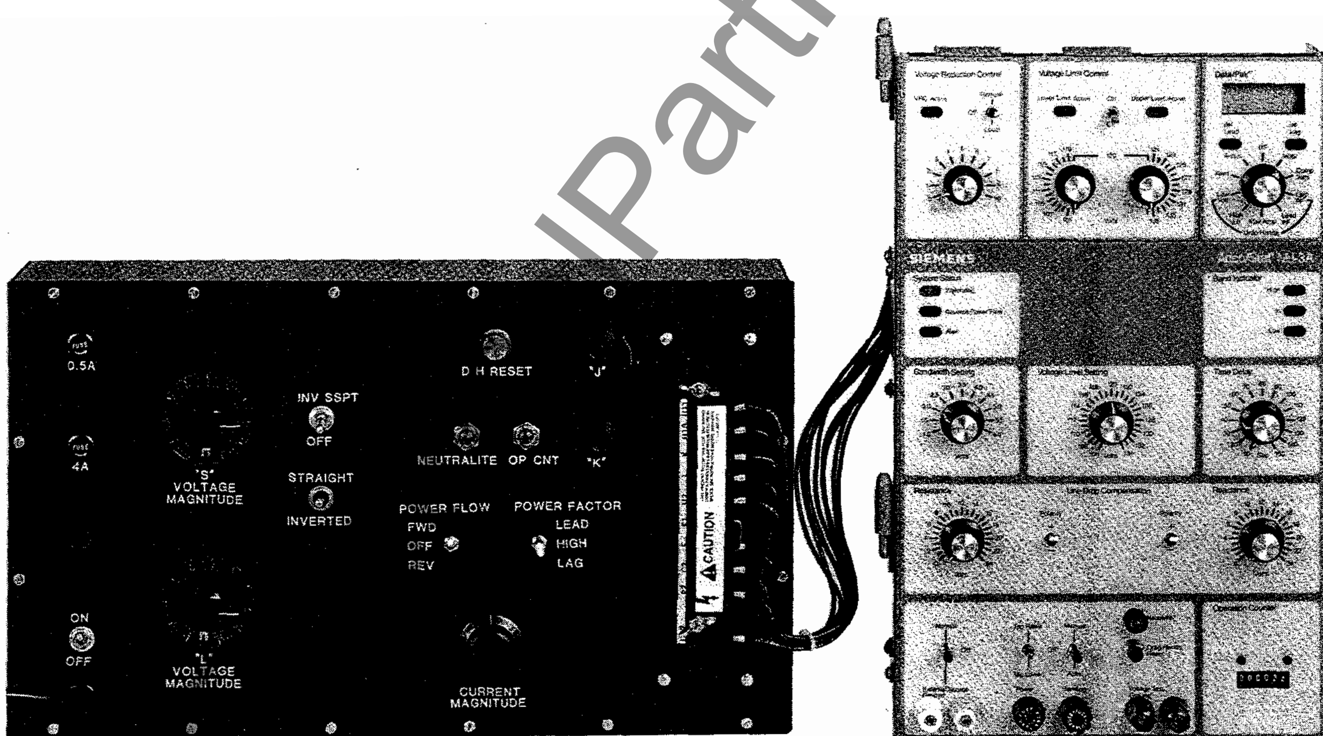
SIEMENS

Operation

Instructions



ACCU/STAT® MJ SERIES
REGULATOR CONTROL
OPERATIONAL PERFORMANCE EVALUATION

21-115527-003

response. Set 8 position DIP switch, position #7 to closed incorporating a 180° shift via computer software.

Observation:

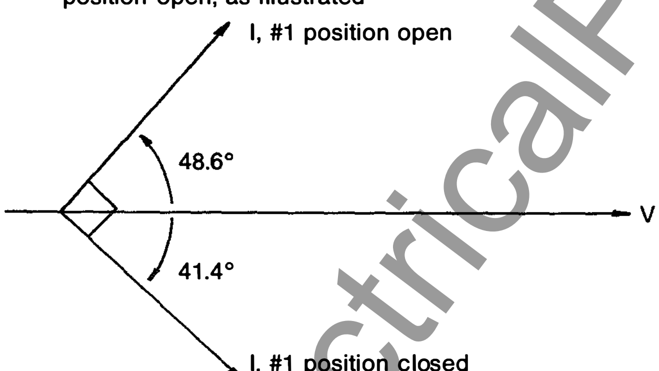
1) The Reverse Power Flow lite illuminates (after 5 seconds).
2) The power factor remains at 0.75 lag.

Therefore, the 180° phase shift as accomplished by simulator power flow reversal (or CT polarity reversal) is identical to changing the DIP switch #7 position.

Reset DIP switch position #7 open.

37. Other DIP switch functions can be checked using the power factor display. For example, set as for FPF, lagging power factor, which results in the 0.75 lag display. Recognize that this is an angle, relative to the voltage of $\theta = \cos^{-1} 0.75 = 41.4°$

The current signal will be advanced 90° by setting #1 position open, as illustrated



As a result, when the current is advanced by 90° it shifts to a position where it leads the voltage by 90° − 41.4° = 48.6°. Now set DIP #1 position open.

Observation:

Power Factor Display = cos 48.6° = 0.66 lead.

38. Leaving switch #1 position open, open switch position #5, which brings switch position #6 into play. Observe the following:

Switch 6 Position	Effect	New Current Angle	PF Display
Closed	30° advance	48.6° + 30° = 78.6° advance	.20 lead
Open	30° retard	48.6° − 30° = 18.6° advance	.95 lead

The operator is encouraged to select other combinations, using the leading power factor position on the simulator box to demonstrate his understanding. When finished, position 1, 5 and 6 should be closed; position #7, open.

If the control is equipped with voltage reduction accessory, proceed with step 39.

39. Set the control for 120V and the simulator so that the control is IN band. Have the VRC turned off. Set the VRC rotary switch to 5% setting. Activate VRC using either the LOCAL position of the VRC toggle switch, or REMOTE position with closure of VRC points on main control. The control is now set to hold output voltage to 120V − 5% = 114V.

Observations:

1) Immediately upon implementation, the VRC goes into effect, K is illuminated, calling for voltage reduction without concern for the time delay setting.
2) The band indicator lights respond around a sensed voltage of 114V, not 120V.

Turn the VRC off.

If the control is equipped with voltage limit control accessory, proceed with step 40.

40. Have the VLC turned off. Set the VLC LOWER rotary switch at 115V, set the VLC UPPER rotary switch at 125V. Now turn the VLC on.

Using the variac on the simulator, raise the voltage to slightly above 124V.

Observation:

VLC upper becomes active (the control will not make another raise command, which could put the voltage above the 125V setting).

Raise the voltage, using the variac to where the voltage is above 125V.

Observation:

The band indicator lites extinguish, the K lite on the simulator illuminates immediately (overriding the time delay) indicating a tapchanger run-back.

If the control is equipped with both voltage limit control and voltage reduction control accessories proceed with step 41.

41. Turn both accessory toggle switches to OFF. Set rotary panel switch on VRC to 10%. Set VLC LOWER to 115V, VLC UPPER to 125V. Set the simulator box so that *DATA/PAK* reads about 120V. Turn on VLC, turn on VRC.

Now switch current back on by going to Forward Power Flow.

Observation:

AMPS and MAX AMPS will track each other. After 2 minutes switch the current (power flow) off.

Observation:

AMPS tracks the time lagged current down, to 10 in 1 minute or 1 in 2 minutes, but MAX AMPS retains the 100 as it holds the maximum value attained since last reset by the operator.

33. Still on the topic of current, illustrate how the CT multiplier, DIP switch #5 works. Reset DIP #7 Pos. #4 to closed for instantaneous response. Set the simulator box for forward power flow, *DATA/PAK* for amps and any convenient current magnitude using forward power flow and the potentiometer. Now change the DIP switch #5 setting to OCOOC which is the setting used for a 1000 A CT primary.

Observation:

We've not actually changed the current in the MJ control, but the amps display records 5 times the original value. (i.e 1000A setting/200A setting = 5).

Reset the DIP switch #5 to CCOCC.

34. Until now, for everything done, COMP VOLTS = VOLTS. VOLTS is the voltage measured at the regulator. COMP VOLTS is a value which the MJ computer calculates as representative of the voltage at the "load center" if line drop compensation is used. Thus, the control actually responds to COMP VOLTS, and when the voltage level setting is established on the front panel, it is really COMP VOLTS that we wish to hold. The MJ control uses a rather involved algorithm to calculate COMP VOLTS bases on VOLTS, line current, power factor and the resistance and reactance volts set on the front panel. Without being concerned with the equation, make settings as indicated in the table, and note the observed COMP VOLTS.

Observe:

Volts	I	PF	R Volts	X Volts	Comp Volts
120.0	100	.99 Lag	0	0	120.0
120.0	100	.99 Lag	+6	+8	116.5

These example cases will give a feel for COMP VOLTS. Line 1 shows that without line drop compensation, VOLTS = COMP VOLTS. Line 2 shows that with realistic LDC values set, COMP VOLTS is lower than VOLTS, i.e. there is a drop on the line between the regulator and the load center.

35. Use settings of Line #2 above, i.e. R = +6, X = +8. Using the L variac adjust COMP VOLTS to 120V.

Observation:

The control, with voltage level setting = 120V is IN band.

Using the L variac adjust VOLTS to 120.

Observation:

COMP VOLTS is now 116.3 V. That is out-of-band low and control will call for a raise (J) command.

Reset line drop compensation, Vr and **Vx** to zero.

36. The Instruction Book defines the use of DIP switches, positions 1,5, 6 and 7 in terms of their settings for use on particular regulators. In reality, each of these switches merely shifts the phase relation of the current signal relative to the voltage signal. Using these switches in various combinations, the current can be shifted in 30 degree increments for a full 360 degree spectrum. The functions are as follows:

	Shift of current relative to voltage, switch position	
Switch Position	**Open**	**Closed**
1	90° advance	No shift
6, with 5 closed	No shift	No shift
6, with 5 open	30° retard	30° advance
7, with 8 closed	No shift	180° shift
7, with 8 open	180° shift	No shift

Since a 180° shift is identical to a power flow reversal, with no change in power factor, that is easily simulated.

Set the simulator for FPF, maximum current and lagging power factor.

Observations:

1) The Reverse Power Flow lite is off.
2) The power factor is about 0.75 lag.

On the simulator box, switch to RPF.

Observations:

1) The Reverse Power Flow lite illuminated (after 5 seconds).
2) The power factor remains at 0.75 lag.

On the simulator box, revert to FPF, wait 5 seconds for

Amp (#7) Volt (#6) PF (#8)	{COCC}	*DATA/PAK* drag-hands will display current, voltage and power factor with a time lagged response of 1 minute. Present value on *DATA/PAK* will display instantaneous response.

Change settings on the simulator box, as required for forward power flow, high power factor and maximum current magnitude. Set L variac so the *DATA/PAK* displays about 120V.

Observation:

There are two LED's flashing on the interface board. LED #1 is the watchdog for the interface board computer. That LED #2 is flashing indicates the interface board computer is in proper communication with the main MJ computer.

30. Check for meaningful displays on *DATA/PAK*. Start at COMP VOLTS and rotate the switch counterclockwise.

    Observations:

    1) COMP VOLTS and VOLTS display the same value, and that is the same as displayed on a meter connected to the test terminals.
    2) PF displays a very high, slightly lagging, power factor probably about 0.99 lag but may vary slightly with the particular simulator box.
    3) AMPS displays about 160, again subject to variation with the simulator. Note that the CT primary multiplier was set in step 24 to 200. Therefore, we are simulating a 200 to 0.2 (=1000) ratio. With this setting we are displaying the actual current (in milliamperes) in the MJ current circuit while simulating the displayed current (in amperes) in the regulator.
    4) ALERT may be retaining old information. Depress the reset on the side of the MJ control. The display will now be 0000.
    5) LOW VOLT, HIGH VOLT, MAX AMP, LEAD PF and LAG PF are drag hands (values of extremes retained in memory) which have been stored during previous testing. Depress the *DATA/PAK* drag hands reset button while displaying each of these parameters.

       Observation:

       In most cases the value displayed will change. The value displayed will then be the present 1 minute lagged value for each parameter. For example, there is in the computer a value for 1 minute lagged voltage. This value will appear on both HIGH VOLTS and LOW VOLTS when the reset is activated while viewing those positions.

31. On the subject of time lagging (or integrating) let's switch to current considerations. We've set all three sets of DIP switches to 1 minute integration so that responses will occur in reasonable time, but recognize that when the current response is set to 15 minutes (as at the factory) or 30 or 60 minutes, that this represents current demand, a very important parameter to many utilities. How it works: Set *DATA/PAK* to AMPS and set the current as close as possible to 100. Turn off the current using the Forward/Off/Reverse Power Flow switch. Take a 2 minute break while the integrated value settles essentially to zero. Now switch *DATA/PAK* to MAX AMPS display and reset the *DATA/PAK* drag hands.

    Using a watch with sweep second hand, start timing as the simulator is set to forward power flow.

    Observation:

    The MAX AMPS display does not immediately read the 100A that has been preset to be the instantaneous value. Instead the value increments upward, quickly at first, and then more slowly as the display approaches 100. The display is set to respond to 90% of the incremental change in the time period set. Consequently, in one minute, the display will read .90 x 100 = 90. In two minutes, 99%, in 3 minutes 99.9% etc. In reality, the display has accomplished essentially its full change in 2 times the lagging period set on the DIP switch.

    The lag period for current will usually be set to 15 or 30 minutes to replicate a demand meter. Voltage and power factor are factory set at 1 minute only to minimize the retention of transients in *DATA/PAK* memory.

32. Occasionally a utility would rather continuously display the integrated demand (as on current) rather than instantaneous current. To do so, set DIP pos. #4 of switch #7 to open. Now with *DATA/PAK* set to AMPS (not draghand MAX AMPS) we display the continously updated time lagged value. Revert to zero current by setting Forward/Off/Reverse Power to OFF. Again, wait 2 minutes and reset MAX AMP draghand.

    Observations:

    1) AMPS decremented downward, displaying continuously updated time lagged rather than instantaneous current.
    2) MAX AMP went from about 100 to nearly 0 when reset.

under any automatic mode of operation. You may do any control or simulator box operation to demonstrate that this is true.

22. Remove the AUTO INH jumper.

23. On the main control 8 position DIP switch, switch pos. #8 is designated set closed for a "straight" regulator or open for an "inverted" regulator. This merely tells the MJ control to sense the voltage of source #1 (the tertiary winding) or source #2 (the voltage transformer) according to the following:

	FPF	RPF
Straight regulator	VT	Tertiary
Inverted regulator	Tertiary	VT

This can be demonstrated, using the simulator, by misadjusting switch position 8. Start with the control sensing FPF and everything set for a straight design regulator (#8 position closed). For this test, set the power flow switch to off.

Observation:

"L" variac alters the voltage. Now set switch #8 open, i.e. incorrectly for the "straight" conditions of the simulator box.

Observation:

"S" variac alters the voltage.

24. Set the simulator box to "INVERTED" style regulator and source side PT "ON". It is necessary also, now, to set 8 position DIP switch, position #7 closed so that the MJ control is fully configured for use with an inverted regulator.

Set the box for FPF, high power factor and maximum current magnitude.

Observation:

The MJ control senses forward power flow. Voltage level sense responds to the 'L' voltage variac.

25. Set the simulator box to RPF. Set the voltage to out of band; low, i.e. less than 118 volts.

Observation:

The control voltage level sense responds to the 'S' voltage variac. After time out, the 'K' lite illuminates indicating a raise command under the reverse power flow condition.

26. Return to FPF. Simulate removal of the voltage source on the source side of the regulator by setting the SSPT to OFF.

Observation:

Response of the control follows the command of the 'L' voltage supply.

27. Set the simulator box for RPF.

Observation:

After 5 seconds the control switches to try to sense the source side voltage. Since there is no voltage source, the voltage sensed is zero. The ALERT lite is on indicating this condition, even though current is present.

To this point it has not been necessary to have a *DATA/PAK* accessory on the MJ control. Starting here it is presumed that *DATA/PAK* is present.

Before proceeding, reset the MJ control and the simulator box. Set the 8 position DIP switch COCCCCOC and the box for straight regulator.

28. Perhaps in the earlier sequence you noted the red LED in the side panel slot. This is the calibration lite. While it's not necessary to have *DATA/PAK* to calibrate the control (see Instruction Book), it can be very handy. Observe the voltage as displayed on *DATA/PAK* and the meter at the test terminals. Using a small flat tipped screwdriver, rotate the adjustment switch until the two meters display the same voltage as nearly as possible. (Each click of the rotary switch represents 0.25V). The MJ control is now calibrated against the reference meter. Presuming everthing is set for FPF, adjust the voltage with the L variac to the value set on the front panel voltage level setting (any voltage level setting value).

Observation:

When the applied voltage is equal to that of the voltage setting +/− .12 volt, the calibration LED on the side is illuminated.

29. The *DATA/PAK* requires that an interface printed circuit board be present to mate *DATA/PAK* (and voltage reduction control and voltage limit control) to the main MJ control. Note that there are additional DIP switches on the interface board.

Set these switches as:

Switch	Setting	Setting Meaning
CT ratio (#5)	CCOCC	Set for 200A CT primary rating.

16. Adjust the S variac.

    Observation:

    The voltmeter responds accordingly.

17. Depending on the elapsed time and an out-of-band condition the J or K lite might be illuminated. Adjust the voltage, using the S variac, until the voltmeter displays about 120 volts, i.e. an IN band condition. Because the timer is probably decrementing, hold the voltage IN band for at least 30 seconds before proceding. Now run the voltage down to below 118V using the S variac. The out-of-band LOW lite comes on. Wait the established 30 seconds time delay.

    Observation:

    The **K** lite comes on. Remember, we're in reverse power flow mode; therefore, the tapchange drive motor must reverse direction from that which would be realized under FPF.

At this point the operator may wish to repeat some of trials of step 9 above under the reverse power flow condition. Remember: J and K responses will reverse.

18. Now we will observe control response to the setting of the 8 position DIP switch, position #2. This switch is categorized as low current inhibit. When the switch is set open, as it has been to this point, the control will operate in the automatic mode regardless of the magnitude of current. However, if the #2 switch is set closed, the control will not operate in automatic mode unless the current is greater than 2%. The current may represent either forward or reverse power flow. We have the ALERT lite to tell the current magnitude relative to the 2% threshold.

    Reset the simulator box for forward power flow and the current potentiometer for maximum current (fully clockwise). Set 8 position DIP switch, position #2 closed. Using the L variac set the voltage out of band, low.

    Observation:

    After waiting the 30 second time delay the J lite illuminates.

    Now return the voltage to an IN band condition and turn the current magnitude down until it simulates a less than 2% condition as revealed by ALERT lite illumination. Again, using the L variac set the voltage out of band, low.

    Observation:

    Thirty seconds passes with no signal to J. The tapchange has been prevented because the current is low (less than 2%) and DIP switch position 2 is closed.

    Reset DIP switch #2 to open. J illuminates immediately.

19. We've demonstrated control response to reverse power flow. It has not been important to have had the relay for reverse power flow applications installed at the RLY 1 position. At this point, if the relay is installed, turn the control off and reconfigure the jumpers on the 12 point sensing transformer terminal strip, as

    PB to 20
    P14B to 20
    P14A to 25
    PA to 20
    Remove the jumper which had been P to P14.

    (This follows example case 4 of "Configuring the *Accu/Stat* Control" in the MJ Instruction Book).

    Using these settings, the MJ control introduces no voltage correction under FPF, and a minus 5V correction under RPF.

    Turn the control back on and make appropriate simulator box settings so that the control is responding to FPF. Set the current magnitude potentiometer fully clockwise. Under the mode of operation as configured the control is responsive to the P2 voltage. Use the voltmeter to compare the voltage at the test terminals to that as measured from P2 to E on the disconnect terminal at the simulator box.

    Observation:

    There is no voltage correction introduced in the sensing transformer under FPF condition. The voltmeter reads the same at both places.

20. Change the simulator box settings so that the control is responding to RPF. The control is now responding to the voltage at U2. Now compare the voltage measured at the test terminals versus that at U2 to E.

    Observation:

    The sensing transformer has been configured to drop the voltage by 5V under RPF condition. The test terminal voltage is therefore 5 volts lower than the voltage at U2.

21. Turn the control off and remove the jumpers installed in step 18 and replace the P to P14 jumper. If you're working with an MJ-3 control also add a jumper across the AUTO INH terminals. Turn the control back on.

    Observation:

    The AUTO INH closure acts to prevent all tapchanging

7. Test the MANUAL raise and lower functions. Place the MANUAL/AUTO toggle switch to MANUAL. Toggle the TAP RAISE/TAP LOWER switch in each direction.

   Observation:

   When the switch is toggled to "TAP RAISE", the 'J' lite illuminates on the simulator box; "TAP LOWER" illuminates the 'K' lite.

8. Now toggle the AUTO/MANUAL switch to AUTO. (The band indicator lite should still be HIGH).

   Observation:

   Depending on how long it took to accomplish step 7, the "K" lite may illuminate indicating that the MJ control has been out-of-band HIGH for more than the time delay setting (i.e. 30 seconds) and it is giving an automatic lower command. If not, wait briefly for the time out function to complete and the "K" lite to come on.

9. Now repeat the essence of step 7 but with a lowering voltage using the L variac and with recognition of the J and K lites. Slowly lower the voltage to slightly below 122V.

   Observation:

   The HIGH lite turns off as we are now in-band. However, the "K" lite does not immediately turn-off. Once a tap change is initiated, the MJ control continues to command tap changer action until the voltage satisfies a 75% of bandwidth-setting criterion. Consequently, the K circuit is not opened until the voltage drops to 120V + (0.75 x 0.5 x 4V) = 121.5V. Continue the voltage reduction. As the voltage drops below 118V the band indicator low lite comes on. If the voltage then stays below 118V, the "J" lite will come on after waiting out the established time delay of 30 seconds.

10. Now we're out-of-band low, with the voltage something less than 118V. Using the L variac, bring the voltage IN band, as to 120V for 10 seconds. Then quickly lower the voltage again to clearly below 118V.

    Observation:

    The "J" lite extinguished as the voltage came above 118.5 volts (why not 118V?). However, it did not immediately reappear as the voltage dropped below 118V, nor did it wait out the 30 second time delay setting. In fact, while in band the timer was decrementing from 30 sec (although not at a one-second per second rate). The "J" lite reappears after again crossing the low band threshold after about 80% of the time duration for which operation was in band.

    Before proceeding, the operator may wish to repeat the running through band checks using his own selection of voltage level setting, bandwidth setting and time delay. Can the proper response of the HIGH-IN-LOW and "J" and "K" lites be confirmed? Continue to the next step with the voltage nominally at 120V.

11. Confirm that the ALERT lite has been illuminated to this time due to a low current condition by setting the simulator box to forward power flow.

    Observation:

    The ALERT lite goes off. The ALERT lite on an MJ control will be illuminated anytime that the current signal is less than 2% of the regulator current transformer rating. Note: Since all Siemens regulators use a 0.2A CT secondary this is equivalent to stating that the ALERT lite is on anytime the MJ control signal is less than 2% of 200 mA, or 4 mA.

12. Adjust the current magnitude potentiometer counter clockwise.

    Observation:

    At some point, the ALERT lite comes on. Where the lite came on is indicative of the 2% current threshold.

13. Re-adjust the current magnitude potentiometer to setting where the current magnitude is clearly greater than 2% and the ALERT lite is off. Toggle the forward power flow switch on the simulator box to OFF.

    Observation:

    The ALERT lite returns immediately. (OFF means zero current flow, obviously this is less than 2%).

14. Toggle the simulator box switch to reverse power flow.

    Observations:

    1) The ALERT lite extinguishes very quickly. Even though the control is sensing a simulated reverse power flow (RPF) condition, the current magnitude criteria is satisfied.

    2) After a time delay, locked into the MJ software at 5 seconds, the control acts upon the RPF recognition. The Reverse Power Flow lite is illuminated.

15. At this point attempt to alter the voltmeter voltage by adjusting the L variac.

    Observation:

    There is no response on the voltmeter. Reason: We're acting under the rules of RPF, i.e. the regulator is to respond to the **source** side voltage.

4. Voltage level = 120V.
5. Time delay = 30 seconds.
6. Resistance volts = 0, polarity = +.
7. Reactance volts = 0, polarity = +.
8. 8 position DIP switch = COCCCCOC.
9. If voltage reduction control is present, set to off.
10. If voltage limit control is present, set to off.
11. If *DATA/PAK* is present, set to VOLTS.

MJ Control Jumper Connections:

1. On the 12 point sensing transformer terminal strip at the rear of the control, connect a jumper between the P and P14 points (the two bottom points). This should be the only jumper connected on that strip for the start of the test.
2. To the six point terminal strip at the rear of the control:
   A. Connect a jumper C2 to C.
   B. Connect a jumper N0 to N10 on MJ-1A or MJ-2A.
   C. Be certain that there is no jumper at "VRC".
   D. Be certain that there is no jumper at "AUTO-INH" on MJ-3.
3. The presence or absence of a relay at RLY 1 position is not important to the first tests.

Connect a voltmeter at the voltage test terminals. It is preferred that this be a true rms reading digital meter, however, if the meter is one which displays an average voltage with an rms correction (as for most common dial pointer meters) the test procedure should continue with 8 position DIP switch position #4 set OPEN. Note: Even if *DATA/PAK* is present and displaying volts, the operator may gain additional confidence in the performance of the control by using the independent voltmeter.

TEST CHECK PROCEDURE

1. Turn power switch "on", on simulator box.
2. Set Normal/External source switch on MJ control to "normal".

   Observations:

   1) The watchdog lite should immediate start to flash at about a 6 Hz rate. This is the visible evidence to the operator that the MJ control computer program is cycling.
   2) The reverse power flow lite will be off on an MJ-3. There is some small chance that it will be on on a MJ-1A or MJ-2A. If it is, depress the reset button at the top of the slot cutout on the side of the control to have the RPF lite extinguish.
   3) The alert lite will be illuminated.
   4) Check the voltage present at the voltmeter test terminals. It will probably be less than 120V depending upon the line voltage to the simulator box and the setting of the L variac. Now adjust the L variac until the voltage is in the range of 115 to 117 volts. The band indicator "low" lite will be illuminated indicating that the voltage sensed by the control (i.e. 115V to 117V) is lower than the MJ control is programmed to maintain (i.e. 120V +/- 2V).
3. Test the *Neutralite*™ by depressing the *Neutralite* button on the simulator box.

   Observation:

   The *Neutralite* on the control panel stays illuminated as long as the button is depressed.
4. Test the operations counter by depressing operation count button on the simulator box.

   Observation:

   The operator counter displays only even digits. The right hand digit of the counter is held midway between digits while the button is depressed. When the button is released, the counter displays a number 2 units greater than before the test sequence.
5. Test the drag hands reset by depressing the indicated button on the lower front segment of the MJ control.

   Observation:

   The drag hand reset lite is illuminated on the simulator box as long as the button is held depressed.
6. Slowly raise the voltage sensed by the control by adjusting the L variac.

   Observation:

   Initially, the "LOW" band indicator lite is on. As the voltage attains 118 volts (i.e. voltage level setting minus ½ bandwidth setting) the control comes "IN" band. As the voltage continues to rise past 122 volts, the voltage goes out of band "HIGH." Run the voltage to the range of 123 to 125 volts.

SIMULATOR BOX PRINCIPLES OF OPERATION

The objective of the box is to simulate to an *Accu/Stat®* control the inputs and outputs of the regulator. The control mates physically and electrically with the box via the 10 pin polarized disconnect switch (PDS) just as it does with a regulator.

The PDS is illustrated on the schematic as ——>>—— with the appropriate terminal designated. Thus, everything inside the arrows is the *Accu/Stat* control. Everything outside of the arrows represents components of the simulator box.

Circuits toward the right side of the schematic are simple power circuit checks:

- U10 for checking the operation counter.
- U11 for checking the drag hand reset.
- U12 for checking the *Neutralite™*
- J and K for checking power to the tapchange drive motor.

The voltage adjustment involves two variacs, item Q, the outputs of which are designated 'S' and 'L'. These designators stand for "source" and "load" as long as the unit is configured for forward power flow. Note: When reverse power flow is simulated, the source voltage is actually that at 'L', and vice versa. The switch for INV/STRAIGHT will be set to configure the box to represent an Inverted or a Straight design regulator. The SSPT switch will be closed when it is desired to represent a source-side potential transformer on an inverted style regulator. When configured as "straight", the box simulates straight design regulators with polarity mark on E2 of the tertiary winding.

The current path is that involving transformer, item P, leading to the PDS at C2. A polarity reversal of the center tapped transformer sets the current either in-phase or 180° out-of-phase with U, in order to accomplish a forward power flow or reverse power flow representation. The phase angle of the current may be shifted to lagging or leading and the magnitude adjusted by the incorporation of the inductor, capacitor and potentiometer.

TEST SEQUENCE

The simulator box is an excellent aid for programmed learning of the features of an MJ control. With clear recognition of how the control **should** perform under given circumstances, the box also becomes an efficient tool for confirming or challenging suspected problem areas. The *DATA/PAK™* accessory, optionally available on any *Accu/Stat* control in the MJ series, is required for visual feedback to the test operator of many control conditions. Consequently, it is urged that at least one *DATA/PAK* package be available for use with the control being tested. If a *DATA/PAK* is not available, testing is less instructive, although some diagnosis is still possible.

> **⚠ CAUTION**
>
> Improper handling of MJ series controls will subject controls to static electrical discharge.
>
> Static discharge will cause sensitive electronic components to fail.
>
> Test operators should be grounded using a wrist strap connected to ground when working at the component level of the control.

TESTING/CHECKING SEQUENCE

The first 27 steps do not require the *DATA/PAK* accessory.

Initializing Procedure:

Simulator Box, set:

1. Power switch "off".
2. S and L variacs at about 80% point.
3. Power flow "off".
4. High power factor.
5. Straight regulator.
6. SSPT "off".
7. Current magnitude potentiometer fully clockwise.

MJ Control, settings:

1. Normal/External source switch "off".
2. Manual auto switch "off".
3. Bandwidth = 4.OV.

TESTER/DEMONSTRATOR CONSTRUCTION

Complete simulators may be purchased from Siemens, Regulator Business Unit, Jackson, MS. Contact your local representative for ordering information.

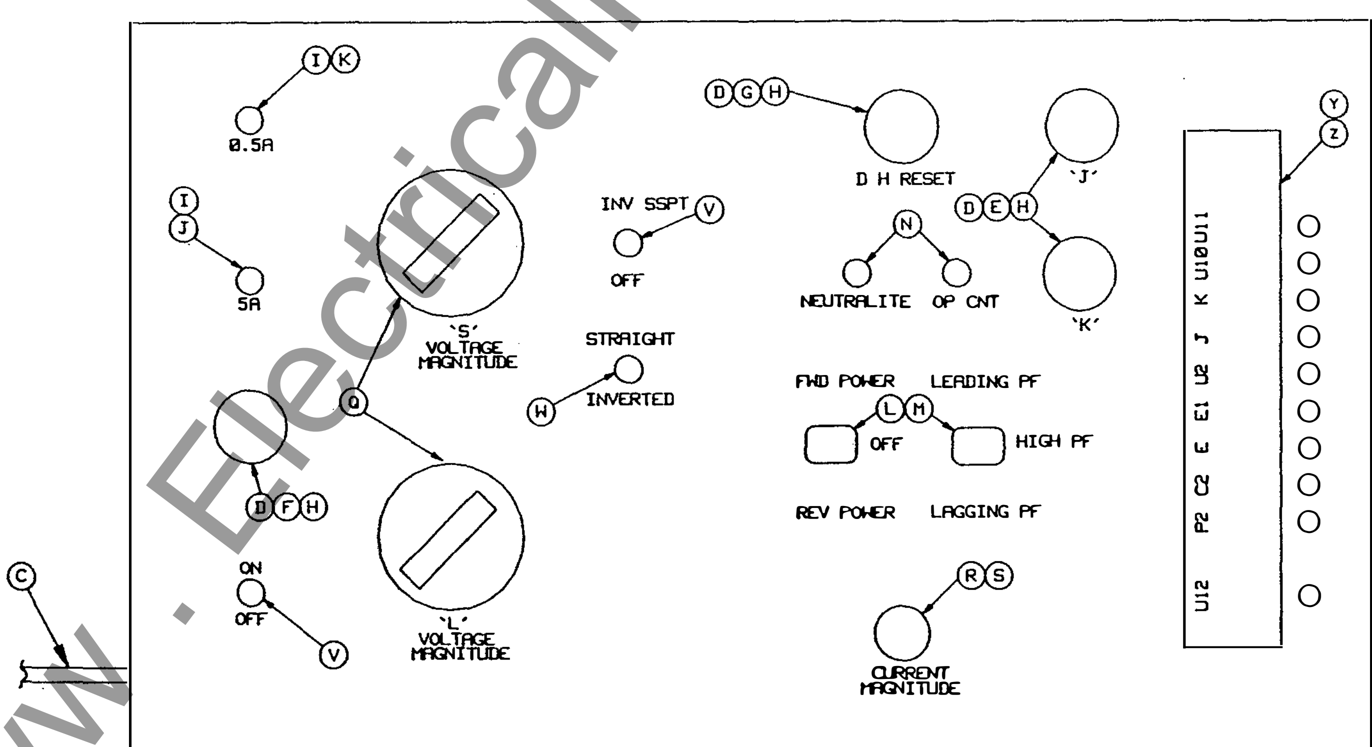
Some may choose to build a simulator. In that case, following is a list of material which may be used. The stock number shown is taken from Newark Electronics, catalog 109.

PARTS LIST

Item	Qty	Part No.	Description
A	1	90F969	Aluminum Chassis
B	1	90F868	Chassis Bottom
C	1	36F1821	Line Cord
D	4	65F1075	Light Sockets
E	2	25F1582	Lens (Red)
F	1	25F1583	Lens (Green)
G	1	25F1584	Lens (Amber)
H	5	27F260	Bulbs (1 spare)
I	2	27F668	Fuseholder
J	5	27F661	Fuses (5A) (4 spare)
K	5	27F654	Fuses (0.5A) (4 spare)
L	2	22F555	Lever Switch
M	2	22F647	Knob for Lever Switch
N	2	24F204	Push Button Switch
P	1	81N5363	Transformer 6.3VCT
Q	2	05F301	Variable Transformer
R	1	10F464	2.5 kohm Potentiometer
S	1	57F2357	Knob for Potentiometer
T	1	01F893	35 mHy Choke
U	1	15F119	100 uF Capacitor
V	2	23F006	Toggle Switch
W	1	23F009	Toggle Switch
X	1	37F503WA	Hook up wire, color #1

Additional material should be ordered from Siemens, Jackson, MS.

Y	1	21-303762-603	Jack Plug (Female)
Z	2	00-637117-501	Wing Nuts



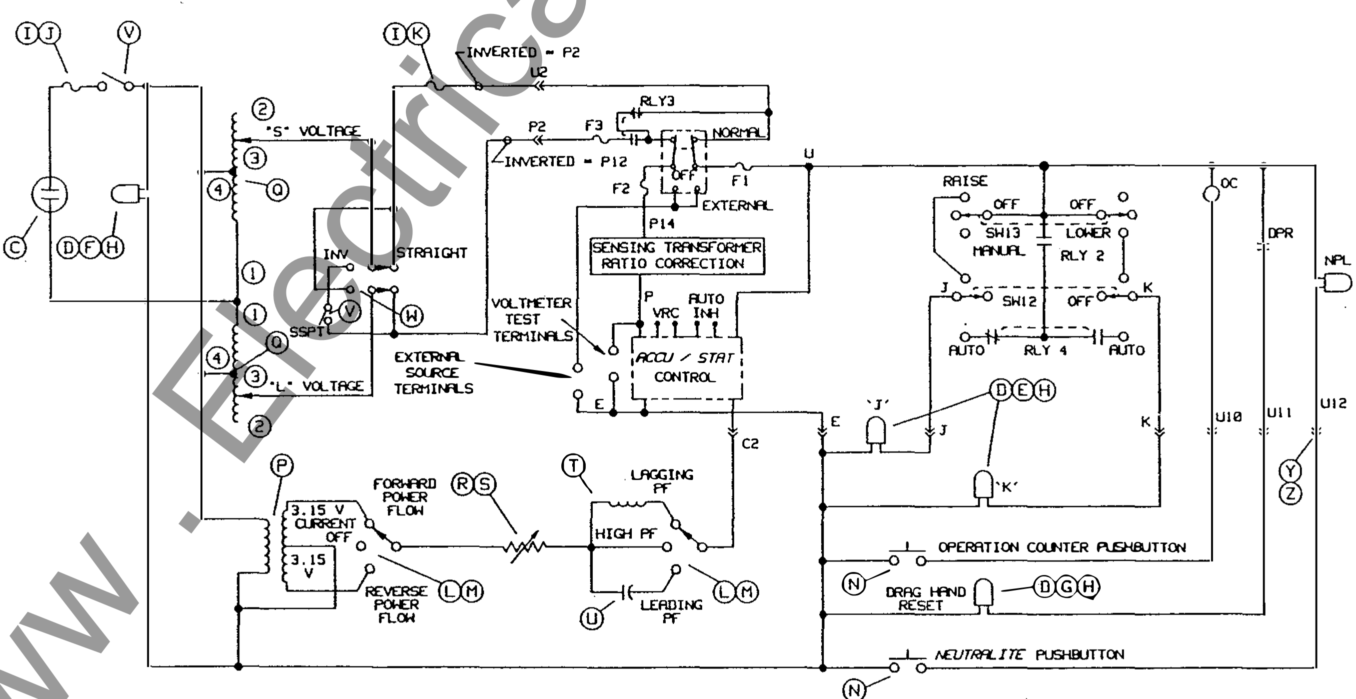
SUGGESTED CONSTRUCTION AND LABELING PLAN

THE SIMULATOR BOX

Three drawings describe the Simulator Box:

1. The schematic diagram.
2. The parts list.
3. Suggested physical orientation for components.

These drawings are intended to be sufficiently detailed that anyone can procure the parts and build the box for his own use.



SIMULATOR BOX SCHEMATIC

INTRODUCTION

Digital is the trend. Everyone recognizes that pocket calculators are now almost indispensable, and compact disk stereo systems are now replacing LP records. In the same way the *Accu/Stat*® MJ series of controls incorporate state of the art digital electronics replacing the analog devices of the past. The controls are special purpose digital computers programmed to sense the required inputs and provide appropriate output commands for a step-voltage regulator (or an LTC transformer).

It will be recognized that a general purpose digital computer, such as a "PC", can be programmed by an operator to accomplish an unlimited variety of tasks. Even though the MJ controls are special purpose computers, and the basic control coding is not accessible to the user, the operator does have the opportunity to program the control, or "customize" it, for his particular application. Some of the operator selectable program is dictated entirely by user preference, while other aspects are a function of the regulator or the system with which the control is applied. Failure to properly program the latter functions may cause the MJ to improperly command the regulator.

Operator selectable programming is accomplished, in all cases, using the various switches on the control. For example, when the operator sets the voltage level setting at 120V, he is programming the computer to recognize that value as the center of the allowable bandwidth of voltage. In this way, the rotary switches accessed from the front panel are all examples of operator selectable programming set to suit his particular needs.

The small lever ("DIP") switches, which are designed to be less convenient, include some which **must** be set per instructions in order for the control to perform properly. Others of the DIP switches are user preference selectable.

Following are examples of possible difference in regulator design or utility operation which must be accounted for in the programming of the DIP switches:

- The regulator is single phase or three phase
  - A single phase regulator is of the "straight" or "inverted" design style.
  - A three-phase regulator uses a line to ground or line to line voltage transformer; a single or cross connected current transformer.
- The regulator will be on a wye, open delta or closed delta system.

A control box which simulates the regulator interface to the MJ control has been developed to assist the user in understanding how correct programming of an MJ control is essential for proper operation. Using the "box" it is instructive to set a switch incorrectly and observe the control response without involving real distribution system conditions. It will also be evident that the box is an excellent tool for trouble identification in a faulty control for an operator who is well acquainted with the product.

TABLE OF CONTENTS

Observation:

The "K" lite comes on on the simulator box indicating the regulator is stepping the voltage down, because of VRC.

Simulate this operation by adjusting the variac downward.

Observation:

As voltage goes below 115V, the lite switches to J indicating the VLC has assumed command from the VRC, and VLC is commanding a voltage increase.

CONCLUSIONS

An MJ control is a computer. When the output of a computer is perceived to be in error, the problem will usually be one of:

- Faulty hardware,
- Inappropriate inputs or
- User mis-perception proper response

The simulator box should be considered to be a tool which, with these instructions, help the user become well acquainted with regulator control principles. In so doing, he has the opportunity to simulate improper or unrealistic commands and observe the response.

If the simulator box has been used to confirm a suspected problem, it should be noted that proper response to the steps of this procedure virtually assure that the control is performing properly to the extent of the front panel switch settings used. If a problem is found , the control may be returned to Siemens for repairs. Contact your local Siemens representative.

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