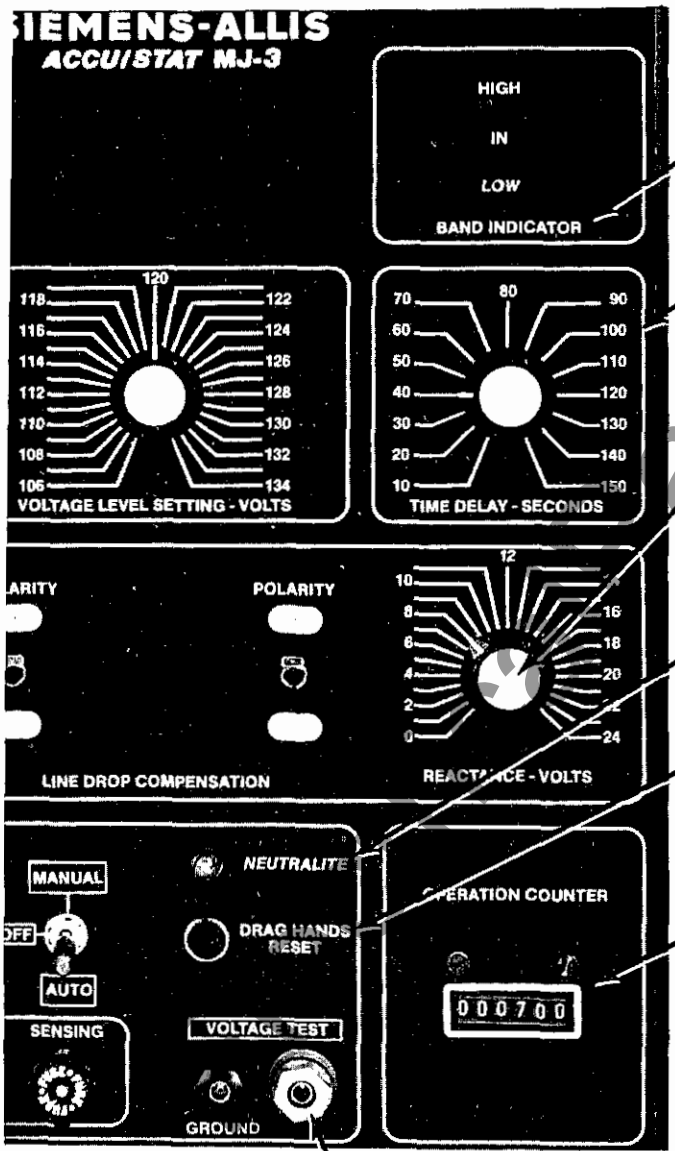
Equipment damage can occur.

Observe proper polarity of external power supply.

Independent fusing of the power and voltage sensing circuits.

Selection of Automatic Control or Manual Raise/Lower command of the regulator.

FACEPLATE CONTROLS



Indication of output voltage relative to bandwidth setting.

Intentional time lag between out of band condition and start of tapchanger drive motor.

Line drop compensation is used to model the resistive and reactive voltage drop of the line to cause the regulator to hold the voltage desired at the load center. This feature is inactive during system reverse power flow condition.

The light is illuminated when the regulator is in the neutral position.

The drag hands on the tap position indicator are reset to the present tap position by depressing this button.

A count of the number of regulator tap change operations.

A voltmeter will display the regulator output voltage.

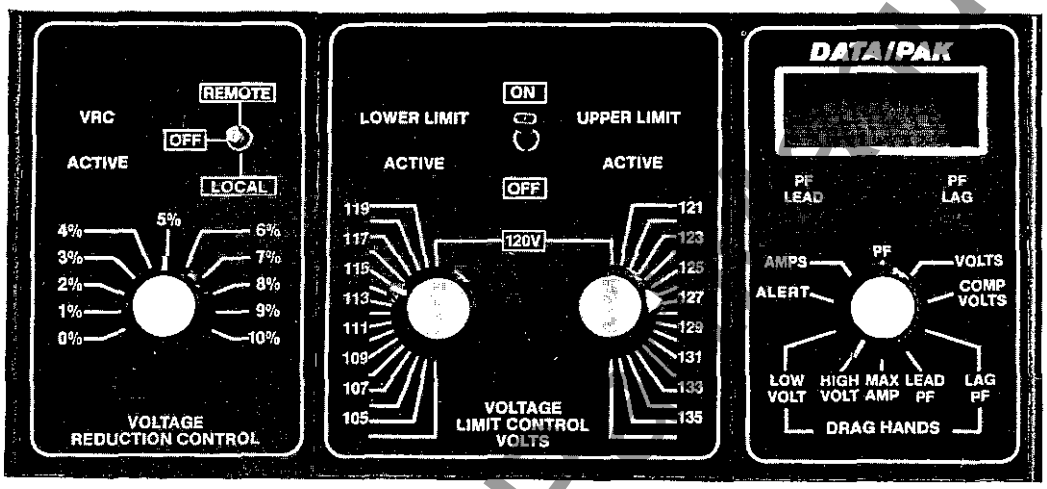
WARNING

Voltage applied at test terminals may energize regulator to high voltage through voltage transformer.

Death or severe electrical shock can occur.

Do not connect any voltage source at the voltage test terminals.

ACCESSORY FUNCTIONS



Any combination of Voltage Reduction Control, Voltage Limit Control and *DATA/PAK* Display may be supplied as optional accessories to an *Accu/Stat* MJ Control. When supplied, the accessory package will be oriented above the basic control in the relative position pictured.

- Voltage Reduction Control. When activated causes the regulator to lower its output voltage by the preset percentage. Control can be activated locally for test or remotely, as via a SCADA system connected to appropriate points on the rear of the control. When activated, the command for reduction is immediate, overriding the time delay set on the basic control. An LED is illuminated when the VRC is active.

- Voltage Limit Control. The VLC is automatically activated and a tapchange prevented if the **next** tapchange raise (or lower) would put the output voltage above (or below) the preset limit. Further, if because of a change in system condition, the voltage moves outside the limits, the control will automatically operate to put the voltage within the limits. As with the VRC, activation due to VLC is immediate and without regard to the basic control time delay setting. Individual LED's display when the lower or upper limit is active.

It is apparent that the basic control, VRC, VLC and the Automatic Tapchange Inhibit feature (see page 11) need a ruling priority.

- Highest Priority — Automatic Tapchange Inhibit
- Second Priority — Voltage Limit Control
- Third Priority — Voltage Reduction Control
- Fourth Priority — Basic control panel voltage level setting, including effect of line drop compensation and time delay.

- *DATA/PAK* Display. Many meter functions are built-in and may be conveniently displayed.

  - COMP VOLTS. The present voltage at the theoretical load center based upon known regulator output voltage and current and the resistance (R) and reactance (X) of the line as modeled in Line Drop Compensation. It is the voltage to which the regulator responds. Compensated volts will be the voltage level setting to within the tolerance of the bandwidth.

  - VOLTS. The present output voltage of the regulator. This will be identical to comp volts if line drop compensation is set to zero. It is to this voltage that the VLC option responds.

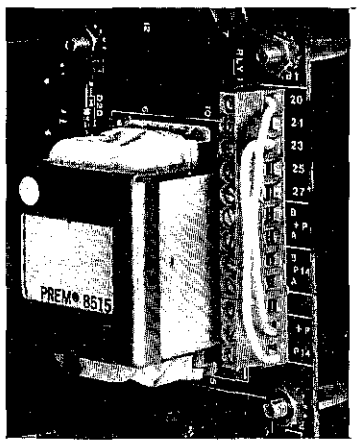
- PF. The present line power factor at the regulator. The PF LEAD or PF LAG light will illuminate when the switch is in the PF position.
- AMPS. The present load current. The current display will be in error to ±10% during condition of system power reversal because the CT is then effectively on the source of the regulator and consequently includes shunt winding current.
- DRAG HANDS. Extremes of the above parameters are recorded in non-volatile permanent memory and may be accessed via the drag hand position. The memory is reset to the present value by depressing the button switch above the display while displaying the particular parameter.
- ALERT. There are certain conditions which affect the operation of the control of which the operator should be aware, and other conditions which may be useful to the technician if repair is required. In the event the ALERT light is illuminated on the basic control, switching the *DATA/PAK* unit to ALERT will display the reason for the alert signal. See page 20 for additional detail.

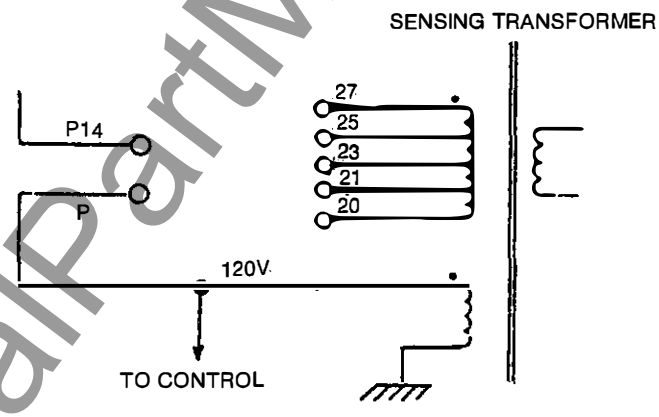
The *Accu/Stat* MJ control must be configured to the regulator with which it is being used.

INSTALLING JUMPERS AT THE SENSING TRANSFORMER

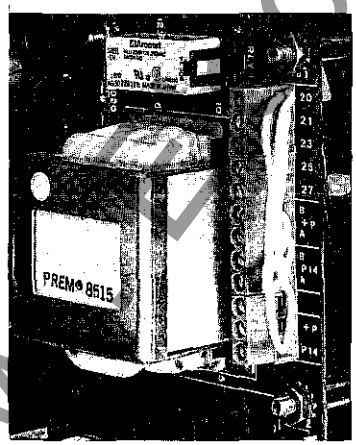
Some regulators are built with a turns ratio that does not provide exactly 120 volts to the control at rated voltage. To compensate for this and provide 120 volts to the control, a tapped sensing transformer is used in the MJ panel. This adjustment of the "P" voltage to 120 volts, if required, is accomplished using taps on the sensing transformer. These taps are brought to the terminal block located on the control transformer board as illustrated pictorially and schematically below.

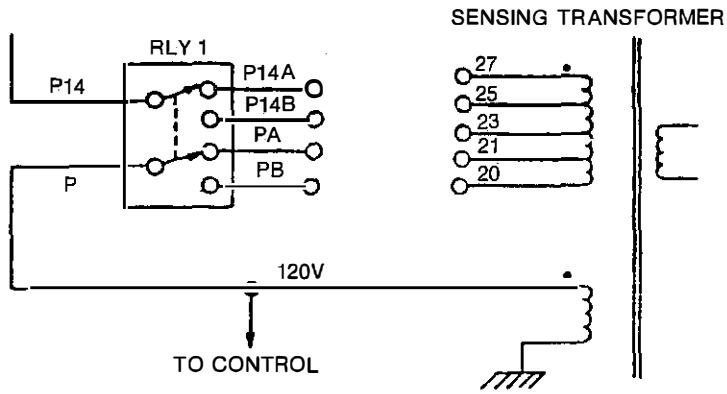
The two illustrations differ by the presence of a relay at the RLY1 position. **Even though the basic control will recognize the existence of a power reversal, this relay must be added for the control to function properly under reverse power flow conditions.**





Where reverse power flow is not expected.





Where reverse power flow may occur.

> **⚠ CAUTION**
>
> Failure to include a relay at RLY1 position may result in improper voltage level sense of the control under condition of system power flow reversal.
>
> The regulator output voltage may not be held to the desired voltage. User property damage can occur.
>
> Include RLY1 and appropriate sensing transformer connections if a system power flow reversal is anticipated.

If the regulator will be used on a system where reverse power flow is not a consideration, voltage compensation may be made using points P14 and P in conjunction with points 20, 21, 23, 25 and 27. If reverse power flow can occur, points P14A and PA are used for one mode (FPF or RPF) and point P14B and PB are used for the other as follows:

	Regulator Style*		
Power Flow Condition	**1ϕ Straight**	**1ϕ Inverted**	**3ϕ**
Forward	P_{14B}, P_B	P_{14A}, P_A	P_{14B}, P_B
Reverse	P_{14A}, P_A	P_{14B}, P_B	P_{14A}, P_A

* See Appendix I for a description of how to determine if a given regulator is of "straight" or "inverted" design, based upon the nameplate information.

Consequently, the basic connections for the terminal strip will differ based upon:

1) The regulator is, or is not, subject to a system power flow reversal.
2) Single phase or three phase regulator.
3) Single phase regulator of straight or inverted design.

Note, in regard to the terminal strip designations 20-21-23-25-27 that these numbers are indicative of the voltage of each tap. Thus, 120V ± 7V at P14 may be adjusted to the required 120V at P by appropriate use of the taps, configuring the primary of the sensing transformer as an autotransformer. Consult the factory in the event more than 7 volts of correction is required.

The following examples will illustrate the procedure.

EXAMPLE CASE 1: Forward Power Flow Only, 1ϕ Regulator, Straight Design

Examination of the nameplate will show P2 voltage as 120V. Consequently, no voltage correction is needed. Connect "P14" and "P" to terminal 20.

EXAMPLE CASE 2: Forward Power Flow Only, 1ϕ Regulator, Inverted Design

Examination of the nameplate will show the P2 voltage as a value between 113V and 127V. This will be the P14 voltage which is to be corrected to 120V at P. The sensing transformer will be connected to accomplish this correction.

To determine the correction required, subtract 120V from the P14 voltage, observing the proper sign of the result. Implement this correction via the 20-21-23-25-27 taps of the sensing transformer.

Example: P2 = 125V
Calculate: 125-120 = +5 V
Connect: P14 to 25; P to 20

Example: P2 = 116V
Calculate: 116-120 = –4V
Connect: P14 to 21; P to 25

Note 1: In the second example, a negative voltage is calculated which is recognized by reversing the polarity of the tap section of the sensing transformer.

Note 2: In the second example, a 4V correction is accomplished by using taps which represent the magnitude difference of 4V. It is not necessary to always use Point 20.

EXAMPLE CASE 3: Forward Power Flow Only, 3ϕ Regulator

Siemens three phase regulators are of the straight design, so normally the provisions of Example Case 1 will apply. There are, however, isolated cases where the P2 voltage is not the exact reference voltage. Examination of the nameplate will show if this is true. In such cases, the procedure of Example Case 2 will apply if a 120V reference is desired. Note: The reference voltage for a 3-phase regulator may not be 120V; in many cases 115V or other reference voltage has been used.

EXAMPLE CASE 4: Subject to Reverse Power Flow, 1ϕ Regulator, Straight Design

For a straight design regulator use:

1) P14B and PB terminals for sensing transformer tap connections for condition of forward power flow.

2) P14A and PA terminals for sensing transformer tap connections for condition of reverse power flow.

Examination of the nameplate will show P2 voltage as 120V. Consequently, no voltage correction is needed for FPF condition. Connect P14B and PB to terminal 20.

The auxiliary winding is used as the source side VT for RPF. Examination of the nameplate will show this voltage (U2) as a value between 113V and 127V. This will be the P14A voltage which is to be corrected to 120V at P. The sensing transformer will be connected to accomplish this correction.

To determine the correction required, subtract 120V from the P14A voltage, observing the proper sign of the result. Implement this correction via the 20-21-23-25-27 taps of the sensing transformer.

Example: U2 = 125V
Calculate: 125-120 = +5V
Connect: P14A to 25; PA to 20

Example: U2 = 116V
Calculate: 116-120 = -4V
Connect: P14A to 21; PA to 25

Note 1: In the second example, a negative voltage is calculated which is recognized by reversing the polarity of the tap section of the sensing transformer.

Note 2: In the second example, 4V correction is accomplished by using taps which represent the magnitude difference of 4V. It is not necessary to always use point 20.

EXAMPLE CASE 5: Subject to Reverse Power Flow. 1ϕ Regulator, Inverted Design

For an inverted design regulator use:

1) P14A and PA terminals for sensing transformer tap connections for condition of forward power flow.

2) P14B and PB terminals for sensing transformer tap connections for condition of reverse power flow.

The auxiliary winding is used as the voltage source for FPF. Examination of the nameplate will show this voltage (P2) as a value between 113V and 127V. This will be the P14A voltage which is to be corrected to 120V at P. The sensing transformer will be connected to accomplish this correction.

To determine the correction required, subtract 120V from the P14A voltage, observing the proper sign of the result. Implement this correction via the 20-21-23-25-27 taps of the sensing transformer.

Example: P2 = 125V
Calculate: 125-120 = +5V
Connect: P14A to 25; PA to 20

Example: P2 = 116V
Calculate: 116-120 = -4V
Connect: P14A to 21; PA to 25

Note 1: In the second example, a negative voltage is calculated which is recognized by reversing the polarity of the tap section of the sensing transformer.

Note 2: In the second example, a 4V correction is accomplished by using taps which represent the magnitude difference of 4V. It is not necessary to always use Point 20.

Examination of the nameplate will show P12 voltage as 120V. Consequently, no voltage correction is needed for RPF condition. Connect P14B and PB to terminal 20.

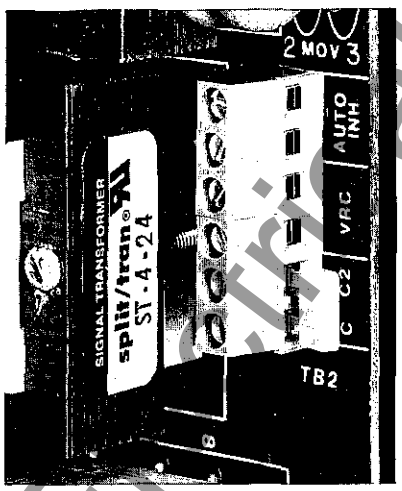
EXAMPLE CASE 6: Subject to Reverse Power Flow, 3ϕ Regulator.

It would be unusual to apply a three phase regulator in a system where reverse power flow could occur. If, however, the situation does exist:

1) Treat the regulator as a straight design
2) Follow procedure of Example 3 for forward power flow condition.
3) Follow procedure of Example 4 for reverse power flow condition.

INSTALLING JUMPERS AT THE AUXILIARY CONNECTION TERMINAL STRIP

The *Accu/Stat* MJ-3 control includes provisions for three auxiliary connections.



1) Automatic Tapchange Inhibit. The closure of an external contact across the AUTO INH terminals will prevent automatic (only) operation of the control. This represents the highest level of command in the priority of automatic operation. The auto inhibit feature is new with the MJ-3.

Note: The *Accu/Stat* MJ-1A and MJ-2A controls do not include the automatic tapchange inhibit feature. The corresponding terminals are designated N0-N10 and must remain shorted at all times.

2) Voltage Reduction Control. The closure of an external contact across the VRC terminals will cause the regulator to reduce the output voltage by the percentage which has been preset on the accessory component. The toggle switch on the component must also have been set to REMOTE.
3) Current Transformer Secondary. The nominal 200 mA secondary of the regulator CT is routed through these terminals. These terminals are shorted at the factory and must remain shorted except as they are used to accommodate auxiliary apparatus, such as a current demand meter.

DANGER

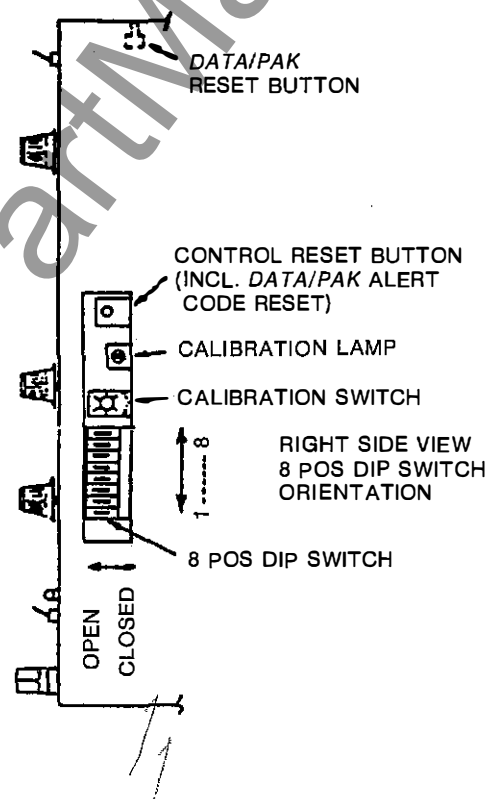
Open CT secondary will result in high voltage at CT terminals.

Death, severe injury or damage to equipment can occur.

Do not operate with CT secondary open. short circuit or apply burden at CT secondary (C2-C) during operation.

SETTING THE 8 POSITION DIP SWITCH

The *Accu/Stat* MJ control must know certain details concerning desired operating mode, regulator design, and power system arrangements. This information is programmed into the MJ through the 8 position DIP switch located at the lower part of the slot found on the right side of the control. The functions of each switch are as follows:



Opening Switch 1 advances current 90 degrees. Set closed for all single phase regulators. Set closed on three phase regulators with single phase CT. Set open on three phase regulators with phase to phase connected CT's.

Closing Switch 2 will prevent any tap change if current is less than 2 percent of the regulator's rated current. To enable low current tap change, Switch 2 should be open.

Switch 3 not used at present, set closed.

With Switch 4 in the closed position, the control panel senses true RMS voltage and current. In the open position, the control will sense averaged derived RMS values, the same as sensed in previous analog controls. Any difference in the values is attributable to harmonic distortion. Factory set closed.

Switch 5 should be closed on regulators on wye connected systems and should be open on regulators on delta connected systems.

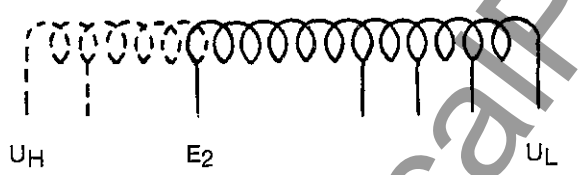
Switch 6 should be closed on "lagging" regulators on delta systems and open on "leading" regulators on delta systems.* Switch 6 has no effect when Switch 5 is set for a wye system.

* See Appendix II for a description of how to determine the "leading" and "lagging" regulators on an open delta system.

The relative polarity of the utility (tertiary) winding and the current transformer must be established for the MJ. Switch 7 shifts the current signal 180° if open. The correct switch setting is established by examination of the utility winding diagram and knowledge of the regulator design.

See Appendix I for a description of how to determine if a given regulator is of "straight" or "inverted" design, based upon nameplate information.

1. For a single phase inverted design regulator, set Switch 7 closed.
2. For a single phase straight design or a three-phase regulator, refer to the nameplate illustration of the utility winding. The winding will appear basically as shown below. (The dashed segment may not be present. U_H, if present, is on the opposite side of E_2 from U_L. Numerically, the subscript "H" represents a number higher than the number represented by L. There may be more or less taps than shown. U_L may be to the right or left of U_H).



The polarity mark will be on U_H or E_2 or U_L

a. If the polarity mark is on U_H or E_2

1) For a single phase straight design regulator or a three phase regulator with a single current transformer, set Switch 7 closed.

2) For a three phase regulator with two cross connected current transformers, set Switch 7 open. (Refer to nameplate for CT connections).

b. If the polarity mark is on U_L

1) For a single phase straight design regulator or a three phase regulator with a single current transformer, set Switch 7 open.

2) For a three phase regulator with two cross connected current transformers, set Switch 7 closed. (Refer to nameplate for CT connections).

Switch 8 is to be closed for straight design single phase regulators and for all three-phase regulators. Set this switch open for inverted design regulators.

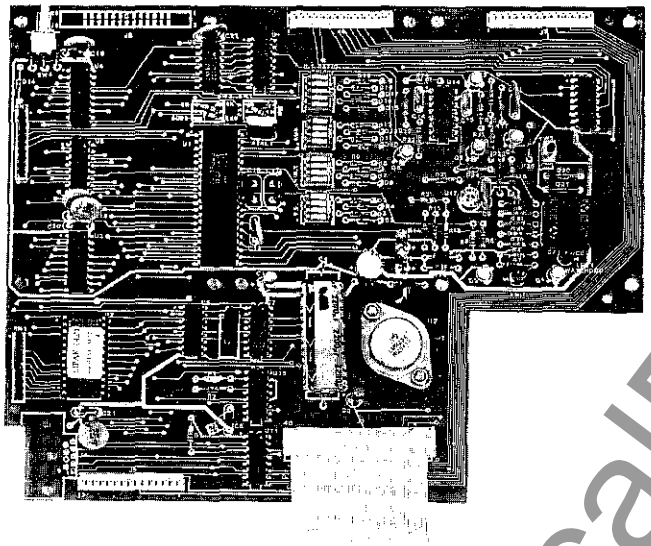
8 POSITION DIP SWITCH SUMMATION

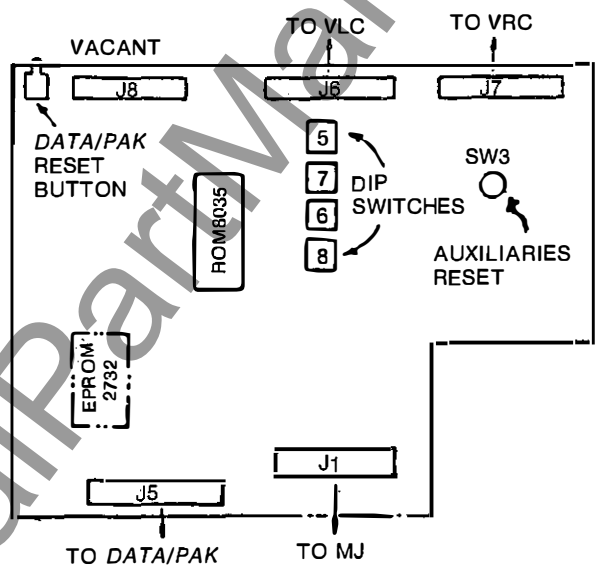
Switch No.	Function	Condition Open	Condition Closed
1	90° Current Advance	Advance In	Advance Out
2	Low Current Inhibit	Automatic Operation at any or no load	No Automatic Operation at less than 2% load
3	Not Used At Present	—	—
4	Sample Mode (Voltage and Current)	Average Derived	True RMS
5	WYE/Delta Regulator Configuration	Delta	WYE
6	30° Delta Regulator Configuration	Delta Conn. Leading Regulator	Delta Conn. Lagging Regulator
7	Utility Winding Polarity		
8	Straight/Inverted Regulator	Inverted	Straight and All Three Phase

SETTING *DATA/PAK* CURRENT DISPLAY (5 Position DIP Switch, if Supplied)

Controls equipped with *DATA/PAK* accessory require the correct CT ratio be input to the control to provide the correct current display. This is accomplished by properly setting the 5 position DIP switch (SW5) located on the auxiliary printed circuit board (PCB). Reference figure below.

Set the 5 position DIP switch in accordance with the following table to provide the proper multiplier for the current display on *DATA/PAK*. See nameplate for CT primary rating.





CT Primary Rating	Pos 1	Pos 2	Pos 3	Pos 4	Pos 5
50	C	C	C	C	C
75	O	C	C	C	C
100	C	O	C	C	C
150	O	O	C	C	C
200*	C	C	O	C	C
250	O	C	O	C	C
300	C	O	O	C	C
350	O	O	O	C	C
400	C	C	C	O	C
600	O	C	C	O	C
700	C	O	C	O	C
800	O	O	C	O	C
1000	O	C	O	O	C
1200	C	O	O	O	C
1400	C	C	O	O	C
2000	O	O	O	O	C

O = Open C = Closed

* This setting may be used for direct reading of CT secondary current (in milliamperes).

SETTING *DATA/PAK* INTEGRATION TIME FOR VOLTAGE, CURRENT AND POWER FACTOR

Accu/Stat MJ controls will display voltage, current and power factor as a time integrated readout. The time intervals selected can be set independently of each other via three 4 position DIP switches (SW6-Volts, SW7-Amps, SW8-Power Factor).

Position 4 on Switches 6, 7, and 8 relates to present value parameters on the *DATA/PAK*. Set closed for instantaneous response. Set open for lagged response. If position 4 is set open, integration periods will be that selected by positions 1, 2 and 3. (Factory set closed).

Positions 1, 2, and 3 select the integrating period for drag hand parameters (and the present value parameters if position 4 is set open).

Demand Period (Min.)	POS 1	POS 2	POS 3
0.25	C	C	C
0.50	O	C	C
1.0	C	O	C*
2.0	O	O	C
5.0	C	C	O
15.0	O	C	O**
30.0	C	O	O
60.0	O	O	O

* Factory set, SW6, SW8

** Factory set, SW7

SETTING THE BASIC FUNCTIONS

Accu/Stat MJ control panels perform the basic control functions as they are influenced by the desired voltage level, voltage bandwidth, time delay and line drop compensation settings. Settings are accomplished via incremental switch point using rotary switches on the face of the control. No locking of the knobs is required.

- Voltage Level — Calibration is in terms of a 120V base, or other base voltage as may be noted on the nameplate. This is the voltage to which the regulator responds. It will be the voltage at the load center when line drop compensation is used.
- Bandwidth — The displayed value indicates the total bandwidth voltage; the bandwidth range is divided equally above and below the voltage level setting. Set a bandwidth large enough to assure that a single tapchange cannot cause the output voltage to go through the band and small enough to force the regulator to hold the desired tolerance on the output voltage.
- Time Delay — It is not normally desired to respond to voltage dips or disturbances of short duration. Set the intentional time delay to a duration for which the voltage must remain out of band before the control initiates a tapchange.
- Line Drop Compensation — The line drop compensation is set to compensate for the line voltage drop between the regulator and the load center, usually by holding a higher voltage at the regulator output. The increase in voltage at the regulator caused by line drop compensation is a function of the resistance and reactance settings of the control, and the actual line current. Knowledge of line current and line impedance can be manipulated into the magnitude of the line voltage drop.

There are several methods used to determine line drop compensation settings. The "Load Center" method is probably the most commonly used and most clearly illustrates the procedure.

1. Using knowledge of the distribution feeder and Appendix III, establish the conductor resistance and reactance per mile of the feeder.

   EXAMPLE: Conductor 4/0 ACSR, Regular Flat Spacing at 24 inches.

   $$D = \sqrt[3]{24 \times 24 \times 48} \cong 30 \text{ inches}$$

   R = 0.592 ohms/mile X = 0.692 ohms/mile

2. Determine compensation multiplier, k, as

   - Single Phase

   $$k = 2.0 \times \frac{\text{Current Transformer Primary Rating}}{\text{Voltage Transformer Ratio}}$$

   - Wye Connected

   $$k = 1.0 \times \frac{\text{Current Transformer Primary Rating}}{\text{Voltage Transformer Ratio}}$$

   - Delta Connected

   $$k = 1.73 \times \frac{\text{Current Transformer Primary Rating}}{\text{Voltage Transformer Ratio}}$$

   EXAMPLE: The regulators involved are 3 - 333 kVA at 7.2 kV configured in a wye connected three phase bank

   (The C.T. primary for this regulator is 400 A)

   $$k = 1.0 \frac{400}{7200/120} = 6.67$$

   NOTE: Multipliers for many common system voltages and regulator ratings are included in Appendix III.

3. Resistive Compensation Setting = k x line length (mi) x resistance (ohms/mi)

   Reactance Compensation Setting = k x line length (mi) x reactance (ohms/mi)

   EXAMPLE: The line is 3 miles long.

   Resistance Setting = 6.67 x 3 x .592 = 12V
   Reactance Setting = 6.67 x 3 x .692 = 14V

Polarity switches on the MJ series control should be set in the positive position.

SETTING THE ACCESSORY FUNCTIONS

- Voltage Reduction Control — Set the knob to the percent voltage reduction desired when activated. Place the toggle switch in "Remote" to have activated by external means.
- Voltage Limit Control — Set knobs to the maximum and minimum voltages desired to be held at the regulator.

The maximum voltage might be set to a value of 128V to assure line drop compensation does not cause an unduly high voltage at the regulator.

The minimum voltage might be set to a value of 115V to assure that implementing a remote voltage reduction does not cause an unduly low system voltage.

INSTALLATION AND PRELIMINARY CHECKOUT

The following steps are recommended to be followed at time of the initial installation.

1) Be sure the control has been properly configured for the regulator application to which it is being applied. See page 8-15.

2) If present, set the voltage reduction control and voltage limit control accessories on the OFF position and set the *DATA/PAK* switch on caps. Set the EXTERNAL SOURCE/NORMAL power switch and the MANUAL/AUTO transfer switch to the OFF position.

3) Place the MJ control panel on the hinges in the enclosure. Connect the polarized disconnect plug making sure that both wing nuts are tight. Note: If placing the MJ control on an existing regulator which uses an older series of control and a voltage limit control, voltage reduction control, or reverse power flow detector, remove those accessory items prior to installing the MJ.

⚠ WARNING

Hazardous voltages will be present on various control leads when regulator is energized.

Death, severe personal injury or property damage can result from contact with control line conductors.

By-pass the regulator and de-energize before removing accessory items from the control box.

4) With the control physically in place and connected at the polarized disconnect plug, set the voltage level, bandwidth, time delay and line drop compensation settings to the desired values. See pages 16-17.

5) Turn the EXTERNAL SOURCE/NORMAL Power Switch to the NORMAL setting. The control panel is now energized. The WATCHDOG light should now be flashing at a 6 Hz rate.

6) The ALERT light may be activated at this time. If it is, set the *DATA/PAK* switch (if present) to ALERT. A code will appear. Refer to page 20 for instructions to decipher the code.

7) Verify Manual Operation. Move the transfer switch from OFF to MANUAL. Press the spring return transfer switch to the TAP RAISE position. The regulator will run in the raise direction. After the regulator makes a few tap changes, push this transfer switch to the TAP LOWER position. The regulator will run in the lower direction. Run the regulator to the neutral position and verify that the *Neutralite*™ operates properly. Return the transfer switch from the MANUAL position to the OFF position.

8) The REVERSE POWER FLOW light should be illuminated only if, in fact, a power reversal condition exists. If the lamp is erroneously on or off, most likely DIP switch position 7 is set improperly.

9) Verify Automatic Operation. Set the LINE DROP COMPENSATION settings to zero. Set the VOLTAGE LEVEL SETTING to the voltage read on the *DATA/PAK* present voltage display, if supplied, or to the value read with a meter at the external test terminals. The "IN" BAND INDICATOR light will now be illuminated. Set the transfer switch from "OFF" to "AUTO". Increase the voltage level setting until the "LOW" band indicator light is activated. After the regulator completes the preset time delay, the regulator will automatically raise the voltage until the "IN" band indicator light is again activated. To verify automatic operation in the reverse direction, lower the voltage level setting until the "HIGH" band indicator light is activated. After the regulator again completes the preset time delay, the regulator will automatically lower the voltage until the "IN" band indicator light is activated.

Note: If the control will not operate in the automatic mode, check Switch 2 on the 8 position DIP switch located in the slot on the side of the MJ control. If Switch 2 is closed and the control is being checked out in a shop or on a regulator that is not carrying load current, there will not be the required minimum 2% current. Simply set Switch 2 to the open position to permit the control to operate in automatic mode under the low current condition. Be sure to set Switch 2 back to the closed position after completing the checks if this is the desired position for the system.

10) If present, verify VOLTAGE LIMIT CONTROL (VLC). Set the upper limit on the VLC to a value above the present voltage being read on the *DATA/PAK* display. Set the lower limit to a value below that being read. Turn the VLC on. Raise the voltage level setting to a value above that set on the upper limit of the VLC. After the control times out, the regulator will start running in the raise direction until the upper limit light on the VLC is activated. At this point, the regulator will stop and the voltage on the *DATA/PAK* unit will be slightly less than that set on upper limit of the VLC. (Note: Under actual line conditions, the output voltage may become higher or lower than set on the VLC. When this situation occurs, the control will operate the regulator, without time delay, to an output voltage between the limits set on the VLC). Now lower the voltage level setting to a value below that set on the lower limit setting of the VLC. After the control times out, the regulator will begin lowering the the voltage until the lower limit light on the VLC is activated. At this point, the regulator will stop and the voltage on the *DATA/PAK* will be slightly higher than that set on the lower limit of the VLC. Return the voltage level setting to its previous setting and turn the VLC off.

11) If present, verify VOLTAGE REDUCTION CONTROL (VRC). After the voltage returns to its balanced position, set the voltage reduction control (VRC) to 3% and note the voltage shown on the *DATA/PAK* display. Set the BANDWIDTH to 1.5 volts. Now set the VRC for local operation. The regulator will now run (without time delay) in the lower direction until the voltage on the *DATA/PAK* display is approximately 3% lower. Once complete, set the VRC switch back to the OFF position. The voltage will return to that set on the voltage level setting.

12) When proper operation of the control has been verified, reset all control panel adjustments to the desired values.

USING THE *DATA/PAK* ALERT CODES

There are certain abnormal conditions of which the operator should be aware and which may affect control operation. If the cause of such an alert condition prevails, the ALERT light will be illuminated in the front of the control. A code will simultaneously be shown on the *DATA/PAK* display signaling the cause of the alert condition. Also, a condition which causes an alert may pass. If such is the case, the ALERT light will extinguish with the passing of the event, but a code describing the condition will remain in storage and be accessible on the *DATA/PAK* unit, until reset.

Only the following codes are of significance to the user:

Code Viewed In Position	Display	Explanation
Left	1	Load Current is less than 2% of CT primary rating.
Left	2	Voltage Level sense is very low. Probably a loss of the voltage signal.
Left	3	Simultaneous low current and low voltage condition.
Left Center	8	Load current is greater than 350% of CT primary rating.

Numerous other codes may occasionally be displayed. If a control problem is suspected, the code may be of value to the technician to analyze the problem. Otherwise, the alert code should simply be reset without further concern.

To reset the *DATA/PAK* alert code, depress and release the basic control reset button located on the right side of the control panel as illustrated on page 12.

CALIBRATION

The Accu/Stat MJ is calibrated at the factory and will normally not ever require subsequent field adjustment. The following procedure may be used if, however, it is determined that calibration is necessary.

1) Set the EXTERNAL SOURCE/NORMAL switch to OFF.

2) Place a jumper between the P and P14 points on the terminal strip. This must be the **only** jumper on the sensing transformer tap terminal strip.

3) Connect a nominal 120VAC source at EXTERNAL source terminals observing proper polarity.

4) Connect the voltmeter against which the control will be calibrated at the voltage test terminals. Determine if the voltmeter used is a true rms reading meter or is displaying an rms value calibrated from an average voltage sample.

5) Set position 4 of the 8-position DIP switch to

   "CLOSED" if the reference voltmeter is displaying true rms voltage

   or

   "OPEN" if the reference voltmeter is displaying an rms value calibrated from an average voltage response.

6) Set the EXTERNAL SOURCE/NORMAL power switch to EXTERNAL SOURCE. The control is now energized.

7) Set the VOLTAGE LEVEL SETTING to the voltage level read on the reference voltmeter.

8) When the voltage level setting and meter reading are equal, the red lamp in the right hand side slot will illuminate. Rotate the calibration switch until this condition is satisfied. The control is now calibrated.

9) Once completed, be sure to reset the DIP switch, position 4, if necessary. Reconnect the proper jumpers on the sensing transformer tap terminal strip.

TROUBLE SHOOTING

When equipped with all accessories, the *Accu/Stat* MJ control consists of six printed circuit boards. Generally, field repairs are limited to the printed circuit board level.

Experience reveals in many cases that presumed faulty operation of the control is the result of a simple misunderstanding or improper configuring of the control to the regulator on which it is used. Also, there have been numerous cases reported of (especially) line power factor display on DATA/PAK being unbelievable, but, in fact, correct.

If difficulty is encountered, the following steps are recommended.

1. If possible, substitute another control on the regulator. This will aid in confirming that the particular control is at fault and that the problem does not reside in the regulator.
2. Check the control against the series of symptoms, possible causes and remedial actions listed below. A simple defect may quickly become apparent and be easily resolved.
3. Complete the check sheet. Call your local Siemens-Allis representative for advice or instructions to call the factory.

SYMPTOMS	POSSIBLE CAUSE	REMEDIAL ACTION
Unit does not "wake-up" (watchdog dark) when power is applied.	Faulty fuse F1	Check fuse, replace if necessary.
	If on Normal Source, U2 voltage not present at PDS.	Tighten PDS wing nuts.
The WATCHDOG and other front panel lights stay on continuously.	The control is in a reset mode, perhaps due to excessive moisture on the printed circuit board.	Allow the control panel to thoroughly dry. Check the integrity of the control box for leaks.
The regulator has erroneously run to full lower position in automatic mode.	The MJ-1A or MJ-2A control is in a reset mode, perhaps due to excessive moisture on the printed circuit board.	Allow the control panel to thoroughly dry. Check the integrity of the control box for leaks.
Voltage present at U2 (or External Source Terminal). but voltage not present at test terminals.	Faulty fuse F2 or F3	Check fuses, replace if necessary.
	Sensing transformer jumpers not installed correctly.	Install jumpers per section, "Installing Jumpers at the Sensing Transformer", page 8.
	Unit is wired for reverse power flow and relay RLY1, is not present.	Install relay RLY1 in socket at top of transformer board.
	Unit is erroneously sensing reverse power flow and is not equipped for reverse power flow operation.	Check settings of DIP switches, especially position #7 per section "Setting the 8-position DIP Switch", page 12.
	The polarized disconnect switch (PDS) jack plug is not making proper contact at P2.	Tighten the wing nuts on the PDS.

SYMPTOMS	POSSIBLE CAUSE	REMEDIAL ACTION
Control is indicating "Reverse Power Flow" on known Forward Power Flow Condition.	DIP switch set incorrectly.	Check settings of DIP switches, especially position #7 per section "Setting the 8-Position DIP Switch", page 12.
Voltage at Voltmeter Test Terminal and *DATA/PAK* volts differ.	Test terminal meter and *DATA/PAK* volts are not both sensing true rms voltage or average derived voltage.	Set 8-Position DIP switch, position #4 for same response as meter used at test terminals. See "Setting the 8-Position DIP Switch", page 12.
	The MJ control is out of calibration.	Calibrate the control per section "Calibration", page 21.
The tested time delay is less than the delay set on the front panel.	There was some amount of pre-stored time delay at the start of the test.	Be certain, before starting a time delay check that the control has been "in" band for at least 25% longer than the time delay setting.
Control operates regulator in MANUAL Mode. Unit will not operate in AUTO mode.	The load current is less than 2% and DIP Switch position #2 is closed.	Set DIP switch position #2 to open. See also section "Setting the 8-Position DIP switch" page 12 for additional detail.
DATA/PAK present value display is not accurately showing known correct values.	Positions 4 on DIP switches 6, 7 & 8 are set OPEN for a time lagged response.	Set positions 4 on DIP switches 6, 7 & 8 to CLOSED for short-term updating.
DATA/PAK ALERT code shows values other than defined in section "Using the *DATA/PAK* Alert Codes" page 20 but ALERT light is **not** illuminated.	A momentary system disturbance caused an erroneous code to appear.	Log the code displayed. Depress the control reset button to clear the ALERT code. No remedial action is indicated unless the pattern persists.
DATA/PAK AMPS displays flashing 8888.	This is programmed response if load current exceeds 350% of CT primary rating.	Reset display.
DATA/PAK Drag Hand displays appear to be too high or low to be realistic.	Line conditions are causing the response observed.	Set the integration response period to a longer time duration to cause additional "filtering" of a momentary condition.

In the event the above checks do not reveal the cause of the problem and it is deemed necessary to call the factory, pre-completion of the following check sheet may be beneficial.

Accu/Stat MJ Control S/N _____

Used on regulator S/N _____ kVA _____ Voltage _____

Description of difficulty encountered:

Measurements: Voltage at PDS: U2 to E _____

Voltage at PDS: P2 to E _____

Voltage at Voltmeter test terminals _____

List all connections at terminal strips on rear (right side).

List all DIP switch settings.

Is RLY1 present (in socket) at top of transformer board? _____

List condition of all front panel lights.

Watchdog _____; RPF _____; Alert _____; High _____; In _____; Low _____

List conditions of interface board (rear) lights, if present

LED1 Watchdog _____; LED2 Xmit _____.

List all *DATA/PAK* readings, if accessory is present.

NOTES

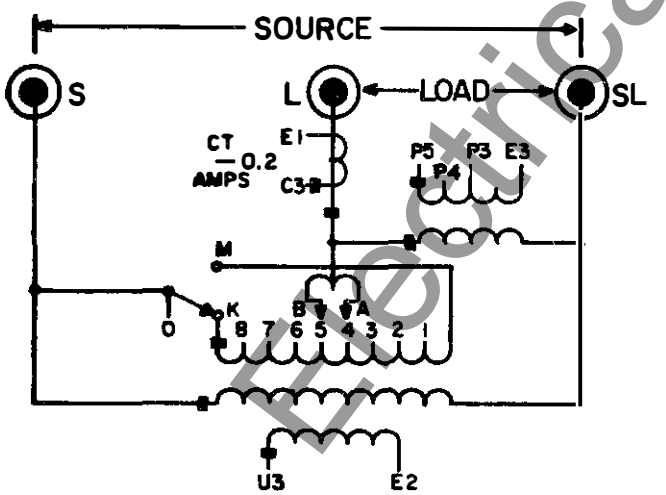
DETERMINATION OF "STRAIGHT" OR "INVERTED" DESIGN OF A STEP-VOLTAGE REGULATOR

The efficient design of a step-voltage regulator dictates that either of two fundamentally different design criteria will be used. It is necessary to know which basic regulator design has been used when configuring the *Accu/Stat* MJ control to the regulator.

The designations "straight" and "inverted" are frequently used to denote the difference. The important differences are discerned by checking the following points against the nameplate electrical diagram.

CHARACTERISTICS OF A "STRAIGHT" DESIGN REGULATOR

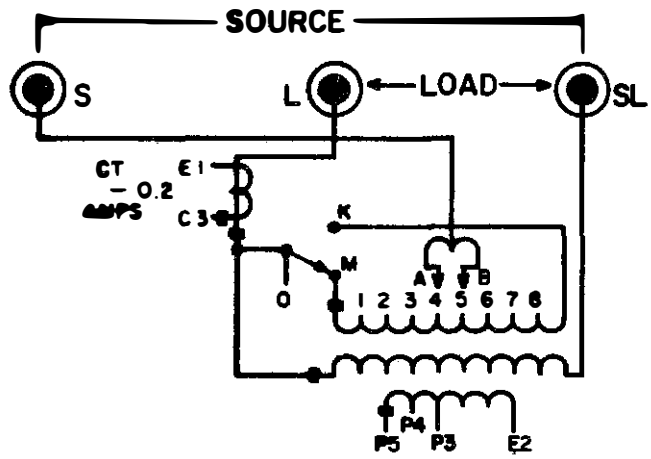
- The 'S' (source) bushing is connected to the tapchanger reversing switch and to one end of the shunt (exciting) winding.
- The 'L' (load) bushing is connected via the preventive autotransformer to the moving contacts of the tapchanger.



Typical Schematic
Straight Design Regulator

CHARACTERISTICS OF AN "INVERTED" DESIGN REGULATOR

- The 'S' (source) bushing is connected via the preventive autotransformer to the moving contacts of the tapchanger.
- The 'L' (load) bushing is connected to the tapchanger reversing switch and to one end of the shunt (exciting) winding.



Typical Schematic
Inverted Design Regulator

APPENDIX II

DETERMINATION OF "LEADING" AND "LAGGING" REGULATORS IN AN OPEN DELTA SYSTEM

The following steps will determine which of the two regulators is the "leading" and which is the "lagging" on an open delta installation.

1. Set both transfer toggle switches on both *Accu/Stat* MJ controls to OFF.
2. Temporarily set the 8-position DIP switch, position #5 CLOSED (as would be correct for use on a wye connected system). The position #6 switch setting is immaterial at this point.
3. Assure that there is load current on the line. The load current must be of sufficient magnitude to cause a definite response of the line drop compensation circuit. Normally 25% of the regulator rating will be adequate.
4. Adjust front panel switches on both *Accu/Stat* MJ controls to the same settings:

Bandwidth	=	2.0 V
Voltage Level	=	120 V
Time Delay	=	10 Seconds
Resistance Volts	=	0 V
Reactance Volts	=	12V, Polarity = +

5. Set the toggle switches to NORMAL source and AUTO control.
6. Allow sufficient time for the regulators to run and come to rest in band. The regulator nearer the maximum raise tap is the "lagging" regulator. The other regulator is the "leading" regulator.

   Note: The amount of tapchange excursion can be made more or less, if desired, by appropriate adjustment of the reactance volts setting.
7. Readjust the 8-position DIP switch, position #5 to OPEN.
8. Set the 8-position DIP switch, position #6 on each regulator, respectively,

   LAGGING regulator = CLOSED
   LEADING regulator = OPEN

DETERMINATION OF DISTRIBUTION LINE RESISTANCE AND REACTANCE

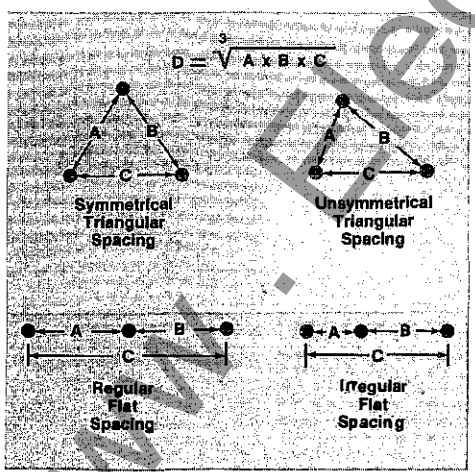
See page 16.

TABLE I DISTRIBUTION LINE RESISTANCE AND REACTANCE

OHMS PER CONDUCTOR PER MILE AT 60 Hz

COPPER — HARD DRAWN										ALUMINUM — STEEL REINFORCED									
CONDUCTOR SIZE	RESISTANCE AT 50°C	REACTANCE* DISTANCE "D" BETWEEN CENTERS OF CONDUCTOR								CONDUCTOR SIZE	RESISTANCE AT 50°C	REACTANCE* DISTANCE "D" BETWEEN CENTERS OF CONDUCTOR							
MCM		18"	24"	30"	36"	42"	48"	54"	60"	MCM		18"	24"	30"	36"	42"	48"	54"	60"
1000	.0685	.449	.484	.511	.533	.552	.568	.593	.595	1272.0	.0851	.421	.456	.483	.505	.524	.540	.555	.567
750	.0888	.466	.501	.529	.550	.569	.585	.600	.612	954.0	.1128	.439	.474	.501	.523	.542	.553	.573	.585
600	.1095	.481	.516	.543	.565	.584	.600	.615	.627	795.0	.1373	.450	.485	.512	.534	.553	.569	.584	.596
500	.1303	.492	.527	.554	.576	.595	.611	.626	.638	556.5	.1859	.469	.504	.531	.553	.572	.588	.603	.615
400	.1619	.507	.542	.569	.591	.610	.626	.641	.653	477.0	.216	.479	.514	.541	.563	.582	.598	.613	.625
350	.1845	.515	.550	.577	.599	.618	.634	.649	.661	397.5	.259	.490	.525	.555	.574	.593	.609	.624	.636
300	.215	.525	.560	.587	.609	.628	.644	.659	.671	336.4	.306	.500	.535	.562	.534	.603	.619	.634	.646
250	.257	.536	.571	.598	.620	.639	.655	.670	.682	266.8	.385	.514	.549	.576	.598	..617	.633	.648	.660
AWG										AWG									
4/0	.303	.546	.581	.603	.630	.649	.665	.630	.692	4/0	.592	.630	.665	.692	.714	.733	.749	.764	.776
3/0	.382	.554	.589	.616	.638	.657	.673	.688	.700	3/0	.723	.670	.705	.732	.754	.773	.789	.804	.816
2/0	.481	.581	.616	.643	.665	.684	.700	.715	.727	2/0	.895	.690	.725	.752	.774	.793	.809	.824	.836
1/0	.607	.595	.630	.657	.679	.698	.714	.729	.741	1/0	1.12	.705	.740	.767	.789	.808	.824	.839	.851
1	.757	.609	.644	.671	.693	.712	.728	.743	.755	2	1.69	.714	.749	.776	.798	.817	.833	.848	.860
2	.964	.623	.658	.685	.707	.726	.742	.757	.769	4	2.57	.708	.743	.770	.792	.811	.827	.842	.854
4	1.518	.648	.683	.710	.732	.751	.767	.782	.794	6	3.98	.722	.757	.784	.806	.825	.841	.856	.868
6	2.41	.677	.712	.739	.761	.780	.796	.811	.823										
8	3.80	.714	.749	.776	.798	.817	.833	.848	.860										

*60 Hertz reactance in ohms per mile of each conductor of a single phase, or of a three phase, symmetrical triangular spacing. For other arrangements of conductors see below. The reactance for other frequencies is F/60 times the table values. Reactance values are for concentric stranded copper conductors and are approximately correct for aluminum cable conductors.



DETERMINATION OF "D"

TABLE II COMPENSATOR MULTIPLIER TABLE

Regulator Operating Data (See nameplate)		Circuit Connection			Regulator Operating Data (See nameplate)		Circuit Connection		
Regulator Operating kV and (Voltage, Trans. Ratio)	Regulator Current Rating	Single	Delta	Wye	Regulator Operating kV and (Voltage, Trans. Ratio)	Regulator Current Rating	Single	Delta	Wye
19.9 (166/1)	50	.60	.52	.30	5.0 (40/1)	100	5.00	4.33	2.50
	100	1.20	1.04	.60		150	7.50	6.49	3.75
	167	2.40	2.08	1.20		200	10.00	8.66	5.00
	200	2.40	2.08	1.20		250	17.50	15.15	8.75
14.4 (120/1)	50	.83	.72	.42		334	17.50	15.15	8.75
	100	1.67	1.44	.83		500	35.00	30.30	17.50
	200	3.34	2.88	1.67		625	35.00	30.30	17.50
	300	5.01	4.32	2.49		668	35.00	30.30	17.50
	400	6.68	5.76	2.52		835	35.00	30.30	17.50
13.8 (115/1)	50	.87	.75	.44	4.16 (34.7/1)	100	5.76	4.98	2.88
	100	1.74	1.50	.87		150	8.64	7.48	4.32
	150	2.61	2.25	1.31		200	11.53	9.97	5.76
	200	3.48	3.00	1.74		250	20.20	17.48	10.10
7.62 (63.5/1)	50	1.57	1.36	.79		334	20.20	17.48	10.10
	75	2.36	2.04	1.18		500	40.40	34.96	20.20
	100	3.15	2.72	1.57		625	40.40	34.96	20.20
	150	4.72	4.08	2.36		668	40.40	34.96	20.20
	219	7.87	6.82	3.94		835	40.40	34.96	20.20
	328	12.60	10.90	6.30	2.5 (20/1)	200	20.00	17.30	10.00
	438	12.60	10.90	6.30		300	30.00	25.96	15.00
	548	12.60	10.90	6.30		400	40.00	34.60	20.00
7.2 (60/1)	50	1.67	1.44	.83		500	70.00	60.55	35.00
	75	2.50	2.16	1.25		668	70.00	60.55	35.00
	100	3.34	2.89	1.67		1000	140.00	121.10	70.00
	150	5.00	4.33	2.50		1250	140.00	121.10	70.00
	219	8.34	7.22	4.17		1332	140.00	121.10	70.00
	328	13.33	11.55	6.67		1665	140.00	121.10	70.00
	438	13.33	11.55	6.67					
	548	13.33	11.55	6.67					

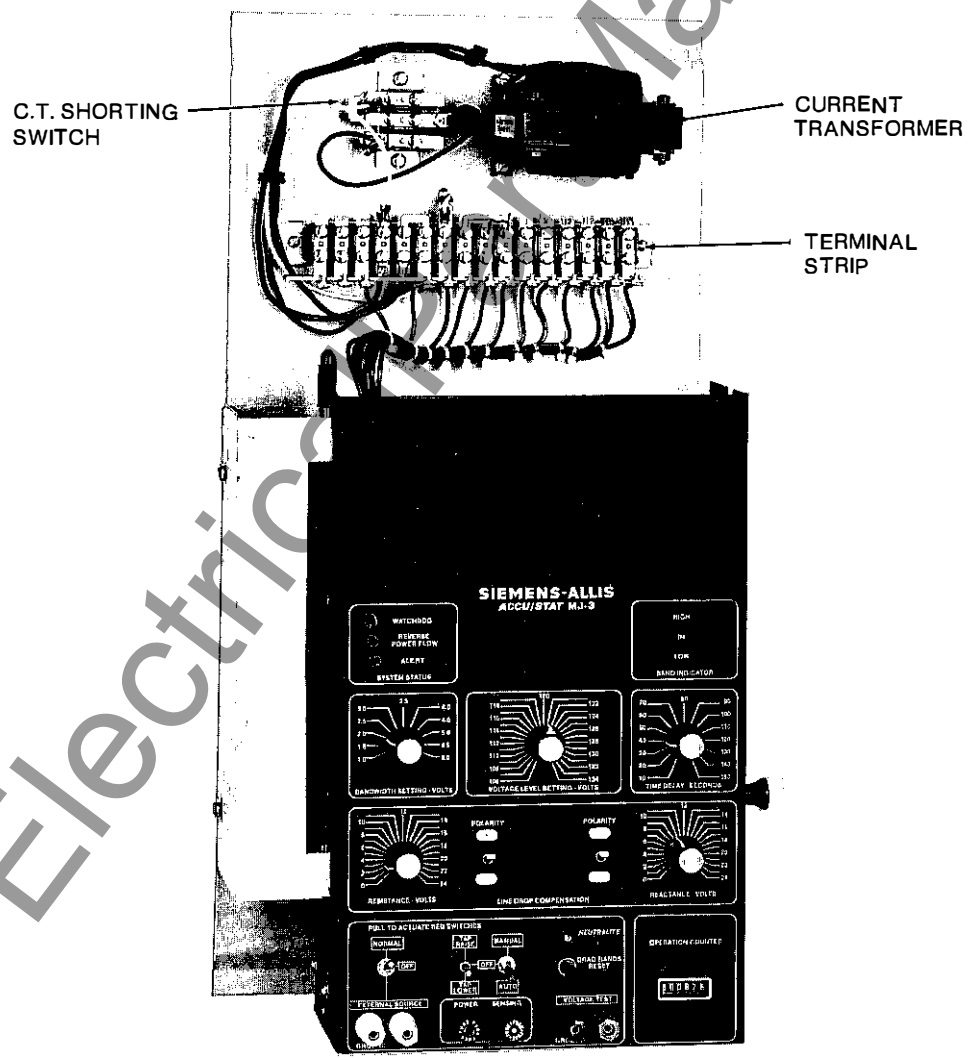
APPENDIX IV

ACCU/STAT MJ-3T CONTROL

An adaptation of the *Accu/Stat* MJ-3, the MJ-3T, is specially equipped for use on Load Tapchanging (LTC) Transformers.

The *Accu/Stat* MJ-3T is provided complete with auxiliary 5.0./0.2A current transformer, CT shorting switch and a terminal strip permitting convenient customer use of a handcrank interlock and deenergization of automatic operation upon circuit breaker operation.

Instruction Manual 21-115527-002 provides additional detail.



The *Accu/Stat* MJ-3T LTC Transformer Control

CONTROL DIAGRAMS

A control diagram is prepared for every regulator which may be factory equipped with an *Accu/Stat* MJ control. The two control diagrams included in this control manual are intended only to be typical and only for general reference purposes. The proper control diagram for a given regulator, when factory equipped with an MJ control, is included with the regulator when shipped. Further, the nameplate is stamped with the number of the appropriate control diagram to facilitate proper identification and ease of replacement of the diagram, if lost or damaged.

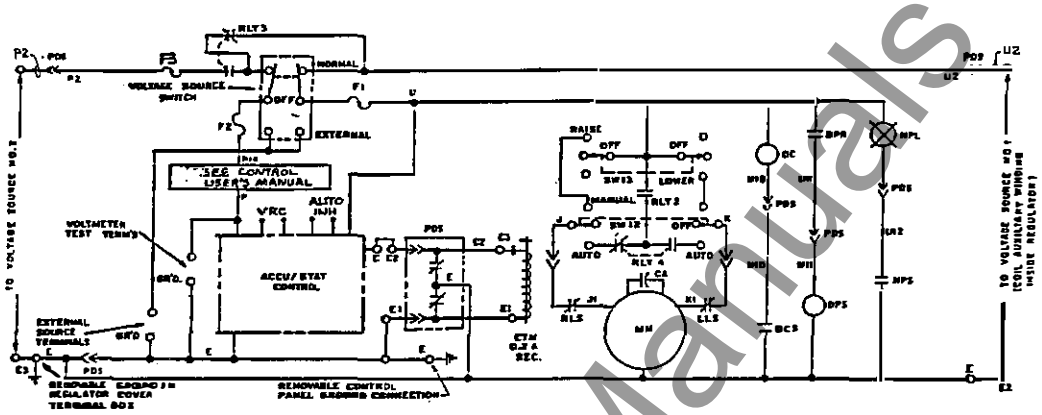
⚠ CAUTION

Connecting the *Accu/Stat* MJ control to a particular regulator in accordance with the example illustrations attached may result in improper regulator operation.

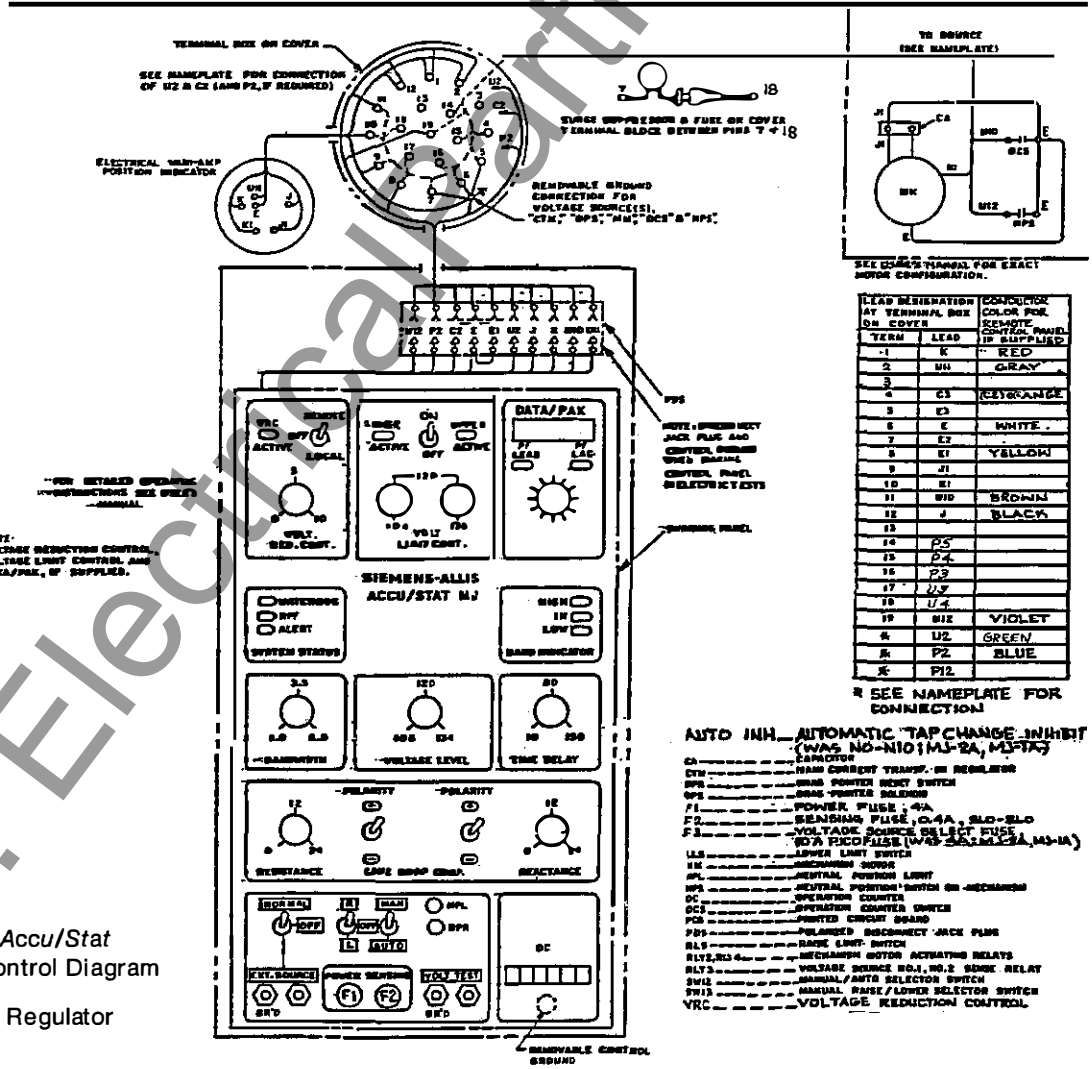
Can cause damage to the regulator or control components.

Use the example diagrams only for illustration purposes. Refer to the regulator nameplate for the proper control diagram to use with a particular installation.

APPENDIX V



SCHEMATIC DIAGRAM



LEAD DESIGNATION AT TERMINAL BOX ON COVER		CONDUCTOR COLOR FOR REMOTE CONTROL PANEL (IF SUPPLIED)
TERM	LEAD	
1	K	RED
2	MH	GRAY
3		
4	C3	(C1) ORANGE
5	E3	
6	E	WHITE
7	E2	
8	E1	YELLOW
9	J1	
10	K1	
11	BRD	BROWN
12	J	BLACK
13		
14	P5	
15	P4	
16	P3	
17	U3	
18	U4	
19	BLK	VIOLET
A	U2	GREEN
B	P2	BLUE
C	P12	

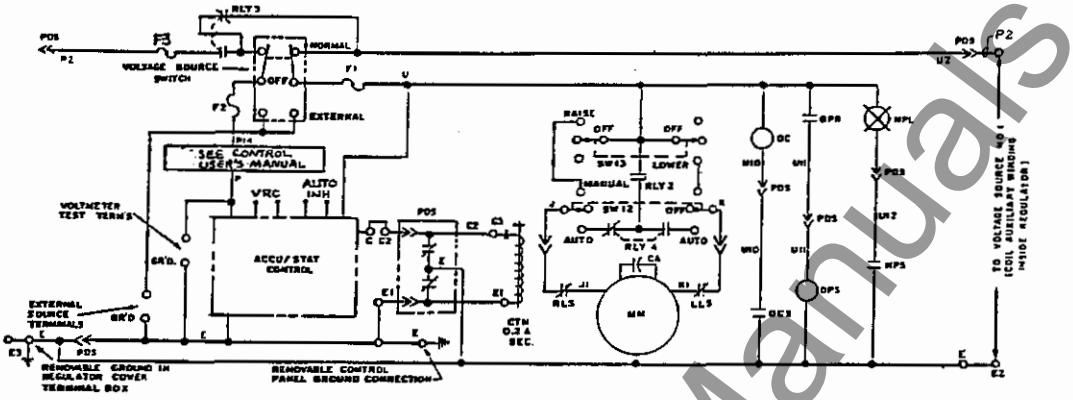
* SEE NAMEPLATE FOR CONNECTION

AUTO INH — AUTOMATIC TAP CHANGE INHIBIT (WAS NO-N10 | MJ-2A, MJ-1A)

C1 — CAPACITOR
CTN — MAIN CURRENT TRANSF. IN REGULATOR
BPR — BAND POINTER RESET SWITCH
BPS — BAND POINTER SOLENOID
F1 — POWER FUSE, 4A
F2 — SENSING FUSE, 0.4A, SLO-BLO
F3 — VOLTAGE SOURCE SELECT FUSE, 80A PICOFUSE (WAS 25A, MJ-2A, MJ-1A)
LLS — LOWER LIMIT SWITCH
MH — MECHANISM MOTOR
MPL — NEUTRAL POSITION LIGHT
NPS — NEUTRAL POSITION SWITCH ON MECHANISM
OC — OPERATION COUNTER
OCS — OPERATION COUNTER SWITCH
PCB — PRINTED CIRCUIT BOARD
PDS — POLARIZED DISCONNECT JACK PLUG
RLS — RAISE LIMIT SWITCH
RLY2, RLY4 — MECHANISM MOTOR ACTUATING RELAYS
RLY3 — VOLTAGE SOURCE NO.1, NO.2 SENSE RELAY
SW12 — MANUAL/AUTO SELECTOR SWITCH
SW13 — MANUAL RAISE/LOWER SELECTOR SWITCH
VRC — VOLTAGE REDUCTION CONTROL

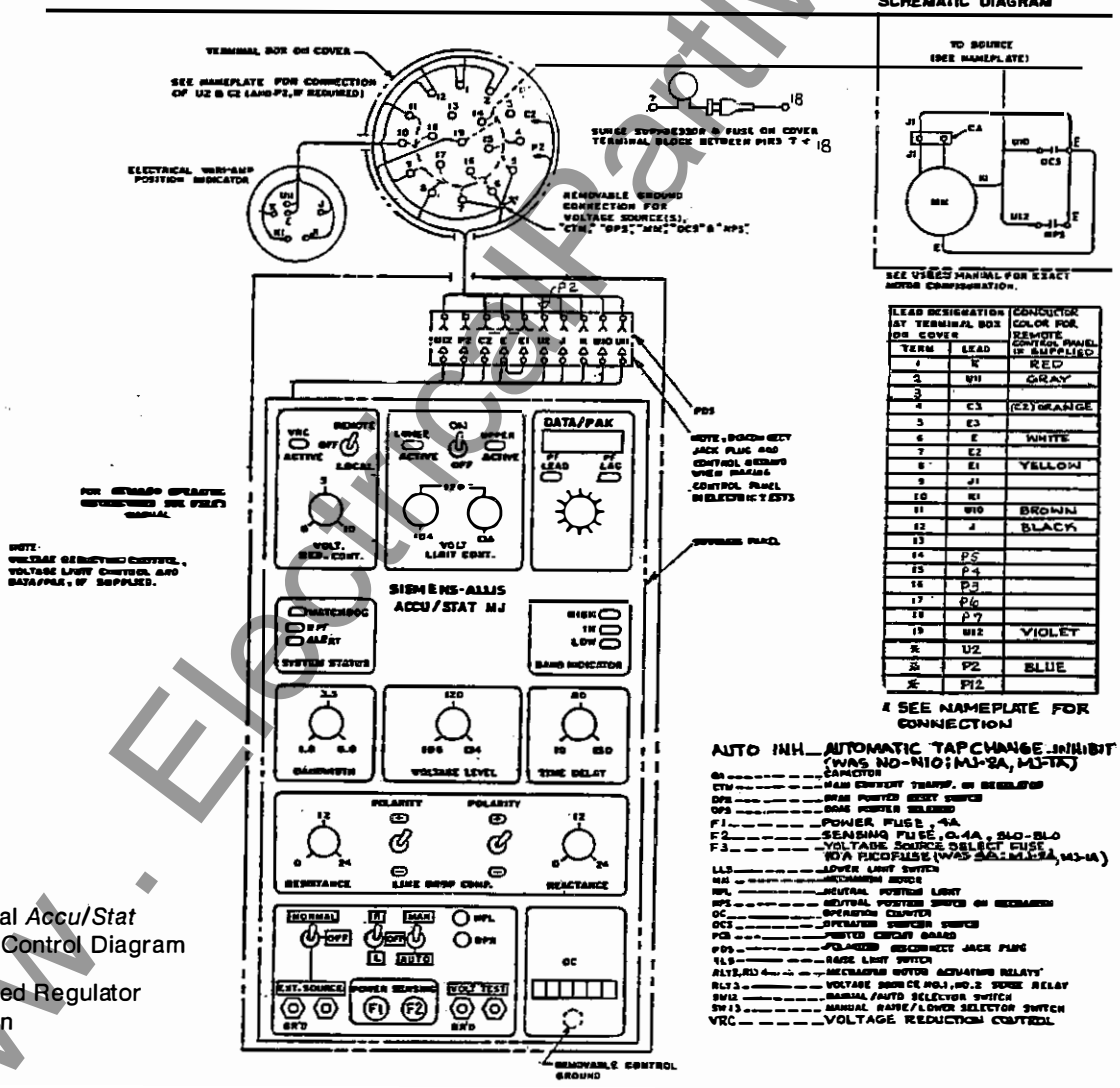
Typical *Accu/Stat* MJ-3 Control Diagram

Straight Regulator Design



F1 & F2 ACCESSIBLE FROM FRONT PANEL
F3 on PCB

SCHEMATIC DIAGRAM



LEAD DESIGNATION AT TERMINAL BOX OR COVER		CONDUCTOR COLOR FOR REMOTE CONTROL PANEL IF SUPPLIED
TERM	LEAD	
1	K	RED
2	W11	GRAY
3		
4	C3	(C2) ORANGE
5	E3	
6	E	WHITE
7	E2	
8	E1	YELLOW
9	J1	
10	K1	
11	W10	BROWN
12	J	BLACK
13		
14	P5	
15	P4	
16	P3	
17	P6	
18	P7	
19	W12	VIOLET
*	U2	
**	P2	BLUE
***	P12	

* SEE NAMEPLATE FOR CONNECTION

AUTO INH — AUTOMATIC TAPCHANGE INHIBIT (WAS NO-N10; MJ-2A, MJ-1A)

Typical *Accu/Stat* MJ-3 Control Diagram

Inverted Regulator Design

APPENDIX VI

SCHEMATICS

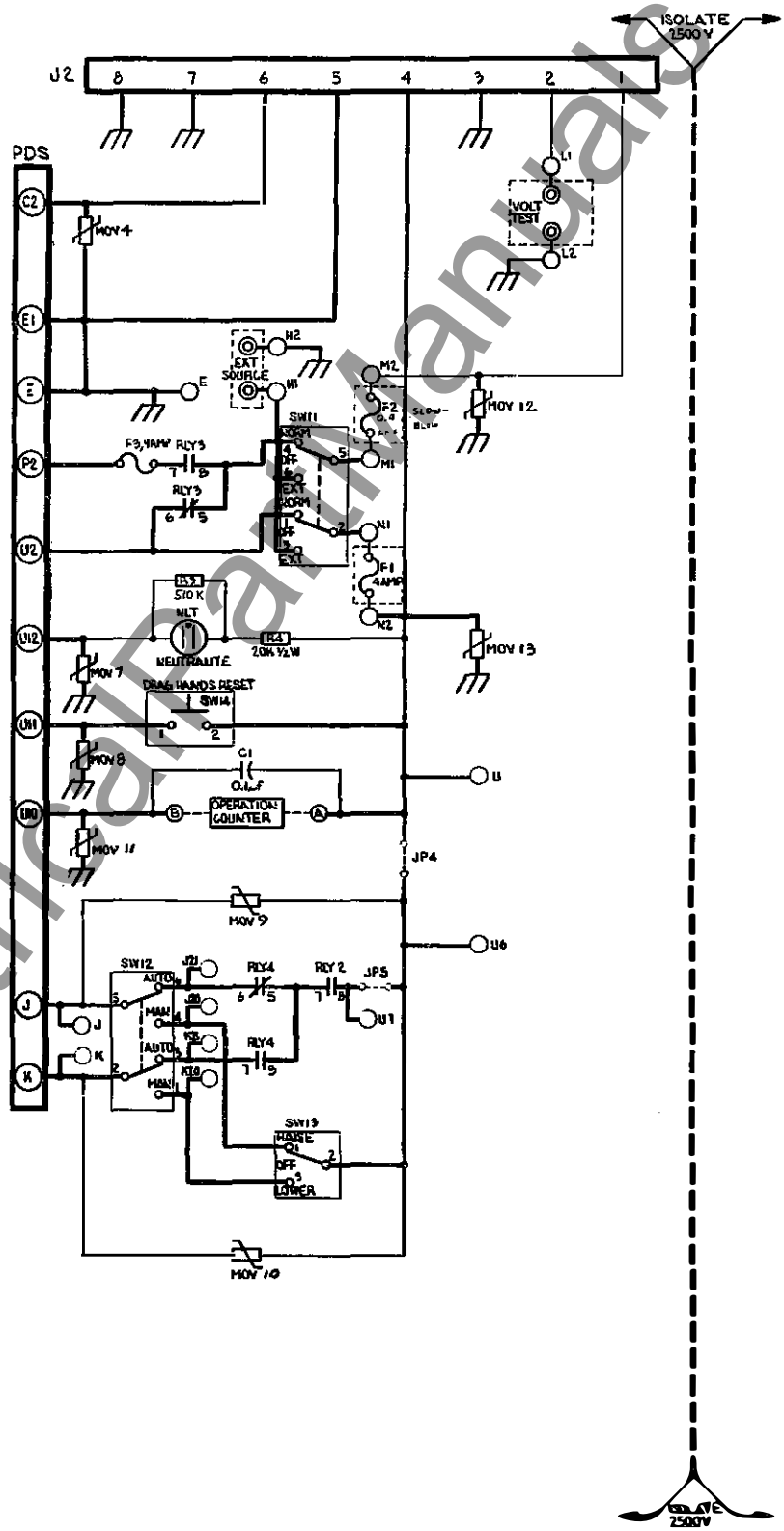
Schematics of all circuit boards used in the *Accu/Stat* MJ series of control are reproduced for reference. The schematics are provided so that those skilled in the field of digital electronics may obtain a greater appreciation of the MJ product. The schematics will be of very limited benefit for purposes of trouble shooting. While power supplies may be checked using commonly available electronic test equipment, the heart of the control, the digital portion including the microprocessor, requires very sophisticated equipment and knowledge of the computer software in order to analyze problem conditions. In fact, random probing of the printed circuit board components with common test equipment such as a VOM will very possibly **cause** component failure.

CAUTION

Indiscriminate probing of critical circuit board components can result in damage to particular devices.

Do not attempt to troubleshoot the MJ control at the component level.

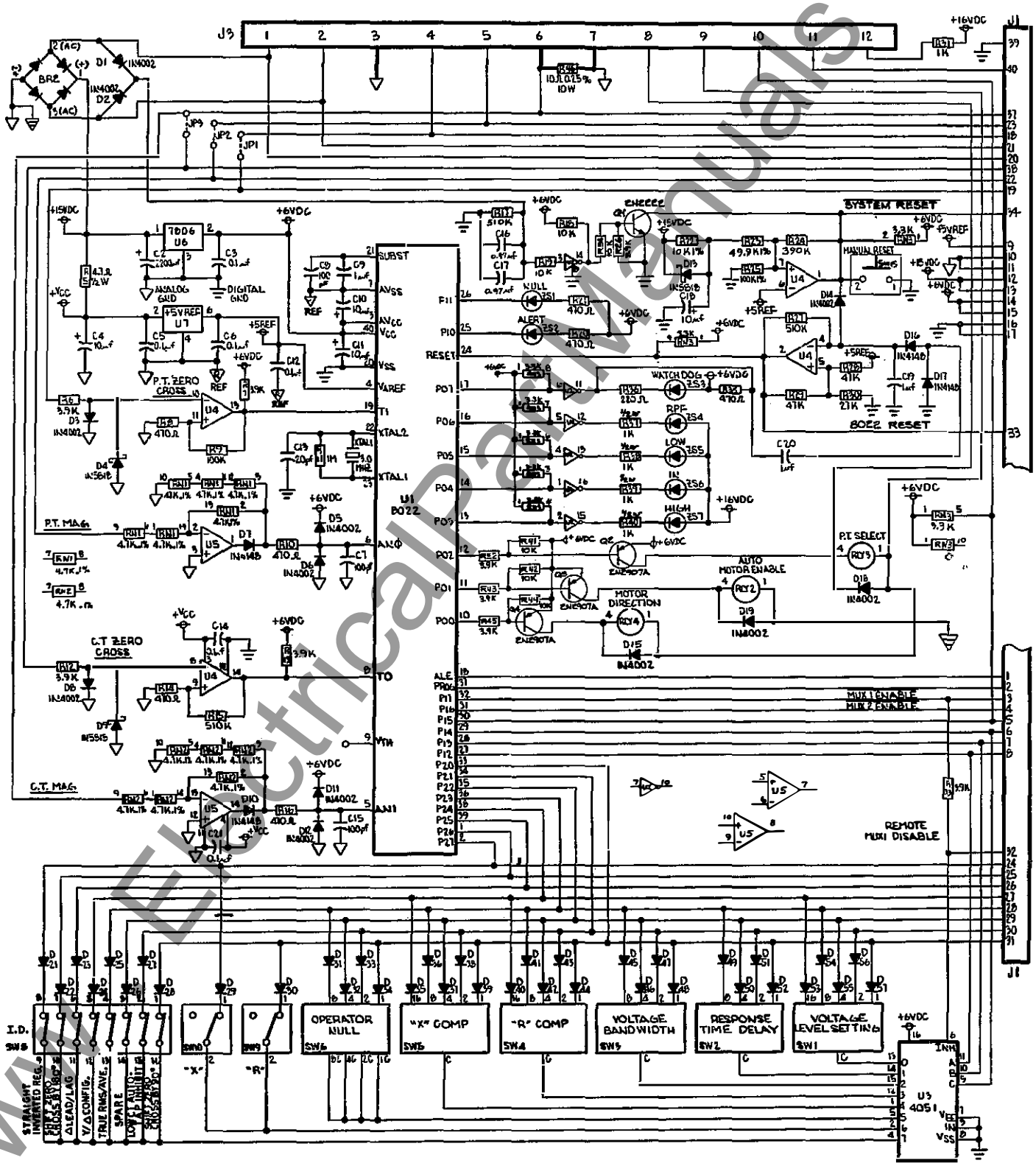
Because of the vulnerability of the components in the *Accu/Stat* MJ controls to damage due to improper servicing procedures, it is urged that defective controls be returned to the factory for repair.

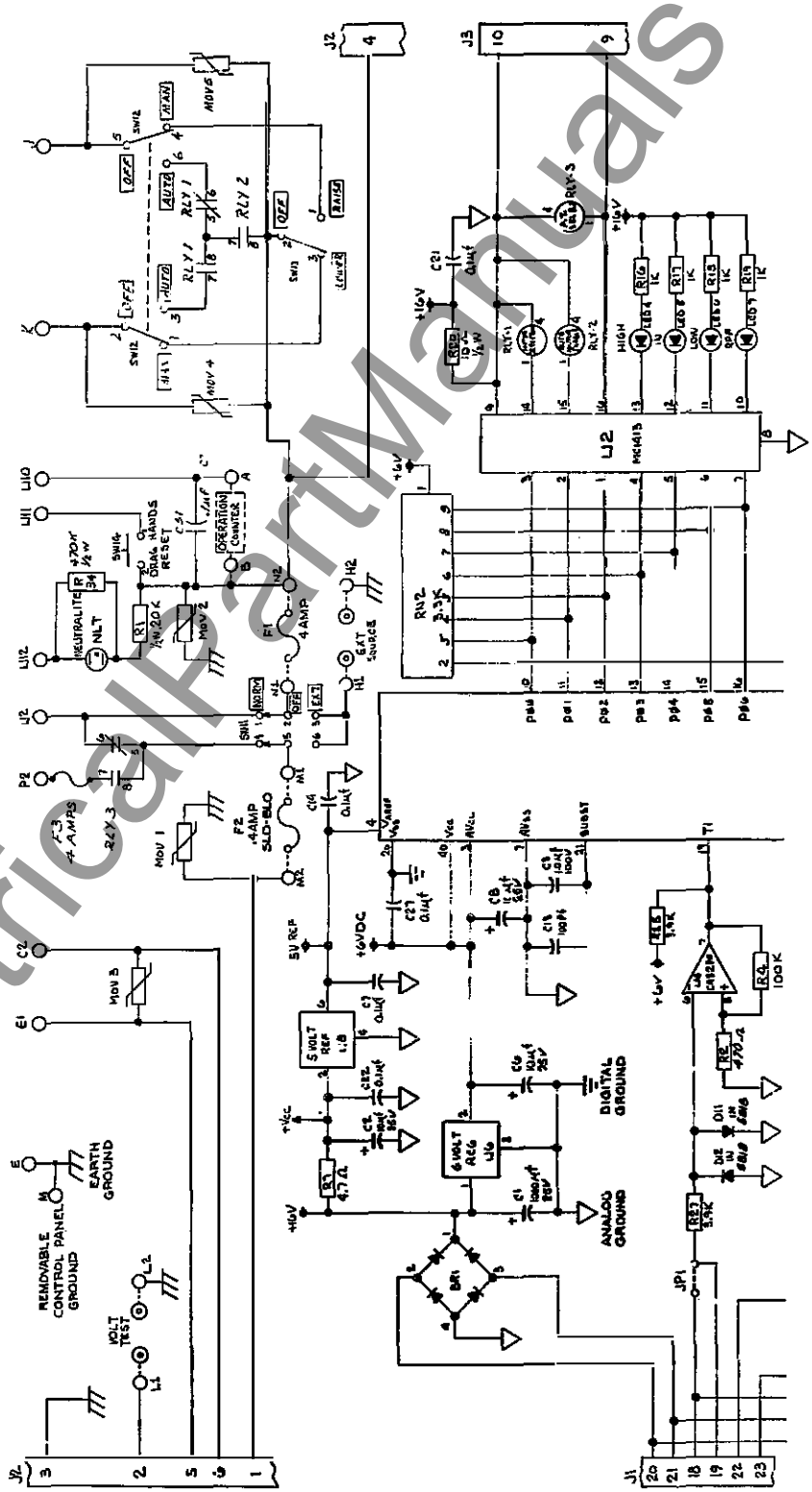


Front Panel
Printed Circuit Board
Schematic

- *Accu/Stat* MJ-3 and MJ-3T Controls

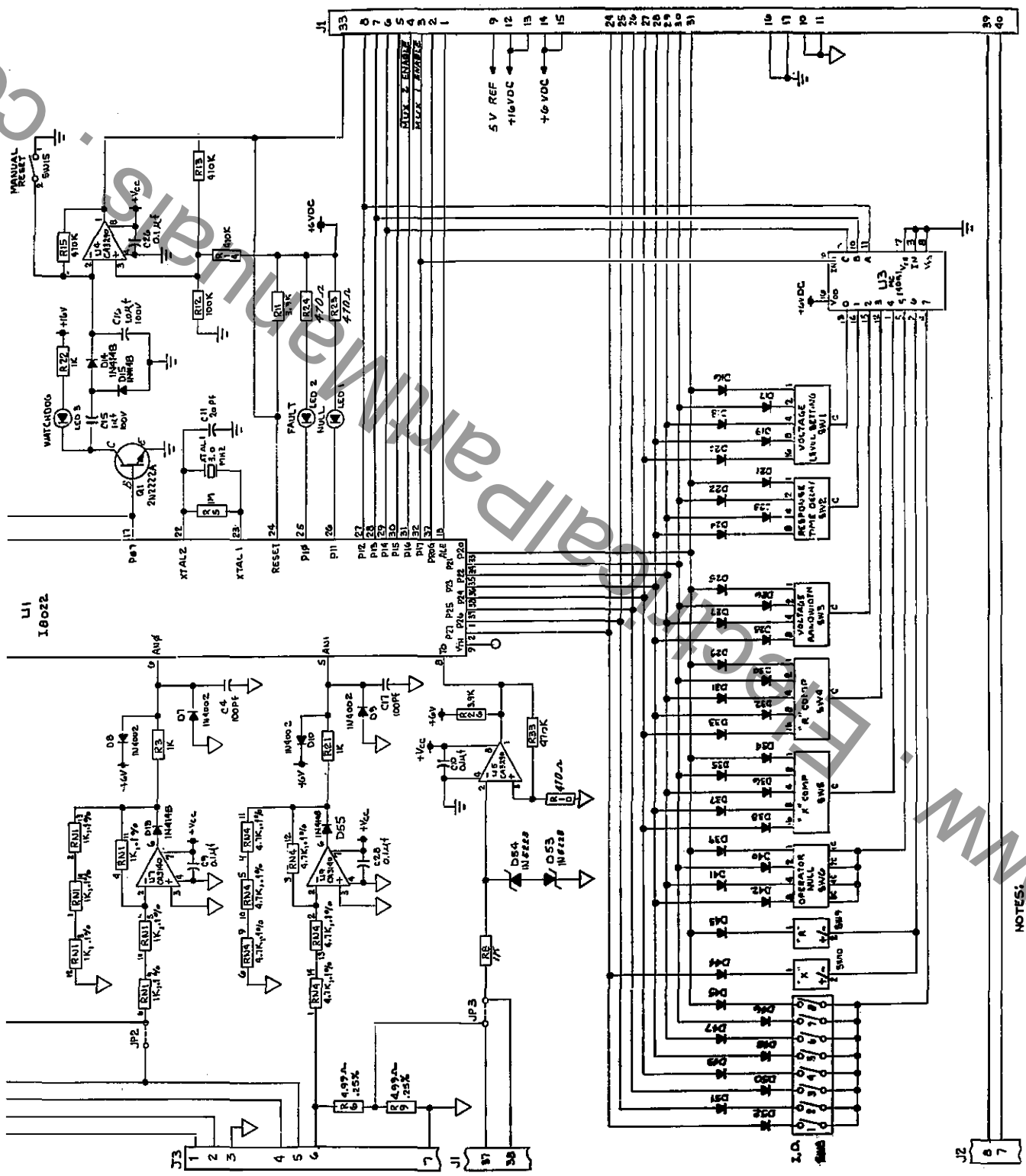
APPENDIX VI

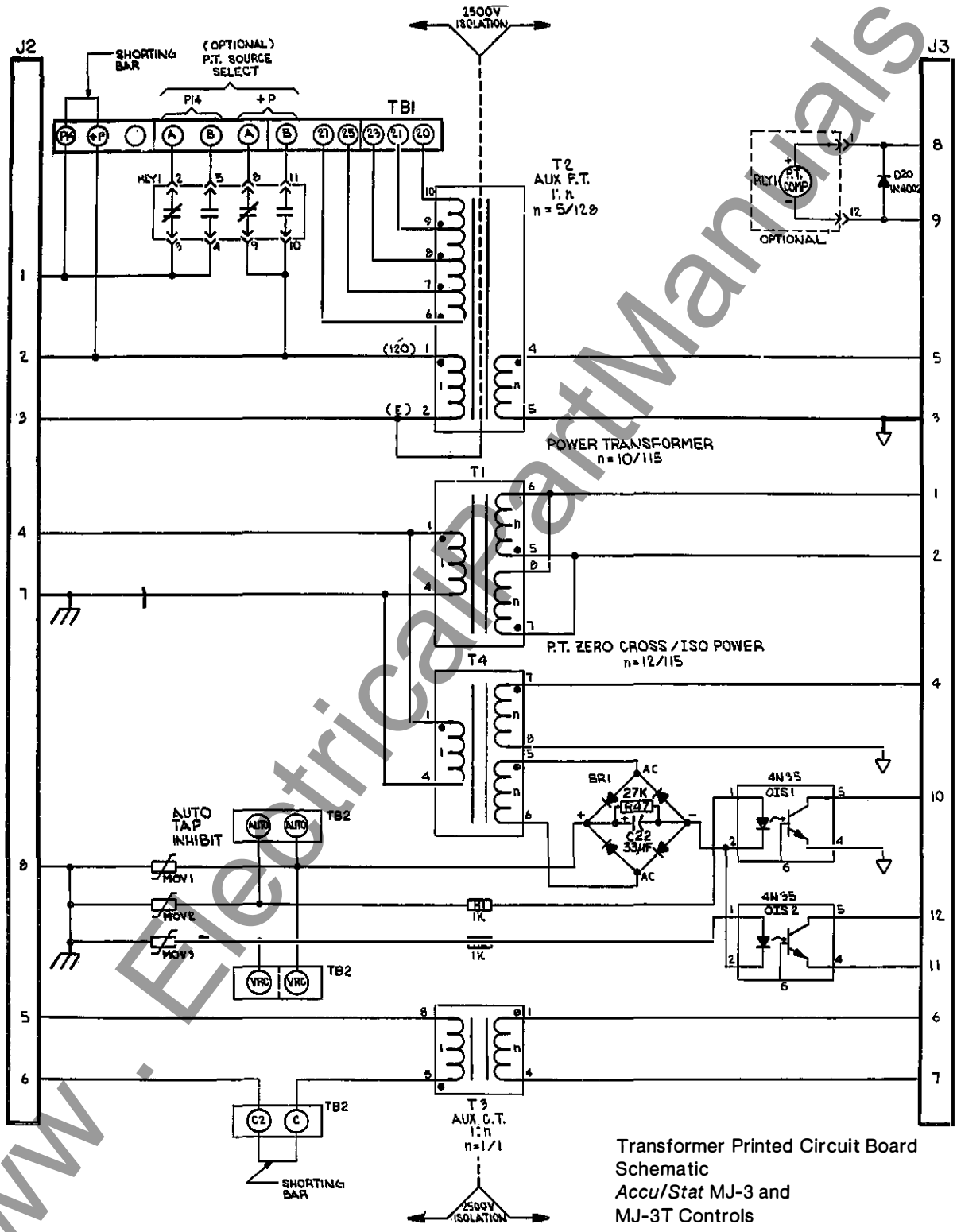




Front Panel
Printed Circuit Board
Schematic
Accu/Stat MJ-1A and
MJ-2A Controls

APPENDIX VI

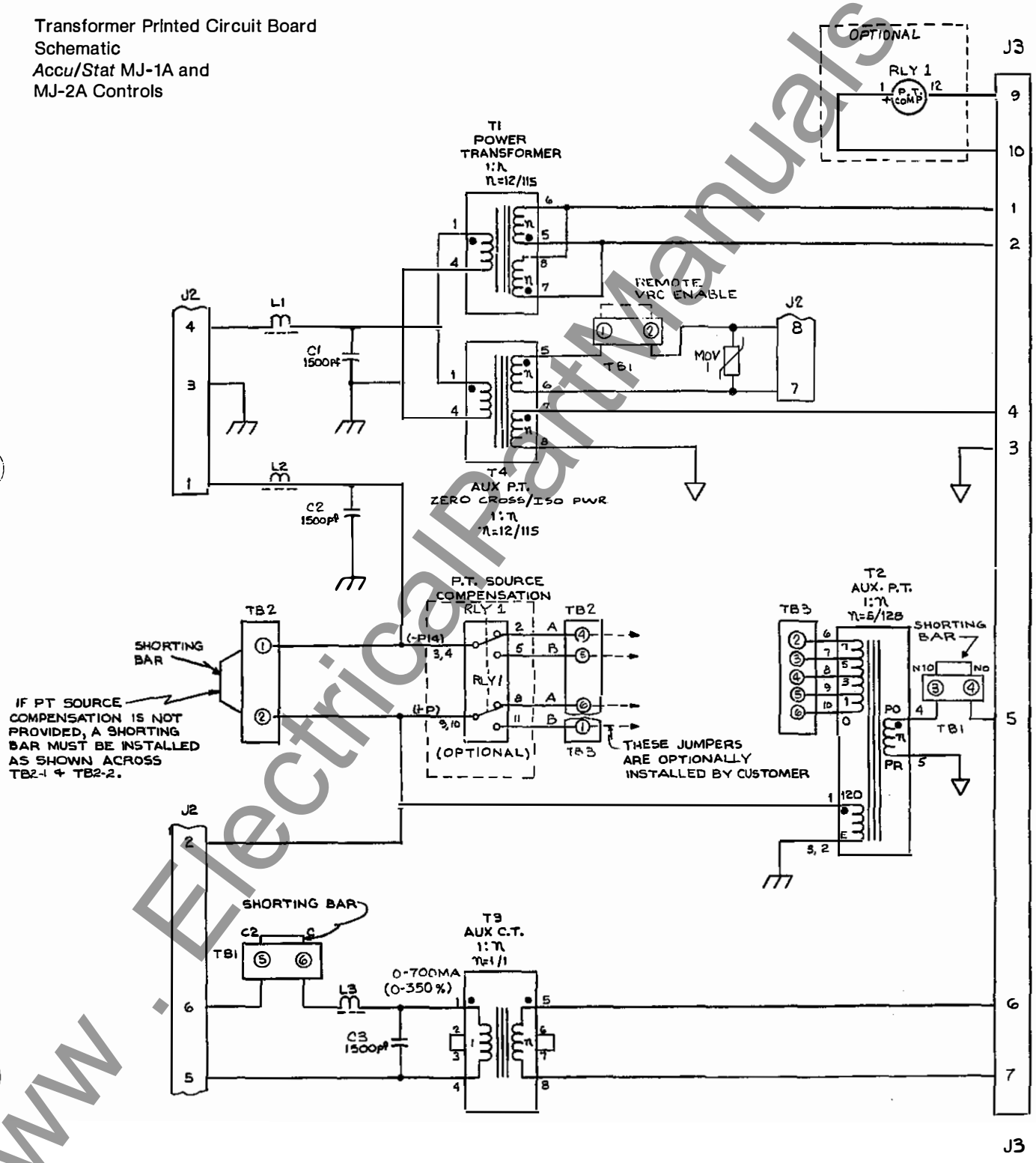


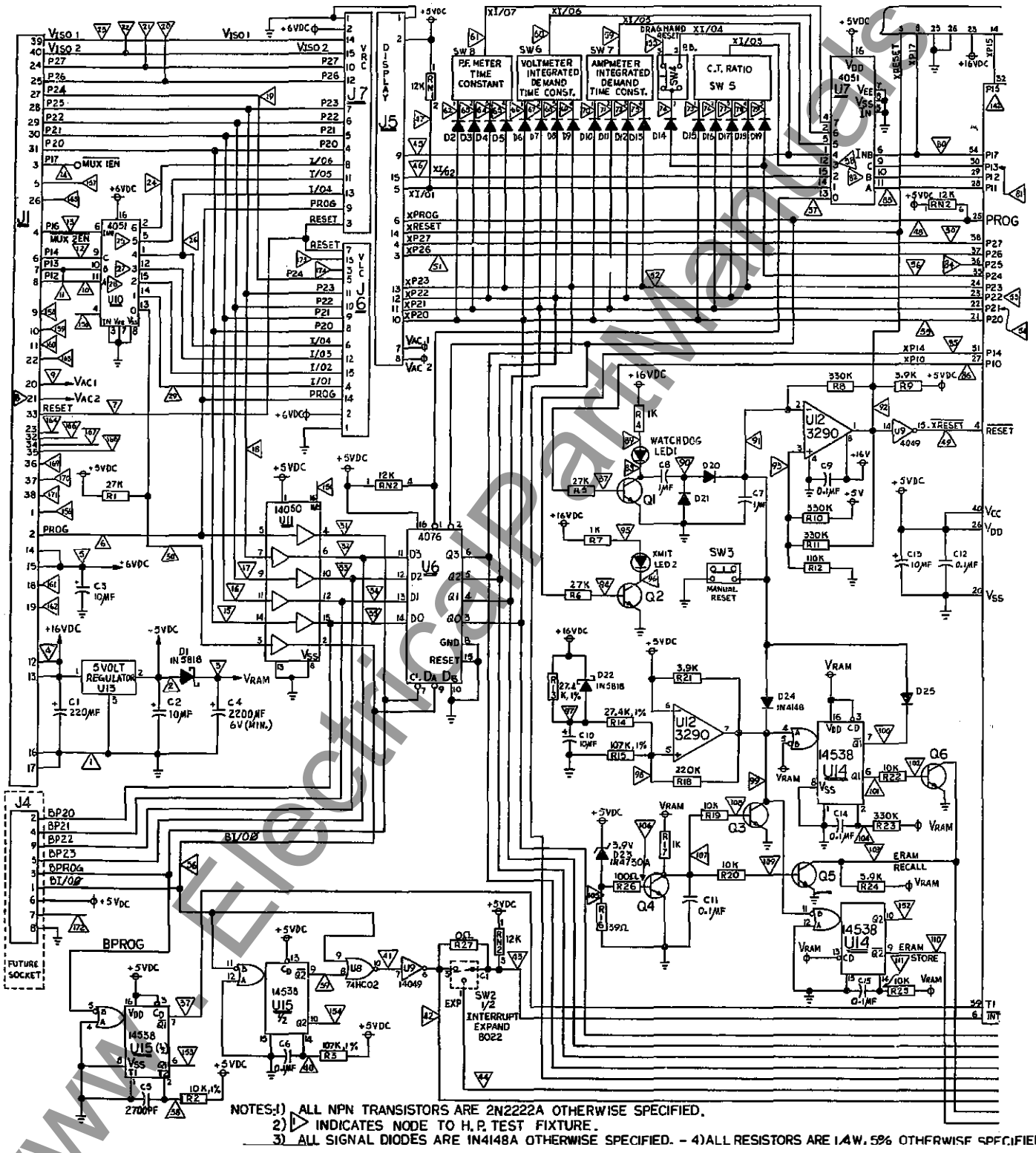


Transformer Printed Circuit Board Schematic
Accu/Stat MJ-3 and MJ-3T Controls

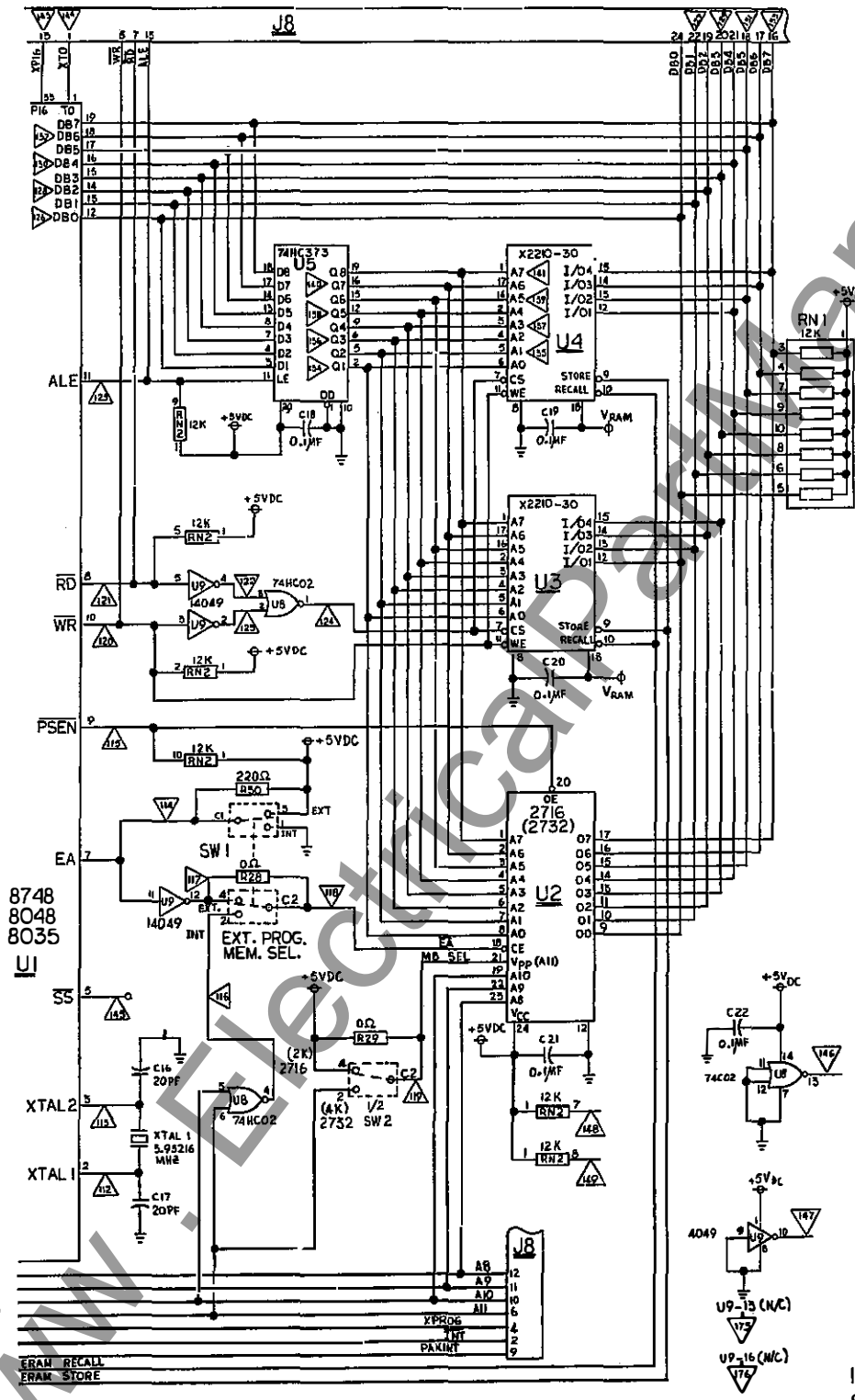
APPENDIX VI

Transformer Printed Circuit Board
Schematic
Accu/Stat MJ-1A and
MJ-2A Controls

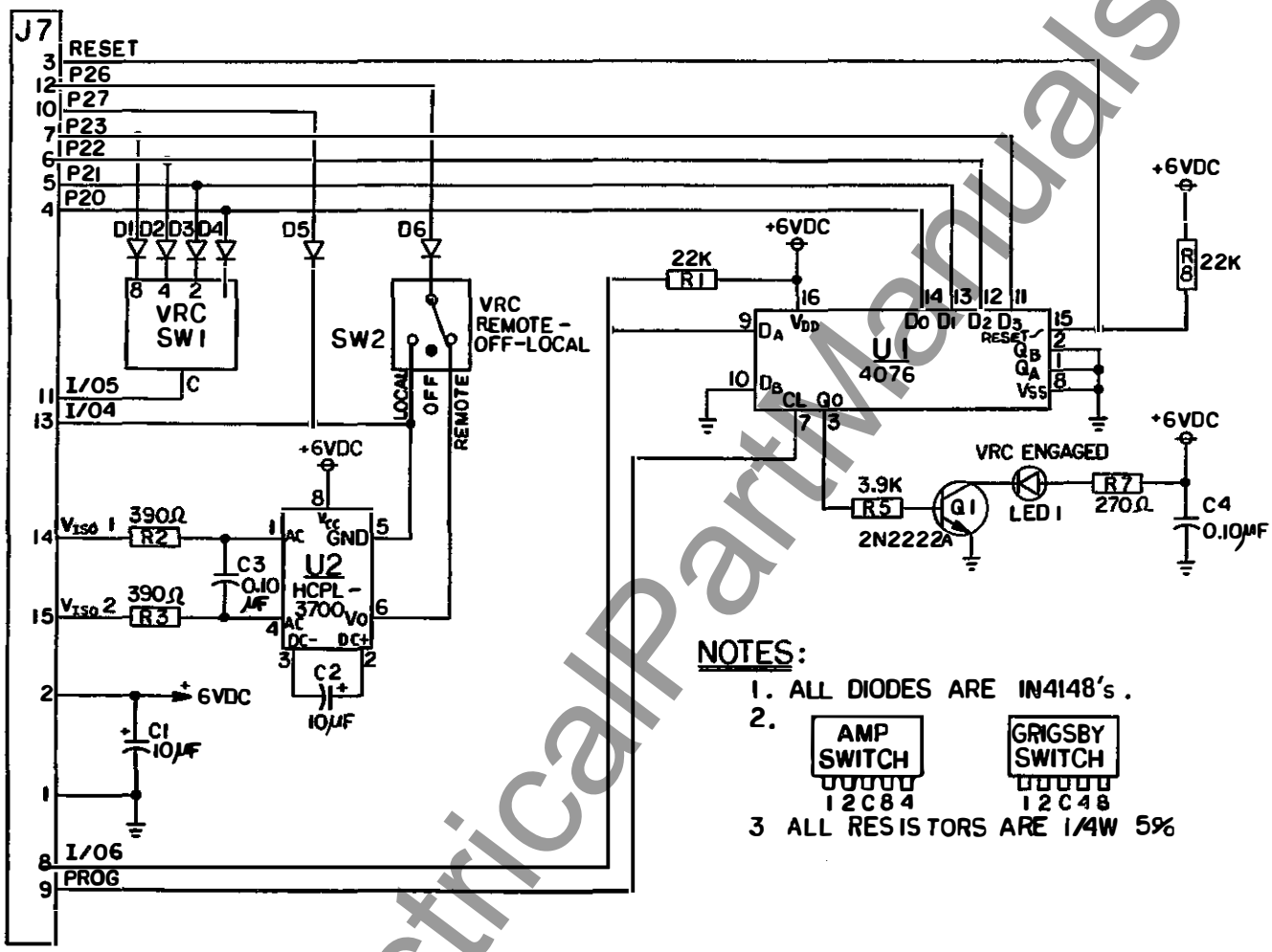




APPENDIX VI

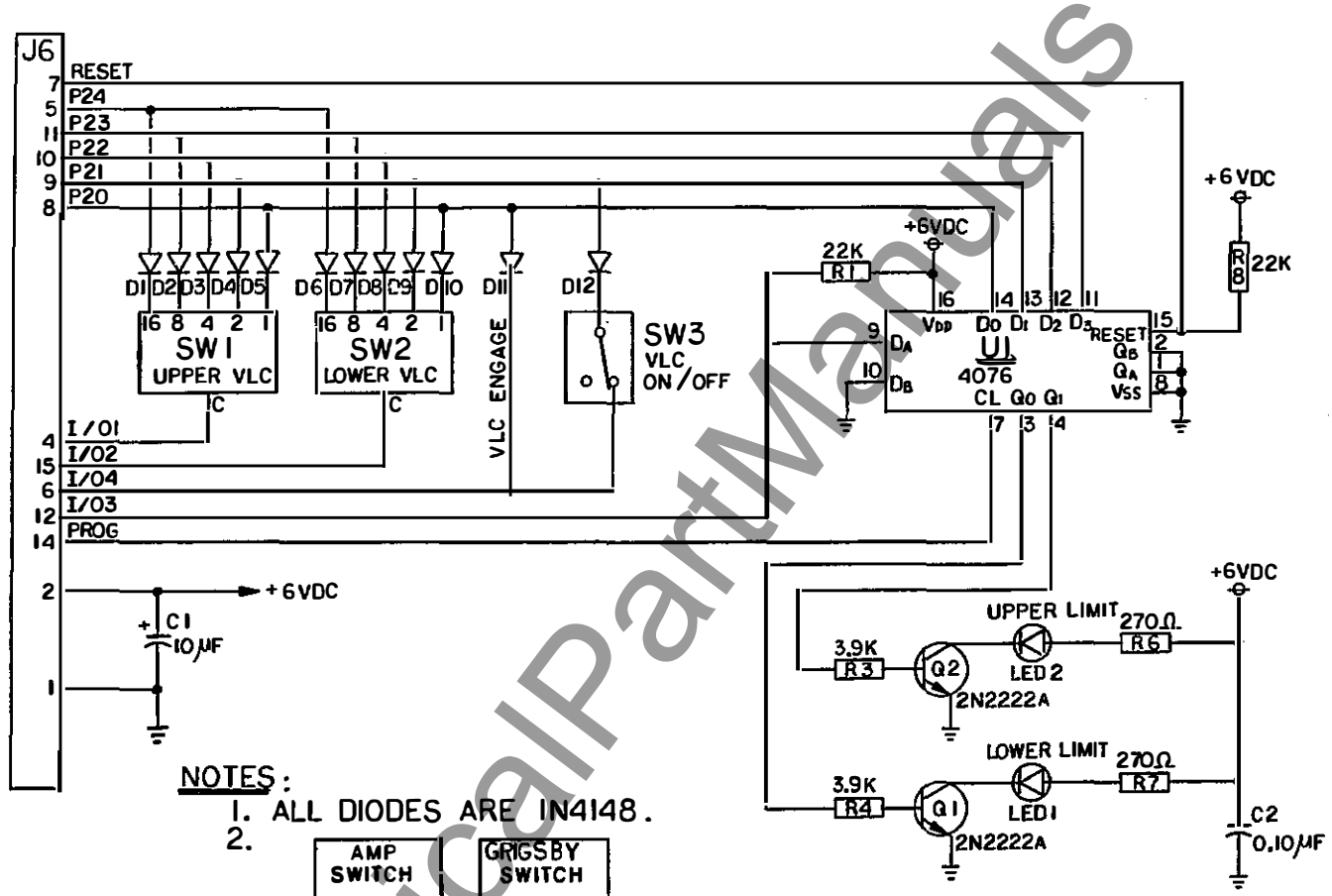


Interface Printed Circuit Board
Schematic



Voltage Reduction Control
Printed Circuit Board
Schematic

APPENDIX VI

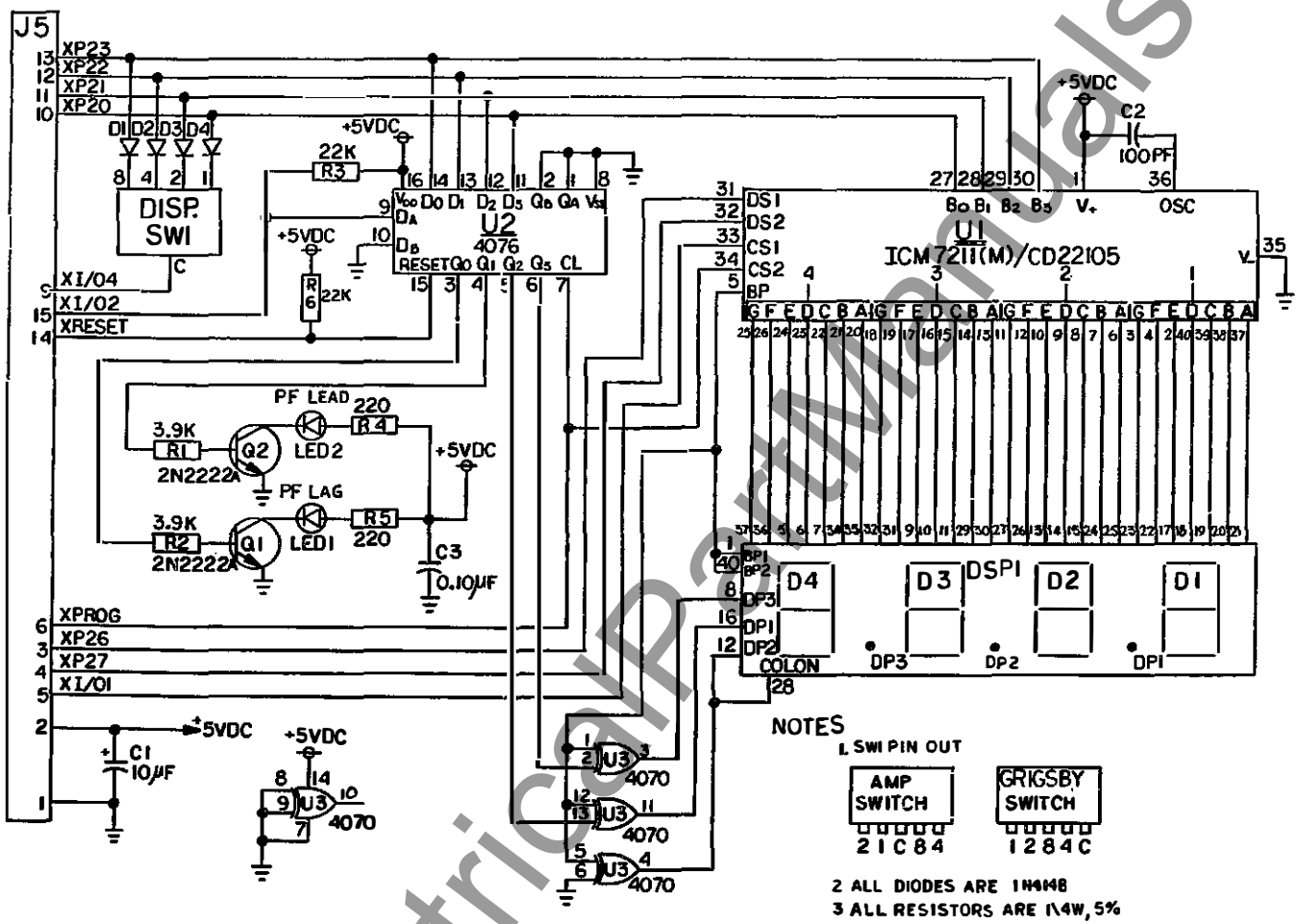


NOTES:

1. ALL DIODES ARE IN4148.
2.

3. ALL RESISTORS ARE 1/4W, 5%

Voltage Limit Control
Printed Circuit Board
Schematic



Data/Pak Unit
Printed Circuit Board
Schematic

SIEMENS

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Power Components Division
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(601) 939-0550

The information in this manual is intended to assist operating personnel by providing information on the general characteristics of equipment of this type. It does not relieve the user of responsibility to use sound engineering practices in the installation, application, operaton and maintenance of the particular equipment purchased.

If drawings or other supplementary instructions for specific applications are forwarded with the manual or separately, they take precedence over any conflicting or incomplete information in this manual.

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