MJ-4A(TM) and MJ-4B(TM) Voltage Regulator Control Panel
Installation and Operations Manual
IMPORTANT

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Siemens reserves the right to make changes at any time without notice of obligations. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material, or both, the latter shall take precedence.

QUALIFIED PERSON

For the purposes of this manual, a qualified person is one who is familiar with the installation, construction, or operation of the equipment and the hazards involved. In addition, this person has the following qualifications:

(a) is trained and authorized to de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.

(b) is trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety procedures.

(c) is trained in rendering first aid.

NOTE

These instructions do not purport to cover all details or variations in equipment, not to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local sales office.

The contents of the instruction manual shall not become part of or modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of Siemens Power Transmission & Distribution, Inc. The warranty contained in the contract between parties is the sole warranty of Siemens Power Transmission & Distribution, Inc. Any statements contained herein do not create new warranties or modify the existing warranty.

DANGER Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
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1 Introduction

The MJ-4A(TM) and MJ-4B(TM), hereafter referred to collectively as MJ-4(TM), is a Voltage Regulator Control Panel, which is a member of the Siemens Accu/Stat® series of digital controls, designed for use with many regulators and load tap changer models.

Although the MJ-4 Control Panel includes some new functions, its operational characteristics are similar to those of earlier-model Accu/Stat MJ-1A, 2A, 3, 3A, MJ-X, and MJ-XL controls. It is electrically and mechanically interchangeable with these controls.

Voltage Reduction Control, Voltage Limit Control, six Power Flow modes, and Data Logging are all standard features of the MJ-4 Control Panel.

In addition to manual and automatic voltage monitoring and control, the MJ-4 Control Panel also offers full remote monitoring and control capability. Via a communications link, a remote operator can monitor operating conditions and adjust setpoints or command tap changes—just as if he/she were locally operating the controls.

When equipped with an optional Communications Module, the MJ-4 Control Panel provides remote communications and SCADA (Supervisory Control And Data Acquisition) compatibility. Please refer to the MJ-4 Communications Module Installation Manual for an in-depth treatment of the Communications Module.

The regulator control function has two operating modes—manual and automatic. Remote control can be enabled or disabled for each of these operating modes. The operating modes and remote control settings are described in Section 2.5.

- **Manual control.** In Manual mode, the operator directly controls the regulator tap changer and uses this mode to enter regulator setpoints for automatic control.

- **Automatic control.** In Automatic mode, the microprocessor controls the regulator tap changer, based on setpoints stored in memory.

- **Remote control.** If enabled, this setting permits a remote operator to change operational values and setpoints as well as to monitor operational values. If disabled, a remote operator can only monitor operational values.

1.1 About This Manual

This manual is designed to help you become acquainted with all aspects of the MJ-4 Control Panel. The manual starts with the operator panel and controls, followed by physical installation considerations, setup procedures, day-to-day operations, and finally, troubleshooting. The Appendices provide further information about MJ-4 Control Panel operation and setup.

Note: This manual describes features embodied in MJ-4 software version 4.10

1.2 Features of the MJ-4A & MJ-4B Control Panels

This section briefly describes the standard MJ-4 Control Panel features and functions.

Display Panel and Operator Controls

Operator input to the MJ-4 Control Panel is accomplished through a set of touch-keys. MJ-4 output is presented in plain text through a sixteen-character alphanumeric display panel. For status items, such as Voltage Reduction and Voltage Limit, indicators provide a quick-glance summary of MJ-4 Control Panel operating conditions.

Metering

The MJ-4 Control Panel maintains and presents operational data to help you monitor system operation. Instantaneous and demand values (along with minimum and maximum for each) are readily available.

Data Logging

The Data Logging function maintains historical data for subsequent review and analysis. This data can be very useful in the assessment of load characteristics by time of day or season; the reconstruction of system problems; and the improvement of the overall efficiency of the power distribution system.

Voltage Limit Control

Voltage Limit Control (VLC) automatically maintains regulator output voltage within preset high and low limits.

Line Drop Compensation

Line Drop Compensation (LDC) models the resistive and reactive voltage drop of the line. The resulting model is used by the microprocessor to correct regulator output voltage for the effects of line drop between the regulator and the load.

Voltage Reduction Control

Voltage Reduction Control (VRC) reduces output voltage and can be activated automatically, manually, or remotely.

Reverse Power Flow Detection and Operation

In many systems, power only flows in one direction; however, in some systems power flow reverses from time to time. To accommodate power flow reversal, the MJ-4 Control Panel monitors power flow direction and adjusts its operation accordingly. Six different Power Flow Modes allow flexibility in selecting a control algorithm which best matches the power flow needs of the system.
1 Introduction

Communications
The MJ-4 panel provide local communications via the front-panel data port, and supports remote communications with the MJ-4 Communications Module.

Barrier Terminal Strips
Terminal contacts on the back of the MJ-4 Control Panel allow for external control over certain functions such as VRC activation and tap changing. These terminals can be used to provide an electrical interface to a SCADA system for remote control applications and/or other desired control functions.

1.3 Mounting on Siemens Regulators
The MJ-4 Control Panels are mechanically and electrically compatible and interchangeable with earlier MJ, IJ and SJ series and earlier control units. They can be mounted in the existing enclosure by simply swinging the control to be replaced outward on its hinges, disconnecting the polarized disconnect switch (PDS), then removing the unit and inserting the new unit. (See Appendix B.)

1.4 Mounting on Cooper Regulators
A retrofit kit is available for mounting the MJ-4 Control Panels on Cooper regulators. The kit includes all of the necessary hardware and complete instructions for mounting and connecting the MJ-4 to the regulator. The retrofit is accomplished without the necessity of replacing the waterproof housing. See the Retrofitting Cooper Regulators Application Note for details.

Contact your Siemens representative for ordering information.

1.5 Mounting on GE Regulators
A retrofit kit is available for mounting the MJ-4 Control Panel on GE regulators. The kit includes all of the necessary hardware and complete instructions for mounting and connecting the MJ-4 to the regulator. The retrofit is accomplished without the necessity of replacing the waterproof housing. See the Retrofitting GE Regulators Application Note for details.

Contact your Siemens representative for ordering information.

1.6 Mounting on Load Tap Changers
A retrofit kit is available for mounting the MJ-4 Control Panels on LTCs. The kit includes all of the necessary hardware and complete instructions for mounting and connecting the MJ-4 to the LTC.

Contact your Siemens representative for ordering information.

1.7 Support Documentation
In addition to this manual, Siemens provides a number of supporting documents that provide details about the use of Siemens regulators and control products.

Contact your Siemens representative or visit the Siemens T&D website for a complete list of Application Notes and other supporting documentation.

1.8 Siemens Website
The Siemens website contains information about all of the Siemens transmission and distribution products, including regulators and controls.

All voltage regulator products can be located on the Voltage Regulator product page after navigating to the Siemens PT&D website below:

http://www.usa.siemens.com/energy

Browse this section for information about the regulators, regulator accessories, upgrades, downloadable files, and more.

1.9 Control Panel Type
There are two models of Voltage Regulator control panels described in this manual: the MJ-4A and the MJ-4B.

The MJ-4A has discrete three position switches for the Auto-Manual functionality and Raise/Lower. The MJ-4B has push buttons for the above functionalities.

This manual is written describing the features of the control panel in general and in specific sections the differences between the MJ-4A and MJ-4B are explained.
Figure 2.1    MJ-4A Front Panel
Figure 2.2 MJ-4B Front Panel
2.1 Introduction to the Front Panel

The Front Panel (Figure 2.1 and 2.2) provides access to all controller information. Configuration settings, setpoint adjustments, and data requests are entered through a set of large touch-keys. Front panel output devices include a number of indicator lights (LEDs) and a sixteen-character alphanumeric display screen.

The front panel is logically divided into three areas from top to bottom:

The top third of the front panel contains various indicator lights, an RS-232 serial port for local data communication, and a sixteen-character display screen. Also included in this area are touch-keys for the selection and modification of setpoints and data. The keys to the right of the display screen select specific readings or settings; the keys below the display screen can be used to change the selected value. This section also contains the Quick, Op Count, and Messages fast-path keys.

The middle third of the front panel includes a group of special fast-path keys that provide direct access to frequently-used functions (Regulation Setting, Line Drop Compensation, Voltage Reduction Control, Voltage Limit Control, Neutralite Test, and Drag Hands Reset).

In the bottom third, the MJ-4A Panel has mode and raise lower switches, whereas the MJ-4B panel has mode push buttons for the same, both panels have a power switch, binding posts for the attachment of external power and metering equipment, and controller fuses.

This chapter describes each of the front panel controls and explains how you can use them to select, view, and change stored data. For more detailed information about the functions provided by these controls, read chapters 4 and 5.

2.2 Sixteen-Character Display Screen

The microprocessor presents information to the operator by way of a sixteen-character alphanumeric display screen. This display screen presents both alphabetic and numeric characters in plain text, eliminating the need for special codes. The display screen uses high contrast, active LED technology that is easy-to-read in direct sunlight as well as in low light conditions.

2.3 Data Display

Front panel touch-keys provide easy access to all data stored in MJ-4 Control Panel memory.

To view or change a given data item you must first display it. Two types of touch-keys are provided to help you display a data item:

- Use the menu selection keys to view any stored data item grouped by Menu Headings.
- Use the fast-path keys to jump directly to frequently-used data items without scrolling.

2.3.1 Menu Selection and Change Keys

Use the Menu Selection and Change keys, located in the top third of the front panel, to view and change controller setpoints and data items.

To view a specific data item, you must first select the Menu that contains that item. For example, meter readings are selected from the <METER> Menu; setpoints are selected from the <REGULATOR> Menu. Once the correct Menu is selected use the Scroll keys to step through the data items in that Menu until the desired data item is viewed on the display screen. (For details about the Menus, see Chapter 3 and Appendix G.)

Menu Key

Press this key once to return to the top of the current Menu. To return to the start of all Menus from any position in any Menu press this key twice.

Scroll Keys

These triangular keys surround the Menu key. Their shape indicates the direction of scrolling performed by the key.

Use the right and left Scroll keys to scroll across Menu headings and move the cursor when in Change mode.

Use the up and down Scroll keys to scroll through data items within a column and change settings when in Change mode.

Change Key

Use this key to place the panel in the Change mode. In Change mode, you can make changes to setpoints and other stored configuration information.
To change an item:

1. View the item using either the menu selection keys or the fast-path keys.

2. Press the Change key. The displayed data item flashes to indicate that it can be changed.

3. Use the Scroll keys to make the desired change.

**Save Key**

After using the Change key and the Scroll keys to modify a data item, press the Save key to record the change and exit the Change mode. The displayed data item will stop flashing.

**Cancel/Reset Key**

The function of this key depends upon the function currently being performed:

- If the microprocessor is in Change mode, press the Cancel/Reset key to exit the Change mode and cancel any changes. (The data item will revert to its previous setting.)

- If you are viewing a max or min value, press the Cancel/Reset key to reset the item to the present meter value.

- If you are viewing Tapmax/Tapmin data items, press the Cancel/Reset key to reset them to the current tap position. (See Section 5.7, <COUNTERS> Menu.)

- If you are viewing an ALERT, press the Cancel/Reset key to acknowledge the Alert. (See Section 5.8, <ALERTS> Menu.)

**Max/Min Key**

Use this key to view max/min values for meter parameters. First view the desired data item, then press the Max/Min key to view the maximum value. Press the Max/Min key again to see the minimum value. Press the Max/Min key a third time to exit the Max/Min mode without resetting the values.

Max/Min data items are displayed for a short period of time, after which the display returns to the current value. The length of this period can be selected by the operator. (See Section 4.3.24, Min/Max Time Out.)

For example, if you wish to see the minimum load voltage since the last reset, use the Menu Selection keys to select Vld from the Meter Menu. The current voltage value is displayed on the screen. Press the Max/Min key. The maximum value will display for a short time. Press the Max/Min key again to view the minimum value.

To clear max/min values, see Cancel/Reset Key description.

To display max/min Time/Date stamp, see the Save key Special Use description.

### 2.3.2 Fast-Path Keys

Fast-path keys are shortcuts that provide direct access to frequently used data items. Once you have selected a data item with a fast-path key, use the Change, Scroll, and Save keys to view and change the data item just as you would do with the menu selection keys.

Many of the data items selected by the fast-path keys have both forward and reverse values. For example, if you press the fast-path key labeled “Voltage Level,” the data item “Fwd Volts” appears on the display screen. Press the key again to view the reverse value. “Rev Volts” is displayed. Press the key repeatedly to alternate the display between forward and reverse values.

**Regulation Setting Fast-Path Keys:**

**Voltage Level Key**

The Voltage Level setpoint defines the output voltage you want the regulator to maintain. Use this key to view the Voltage Level setpoint. Once you display the Voltage Level, press the Change key to modify the value.

**Bandwidth Key**

The Bandwidth setpoint defines a voltage range (on either side of the Voltage Level setpoint) which you consider to be acceptable. When regulator output voltage falls outside this value, the MJ-4 Control Panel activates the tap changer motor to restore the voltage to an in-band condition. Use this key to view the Bandwidth setpoint. Once you display the Bandwidth, press the Change key to modify the value.
Time Delay Key

The Time Delay setpoint defines the amount of time you want the controller to wait (after regulator output voltage has fallen outside the Bandwidth limit) before activating the tap changer motor. Use this key to view the Time Delay setpoint. Once you display the Time Delay, press the Change key to modify the value.

Line Drop Compensation Fast-Path Keys

Line Drop Compensation (LDC) defines your estimate of the voltage drop between the regulator and the load center. The MJ-4 control program adjusts regulator output voltage to compensate for this drop. Specify both Resistive and Reactive components of Line Drop Compensation. See Appendix D.2 for instructions about calculating the line drops.

Resistance Key

Press this key to view the Resistive LDC component. Once you display the Resistive LDC, press the Change key to modify the value.

Reactance Key

Press this key to view the Reactive LDC component. Once you display the Reactive LDC, press the Change key to modify the value.

+/− Polarity Select Key

While in the Change mode, press this key to define the polarity of either the Resistive or Reactive LDC component.

Other Fast-Path Keys

Alert Key

Press this key to view the contents of the <ALERTS> Menu. If any Alert messages are active, press this key repeatedly to step through them in order of priority. If no Alerts are active, the message “No Active Alerts” will be displayed. Section 5.8 contains additional information on how to determine the meaning of the various Alerts, and how to acknowledge them.

Press the Cancel/Reset Key to acknowledge the messages.

Voltage Reduction Control (VRC) Key

Press this key to view the Voltage Reduction Control data items. The first data item in that function is VRC status. Press this key repeatedly to step through the VRC settings (Local % reduction, Stage 1-3, VRC Remote, etc.) and then return to VRC Mode and repeat the sequence. See Section 4.4.3 for a discussion of these data items.

Voltage Limit Control (VLC) Key

Press this key to view the VLC Enable data items. Press the VLC key repeatedly to step through the VLC - Upper Voltage setpoint, and the VLC - Lower Voltage setpoint and then repeat the sequence. See Section 4.4.4 for a discussion of these data items.

Operation Counter (Op Count) Key

Press this key to select the <COUNTERS> Menu. The first parameter displayed is the Total Operations count. Press this key repeatedly to step through the <COUNTERS> Menu data items. See Section 5.7 for a discussion of this Menu.

Maintenance Key

Press this key to view the Overall Contact status screen from the <MAINTENANCE> menu. Press the key repeatedly to scroll through the contact status screens and the settings for the maintenance algorithm.
2. Using the MJ-4A & MJ-4B Operator Panel and Controls

**U2 P2 Key**

Press this key to toggle between the U2 and P2 voltages when the setting under <ADV CONFIGURE> menu U2/P2 out is set to Toggle.

**Neutralite Test Key**

Press this key to illuminate the Neutralite Indicator. This is an LED test.

**Drag Hands Reset Key**

Press this key to reset the electromechanical drag hands on the Position Indicator to the present tap changer position. This also resets the electronically stored max/min tap position values (viewable from the display).

**Quick Key**

Press this key to view the items stored in the Quick List. The user-defined Quick Key can display up to 15 different commonly referred to screens. See Section 4.10 for how to setup this functionality.

**Remote/Local Key**

Press this key to enable or disable remote control of the control panel. The Remote Disabled LED indicates the status of Remote control.

**Auto / Manual Key**

The Auto/Manual key is present in the MJ-4B Panel. The MJ-4A panel has discrete switch for the same functionality.

Press this key to enable or disable automatic tap changes of the regulator. The Auto Disabled LED indicates whether or not automatic tap operations will occur.

**Raise and Lower Keys**

The Raise and Lower keys are present in the MJ-4B Panel. The MJ-4A panel has discrete switch for the same functionality.

While Automatic tap operations are disabled, the Raise and Lower keys are active. Press and Hold the Raise key to increase the tap position. Press and Hold the Lower key to decrease the tap position.

2.4 Indicators

The front panel also provides user information via individual status indicators. These indicators provide a direct means of assessing operational status.

**Alert LED**

This indicator is illuminated whenever one or more alerts are active. The indicator may either flash or remain on steadily.

- If flashing, it indicates that one or more alert conditions are active and have not yet been acknowledged.
- If the Alert Indicator glows steadily, it means that a previously-acknowledged alert condition continues to exist.

To acknowledge an Alert, view the Alert screen with the Alert button and then press the Cancel/Reset button.

**Reverse Power Flow LED**

The Reverse Power Flow (RPF) indicator is illuminated when the microprocessor senses reverse power flow. The indicator will either be off, on, or flashing depending upon both Power Flow mode and Current direction (see Section 4.3.11 and Table 2.1 below).

<table>
<thead>
<tr>
<th>Power Flow Mode</th>
<th>RPF Indicator Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral R</td>
<td>On</td>
</tr>
<tr>
<td>Idle R</td>
<td>On</td>
</tr>
<tr>
<td>Co-Gen</td>
<td>On</td>
</tr>
<tr>
<td>Bi-Dir</td>
<td>On</td>
</tr>
<tr>
<td>F Lock</td>
<td>Flashing</td>
</tr>
<tr>
<td>R Lock</td>
<td>On</td>
</tr>
</tbody>
</table>

1. (Real component) exceeds 1% rated current for 5 seconds
When the real component of load current drops below 1% of rated current, the RPF indicator continues to display its previous state.

If the real component of current is less than 1% when the MJ-4 Control Panel is powered up, the RPF LED is OFF (indicates forward).

Remote Auto Inhibit LED

This indicator is illuminated when automatic tap changes are inhibited. Either the remote operator has sent an automatic inhibit command, the Automatic Inhibit contacts have been activated, or a local operator has pressed the Auto/Manual pushbutton.

Remote Disabled LED

This indicator is illuminated when Remote control is disabled. When Remote control is enabled a remote operator can change the settings, configuration, and control the regulator remotely. When Remote control is disabled, a remote operator can only view the status of the control panel. Only a local operator can change the Remote control status by using the Remote/Local Switch pushbutton.

Band Indicator LEDs

Three Band Indicators, “High”, “In Band,” and “Low,” are located at the top of the front panel. The microprocessor continuously compares load voltage (corrected for line drop) against the Voltage Level and Bandwidth setpoints. The Band Indicator LEDs show the results of this comparison (see Table 2.2).

“In Band” indicates that regulator output voltage is within voltage and bandwidth setpoints.

“High” indicates that regulator output voltage is out-of-limits on the high side.

“Low” indicates that regulator output voltage is out-of-limits on the low side.

In all power flow modes except Neutral Reverse, if one of the three Band Indicators is flashing, it is an indication that tap changes are being inhibited by the control program. In Neutral Reverse, the flashing Band Indicator in conjunction with a Reverse Power Flow condition may mean that the control program is returning the tap position to Neutral.

### Table 2.2 Band Indicator Status

<table>
<thead>
<tr>
<th>Power Flow Mode</th>
<th>Band Indicator Status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RPF active and current magnitude exceeds I Threshold %</td>
</tr>
<tr>
<td>Neutral R</td>
<td>Flash</td>
</tr>
<tr>
<td>Idle R</td>
<td>Flash</td>
</tr>
<tr>
<td>Co-Gen</td>
<td>On solid</td>
</tr>
<tr>
<td>Bi-Dir</td>
<td>On solid</td>
</tr>
</tbody>
</table>

In the above table, the indicator that is flashing or on solid is the respective Band Indicator (High, Low, or In Band). If all band indicators are off, it is an indication that Voltage Limit Control (VLC) is active, and compensated regulator output voltage is higher than the VLC upper limit, or lower than the VLC lower limit.

### Figure 2.3 Band Indicators and VLC Indicators

#### Raise / Lower LED Indicator

The Raise / Lower indicator remains on continuously whenever the tap changer motor is raising or lowering the tap position. The Raise / Lower indicator can be configured to Flash whenever the tap changer motor is lowering the tap position. By choosing the setting under the <ADV CONFIGURE> menu LowerLED.
Voltage Limit Control LED Indicators
The Voltage Limit Control (VLC) indicators illuminate to indicate that VLC is active. With the VLC upper limit activated, the VLC Upper indicator is illuminated. If the VLC lower limit is activated, the VLC Lower indicator is illuminated.

If VLC is active, and Vld is within 1 volt of the VLC limit, the appropriate VLC and Band Indicator will both be illuminated.

Voltage Reduction Control Active Indicator LED
This indicator is illuminated whenever Voltage Reduction Control is in effect. The VRC LED indicator flashes a unique pattern to indicate which stage, step, or set is active, depending upon the VRC Mode as described in Table 2.3. (See Section 4.4.3 for more information.)

Table 2.3 VRC Indicator Flash Patterns

<table>
<thead>
<tr>
<th>Flashing Pattern</th>
<th>Local (MJ-X)</th>
<th>Remote (MJ-3A)</th>
<th>Auto</th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td>Active</td>
<td></td>
<td></td>
</tr>
<tr>
<td>long-short</td>
<td>Stage-1</td>
<td>Step 1</td>
<td>Set 1</td>
</tr>
<tr>
<td>long-short-short</td>
<td>Stage-2</td>
<td>Step 2</td>
<td>Set 2</td>
</tr>
<tr>
<td>long-short-short</td>
<td>Stage-3</td>
<td>Step 3</td>
<td></td>
</tr>
</tbody>
</table>

Neutralite Indicator
The Neutralite indicator illuminates when the tap changer is in the Neutral position. The Neutralite indicator also illuminates when the Neutralite Test key is pressed and held.

2.5 Switches

Power Switch
This three-position switch selects the power source for the MJ-4 Control Panel.

- In the upper (Normal) position, the regulator Utility (tertiary) winding provides power through the polarized disconnect switch (PDS).
- In the lower (External Source) position, the External Source terminals (described below) provide power.
- In the middle (Off) position, the Control Panel is turned off. This is also called the By-Pass Position.

Tap Control Switches (Mode Select Switches)
Auto/Off/Manual Switch (MJ-4A)
In the MJ-4A panel, the 3 position discrete switch, has the Center = OFF, Down = Manual and Up = Auto functionalities. When in Auto, the panel may be switched between Auto-Remote or Auto-Local modes by pressing the Remote / Local push button.

Auto/Manual Push button (MJ-4B)
This push button determines whether the MJ-4B Control Panel is under manual control or microprocessor control. Note that the ultimate determination of the point of control can be changed remotely if Remote Disabled is not activated.

Tap Control Modes
- Manual / Auto Disabled (By-Pass Position), The operator has control of the regulator’s tap changer motor; automatic tap changes are disabled. In this mode, a local operator can use the Raise and Lower switches or push buttons to adjust the tap position or a remote operator could control the tap motor.
- Auto Enabled. The microprocessor has control of the tap changer motor and local manual tap changes are disabled.

Remote / Local Push button
This push button determines whether the MJ-4 Control Panel is under local control or remote control. Note that the ultimate determination of the point of control is established manually; this switch setting cannot be overridden from a remote location.

- Remote Disabled. In this mode, a remote operator can obtain MJ-4 Control Panel data. However, the remote operator cannot make configuration changes or exercise control of the tap changer motor.
- Remote Enabled. In this mode, a remote operator has access to all functions available to the local operator, including the ability to override automatic control of the tap changer motor.
- This push button is common for both the MJ-4A & MJ-4B Panels.

Raise and Lower Switches / Push buttons
When the Auto Disabled LED is ON, this discrete switch or push buttons activate the tap changer motor to raise or lower the tap position.
Switch Positions for Bypassing
The front panel switches must be in the following positions before bypassing the regulator.

- Auto / Manual - OFF (MJ-4A)
  Auto / Manual - Remote Auto Inhibit LED=ON (MJ-4B)
- Remote Switch - Remote Disabled LED is ON
- Power Switch - OFF

2.6 Binding Posts
Front panel binding posts are dual banana-style receptacles on standard 0.74 inch centers.

External Source Binding Posts
These binding posts can be used to apply 120 V external power to the MJ-4 Control Panel when the power source switch is in the External Source position. The binding posts are dual banana-style receptacles.

Ensure that any voltage source attached to these binding posts is properly polarized.

Note:

- Voltage Calibration Binding Posts
  These binding posts can be used with an external voltmeter to monitor regulator P2 or U2 voltage. Displaying “U2 Cal” or “P2 Cal” in the <DIAGNOSTICS> menu defines the voltage (U2 or P2) you can read at these binding posts. The binding posts are dual banana-style receptacles.

Note that the voltage measured at these binding posts is not turns-ratio corrected. By contrast, the metered voltage presented on the display screen (under <METER>) is corrected by control-program software. (See Section 4.3.7 and Section 4.3.8 for configuring the voltage transformer U2/P2 turns ratio).

CAUTION
Possible explosion if bypassed while not on neutral.
Will cause death, serious injury, or property damage.
To prevent:
Place regulator in neutral position before bypassing and disable control panel.
See Appendix E for details.

WARNING
Voltage applied at calibration terminals may energize regulator with high voltage through voltage transformer.
Could result in death or serious injury.
To prevent:
Do not connect any voltage source at the voltage calibration terminals.

2.7 Fuses
Power Fuse
This 6.0 Amp fuse protects the MJ-4 Control Panel circuit and the tap changer motor circuit.

Sensing Fuse
This 0.75 Amp slow-blow fuse protects the MJ-4 Control Panel sensing circuit.

External Power Source Protection Fuse
This 6.0 Amp fuse protects the MJ-4 Control Panel circuit and the tap changer motor circuit when powered through the external source binding posts.

CAUTION
Improper external power connection will place 120V on the ground circuit.
May result in minor or moderate injury including equipment damage.
To prevent:
Observe proper polarity of external power supply.

WARNING
Hazardous voltage present on various control leads when regulator is energized.
Could result in death or serious injury including equipment damage from contact with live line conductors.
To prevent:
Bypass the regulator and de-energize before removing accessory items from the control box.
2.8 Terminal Strip Connections

Complete descriptions of all terminal contacts are provided in Appendix K.

Terminal strips are located on the lower back side of the MJ-4 Control Panel. These terminals can be used to provide access to certain microprocessor and other control functions. Necessary jumpers are installed at the factory and there is no need to add or change any of them unless you need to access the electrical signals present there.

The terminal strips include four terminal pairs for VRC control and external inhibit function. The terminal strips include the Current Circuit terminal pair.

Each terminal strip contact is screw type, to facilitate connection and disconnection of external wiring.

Current Circuit Terminal Contacts

The nominal 200 mA secondary of the regulator current transformer (CT) is routed through these terminals labeled C and C2. This terminal pair is provided with a removable shorting bar to accommodate auxiliary apparatus. These terminals are shorted at the factory and must remain shorted unless an appropriate external device is attached.

---

DANGER

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

Will result in death or serious injury including equipment damage.

To prevent:

Do not operate with CT secondary open.
Short circuit or apply burden at CT secondary (C2-C) during operation.
Power and Motor Control Terminal Contacts

A simplified schematic drawing of the power and motor control terminal connections is shown in Figure 2.3 below.

---

**Figure 2.4** Simplified Schematic of "Terminal" Remote Control Connections
2.9 Local Data Port

The Local Data Port on the front panel supports connection to a PC or other communications device. It transfers data in either direction: the MJ-4 Control Panel can provide meter and status information to an external device, and the control program can be configured from an external device.

The Local Data Port supports data transmission at standard data rates from 300 to 19200 baud, inclusive, using the 2200 communications protocol enhanced with MJ-4 data fields.

The physical interface is a standard 9-pin D-type subminiature connector.

The pinouts match the PC-AT™ RS-232 port connector (see Table 2.4):

Table 2.4 Local Data Port Pinouts

<table>
<thead>
<tr>
<th>Signal Description</th>
<th>&quot;DTE&quot; Pin Number(s)</th>
<th>&quot;DCE&quot; Pin Number(s)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>MJ-4 output</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>MJ-4 Input</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Signal Ground</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>DCD, DSR, CTS )</td>
<td>– (no connection)</td>
<td>– (no connection)</td>
</tr>
</tbody>
</table>

* indicates factory default settings.

Normally, only pins 2, 3, and 5 are needed to communicate through the Data Port.

When using a straight-through cable, the Local Data port should be jumpered as “DCE” for connection to a terminal device (such as a notebook or laptop computer); and as “DTE” for connection to a modem. By default, the Local Data Port is jumpered as DCE.

Figure 2.4 shows the jumper location for the Data Port connections.

The device used for communications must be configured to match the following Data Port items in the <COMMUNICATIONS> Menu.

- DatPortBaud
- Data Parity
- DataPortAddr - If addressing is on, use the Comm Addr parameter as the Data Port address.
The MJ-4 Control Panel stores a considerable amount of data. Some of the data items are setpoints used to control the tap changer; others are meter readings and logged historical data that can be used to monitor system activity. All of the major data items can be displayed on the 16-character screen. The setpoints and other configuration items can be displayed and changed from the front panel.

This chapter describes how data items are organized, how to view a specific data item, and, if applicable, how to change it.

3.1 Viewing Data Items

The MJ-4 Control Panel provides two techniques for viewing data items:

1. Use Menu Selection keys and Scroll keys to view any data item.
2. Use Fast-path keys to view certain frequently-used data items.

3.2 Understanding Menus

MJ-4 Control Panel information is organized into lists (Menus) of related data. Each specific piece of information in MJ-4 memory is known as a data item. To view or change a specific data item, you must select the Menu that contains the desired item. Appendix G provides a Menu Structure Quick Reference for help in locating a specific data item.

For example, the `<LOG SETUP>` Menu contains data items that you can use to define logging requirements. To define logging requirements, view the `<LOG SETUP>` Menu; then display the particular data item from that Menu. As another example, the `<METER>` Menu contains meter-reading data. To determine the present load voltage meter reading, view the `<METER>` Menu and then the Load Voltage data item from that Menu. The `<METER>` Menu is considered the home position in the MJ-4 Control Panel’s menu structure.

MJ-4 Control Panel Menus are divided into two major categories:

1. Setup Menus define the environment. In general, these Menus are only used at installation. Examples include:
   - the `<CONFIGURE>` Menu, which defines the regulator and its application.
   - the `<REGULATOR>` Menu, which defines setpoints.
   - the `<LOG SETUP>` Menu, which defines logging preferences, etc.

2. Operational Menus contain daily operational information that can help you monitor system performance. Examples include:
   - the `<METER>` Menu, which provides rms meter readings.
   - the `<DEMAND>` Menus, which provide Demand data.
   - the `<LOG>` Menu, which contains historical data.

3.3 Using the Menu Selection Keys to View Data Items

This section describes how the Menu Selection and Scroll keys can be used to view data items.

Think of the Menu arrangement as a table of data items on a sheet of paper as illustrated in Table 3.1.

Each column of the table has a heading (Menu name). Since you are viewing this “table” through a 16-character window, you must scroll through the table to view the desired data item. The following scrolling rules apply:

- At the heading level, scroll through the Menu headings with the left and right Scrolling keys.
- Within a selected menu, use the up and down Scrolling keys to step through the various data items.

<table>
<thead>
<tr>
<th></th>
<th><code>&lt;FW DEMAND&gt;</code></th>
<th><code>&lt;REV DEMAND&gt;</code></th>
<th><code>&lt;COUNTERS&gt;</code></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>data item 1</td>
<td>data item 1</td>
<td>data item 1</td>
<td>data item 1</td>
<td>data item 1</td>
</tr>
<tr>
<td>data item 2</td>
<td>data item 2</td>
<td>data item 2</td>
<td>data item 2</td>
<td>data item 2</td>
</tr>
<tr>
<td>data item 3</td>
<td>data item 3</td>
<td>data item 3</td>
<td>data item 3</td>
<td>data item 3</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
</tbody>
</table>
**3 Viewing and Changing MJ-4A & MJ-4B Data Items**

If you are not sure where you are in the Menu structure, press the Menu key once to return to the top of that menu. Press the Menu key again to return to the `<METER>` Menu or home position.

Viewing a specific data item with the Menu Selection keys is a two-step process:

1. View the Menu that contains the desired data item by stepping left and/or right through the Menu structure. Use the `<` key to move left and the `>` key to move right. Data items are grouped according to function so you can readily determine which Menu contains the desired data item. (See the Menu Structure Quick Reference in Appendix G for help in locating a specific data item.)

2. View the desired data item by stepping up or down through the Menu until you see the data item name and its value on the display screen. Use the `v` key to move down in the list; use the `^` key to move up in the list.

**Example**

Suppose you want to view the regulator Forward Time Delay setpoint. This data item is contained in the `<REGULATOR>` Menu:

1. Press the Menu key twice to return to the `<METER>` Menu.

2. Press the `>` key multiple times to step through several menus. When `<REGULATOR>` appears on the display screen, you are positioned in that Menu and you can view its data items.

3. Press the `v` key multiple times to step down through the various data items in the Menu (Fwd Volts, Fwd BW, and so on) until “Fwd Delay nnnS” appears. “nnn” will be the currently stored value (in seconds) for Forward Time Delay.

**3.4 Changing Data Items**

To change data, you must first view it, as described above. Then press the Change key. The displayed value flashes to indicate that a Change will be accepted and to indicate the data that is to be changed. Press the `^` and `v` keys to sequence through the acceptable values. When the desired value is displayed, press the Save key to complete the change.

The procedure for changing configuration parameters is slightly different from the procedure for changing alphanumeric ones. Examples of each type of change follow:

**Changing Configuration Parameters**

In some cases, you will be choosing from one of several alphabetic settings (for example, the `<CONFIGURE>` Menu asks you to select among three System types: WYE, DELTA LAG, and DELTA LEAD).

**Example**

Suppose you want to change the system type from Delta Lag to Wye. You know (perhaps from checking the Menu Structure Quick Reference Appendix G) that the System data item is in the `<CONFIGURE>` Menu, so you must first scroll to that Menu.

1. Press the Menu key twice to return the display to `<METER>`.

2. Press the `>` key to step through the Menus until `<CONFIGURE>` is viewed.

3. Press the `v` key until Syst: appears. In this example, the display screen would indicate that the present setting is Syst:DELTA LAG.

4. Press the Change key. DELTA LAG flashes to indicate that it is the data to be changed. Note: The underscore in this section of the manual denotes flashing.

5. Press the `v` key to see the next option. Syst:DELTA LEAD appears on the screen.

6. Press the `v` key again to see another option. Syst:WYE appears. Since this is the option you want, press the Save key to complete the change. Syst: WYE continues to appear, but WYE no longer flashes. This indicates that the change has been accepted.
Changing Alpha or Numeric Settings

The process of changing alpha or numeric settings is similar to that of changing configuration parameters, except that there are more choices because there may be multiple characters to change, and each character may range in value from 0 to 9, and/or A-Z.

Example

Suppose you want to change the regulator Forward Volts setpoint from 123.0 volts to 122.5 volts. Setpoints are contained in the <REGULATOR> Menu, so you need to view that Menu.

1. Press the Menu key twice to return the display to the <METER> Menu.
2. Press the ➢ key repeatedly until <REGULATOR> is viewed.
3. Press the ↑ key until FwdVolts: 123.0 appears.
4. Press the Change key to activate Change mode. (The flashing digit indicates the digit to be changed.) FwdVolts: 123.0 appears. Note: the underscore in this section of the manual (in this case under the 0) denotes flashing.
5. Press the ◀ key five times to increment the digit from 0 to 5.
6. Press the ◀ key to step left one digit. FwdVolts: 123.5 appears. The digit 3 is flashing to indicate that it can be changed.
7. Press the ↑ key to decrement the digit from 3 to 2.
8. Press the Save key to make the change take effect. FwdVolts: 122.5 appears. The flashing stops to indicate that the change is complete.

3.5 Using the Fast-Path Keys to View/Change Data Items

Fast-path keys are the labeled keys on the middle portion of the MJ-4 Control Panel, such as the Voltage Level key. Use the Fast-path keys as a shortcut to certain frequently-used data items. Simply press the fast-path key and the desired data item appears immediately.

After viewing an item with a fast-path key, the change procedure is the same as the one just described. In the previous example, the Voltage Level fast-path key would replace steps 1-3 and save a number of key strokes.
4 Setting Up the MJ-4A & MJ-4B Control Panel

4.1 Setup—Overview

MJ-4 Control Panel setup procedures allow you to customize the control panel to your needs and to the environment in which it is installed. You can describe specific regulator parameters and power-flow conditions, and define automatic-mode operation. Previous generation controllers used dip switch settings and jumpers for this purpose. With the MJ-4 Control Panel, simply use front panel touchkeys and the display screen to define the operating environment. Also, the MJ-4 communication facilities in conjunction with the MJXplorer software can be used to set up the MJ-4 Control Panel.

The setup process for the MJ-4 Control Panel consists of several steps:

**Configuration**
In this step, use the `<CONFIGURE>` Menu to describe the regulator and the power distribution system. Use the `<ADV CONFIGURE>` Menu to adjust optional or advanced settings if desired.

**Setpoints**
In this step, use the `<REGULATOR>` Menu to define Automatic Mode setpoints (voltage level, bandwidth, time delay, etc.).

**Logging Requirements**
In this step, use the `<LOG SETUP>` Menu to define data logging requirements (what values you want logged, how often, under what conditions, etc.).

**Security Definition**
In this step, use the `<PASSWORD>` Menu to define passwords and to activate security protection.

**Communications Definition**
In this step, use the `<COMMUNICATIONS>` Menu to define communications parameters (baud rate, unit address, etc.).

This chapter describes each of the setup parameters, and explains how they are defined. The Communications Module Instruction book contains additional detail and background information to help you make the proper selections.

Note: Depending upon the version of software in your MJ-4 Control Panel, your menus may be slightly different than those described. If your control panel does not support all of the features described, please contact your Siemens representative for details about obtaining the latest version of the software.

Table 4.1  The `<CONFIGURE>` Menu

<table>
<thead>
<tr>
<th>DATA ITEM</th>
<th>DESCRIPTION</th>
<th>VALID INPUTS</th>
<th>DEFAULT</th>
<th>INC</th>
</tr>
</thead>
<tbody>
<tr>
<td>TapChngr</td>
<td>Tap Changer Type</td>
<td>SIEMENS, GE, LTC, LTC.5, or COOP SD, DD, or DD</td>
<td>SIEMENS</td>
<td>-</td>
</tr>
<tr>
<td>Type</td>
<td>Regulator type</td>
<td>STRAIGHT or INVERTED</td>
<td>STRAIGHT</td>
<td>-</td>
</tr>
<tr>
<td>Syst</td>
<td>System wiring configuration</td>
<td>WYE, DELTA LAG, DELTA LEAD</td>
<td>WYE</td>
<td>-</td>
</tr>
<tr>
<td>DeltaPwr</td>
<td>Delta power configuration</td>
<td>OPEN or CLOSED</td>
<td>OPEN</td>
<td>-</td>
</tr>
<tr>
<td>Utility Pol</td>
<td>Utility winding polarity</td>
<td>NORM, REV</td>
<td>NORM</td>
<td>-</td>
</tr>
<tr>
<td>Vprimary Max</td>
<td>Maximum primary voltage</td>
<td>65K (for regulators) or 650K (for LTC transformers)</td>
<td>65K</td>
<td>-</td>
</tr>
<tr>
<td>U2 PT</td>
<td>Utility winding turns ratio</td>
<td>1500 to 65,500:100 to 150</td>
<td>7200:120</td>
<td>1 Volt</td>
</tr>
<tr>
<td>P2 PT</td>
<td>Potential Transformer turns ratio</td>
<td>1500 to 65,500:100 to 150</td>
<td>7200:120</td>
<td>1 Volt</td>
</tr>
<tr>
<td>CRatio</td>
<td>Current Transformer turns ratio</td>
<td>50 to 7200.0:0.0 to 9.5</td>
<td>200:0.2</td>
<td>1:0.1</td>
</tr>
<tr>
<td>I FullLoad</td>
<td>Regulating Device Full Load Rating</td>
<td>50 to 7200</td>
<td>200</td>
<td>1 Amp</td>
</tr>
<tr>
<td>PwrFlow</td>
<td>Power flow modes</td>
<td>F LOCK, R LOCK, IDLE R, BI-DIR, NEUT R, CO-GEN</td>
<td>F LOCK</td>
<td>-</td>
</tr>
<tr>
<td>Basis volts</td>
<td>Controller nominal voltage level</td>
<td>115, 120, or 125v</td>
<td>120</td>
<td>-</td>
</tr>
<tr>
<td>NeutOvRun</td>
<td>Neutral Over Run</td>
<td>0.0 to 3.0 seconds</td>
<td>2.0</td>
<td>0.1 sec</td>
</tr>
<tr>
<td>Reset Min/Max?</td>
<td>Reset all min/max readings</td>
<td>N or Y</td>
<td>N</td>
<td>-</td>
</tr>
<tr>
<td>Vers</td>
<td>Microprocessor software version</td>
<td>NN.NNNN</td>
<td>Reg. Serial#</td>
<td>-</td>
</tr>
<tr>
<td>Memo1</td>
<td>User-supplied text</td>
<td>Up to 10 Characters</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Memo2</td>
<td>User-supplied text</td>
<td>Up to 10 Characters</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
4 Setting Up the MJ-4A & MJ-4B Control Panel

4.2 Setup for Retrofit Panels

If you are retrofitting either a G. E. or Cooper regulator for use with the Siemens MJ-4 Control Panel, please refer to the respective Application Note. Contact your Siemens representative for details.

4.3 Defining Your Regulator—the <CONFIGURE> and <ADV CONFIGURE> Menus

When the MJ-4 Control Panel is delivered pre-installed on a regulator, many of the configuration variables are already set. However, the MJ-4 Control Panel provides a wide range of additional variables that can be used to make the regulator perform more effectively in your system.

Variables in the <CONFIGURE> Menu are summarized in Table 4.1; variables in the <ADV CONFIGURE> Menu are summarized in Table 4.2; both menus are explained in the following pages.

---

**Table 4.2  The <ADV CONFIGURE> Menu**

<table>
<thead>
<tr>
<th>DATA ITEM</th>
<th>DESCRIPTION</th>
<th>VALID INPUTS</th>
<th>DEFAULT</th>
<th>INC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meter Volts</td>
<td>Display Primary or Secondary volts</td>
<td>SEC, PRI</td>
<td>SEC</td>
<td>---</td>
</tr>
<tr>
<td>I Threshold %</td>
<td>Tap change minimum current</td>
<td>0% to 10%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td>I Shift</td>
<td>Current shift for reverse power flow</td>
<td>0° to 359°</td>
<td>0°</td>
<td>1°</td>
</tr>
<tr>
<td>I Load Max</td>
<td>Max. Load Current (For Overcurrent)</td>
<td>0% to 350%</td>
<td>350%</td>
<td>1%</td>
</tr>
<tr>
<td>PT Threshold</td>
<td>Tap change low voltage limit</td>
<td>0 to 134</td>
<td>90</td>
<td>---</td>
</tr>
<tr>
<td>Time</td>
<td>Time of day</td>
<td>HH:MM:SSA/P</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Date</td>
<td>Date</td>
<td>N/N/N/N</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Format</td>
<td>Date format</td>
<td>MO/DA/YR or DA/MO/YR</td>
<td>MO/DA/YR</td>
<td>---</td>
</tr>
<tr>
<td>Daylight Savings</td>
<td>Daylight Savings Time</td>
<td>ON or OFF</td>
<td>ON</td>
<td>---</td>
</tr>
<tr>
<td>Dmd Type</td>
<td>Method for determining Demand</td>
<td>THERMAL or WINDOW</td>
<td>THERMAL</td>
<td>---</td>
</tr>
<tr>
<td>Dmd Time</td>
<td>Demand Period length (minutes)</td>
<td>1 to 999</td>
<td>30</td>
<td>1 Minute</td>
</tr>
<tr>
<td>DmdSubperiods</td>
<td>Number of Demand subperiods</td>
<td>1 to 99 (For Sliding Window mode only)</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Min/Max t.o.</td>
<td>Min/Max display timeout (seconds)</td>
<td>1 to 99</td>
<td>15</td>
<td>1 Second</td>
</tr>
<tr>
<td>Screen t.o.</td>
<td>Show default display screen(min.)</td>
<td>1 to 99</td>
<td>5</td>
<td>1 Minute</td>
</tr>
<tr>
<td>Quick t.o.</td>
<td>Quick menu display timeout second</td>
<td>1 to 99</td>
<td>10</td>
<td>1 Second</td>
</tr>
<tr>
<td>QuickDispTm</td>
<td>Quick menu slideshow time second</td>
<td>1 to 10</td>
<td>2</td>
<td>1 Second</td>
</tr>
<tr>
<td>Auto Variamp</td>
<td>Automatic Variamp Protection</td>
<td>ON or OFF</td>
<td>OFF</td>
<td>---</td>
</tr>
<tr>
<td>Soft Variamp</td>
<td>Software Variamp setting</td>
<td>ON or OFF</td>
<td>OFF</td>
<td>---</td>
</tr>
<tr>
<td>R Limit</td>
<td>Raise Limit (Alert &amp; Soft Variamp)</td>
<td>10, 8¾, 7½, 6¼, 5</td>
<td>10</td>
<td>---</td>
</tr>
<tr>
<td>L Limit</td>
<td>Lower Limit (Alert &amp; Soft Variamp)</td>
<td>10, 8¾, 7½, 6¼, 5</td>
<td>10</td>
<td>---</td>
</tr>
<tr>
<td>Slave-Master</td>
<td>Put two tap changers in locked step</td>
<td>OFF, MA, SL, S2</td>
<td>OFF</td>
<td>---</td>
</tr>
<tr>
<td>Tap Alert</td>
<td>Enable or disable tap alerts</td>
<td>ENABLE or DISABLE</td>
<td>ENABLE</td>
<td>---</td>
</tr>
<tr>
<td>Airt M= C= S=</td>
<td>Metering, Control, &amp; System alerts</td>
<td>Y (to enable) or N (to disable)</td>
<td>Y, Y, Y</td>
<td>---</td>
</tr>
<tr>
<td>Tap Resync</td>
<td>Synchronizes tap position at Neutral</td>
<td>ON or OFF</td>
<td>OFF</td>
<td>---</td>
</tr>
<tr>
<td>CommAutoInh</td>
<td>Turns SCADA auto inhibit on or off</td>
<td>ON or OFF</td>
<td>OFF</td>
<td>---</td>
</tr>
<tr>
<td>DspScr</td>
<td>Defines default display screen</td>
<td>&lt;METER&gt;, TapContr, Vld, Vcomp, Ild, or TotalOps</td>
<td>&lt;METER&gt;</td>
<td>---</td>
</tr>
<tr>
<td>LowerLED</td>
<td>Raise Lower Indicator Functionality</td>
<td>Solid, Blink</td>
<td>Solid</td>
<td>---</td>
</tr>
<tr>
<td>P2 Calc</td>
<td>P2 Calculation</td>
<td>ON,OFF</td>
<td>ON</td>
<td>---</td>
</tr>
<tr>
<td>U2/P2out</td>
<td>Load Voltage Terminal Locking</td>
<td>Vload, Toggle, U2, P2</td>
<td>Vload</td>
<td>---</td>
</tr>
<tr>
<td>I Dir Bias</td>
<td>Current BiasFunctionality</td>
<td>None, Fwd, Rev, NeuT</td>
<td>None</td>
<td>---</td>
</tr>
<tr>
<td>Bias %</td>
<td>Current Bias Percent</td>
<td>0 to 10%</td>
<td>0%</td>
<td>---</td>
</tr>
<tr>
<td>Remote Btn</td>
<td>Remote / Local Button Functionality</td>
<td>Enabled, Disabled</td>
<td>Enabled</td>
<td>---</td>
</tr>
</tbody>
</table>

---

Use of incorrect drawings or Schematics

Could result in minor or moderate injury including damage to the regulator or control components

Use the Example diagram for illustration purposes. Refer to these figures for information that can be obtained from Siemens regulator nameplates.

---

Siemens Energy, Inc.
Figure 4.1  Typical Siemens Regulator Nameplate for older ANSI Type B (Inverted) Regulator

Note: Items are not highlighted on actual nameplate

Figure 4.2  Typical Siemens Regulator Nameplate for ANSI A (Straight) regulator without a Load Side PT.
4 Setting Up the MJ-4A & MJ-4B Control Panel

Figure 4.3  Typical Siemens Regulator Nameplate for ANSI Type A (Straight) regulator
Note: Items are not highlighted on actual nameplate.

Figure 4.4  Typical Siemens Regulator Nameplate for ANSI Type B (Inverted) Regulator
Note: Items are not highlighted on actual nameplate.
4 Setting Up the MJ-4A & MJ-4B Control Panel

The <CONFIGURE> Menu

4.3.1 TapChngr (Tap Changer Type)
The TapChngr data item defines the tap changer mechanism type. Tap changer mechanisms vary among regulating device suppliers. This data item allows the MJ-4 to be configured specifically for the connected tap changer device.

4.3.2 Type (Regulator Type)
The Type data item defines the step-voltage regulator type. The designations “straight” (ANSI Type: A) and “inverted” (ANSI Type: B) are frequently used to denote the difference. See Figures 4.1 to 4.4 for examples.

Since November, 1995, the regulator type is identified by either an ANSI Type A or B designation. Older nameplates did not include this information and the type must be determined from the schematic diagram on the regulator nameplate.

“STRAIGHT” design characteristics: (See Figure 4.2 and 4.3)
- The source (‘S’) bushing is connected to the tap changer reversing switch and to one end of the main winding.
- The load (‘L’) bushing is connected via the preventive autotransformer to the moving contacts of the tapchanger.
- The utility (tertiary) winding leads are labeled U3, U4, U5, ... etc.

“INVERTED” design characteristics: (See Figures 4.1 and 4.4)
- The source (‘S’) bushing is connected via the preventive autotransformer to the moving contacts of the tap changer.
- The load (‘L’) bushing is connected to the tap changer reversing switch and to one end of the main winding.
- Utility (tertiary) winding leads are labeled P3, P4, P5, ... etc.

4.3.3 System (Regulator Installation)
The System data item defines whether the regulator is Delta or Wye-connected. See Appendix D, section D.1 for guidance in determining which regulator is leading and which is lagging (for Delta-configured regulators).

4.3.4 DeltaPwr (Delta Power)
The Delta Pwr item defines the wiring arrangement for Delta-connected systems. Specify either Open or closed. The setting does not matter for a Wye-connected system.

4.3.5 Utility Pol (Utility Polarity)
The Utility Pol data item allows you to correct for polarity differences between the CT winding and the Utility (Tertiary) winding.

To define the Utility Polarity, view Utility Pol; then,
1. If you have a single-phase Inverted-type regulator, specify Utility Pol:Norm.
2. If you have a single-phase Straight-type regulator, see Appendix D, section D.3.

4.3.6 Vprimary Max
The Vprimary Max setting defines the maximum voltage on the primary side of the U2 PT and P2 PT ratios. Set 650k for LTC transformers; use the default of 65k for voltage regulators.

4.3.7 U2 PT (Utility (tertiary) Winding)
The U2 Potential Transformer ratios are used by the control program to scale the voltages supplied by the regulator to the basis voltage (nominal 115, 120, or 125 V).

Many regulators are built with transformer turns ratios that do not provide the exact basis voltage (115, 120, or 125 V) to the controller. Previous generation controllers include a tapped sensing transformer to correct the voltage. Instead of using a sensing transformer, the MJ-4 corrects the voltage mathematically, using the U2 PT turns ratio. Determine the turns ratio for the regulator from the regulator’s nameplate.

The U2 PT data item defines the turns ratio of the winding that appears at the U2 terminal on the Polarized Disconnect Switch (PDS).

To define the turns ratio, you must first determine which column in the nameplate describes the “U2” secondary for a given primary voltage. The U2 pin is attached to the regulator Utility Winding. The U2 lead provides the power to the controller, and is always present. It is often labeled Motor Conn. or Control & Motor on the nameplate. See Figure 4.1 to 4.4 for examples.

View U2 PT, then specify the turns ratio exactly as it is specified on the regulator nameplate (e.g., 7620:121). The microprocessor will correct the reference voltage to the basis voltage (115, 120, or 125 V).

4.3.8 P2 PT (Potential Transformer)
The P2 PT data item defines the turns ratio of the Potential Transformer appearing at the P2 terminal on the Polarized Disconnect Switch (PDS).

Note: For regulators with no potential transformer, set the P2 ratio to the same value as the U2 ratio.
Many regulators are built with transformer turns ratios that do not provide the exact basis voltage (115, 120, or 125 V) to the controller. Previous generation controllers include a tapped sensing transformer to correct the voltage. Instead of using a sensing transformer, the MJ-4 corrects the voltage mathematically, using the P2 PT turns ratio. The turns ratio for a given regulator can be determined from the regulator’s nameplate.

To define the turns ratio, you must first determine which column in the nameplate describes the “P2” secondary for a given primary voltage. P2 describes the pin on the Polarized Disconnect Switch (PDS, or jack plug). The P2 pin is attached to the regulator Potential Transformer secondary (if present), and is usually labeled Control Volts on the nameplate. See Figures 4.1 to 4.4 for examples.

**Note:** For an ANSI type B regulator, the utility winding tap leads are labeled P3, P4, P5, ...etc. and the P2 lead is connected to the U2 terminal on the PDS.

View P2 PT, then specify the turns ratio exactly as it is specified on the regulator nameplate (e.g., 7620:121). The microprocessor will correct the reference voltage to the basis voltage (115, 120, or 125 V). Default value is 120 V.

If an inverted (Type B) regulator has a source-side Potential Transformer, the utility (tertiary) winding leads are labeled P3, P4, etc., and the P2 lead is connected to the “U2” terminal on the PDS. The source-side PT leads are now labeled P12, P13, etc., and the P12 lead is connected to the P2 terminal on the PDS in the control box.

Note also that no reverse power flow relay is required. The microprocessor senses the reversal and applies the appropriate polarity.

### 4.3.9 CTRatio (Current Transformer Ratio)

The Current Transformer ratio defines scaling for current measurements.

View CTRatio; then specify the ratio exactly as specified on the nameplate. See Figures 4.1 to 4.4 for examples.

The primary side of this ratio is also used by the control program to define the CT primary rating. This rating and the I Threshold % define a tap change deadband for use during certain reverse power flow conditions. (I Threshold % is described below.)

### 4.3.10 Full Load

This item specifies the Full Load Current for use in determining when an Overcurrent condition occurs. Typically, the Full Load Current setting is the same as the CT Primary (the first number of the CT Ratio screen), though this is not always the case. Locate the regulator’s Full Load Current specification on the upper right side of the nameplate (just below the “Class” specification). The regulator nameplate shows the Full Load Current as “XXX Amps.” Enter the value for the Full Load Current setting into the MJ-4. See Figures 4.1 to 4.4 for examples.

### 4.3.11 Power Flow Modes

The Power Flow Mode data item allows you to specify which control program algorithm will be used under reverse power flow conditions. Systems which experience power flow reversals have unique control requirements. The MJ-4 Control Panel senses the reversal and modifies its operation based on the Power Flow Mode selected.

This section provides an introduction to each of the modes, and describes how to select the desired mode. See Chapter 7 for a detailed discussion of the operational differences between the modes.

#### Forward Locked Mode

This mode of operation (F LOCK) is intended for use in systems where reverse power flow is not anticipated. Tap changes are inhibited under reverse power flow conditions.

#### Reverse Locked Mode

This mode of operation (R LOCK) is intended for use in systems where reverse power flow is not anticipated. Tap changes are inhibited under forward power flow conditions. This mode a Source-side Potential Transformer is no longer required. See Sections 5.1 and 5.2.

#### Bi-directional Mode

This mode of operation (BI-DIR) is intended for use in systems where reverse power flow is anticipated and voltage regulation is desired under both forward and reverse power flow conditions. For this mode a Source-side Potential Transformer is no longer required. See Sections 5.1 and 5.2.

#### Idle Reverse Mode

This mode of operation (IDLE R) is intended for use in systems where reverse power flow is to be treated as an abnormal situation. When reverse power flow is recognized, the regulator idles at the last tap position held before the reversal.

#### Neutral Reverse Mode

This mode of operation (NEUT R) is intended for use in systems where reverse power flow is anticipated and voltage changes are inhibited under reverse power flow conditions.

#### Co-Generation Mode

This mode of operation (CO-GEN) is for use in systems where consumer-generated power may sometimes flow from the consumer to the Utility. Under reverse current flow conditions, forward regulation is allowed, using reverse Line Drop Compensation settings.

### 4.3.12 Basis volts (Basis Volts)

The Basis Volts data item defines whether the MJ-4 control program is to convert the regulator transformer sec-
ondary voltage to 115, 120, or 125 volts. See U2 PT and P2 PT data items above. Also see Section 5.3.2.

4.3.13 NeutOvRun (Neutral Overrun)
The Neutral Overrun data item keeps the tap motor on for a specified amount of time when making a tap change into the neutral tap position. This ensures that the reversing switch is always closed in order to prevent the contacts from corroding due to capacitive discharge. For regulators with a TLG mechanism set to 2.0 seconds. For regulators with a TLF mechanism set to 1.7 seconds.

4.3.14 Min/Max Reset
The Min/Max Reset data item resets Meter and Demand max/min values in the microprocessor to current instantaneous values. This function is useful when setting up the microprocessor for the first time, or when you want to reset electronically-maintained values.

Note: Do not use this function unless you want to reset all Meter and Demand min/max values; to reset selected values, use the Cancel/Reset key described in Chapter 2. To request that Meter and Demand Max/Min values be reset, view Reset Max/Min; use the Change key and the Scroll keys to change the default N(o) to Y(es). Then press the Save key to complete the change process.

4.3.15 Version
Main Processor software version NN.NNNN. This data item displays the installed version of the microprocessor control program.

4.3.16 Memo 1 and Memo 2
These two data items allow you to record installation-specific information that can be viewed at a later time. For example, you might wish to use one Memo to document the regulator’s serial number, and the other Memo to document its location. This information could then be viewed by a remote operator via a communications link.

To enter data into these data items, view the <CONFIGURE> Menu; then use the Scroll keys to view Memo 1 or Memo 2. The display screen responds by flashing the “blank” character (■) in the leftmost position of the ten-character Memo field. This indicates the character to be changed. Use the A and Y keys to step through the alpha and numeric characters until the desired character is presented on the display screen. Then press the > key to move the cursor to the next character to the right, and so on until all ten characters of the Memo have been entered. When you have completed entering the Memo, press the Save key to complete the change.

Valid characters are A-Z; 0-9; space; comma; semi-colon; period; dash; slash; ampersand (&), and the # character. Default is for Memo 1 to contain the regulators serial number and for Memo 2 to contain the initials of the control panel tester.

The <ADV CONFIGURE> Menu

4.3.17 Meter Volts (Meter Scaling)
The Meter Volts data item determines which voltage is presented on the display screen. You can choose either the Primary side (system voltage—e.g., 7620 V) or the Secondary side (120 V nominal).

Specify PRI if you wish to monitor the system-level voltage; specify SEC if you wish to monitor voltage scaled to the nominal 120 volt range. Voltages in the <METER> Menu are displayed according to the Meter Volts setting.

Note: Power and energy calculations are always derived from the system-level voltage and are not affected by the Meter Volts setting.

4.3.18 I Threshold % (Low Current Threshold)
The I Threshold % data item defines a threshold for load current magnitude, below which automatic mode tap changes are inhibited. This threshold is defined as a percentage of the CT primary rating. (See CTratio above.) For example, in the case of a regulator with a CTratio of 200:0.2, the CT primary rating would be 200 A. If you specify I Threshold % = 4, you are defining a low current threshold of 8 A. (4%*200 A = 8 A).

To set the low current threshold, view I Threshold %: and specify a percentage of the full scale CT primary rating.

4.3.19 I Shift (Current Shift)
The I Shift data item compensates for system current-to-voltage phase differences. Consult the factory for proper application of this data item. (Note: This data item is primarily intended for use with Load Tap Change (LTC) transformers.)

4.3.20 I Load Max (Maximum Load Current)
This item specifies the Maximum Load Current as a percentage of the Full Load Current. When the load current (Ild) exceeds the Maximum Load Current, the MJ-4 activates the Overcurrent Alert condition.

4.3.21 PT Threshold (Potential Transformer Threshold)
The PT Threshold data item defines a low-voltage threshold. This parameter allows you to specify a voltage level below which automatic mode tap changes will be inhibited.

4.3.22 Time and Date Items
Time (Time of Day)
The Time data item allows you to set the real-time clock. Specify the present time, TIME: HH:MM:SS A/P (e.g., 04:34:54P).
Date
The Date data item allows you to set the real-time calendar. Use the format selected in the Format item. If the format defined below is MO/DA/YR, enter the date as 09/30/07.

Format
The Format item allows you to set the format for the Date.

Daylight Sav (Daylight Savings Time)
The Daylight Sav data item automatically adjusts the clock for the time changes on the second Sunday in March and first Sunday in November.

4.3.23 Demand Methods
Demand values are system parameters that have been averaged over a user-defined time period. Demand values are accumulated separately for both forward and reverse power flow conditions. Demand values can be viewed in the Forward and Reverse <DEMAND> Menus. (See Chapter 5.)

The MJ-4 Control Panel accumulates demand values for Load Voltage, Source Voltage, Compensated Voltage, Load Current, kW, kVAR, and kVA. In addition, Power Factor is stored whenever a new kVA maximum or minimum is recognized.

Demand calculations are reset at the following times:

- system power up.
- when demand configuration items are changed.
- when power flow direction changes.

When a demand value is reset, dashes ‘-’ appear on the display screen until completion of the first demand period.

The MJ-4 Control Panel provides two methods of computing demand: the Sliding Window method and the Thermal averaging method.

Sliding Window Method
The Sliding Window (or rolling interval) method divides the time interval into subperiods. Meter values are individually recorded once each second. At the end of each subperiod an average value is derived for each Meter value; the values for the oldest subperiod are discarded and new demand values are calculated.

The DmdTime parameter specifies the number of minutes in the period; the DmdSubperiods parameter specifies the number of subperiods in the demand period. For example, a DmdTime of 30 minutes and a DmdSubperiod of 6 subperiods defines a thirty minute sliding window that moves every five minutes.

To use the Sliding Window method, view Dmd Type and specify WINDOW. Then view DmdTime and specify the length of the period in minutes (1 to 999); view DmdSubperiods and specify the number of subperiods as a number between 1 and 99.

Thermal Method
The Thermal method is typical of the characteristic time lag of mechanical or thermal devices as they absorb electrical energy. It is based on the Code for Electricity Meters, ANSI C12-1975, which defines the interval of a thermal demand meter as the time required for the meter to indicate 90% of a change in the load. Demand values are updated once each second.

For example, if you specify DmdTime = 15, the demand meter indicates 90% of a steady load fifteen minutes after the load is applied. In the next fifteen minutes, it responds to 90% of the remainder of the total load. As a result, the load is constantly averaged and transient variations are not reflected.

Note: The Demand Subperiod data item is ignored by the Thermal method.

4.3.24 Min/Max t.o. (Min/Max Time Out)
The Min/Max t.o. data item defines the length of time that the Min/Max data items will be presented at the display screen. At the end of this period, the display returns to the present value.

To specify the Min/Max timeout period, view Min/Max t.o.; use the Change key and the Scroll keys to define the number of seconds in the time-out period. Then press the Save key to complete the change process.

4.3.25 Screen t.o. (Screen Time Out)
The Screen t.o. data item defines the length of time that any data item is displayed. At the end of the timeout period, the display returns to the default display defined by the DspScr data item.

4.3.26 Quick t.o. (Quick Time Out)
The Quick t.o. data item defines the length of time that the Quick List data items will be presented at the display screen. At the end of this period, the display returns to the previous screen. See section 4.9.

4.3.27 QuickDispTim (Quick Display Time)
The QuickDispTim data item defines the length of time that each data item in the Quick List will be displayed before moving to the next item when the Quick List is in its slide show mode. See section 4.9.

4.3.28 Auto Variamp
The Auto Variamp data item enables a capability that automatically reduces the tap position based on the average load current over the last 10 minutes compared to the I Full Load. For example, if the regulator is at 105% of its rated current on average for the last 10 minutes, the regulator will not be permitted to move past 14 raise or lower and it will move to 14 raise or lower if it is on a higher tap. If the regulator is at 140% of its rated current on average...
4 Setting Up the MJ-4A & MJ-4B Control Panel

for the last 10 minutes, the regulator will not step past 8 raise or lower and it will move to 8 raise or lower if it is on a higher tap.

When planning to overload a regulator use either the Soft Variamp or the knobs on the position indicator. Auto Variamp is for protection in case of accidental overload only. The Variamp limits are defined in the voltage regulator instruction manual.

4.3.29 Soft Variamp (Software Variamp)
The Soft Variamp data item is a software implementation of Vari-Amp knobs on the position indicator. If set ON, then R Limit % and L Limit % will prohibit tap raise/lower past that position. The regulator will be limited by both the Vari-Amp knobs and the Soft Variamp. The actual boundary will be the most restrictive combination of the two (e.g., knobs limit R to 10%, L to 75% and software limit R to 5% and L to 8.75%. In this case the limits would be R at 5% and L at 75%).

4.3.30 R Limit, L Limit
These items set the Tap Position Raise and Lower Limit values; the control uses the limit values to check for “raise/lower limit reached” Alert conditions. Configure these parameters to match the Vari-Amp settings on the side of the Tap Position Indicator Dial mounted on the regulator. (For most applications, the Vari-Amp settings are at 10%.) If the Tap Position reaches or exceeds the R Limit Setting, the control activates the “R Limit Reached” Alert. Likewise, if the Tap Position reaches or exceeds the L Limit Setting, the control activates the “L Limit Reached” Alert.

The R Limit/L Limit settings are always used for alerting—these limit settings only prevent tap raise/lower operations from exceeding the limits if Soft Variamp setting is turned ON.

4.3.31 Slave-Master
The Slave-Master data item defines how to place controls in locked-step with each other. Whenever the Master makes a tap change it tells the slave to make a matching tap change and waits for it to do so. Contact your Siemens representative for information about this custom application.

4.3.32 Tap Alert
The Tap Alert data item enables or disables all tap alerts, including: R Limit Reached, L Limit Reached, Neut Sig Err, Tap Pos ???, and Tap Track Err.

4.3.33 Alrt M=? C=? S=?
The Alrt data item permits groups of alerts to be turned off and on. Metering (M) alerts include Low Current, Low PT Thresh, Over Current, and High Voltage. Control (C) alerts include Auto Inhibit, Pseudo Manual, and Not in Auto System (S) alerts include NV RAM Reset, Low Battery, and Self Test Fault. Press change and use the left/right and up/down arrows to adjust the M, C, and S alert settings.

4.3.34 Tap Resync
The Tap Resync data item determines whether the electronic tap position will resynchronize itself to neutral when the tap changer is on the neutral tap. Turning this data item OFF results in better tap tracking and the control will not adjust its tap position according to the neutral signal. Turning this data item ON will require the neutral signal status to precisely match the electronically tracked tap position and the timing of the operations counter or the maintained tap position will be purposely discarded.

4.3.35 CommAutoInh (Communications Auto Inhibit)
The Comm Auto Inhibit data item provides a way to change the state of the Auto Inhibit status at the control panel. This can be used if the Auto Inhibit state is turned on remotely and the communications link goes down; in this event, someone can go to the controls location and enable automatic operation again.

4.3.36 DspScr (Default Display Screen)
If the Screen Timeout period expires as defined by Screen t.o., the display will change to show the default display screen set by this data item. The following display screens are available: <METER> (default), TapContr (switch position), Vld (load bushing voltage), Vcomp (compensated voltage at load center), Ild (load current), and Total Ops. The first keypress made after a control has timed out will change the screen back to <METER>.

4.3.37 Lower LED
In the MJ-4A and MJ-4B panels, the Raise and Lower LEDs have been combined to one single LED. When lowering the Tap position the user may chose to have the LED glow solid or blink by choosing the setting. The Raising of the tap position will be indicated by the LED glowing solid, the default setting for the Lower LED is solid.

4.3.38 P2 Calc
P2 Calculation can be enabled or disabled from the P2 Calc screen. P2 Calculation should be enabled for regulators that have no PT. For regulators with voltages on both the Load and Source bushing, the P2 calculation may be disabled, so that when the sensing fuse is blown that voltage in the meter menu will be indicated by dashes. The default is for P2 Calculation to be enabled.

4.3.39 U2/P2 Out
When measured with a multi-meter, the Load Voltage(unscaled) terminals on the front panel have been locked to show the Load side voltage by default. The load voltage will vary depending on the user defined power flow mode and the power flow direction. The terminals may be locked to show exclusively U2 or P2 only, or the terminals can be configured to toggle between the two voltages with successive key presses of the U2 P2 Key.
4.3.40 Current Bias
The user may choose None, Fwd, Rev or NeutT for current flow modes. The Bias percent is selected from the following Bias % data item.

4.3.41 Bias Percent
The minimum Bias percent is 0% and the maximum is 10%. The user may choose to use any value between the maximum and minimum in increments of 1%. This functionality is only in effect when the power flow mode is Bi-Directional and Current Bias is not selected as “None.” Note that, the Bias percent must be greater than the I Threshold %. Typically, I Threshold % should be set to 0%. For a detailed description, see Section 6.5.3

4.3.42 Remote Btn
The functionality of the Remote / Local button can be enabled or disabled from this screen. When Enabled, pressing the Remote/Local button will cause the control to function as described in Section 6.1; when set to Disabled, the control can enter the Manual, Off, or Auto-Remote modes. The Auto-Local mode is disabled.

This Feature is not available in the MJ-4B Panel, if a user attempts to change the setting on a MJ-4B, the display would show “N/A IN MJ4B.”
4 Setting Up the MJ-4A & MJ-4B Control Panel

4.4 Setting Control Levels—
the <REGULATOR> Menu

The <REGULATOR> Menu defines setpoints used by the MJ-4 Control Panel when operating in Automatic Mode. Variables in the <REGULATOR> Menu are summarized in Table 4.3 and described in detail in the following sections.

<table>
<thead>
<tr>
<th>DATA ITEM</th>
<th>DESCRIPTION</th>
<th>VALID INPUTS</th>
<th>DEFAULT</th>
<th>INCREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fwd Volts</td>
<td>Voltage setpoint level</td>
<td>106.0 to 134.0</td>
<td>120.0</td>
<td>0.1 Volt</td>
</tr>
<tr>
<td>Fwd BW</td>
<td>Bandwidth setpoint</td>
<td>1.0 to 6.0</td>
<td>2.0</td>
<td>0.5 Volt</td>
</tr>
<tr>
<td>Fwd Delay</td>
<td>Time delay setpoint</td>
<td>10 to 180</td>
<td>45</td>
<td>1 Second</td>
</tr>
<tr>
<td>Fwd Comp(R)</td>
<td>Voltage compensation (Resistive)</td>
<td>-24 to +24</td>
<td>0</td>
<td>1 volt</td>
</tr>
<tr>
<td>Fwd Comp(X)</td>
<td>Voltage compensation (Reactive)</td>
<td>-24 to +24</td>
<td>0</td>
<td>1 Volt</td>
</tr>
</tbody>
</table>

Reverse power flow

<table>
<thead>
<tr>
<th>DATA ITEM</th>
<th>DESCRIPTION</th>
<th>VALID INPUTS</th>
<th>DEFAULT</th>
<th>INCREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rev Volts</td>
<td>Voltage setpoint level</td>
<td>106.0 to 134.0</td>
<td>120</td>
<td>0.1 Volt</td>
</tr>
<tr>
<td>Rev BW</td>
<td>Bandwidth setpoint</td>
<td>1.0 to 6.0</td>
<td>2.0</td>
<td>0.5 Volt</td>
</tr>
<tr>
<td>Rev Delay</td>
<td>Time delay setpoint</td>
<td>10 to 180</td>
<td>45</td>
<td>1 Second</td>
</tr>
<tr>
<td>Rev Comp(R)</td>
<td>Voltage compensation (Resistive)</td>
<td>-24 to +24</td>
<td>0</td>
<td>1 volt</td>
</tr>
<tr>
<td>Rev Comp(X)</td>
<td>Voltage compensation (Reactive)</td>
<td>-24 to +24</td>
<td>0</td>
<td>1 Volt</td>
</tr>
</tbody>
</table>

Voltage Reduction Control

<table>
<thead>
<tr>
<th>DATA ITEM</th>
<th>DESCRIPTION</th>
<th>VALID INPUTS</th>
<th>DEFAULT</th>
<th>INCREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRC Stat*</td>
<td>Present VRC % reduction</td>
<td>0.0 to 10.0</td>
<td>- - -</td>
<td>- - -</td>
</tr>
<tr>
<td>VRC Mode:</td>
<td>Voltage Reduction Control mode</td>
<td>OFF, LOCAL, REMOTE, AUTO</td>
<td>OFF</td>
<td>- - -</td>
</tr>
<tr>
<td>VRC1 In</td>
<td>VRC1 contact configuration</td>
<td>VRC, X-COMP</td>
<td>VRC</td>
<td>- - -</td>
</tr>
<tr>
<td>VRC2 In</td>
<td>VRC2 contact configuration</td>
<td>VRC, ALTDELAY, LO XBATT, AUTO INH</td>
<td>VRC</td>
<td>- - -</td>
</tr>
</tbody>
</table>

Voltage Limit Control

<table>
<thead>
<tr>
<th>DATA ITEM</th>
<th>DESCRIPTION</th>
<th>VALID INPUTS</th>
<th>DEFAULT</th>
<th>INCREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLC Enable</td>
<td>Voltage Limit Control</td>
<td>OFF, ON</td>
<td>OFF</td>
<td>- - -</td>
</tr>
<tr>
<td>VLC Upper</td>
<td>Upper limit</td>
<td>106.0 to 134.0</td>
<td>134.0</td>
<td>0.1 V</td>
</tr>
<tr>
<td>VLC Lower</td>
<td>Lower limit</td>
<td>106.0 to 134.0</td>
<td>106.0</td>
<td>0.1 V</td>
</tr>
</tbody>
</table>

*VRC Stat is a view-only item. It appears in the <REGULATOR> menu for viewing convenience.
4.4.1 Regulator Setpoints
Regulator setpoints define the operating limits for Automatic mode operation. Two sets of limits are maintained: one for forward power flow conditions and another for reverse power flow conditions.

Voltage Level Setpoint
The Voltage Level setpoint defines the nominal level you wish the regulator to maintain.

Bandwidth Setpoint
The Bandwidth setpoint defines the voltage range within which the regulator output is maintained. It is divided equally above and below the Voltage Level setpoint.

For example, a Bandwidth of 6 volts with a Voltage Level setpoint of 120.0 volts specifies that any load voltage between 117 volts and 123 volts is “in band.”

Time Delay Setpoint
The Time Delay setpoint defines the amount of time the controller will wait before commanding a tap change.

4.4.2 Line Drop Compensation
The Line Drop Compensation (LDC) data item defines the assumed voltage drop between the regulator and the load center. Settings are expressed in volts.

To specify LDC values, view Fwd Comp (R) for the Forward Resistive component and Fwd Comp (X) for the Forward Reactive component. In systems with reverse power flow, view Rev Comp (R) and Rev Comp (X) to specify the Reverse components.

A Line Drop Calculator software application is available on the Siemens website. This application automatically calculates the LDC values when the system parameters are entered.

4.4.3 Voltage Reduction Control Items
Voltage Reduction Control (VRC) is used to reduce output voltage. When activated, VRC has the effect of lowering the Voltage Level setpoint. Voltage reduction is accomplished in one or more discrete steps which are defined as a percentage of the voltage level setpoint (Fwd Volts, Rev Volts). VRC operates immediately to reduce output voltage without waiting for completion of the Time Delay.

The following sections describe each of the VRC menu items, and explain how to set them.

ALT Delay
When the VRC2 In item is set for ALT DELAY, an alternate time delay is used before commanding a tap change when the VRC2 contacts are closed. When the VRC2 contacts are open, the standard (Fwd Delay) time delay is used.

VRC Status
The VRC Status data item displays present VRC information in the display panel. It can be directly accessed with the VRC fast-path key, or viewed from the <REGULATOR> Menu.

Information displayed includes: percent reduction presently in effect (nn.n%), the VRC mode (L - Local, A - Automatic, R - Remote), and the present step/stage (0-3). For example, if VRC is presently at 5%, Remote, and MJ-X mode Stage 3, the display panel would show VRC Stat =05.0%R3.

VRC1 In
This item defines which feature is implemented when the external terminal block contacts (VRC1) are closed. Select VRC to enable remote Voltage Reduction Control. Choose X-COMP to enable reactive compensation polarity control. When VRC1 contacts are closed, the LDC polarity is reversed.

VRC2 In
This item defines which feature is implemented when the VRC2 contacts are closed. Choose VRC to enable remote Voltage Reduction Control. Choose ALTDELAY to use the ALT Delay feature described above. Choose LO XBATT to use these terminals for monitoring status change (close to open or vice versa). Choose AUTO INH to inhibit the processor from making automatic tap changes.
VRC Mode
This data item defines the VRC mode of operation. Select the desired mode, using the VRC Mode data item. Four options are provided: OFF, LOCAL, REMOTE, and AUTO/REM (see Figure 4.4).

VRC Mode: OFF
Disables VRC function.

VRC Mode: LOCAL
When Local mode is selected, VRC activates immediately to reduce output voltage by the amount specified in the Local VRC % data item.

To enable VRC Local mode, view VRC Mode and select LOCAL. View Local VRC % and define a reduction amount between 0.0% and 10.0% in 0.1% increments.

VRC Mode: REMOTE (via Terminal Contacts)
When this mode is selected, VRC is conditioned to activate VRC upon closure of external contacts. These contacts, which specify the reduction amount, are connected to terminals (labeled VRC1 and VRC2) at the rear of the controller. See Appendixes I and K.

Note that VRC Mode: Remote works differently than VRC Mode: Local. When you enable VRC Mode: Local, voltage reduction begins immediately. When you enable VRC Mode: Remote, the microprocessor is only conditioned to activate VRC. Voltage reduction does not occur until the VRC contacts are activated.

To enable VRC Remote mode, view VRC Mode and select REMOTE. Then to activate voltage reduction, you must close the appropriate VRC contacts.

Remote mode is further subdivided into MJ-X mode, and MJ-3A mode (compatible with the previous-generation control). Both modes use the VRC terminal pairs; the difference is in the way the terminal pairs are used.

MJ-X Mode (“Static” Inputs)
In MJ-X mode, you can specify up to three Stages of voltage reduction—each with a different reduction value. View VRC Remote and select MJ-X. Then view VRC Stage1, VRC Stage2, and VRC Stage3 to set the VRC percentage reduction values.

Two terminal pairs (VRC1 and VRC2) on the external terminal block are used to trigger the three Stages (see Table 4.4).

Table 4.4 VRC Indicator Flashing Pattern for MJ-X Mode

<table>
<thead>
<tr>
<th>Stage</th>
<th>VRC Terminal Pair</th>
<th>VRC LED flashing pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>VRC1 active; VRC2 in-active</td>
<td>long-short</td>
</tr>
<tr>
<td>Stage 2</td>
<td>VRC1 in-active; VRC2 active</td>
<td>long-short-short</td>
</tr>
<tr>
<td>Stage 3</td>
<td>VRC1 active; VRC2 active</td>
<td>long-short-short-short</td>
</tr>
</tbody>
</table>

MJ-3A Mode (“Pulsed” Input)
This mode simulates MJ-3A VRC; it uses only one external contact (VRC1). MJ-3A VRC users can achieve compatibility with existing controllers using this mode.

To use MJ-3A mode, view VRC Remote and select MJ-3A. Then select MJ-3A VRC% and specify the reduction value.

The single MJ-3A VRC% value defines a total reduction value which control program logic subdivides into 33%, 67% and 100% steps.

To achieve a reduction equal to 100% of the MJ-3A VRC% specification, activate the VRC1 contact for more than three seconds (“latched”). To achieve partial voltage reduction, “pulse” the VRC1 contact momentarily (a “pulse” is 300 msec. to 3 seconds). See Table 4.5 below.

Table 4.5 MJ-3A Mode VRC Reduction

<table>
<thead>
<tr>
<th>VRC1 Terminal Pair</th>
<th>VRC Reduction</th>
<th>VRC LED flashing pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>first pulse</td>
<td>33% of specified value</td>
<td>long-short</td>
</tr>
<tr>
<td>second pulse</td>
<td>67% of specified value</td>
<td>long-short-short</td>
</tr>
<tr>
<td>third pulse</td>
<td>100% of specified value</td>
<td>long-short-short-short</td>
</tr>
<tr>
<td>fourth pulse</td>
<td>0% not flashing</td>
<td>none</td>
</tr>
<tr>
<td>latched</td>
<td>100% of specified value</td>
<td>long-short-short-short</td>
</tr>
<tr>
<td>unlatched</td>
<td>none</td>
<td>none</td>
</tr>
</tbody>
</table>

For example, if you specify Fwd Volts=120 V, and MJ-3A VRC% = 10%, the total reduction value is 12 V. This 12 V reduction value is further subdivided into thirds, so a single pulse would result in a 4 V reduction; a second pulse would produce an 8 V reduction, and a third pulse would produce a total of 12 V reduction. Contact activation of three seconds or longer is considered to be a “latched condition” and would (in this example) produce a full 12 V reduction.

Automatic Mode VRC with Remote Override
In Automatic mode, voltage reduction is activated automatically whenever load current exceeds a predefined percentage.

There are two automatic VRC setpoints (AutoVRC1 and AutoVRC2). When load current exceeds the percentage specified in either of the AutoVRC %I data items, regulator output voltage is reduced by the percentage specified in the corresponding AutoVRCset data item.

Only one set is active at a time; they are not additive. AutoVRC remains active until the load current falls below a value that is the lower of:

\[
\text{AutoVRCn} \cdot (1-2 \cdot \text{AutoVRCsetn}(%))
\]

or
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90% · AutoVRCn% · (rated current).

Example 1
AutoVRC1%I = 60%; AutoVRCset1 = 3%.
I turn-off threshold = lower of:
60% · (1-2 · (3%)) · rated current = 56.4% · rated current
or
90% · (60%) · rated current = 54% · rated current
Auto VRC will remain active until load current drops to 54% of rated current.

Example 2
AutoVRC1%I = 80%; AutoVRCset1 = 7%.
I turn-off threshold = lower of:
80% · (1-2 · (7%)) · rated current = 68.8% · rated current
or
90% · (60%) · rated current = 72% · rated current
Auto VRC will remain active until load current drops to 68.8% of rated current.

To choose Automatic mode VRC, view VRC Mode and select AUT/REM. Use AutoVRCset1 and AutoVRCset2 to specify the reduction amount. Use AutoVRC1%I and AutoVRC2%I to specify the low current threshold.

AutoVRC settings are overridden by contact closures on terminal block contacts VRC1 and VRC2.

4.4.4 Voltage Limit Control
Voltage Limit Control (VLC) defines limits for load voltage. When VLC is active, the microprocessor compares load voltage with VLC setpoints. If load voltage changes to a value above VLC Upper, or below VLC Lower, limiting occurs immediately—that is, without waiting for the Time Delay timer to count down. The appropriate LED indicator (VLC Upper/VLC Lower) illuminates to alert the operator that Voltage Limiting is in effect.

- To activate/deactivate VLC, view VLC Enable; then use ON or OFF.
- To set the Upper VLC setpoint, view VLC Upper; then enter a value between 106.0 and 134.0 volts.
- To set the Lower VLC setpoint, view VLC Lower; then enter a value between 106.0 and 134.0 volts.

Note that the upper and lower limits must not overlap. For example, if VLC Lower is 115, VLC Upper cannot be changed to a value less than 115 V.)

4.5 Activating Data Logging—
the <LOG SETUP> Menu
The MJ-4 Control Panel can record status information that will help reconstruct past occurrences. Two logs are maintained: an Event Log, and an Interval Log. Event Log records are stored when predefined Events occur; Interval Log records are stored at predefined time intervals. See Table 4.6; default settings are in bold.

This section describes how to define your logging requirements. See Chapter 5, Reading and Interpreting MJ-4 Control Panel Data, for guidance on how to retrieve logged data.

Table 4.6 The <LOG SETUP> Menu

<table>
<thead>
<tr>
<th>DATA ITEM</th>
<th>DESCRIPTION</th>
<th>VALID INPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Event</td>
<td>Enable event logging</td>
<td>On or OFF</td>
</tr>
<tr>
<td>Event = Tap</td>
<td>Define Tap Change as event</td>
<td>On or OFF</td>
</tr>
<tr>
<td>Event = Neut.</td>
<td>Define Tap at neutral as event</td>
<td>On or OFF</td>
</tr>
<tr>
<td>Event = NN R</td>
<td>Define Tap raise to step NN as event</td>
<td>On or OFF NN=16</td>
</tr>
<tr>
<td>Event = NN L</td>
<td>Define Tap lower to step NN as event</td>
<td>On or OFF NN=16</td>
</tr>
<tr>
<td>Event = VLC</td>
<td>Define VLC activation as event</td>
<td>On or OFF</td>
</tr>
<tr>
<td>Event = VRC</td>
<td>Define VRC as event</td>
<td>On or OFF</td>
</tr>
<tr>
<td>Event = PwrFlow</td>
<td>Define power flow reversal as event</td>
<td>On or OFF</td>
</tr>
<tr>
<td>Event = PwrCyc</td>
<td>Define system power up as event</td>
<td>On or OFF</td>
</tr>
<tr>
<td>Event = Cfg</td>
<td>Define configuration change as event</td>
<td>On or OFF</td>
</tr>
<tr>
<td>Event = Alert</td>
<td>Define any Alert activation as event</td>
<td>On or OFF</td>
</tr>
<tr>
<td>Clr Event Log?</td>
<td>Clear All Event Data</td>
<td>Y or N</td>
</tr>
<tr>
<td>Clr IntervLog?</td>
<td>Clear All Interval Data</td>
<td>Y or N</td>
</tr>
<tr>
<td>Log Interval</td>
<td>Enable Interval logging</td>
<td>On or OFF</td>
</tr>
<tr>
<td>ResLogMinMax</td>
<td>Reset min/max values at start of interval</td>
<td>On or OFF</td>
</tr>
<tr>
<td>Log min/max</td>
<td>Panel will log Instantaneous or Demand Min/Max values</td>
<td>Inst, Dmd</td>
</tr>
<tr>
<td>Interval</td>
<td>Logging Interval</td>
<td>NNhrNNmin</td>
</tr>
</tbody>
</table>

4.5.1 Event Logging
The Event Log captures present readings when an Event occurs. You can determine which Events cause logging activity by selecting the ones you want from the <LOG SETUP> Menu. When that Event occurs, the following readings will be logged:

Event Date and Time, Event Cause, Event ID plus present values for:
Vid, Ild,
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To activate Events Logging, view Log Event; then select ON. You must also define which events are to be logged. To activate logging for a specific Event, view the appropriate Event = data item, and select ON for that Event.

The Event logs contain the 1000 most recent events.

4.5.2 Interval Logging

The Interval Log records data at specific time intervals, as defined in the <LOG SETUP> Menu. At the end of each interval, the following readings are logged:

Interval Date, Time, and Interval ID
Present, max, min, and demand values for:

Vld, Id
KW, KVAR
KVA

Instantaneous value of Vsrc
Instantaneous value of Power Factor
Power Factor at KVAmx
Power Factor at KVAmn

Present, max, and min values for Tap Position
Total Operations

To activate Interval logging, view Log Interval; then select ON.

To define the time between logs, view Interval; then specify the time as HHhrMMmin.

To reset the minimum and maximum values at the start of each interval, view ResLogMinMax; then select ON.

Interval logging is synchronized to the time of day. Interval logging occurs when “seconds” is zero. For 15 and 30 minute intervals, the MJ-4 logs data at even quarter and half-hour increments, respectively. For a 1-hour setting, the MJ-4 logs data on the hour. For 4 and 6-hour settings, the MJ-4 logs data synchronized to 12:00:00 midnight.

The Interval logs contain the 1000 most recent intervals.

4.5.3 Clearing Event/Interval Log Data

To clear the entire Event Log, view the Clr Event Log item, toggle to Y, then press the Save key.

To clear the entire Interval Log, view the Clr IntervlLog item, toggle to Y, then press the Save key.

4.6 Password Security Protection—
the <PASSWORD> Menu

MJ-4 security allows unrestricted read access to any data item while providing password security against changes and resets.

4.6.1 Overview

MJ-4 password protection is a hierarchical system, consisting of a “System Key” that provides a level of protection for the MJ-4 data items, and two Levels of security for MJ-4 data items:

1. A Level 1 password enables the change/reset function; if a valid Level 1 password is entered, any data item (which is not further protected by Level 2) can be changed or reset.

2. A Level 2 password is associated with a specific Menu. When a Menu is protected at Level 2, the Level 2 password must be entered before changes/resets can be made to data items within that Menu.

Entering any Level 2 password provides access to all Level 1 protected data items as well as to data items contained in Menus that are protected by that specific Level 2 password. In other words, when a Level 2 (Menu) password has been entered, the change/reset function is enabled for any data item that is not protected by another Level 2 password.

Either Level can be activated independent of the other.

Security activation and password assignment are separate functions. In other words, even though you have assigned a password to a Level, password checking can be active or inactive for that Level.

With this flexible structure you can set up a security system with:

- A single Level 1 password.
- A Level 1 password with additional Level 2 passwords for specific Menus.
- No Level 1 password, but one or more level 2 (Menu) passwords.
- No passwords at all.
- Passwords defined, but password checking temporarily disabled.

The default configuration for the password security system is with all password protection disabled (except for the <DIAGNOSTIC> Menu).

Control of the security system requires the use of a “System Key,” which protects the changing of passwords and the activation and de-activation of the two security Levels. To ensure proper control of the MJ-4 security system, you may wish to designate one individual as security adminis-
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trator. This person would be responsible for establishing the password protection scheme and for making changes to the passwords as necessary; He/she would be the only individual requiring knowledge of the “System Key.” The “System Key” not only allows the user to change the security system, it also acts as a top level password which allows access to all change/reset functions. Once the “System Key” is entered and until the session is ended, the security system is effectively disabled.

Contact a Siemens representative if your passwords are forgotten.

4.6.2 The <PASSWORD> Menu

The <PASSWORD> Menu serves three purposes:

1. To enter passwords so that you can change/reset password-protected data items.
2. To define passwords.
3. To activate and deactivate security checking.

Table 4.7 below describes the data items in the <PASSWORD> Menu and their default settings.

<table>
<thead>
<tr>
<th>Data item</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>The following data items are used to enter passwords</td>
<td>Enter PW: Prompts operator for a password</td>
<td>xxxx</td>
</tr>
<tr>
<td></td>
<td>End Session ? End password access to protected data items</td>
<td>N or Y</td>
</tr>
<tr>
<td></td>
<td>System Key: Prompt for entering and changing of the System Key</td>
<td>xxxx 0123</td>
</tr>
<tr>
<td>The following data items are visible only after System Key has been accepted.</td>
<td>Level 1</td>
<td>OFF or ON</td>
</tr>
<tr>
<td></td>
<td>Level 1 PW: Level 1 password</td>
<td>xxxx 1111</td>
</tr>
<tr>
<td></td>
<td>Level 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Configure: Enable password for &lt;CONFIGURE&gt; Menu changes</td>
<td>OFF or ON</td>
</tr>
<tr>
<td></td>
<td>Config PW: Password for &lt;CONFIGURE&gt; Menu</td>
<td>xxxx 2222</td>
</tr>
<tr>
<td></td>
<td>Regulator: Enable password for &lt;REGULATOR&gt; Menu changes</td>
<td>OFF or ON</td>
</tr>
<tr>
<td></td>
<td>Reg. PW: Password for &lt;REGULATOR&gt; Menu</td>
<td>xxxx 2222</td>
</tr>
<tr>
<td></td>
<td>Meter: Enable password for &lt;METER&gt; Menu changes</td>
<td>OFF or ON</td>
</tr>
<tr>
<td></td>
<td>Meter PW: Password for &lt;METER&gt; Menu</td>
<td>xxxx 2222</td>
</tr>
<tr>
<td></td>
<td>Demand: Enable password for &lt;DEMAND&gt; Menu changes</td>
<td>OFF or ON</td>
</tr>
<tr>
<td></td>
<td>Demand PW: Password for &lt;DEMAND&gt; Menu</td>
<td>xxxx 2222</td>
</tr>
<tr>
<td></td>
<td>Alert: Enable password for &lt;ALERTS&gt; Menu changes</td>
<td>OFF or ON</td>
</tr>
<tr>
<td></td>
<td>Alert PW: Password for &lt;ALERTS&gt; Menu</td>
<td>xxxx 2222</td>
</tr>
<tr>
<td></td>
<td>Counters: Enable password for &lt;COUNTERS&gt; Menu changes</td>
<td>OFF or ON</td>
</tr>
<tr>
<td></td>
<td>Counters PW: Password for &lt;COUNTERS&gt; Menu</td>
<td>xxxx 2222</td>
</tr>
<tr>
<td></td>
<td>Log Setup: Enable password for &lt;LOG SETUP&gt; Menu changes.</td>
<td>OFF or ON</td>
</tr>
<tr>
<td></td>
<td>Log Set PW: Password for &lt;LOG SETUP&gt; Menu</td>
<td>xxxx 2222</td>
</tr>
<tr>
<td></td>
<td>Evi/Intv: Enable password for &lt;EVENT LOG&gt; and &lt;INTERVAL LOG&gt; Menus.</td>
<td>OFF or ON</td>
</tr>
<tr>
<td></td>
<td>Evi/Intv PW: Password for &lt;EVENT/INTERVAL&gt;</td>
<td>xxxx 2222</td>
</tr>
<tr>
<td></td>
<td>Harmonics: Enable password for &lt;HARMONICS&gt; Menu.</td>
<td>OFF or ON</td>
</tr>
<tr>
<td></td>
<td>Harm. PW: Password for &lt;HARMONICS&gt; Menu</td>
<td>xxxx 2222</td>
</tr>
<tr>
<td></td>
<td>Comm: Enable password for &lt;COMMUNICATIONS&gt; Menu.</td>
<td>OFF or ON</td>
</tr>
<tr>
<td></td>
<td>Comm PW: Password for &lt;COMMUNICATIONS&gt; Menu</td>
<td>xxxx 2222</td>
</tr>
<tr>
<td></td>
<td>Mntn: Enable password for &lt;MAINTENANCE&gt; Menu</td>
<td>ON or Off</td>
</tr>
<tr>
<td></td>
<td>Mntn PW: Password for &lt;MAINTENANCE&gt; Menu</td>
<td>xxxx 3333</td>
</tr>
<tr>
<td></td>
<td>Diagnostics: Enable password for &lt;DIAGNOSTICS&gt; Menu.</td>
<td>ON or Off</td>
</tr>
<tr>
<td></td>
<td>Diagnos. PW: Password for &lt;DIAGNOSTICS&gt; Menu</td>
<td>xxxx 3333</td>
</tr>
</tbody>
</table>

Bold denotes default values

Entering the System Key
To make changes to the security system itself, a “System Key” must first be entered. The System Key is a special password that allows the security administrator to change passwords and to enable/disable Level 1 and Level 2 protection.

To enter the System Key, view the System Key xxxx data item from the <PASSWORD> Menu; then press Change. The display screen responds by flashing “Enter System Key xxxx” in the left-most position of the four-character password field. This denotes the position in which a character is to be entered. (The remaining character positions contain “.”) Use the ↑ and ↓ keys to select the desired character. Then press the → key to move the cursor to the next character to the right, and so on, until all four characters of the password have been entered. To complete the process, press the Save key.

When a valid System Key has been entered, “Sys Key Accepted” appears in the display screen. Re-definition of the security system is then possible. Access to security system re-definition continues until the definition session is:

- Manually terminated by selection of End Session Y(es) in the <PASSWORD> Menu.
- Automatically terminated by expiration of the Screen timeout period.

Because of the security exposure possible during a security system definition session, you should always use the End Session facility when changes are complete to ensure against unauthorized security system re-definition changes.

Changing Passwords
After entering the System Key (see above), scroll down to view Password and Password Enable/Disable items.

To change a Level 1 password, view Level 1 PW: in the <PASSWORD> Menu and use the Change, Scroll, and Save keys to enter the new password. Passwords may consist of any of the following characters: 0-9 and A-Z.

To change a Level 2 password, you must view the Menu associated with that password from the <PASSWORD> Menu. For example, to define a password for the <CONFIGURE> Menu view Config. PW:, then use the Change, Scroll, and Save keys to enter the new password. You may use the same Level 2 password for several Menus, or you may use a different Level 2 password for each Menu.

Enabling/Disabling Password Checking
After entering the System Key (see above), scroll down to view Password and Password Enable/Disable items.

In addition to defining passwords for a given level, you must also enable that level before password checking takes place. When password checking is enabled for a given Level, entry of a valid password will be required before you can change/reset any data item that is protected at that Level. Password checking is enabled for each level separately. In other words, you can enable or disable password protection for Level 1, for Level 2, or for both Levels. If password checking for a given Level is disabled, any data item at that Level can be changed or reset without use of the password.

To activate password checking for Level 1, view the Level 1 parameter; then change the OFF to ON.

To activate password checking for Level 2, you must specify each Menu for which you wish security to be enabled. For example, to enable Level 2 security for the <CONFIGURE> Menu, view CONFIGURE: from the <PASSWORD> Menu; then change the OFF to ON.

Changing the System Key
To change the System Key, (assuming you have not yet entered the System Key):

1. Enter the present System Key. After all four characters have been selected, press Save. The words “Sys Key Accepted” will appear in the display screen. After a short period, the words “System Key” will be displayed.

2. Press the Change key to indicate that you wish to make a change.

3. Enter the new key. After all four characters have been selected, press Save. The words, “Re-enter xxxx” will appear.

4. Verify correct entry by entering the new System Key once again. After all four characters have been selected, press Save.

If your first and second attempts do not match, you will see the words, “Verify failure” and you will be returned to step 2. When you have successfully entered the new System Key twice in succession, the display screen responds with “Sys Key Changed.”

4.6.4 Using the MJ-4A & MJ-4B Control Panel With Password Security Activated

MJ-4 Security does not restrict data reading. However, if password security is active, you must first enter the proper password before you can change or reset protected data. If you attempt to change a password-protected item without first entering the proper password, the display screen responds “PW NOT ENTERED” and you must use the <PASSWORD> Menu to enter the appropriate password.

Note that a Level 2 password includes Level 1 access privileges. Therefore, data items that are only Level 1 protected can be changed or reset after you enter either the
Level 1 password or a Level 2 password. Data items contained in Menus that are password protected by Level 2 passwords can only be changed or reset after you enter the Level 2 password for that Menu.

**Entering passwords**

You can go directly to the `<PASSWORD>` menu and enter the password(s) you want, or when viewing a specific menu item, press Cancel/Reset or Change. If password protection is enabled for this menu, you are prompted to enter the password. (If you see the password prompt, skip step 1 below.)

1. Use the Menu and Scroll keys to view the `<PASSWORD>` Menu. Press the ♣ key. The display screen responds: “Enter PW xxxx.”

2. Press the Change key. The display screen responds by flashing “ ” in the leftmost position of the four character password field. This represents the character to be entered.

3. Use the ♣ and ♣ keys to step through the alpha and numeric characters until the desired character is presented in the display screen.

4. Press the ♣ key to move the cursor to the next character to the right, and so on until all four characters of the password have been entered.

5. When you have completed entering the password, press the Save key.

(If you started in the `<PASSWORD>` menu, go to step 6. Otherwise, go to step 7.)

6. If you entered a valid password, the MJ-4 briefly displays “PW Accepted;” and then displays “Enter PW.” This allows you to enter additional passwords. (You may wish to enter additional passwords if, for example, you have enabled both Level 1 and Level 2; or if you have enabled Level 2 and have different passwords for each Menu.) When you have entered all passwords, you can use the Menu and Scroll keys to view the data item(s) you wish to change or reset. Skip step 7.

7. If you enter the correct password, the MJ-4 briefly displays, “PW Accepted” and then returns to the screen you were viewing when you started this process. If you enter a valid password, but not the correct password for this menu, the MJ-4 displays “Enter PW.” again. This process repeats until you enter the correct password for this menu.

Once a password has been accepted, changes and resets are permitted for the remainder of the session. To end the session, view End Session in the `<PASSWORD>` Menu, and use the Change, Scroll, and Save keys to change the default N[0]o] to Y[es]. If you leave the session enabled (un-terminated) the MJ-4 automatically terminates it when the screen time-out period expires (see `<CONFIGURE>` Menu Screen t.o. data item).

### 4.7 Communications Definition—the `<COMMUNICATIONS>` Menu

The `<COMMUNICATIONS>` Menu provides data items for setting up local communications and remote communications via the Communications Module. These data items are described in the following sections.

#### 4.7.1 Setting Up the Local Data Port

The Local Data Port must be set up for proper operation. The `<COMMUNICATIONS>` Menu contains the Data Port setup items described in Table 4.8:

<table>
<thead>
<tr>
<th>DATA ITEM</th>
<th>DESCRIPTION</th>
<th>INPUTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DatPortBaud:</td>
<td>Local Data Port transmission rate</td>
<td>300, 1200, 2400, 4800, 9600, or 19200</td>
</tr>
<tr>
<td>Data Parity:</td>
<td>Local Data Port Parity Setting</td>
<td>EVEN, NONE</td>
</tr>
<tr>
<td>DataPorAddr:</td>
<td>Enables/Disables Addressing for Data Port</td>
<td>OFF, ON</td>
</tr>
<tr>
<td>Reg Id:</td>
<td>Regulator Identification Number (Note that this is NOT the address for Data Port Communications.)</td>
<td>NNNNN (Range 0-32765)</td>
</tr>
<tr>
<td>Comm Addr:</td>
<td>2200 protocol address for the specific unit</td>
<td>NNN (Range 0-255 See Table 4.8)</td>
</tr>
</tbody>
</table>

**Note:** Default values shown in bold type.

To change the baud rate for the data port, view DatPortBaud under the `<COMMUNICATIONS>` Menu and select one of the options (300, 600, 1200, 4800, 9600, or 19200).

To change the parity for the data port, view Data Parity under the `<COMMUNICATIONS>` Menu and select one of the options (EVEN or NONE).

To enable or disable addressing for the data port, view DataPortAddr under the `<COMMUNICATIONS>` Menu and select one of the options (OFF or ON.) Disable addressing for local communications with MJXplorer or a Data Reader.

To change the Regulator Identification, view Reg Id under the `<COMMUNICATIONS>` Menu and set the desired Reg Id value. For extracting data and generating reports using the MJXplorer software, the Reg Id value appears prominently at the top of the reports. If collecting data from multiple controls, select a different value of Reg Id for each MJ-4 unit.

To set the Communications unit address, view Comm Addr under the `<COMMUNICATIONS>` Menu. Enter the desired address.
The “Comm Addr” screen shows the communications address for the MJ-4 unit. For the Data Port, the usable address ranges are listed in Table 4.9 below. Note that the MJ-4 is device type “1,” and its group address is 254.

### Table 4.9 Data Port Addresses

<table>
<thead>
<tr>
<th>Address Range</th>
<th>Function</th>
<th>How Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Wild Card Address</td>
<td>All controls on system respond.</td>
</tr>
<tr>
<td>1 to 200</td>
<td>Unique Device Address</td>
<td>When an address in this range is sent, only the control that has that unique address responds.</td>
</tr>
<tr>
<td>201 to 254</td>
<td>Device Type, Group Address</td>
<td>Any control with the corresponding group address (which is determined by the control’s device type) receive and execute commands with no return response.</td>
</tr>
<tr>
<td>255</td>
<td>Broadcast Address</td>
<td>All controls on the system receive and execute commands, with no return response.</td>
</tr>
</tbody>
</table>

4.7.2 Using the Communications Module

The Communications Module provides remote communications capability for the MJ-4 Control Panel. The Communications Module is a plug-in option offering choices of communications protocols and physical interfaces. Since the Communications Module Installation Manual describes the configuration items in detail, they are listed only for reference in Table 4.10.

### Table 4.10 Communications Module Configuration Items

<table>
<thead>
<tr>
<th>DATA ITEM</th>
<th>DESCRIPTION</th>
<th>SELECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comm Baud</td>
<td>Communications Module transmission rate</td>
<td>300, 1200, 2400, 4800, 9600, or 19,200*</td>
</tr>
<tr>
<td>Comm Parity</td>
<td>Communications Module Parity</td>
<td>NONE, EVEN, ODD</td>
</tr>
<tr>
<td>Comm Addr</td>
<td>Communications Module Address</td>
<td>NNNNNN</td>
</tr>
<tr>
<td>Resync Time</td>
<td>Communications Module resync time (in characters). Used for Communications Module protocols 2200 and 2179 to determine when one message ends and another message begins.</td>
<td>NNN (range 0-250, 1)</td>
</tr>
<tr>
<td>Tx En Delay</td>
<td>Communications Module Transmit Enable Delay (in milliseconds). Specifies the amount of time between the RTS output being activated and the start of transmit (output) data.</td>
<td>NNN (range 0-250)</td>
</tr>
<tr>
<td>DNP dl Confirm</td>
<td>DNP Data Link Confirm</td>
<td>Y or N</td>
</tr>
<tr>
<td>CM SW RepeatEn</td>
<td>Enable software auto-repeat in Comm Module (MJ-3A protocol only)</td>
<td>Y or N</td>
</tr>
<tr>
<td>Host Addr</td>
<td>Host Address for Unsolicited Responses</td>
<td>NNN (range 0-65535)</td>
</tr>
<tr>
<td>CM Unsolicited</td>
<td>Unsolicited Responses</td>
<td>Y or N</td>
</tr>
<tr>
<td>AutoInhEn-RemRL</td>
<td>Auto Inhibit Enables Remote Raise/Lower</td>
<td>Y or N</td>
</tr>
<tr>
<td>DNPset</td>
<td>select a predefined or custom DNP point set</td>
<td>DNPcfg, 2.x3, 2.x4, etc.</td>
</tr>
<tr>
<td>CM Vers</td>
<td>Comm Module software version</td>
<td>N.NNNN</td>
</tr>
</tbody>
</table>

Note: Default values shown in bold type.

Note: If both the Data Port and the Communications Module are simultaneously set up for remote communications, then the Data Port restrictions on the value of the “Comm Addr” data item must apply.

* See Comm Module Instruction Manual for limitations on 19,200 baud.
### 4.8 Regulator Maintenance—the <MAINTENANCE> Menu

The information contained within the <MAINTENANCE> menu should be used for information purposes only. All voltage regulator maintenance should be completed as described in the Maintenance section of the Siemens Voltage Regulator Manual.

The <MAINTENANCE> Menu allows the user to enable an algorithm which will approximate wear and tear on the Tap changer contacts for Siemens Regulators. The menu allows the user to choose a Tap Changer Type, indicate presence of Balance winding and define the Range of Regulation. The other items in this menu include items which show statuses of the Tap changer contacts and the operations on the contact(s).

The statuses update based on the accumulated losses due to wear and tear. The statuses are classified into EXCELLENT, GOOD, WORN, and REPLACE. The Moving contacts have a common status screen while the Stationary contacts have one screen each.

The contact op counters update as operations are added on the individual contacts.

The first screen in the <MAINTENANCE> menu is the ConsOv screen which is a status screen, it shows the status of the most worn contact(s).

Each of the individual contacts’ status or operations maybe cleared by pressing the Cancel Reset button. If a user wishes to clear all statuses and op counts at once then this can be done by pressing Cancel-Reset key on the ConsOv screen.

If the Maintenance approximation algorithm is disabled, all statuses and contact op counts show “N/A”. If the MaintainRcrds? data item is changed to “Y” then the algorithm is enabled and would update the statuses and opcounts.

The Maintenance menu is password protected by default. The default password of “3333” must be entered before changing settings or resetting any statuses and contact op counters.

The last screen in the maintenance menu is the OP_DUR screen. This screen indicates the last measured op counter pulse duration in seconds which is useful when adjusting the TapInPulse time for TapIn=Pulse under <Diagnostics> (i.e. the Tap Chgr is set to Custom or GE).

The Maintenance Menu also has a fast path key on the front panel. Press this key to view the status and settings screens of the Maintenance menu; repeat the key press to scroll through the Maintenance menu.

### 4.9 Hardware Configuration—the <DIAGNOSTICS> Menu

The <DIAGNOSTICS> Menu includes the MJ-4 hardware configuration items in addition to the calibration and MJ-4 internal test items.

See Section 8 for information about the test and calibration items:

- U2 Cal
- P2 Cal
- C/C2low
- C/C2med
- C/C2high

The MJ-4 provides three hardware configuration items to assure compatibility between the MJ-4 electronics (hardware) and the MJ-4 control program software. The hardware configuration items are listed in Table 4.11 below:

<table>
<thead>
<tr>
<th>DATA ITEM</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP BD VERS:</td>
<td>MJ-4 Main Processor Board Version</td>
</tr>
<tr>
<td>PWR BD VERS:</td>
<td>For MJ-X Compatibility.</td>
</tr>
<tr>
<td>MP MASK VERS:</td>
<td>MJ-4 Microprocessor Mask Version</td>
</tr>
</tbody>
</table>

The Hardware configuration items are initialized at the factory. Normally, these items will not need to be changed or updated.

For all MJ-4 units, the “MP MASK VERS:” item is factory set. “0C” is the default setting and the operator/installer should not change this value.

The <DIAGNOSTICS> Menu also includes the Serial Number and Product Revision code for the MJ-4 Control Panel. These are set at the factory and cannot be changed.

Refer to the Communications Module Instruction Manual for information about the Comm Module items:

- CM Test?
- CM TestStat

The configurable tap changer control settings are also contained in the <DIAGNOSTICS> Menu. Contact your Siemens representative for more information before adjusting these settings.
4 Setting Up the MJ-4A & MJ-4B Control Panel

4.10 Setting up the Quick Key

The Quick Key provides access to the customizable Quick List. The Quick List can be used to step through a series of up to 15 user-set menu items. The Quick List allows creation of a custom menu with the minimal amount of effort. Any changes to the menu parameters must be done using normal configuration and operation procedures. Certain menus cannot be added to the Quick List including: Password Menu, Log Menu(s), Alert Menu.

Adding Items to the Quick List: Use the scroll keys to display the desired menu item to be added. Press the +/- key. Press the Quick Key. Repeat to add more screens to the Quick List. Items are stored in the order that you add them.

Removing Items from the Quick List: Press the Quick Key repeatedly to display the desired menu item to be removed. Press the +/- key. Press the Quick Key. Press the Cancel/Reset key.

Viewing the position of Items in the Quick List: Press the Quick Key repeatedly to display the desired menu item. Press the left arrow key to display the item’s position in the menu stack.

Repositioning Items in the Quick List: Press the Quick Key repeatedly until the desired item is displayed. Press the Change Key. Press the Up and Down arrow keys to move the item up and down one position at a time. When finished, no further key presses are necessary. Press the Quick Key repeatedly to cycle through the new order.

Displaying Items in the Quick List: Press the Quick Key repeatedly to step through the Quick List. The display will flash from bright to dim to signify that the Quick List is being displayed. When finished, press the Cancel/Reset key to exit the Quick List, or if no keys are pressed for the amount of time specified in the Quick t.o. data item, the Quick List will be automatically exited.

The first keypress used to enter the Quick List will always display the Tap Contr screen (showing switch position) before the actual Quick List is displayed itself.

While in the Quick List, press the right arrow key to begin a slideshow that automatically steps through the Quick List. Each screen is displayed for the amount of time specified by the QuickDispTim data item. To stop the slideshow and exit the Quick List press the Cancel/Reset key.
5 Reading and Interpreting MJ-4A & MJ-4B Control Panel Data

5.1 Source and Load Definitions

In the following paragraphs, the term “Source” is defined as the connection point from which real power is flowing. The term “Load” refers to the connection point into which real power is flowing. In addition, for purposes of the following discussion, U2 and P2 refer to the terminals with the “S” bushing voltage is the “Source” voltage and the “L” bushing voltage is the “Load” voltage. With power flowing in the reverse direction, the “S” bushing voltage is the “Load” voltage and the “L” bushing voltage is the “Source” voltage.

The table below shows which MJ-4 parameters represent the “S” and “L” readings for each power-flow condition.

<table>
<thead>
<tr>
<th>Power Flow Mode</th>
<th>Vld</th>
<th>Vsrc</th>
<th>Power Flow Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bi-Dir, Neut R. Idle R</td>
<td>“L”</td>
<td>“S”</td>
<td>Forward</td>
</tr>
<tr>
<td>Bi-Dir, Neut R. Idle R</td>
<td>“S”</td>
<td>“L”</td>
<td>Reverse</td>
</tr>
<tr>
<td>F Lock, Co-Gen</td>
<td>“L”</td>
<td>“S”</td>
<td>Forward</td>
</tr>
<tr>
<td>F Lock, Co-Gen</td>
<td>“S”</td>
<td>“L”</td>
<td>Reverse</td>
</tr>
<tr>
<td>R Lock</td>
<td>“S”</td>
<td>“L”</td>
<td>Forward</td>
</tr>
<tr>
<td>R Lock</td>
<td>“L”</td>
<td>“S”</td>
<td>Reverse</td>
</tr>
</tbody>
</table>

5.2 P2 Voltage Calculation

This feature provides a calculated value of the “P2” bushing voltage when a measured value is unavailable.

When the the P2 voltage reading is less than 50 volts and the P2 Calc setting is enabled under the <ADV CONFIGURE> menu, the MJ-4 automatically calculates the P2 voltage. The MJ-4 displays the calculated P2 value as “Vsrc” or “Vld” according to Table 5.1. If the P2 Calc is disabled, then the P2 Value is not calculated.

The MJ-4 must know the tap position for the “P2 Calculate” feature to work. See sections 5.7 and 5.8 for information about the tap position and the tap position message.

5.3 Meter Data—the <METER> Menu

The Meter data items present operating values such as Voltage, Current, Power, etc. on the display screen. Unless otherwise specified, Meter data includes rms, maximum and minimum values.

To view Meter data, use the Menu Selection keys to view the <METER> Menu; then use the and keys to sequence through the data items.

To view a maximum or a minimum data item, you first view the instantaneous data item and press the Max/Min key. Pressing the Max/Min key twice. To reset Maximum/Minimum data values, first view the rms value, then press the Max/Min key, and then the Cancel/Reset key.

5.3.1 Viewing Min/Max Time and Date Stamps

To view the time and date of occurrence for a minimum or maximum data item, first view the desired min/max data item. With the min/max data item displayed, press the Save key to view the associated time and date stamp. While the time and date stamp is in view, if you press the key, the first metered data item for the menu will be
5 Reading and Interpreting MJ-4A & MJ-4B Control Panel Data

displayed. Pressing the key displays the last metered data item. An example for displaying min/max time and date stamps is shown below:

<table>
<thead>
<tr>
<th>Action</th>
<th>Display Shows</th>
</tr>
</thead>
<tbody>
<tr>
<td>View Vcomp data item in &lt;METER&gt; Menu.</td>
<td>Vcomp = 121.2 F</td>
</tr>
<tr>
<td>Press Max/Min key once.</td>
<td>Vcomp = 124.3 Fmax</td>
</tr>
<tr>
<td>Press the Save key before timeout.</td>
<td>061798 21:26:45</td>
</tr>
<tr>
<td>Press the key.</td>
<td>Vld = 122.5 F</td>
</tr>
</tbody>
</table>

5.3.2 Viewing the <METER> Menu Data

Table 5.1 summarizes the <METER> Menu data items. The remainder of the section defines the data items in detail.

### Table 5.2 Meter Data Items

<table>
<thead>
<tr>
<th>&lt;METER&gt; MENU DATA ITEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vld&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Vs&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Vcomp&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Ild&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>PF&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>KVA&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>KW&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>KVAR&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Freq&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>KWhr&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>KVARhr&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

1. Instantaneous, Max, and Min values
2. Time-cumulative value — no Max/Min

### Vld (Load Volts)

The Vld data item displays the rms load voltage. The value displayed is either the basis voltage (nominal 120 V) or the system primary voltage. (See Meter Volts as defined in the <CONFIGURE> Menu Meter Volts data item, Chapter 4.)

### Vs (Source Volts)

The Vs data item displays the rms source voltage. The value displayed is either the basis voltage (nominal 120 V) or the system primary voltage. (See Meter Volts in the <CONFIGURE> Menu, Chapter 4.)

### Vcomp (Line Drop Compensation Volts)

The Vcomp data item displays the rms voltage present at the theoretical load center. This is the voltage the microprocessor compares with the voltage setpoint to determine when tap changes are required. The value displayed is either the basis voltage (nominal 120 V) or the system primary voltage. (See Meter Volts in the <CONFIGURE> Menu, Chapter 4.)

### Ild (Load Current)

The Ild data item displays the rms regulator current in amperes. Note: The Current Transformer is typically located in the Load Bushing lead. Therefore, under reverse power flow conditions, load current includes regulator excitation current which could be approximately 10% higher or lower than actual load current.

### PF Lead, PF Lag (Power Factor)

This is the present line power factor, derived from the fundamental frequencies only, using the relationship

\[
PF = \frac{Watts}{Volts \times Amps}
\]

Three values are recorded for Power Factor: instantaneous, maximum (most leading), and minimum (most lagging or least leading).

### kVA (Apparent Power)

The kVA data item displays the present kVA load on the regulator. The CT of a regulator is always located in the “L” bushing lead. The MJ-4 calculates the kVA per Table 5.3.

<table>
<thead>
<tr>
<th>Regulator Type</th>
<th>Forward Power Flow</th>
<th>Reverse Power Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI A Straight</td>
<td>kVA = Vld x Ild</td>
<td>kVA = Vs x I(“L”)</td>
</tr>
<tr>
<td>ANSI B (Inverted)</td>
<td>kVA = Vld x Ild</td>
<td>kVA = Vs x I(“L”)</td>
</tr>
</tbody>
</table>

Note: For reverse power flow, Ild is current flowing into the regulator and will differ from actual load current by the amount of excitation current of the regulator.

### kW (Real Power)

The Forward and Reverse kW data items display the real portion of the present kVA load on the regulator.

\[
Real \ Power = kW = \frac{1}{n} \sum_{t=0}^{n} V(t) \times I(t)
\]

The kW is displayed as a positive quantity when power flow is into the load, or as a negative quantity when power flow is into the source.

### kVAR (Reactive Power)

The kVAR data item displays the reactive portion of the present kVA load on the regulator.

\[
Reactive \ Power = kVAR = \frac{1}{n} \sum_{t=0}^{n} V(t) \times I(t+90º)
\]

+ = lagging, - = leading

### Freq (Line Frequency)

The Freq data item displays the line frequency in Hertz (present, max, min).
5 Reading and Interpreting MJ-4A & MJ-4B Control Panel Data

kWhr F and kWhr R (Forward and Reverse Real Energy)

The Forward and Reverse kWhr data items display Kilowatt Hour values. They are accumulated separately for forward and reverse power flow conditions. kWhr is updated once per second, using the formula:

\[ \text{kWhr new} = \text{kWhr old} + \text{kW} \times \frac{1}{3600} \text{(hours)} \]

kVARhr F and kVARhr R (Forward and Reverse Reactive Energy)

The kVARhr F and kVARhr R data items display Kilovar Hour values. They are accumulated separately for forward and reverse power flow conditions. The kVARhr is updated once per second, using the formula:

\[ \text{kVARhr new} = \text{kVARhr old} + \text{kVAR} \times \frac{1}{3600} \text{(hours)} \]

The microprocessor computes and accumulates kVARhr values for each of the four quadrants of the voltage/current phase-angle relationships. These parameters are presented as shown in Figure 5.1.

![Figure 5.1 Power Quadrant Conventions](image)

5.4 Demand Data— the <DEMAND> Menus

Demand measurements are time integration functions of the metered values. The MJ-4 Control Panel performs demand calculations for the following data items: voltage, current, power factor and power.

Demand data is maintained separately for forward and reverse power flow conditions (see Table 5.4). During forward power flow conditions, the microprocessor does not accumulate reverse measurements. During reverse power flow conditions, the microprocessor does not accumulate forward measurements.

You can select one of two methods of measuring demand: the Sliding Window method and the Thermal Averaging method. (See DmdType in Section 4.3.23.)

<table>
<thead>
<tr>
<th>Table 5.4 Demand Data Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fdmd Vld(^1,2)</td>
</tr>
<tr>
<td>Fdmd Vs(^1)</td>
</tr>
<tr>
<td>FdmdVcomp(^1)</td>
</tr>
<tr>
<td>Fdmd Ild(^1)</td>
</tr>
<tr>
<td>PFKVAmax</td>
</tr>
<tr>
<td>PFKVAmin</td>
</tr>
<tr>
<td>Fdmd KW(^1)</td>
</tr>
<tr>
<td>FdmdKVAR(^1)</td>
</tr>
<tr>
<td>FdmdKVA(^1)</td>
</tr>
</tbody>
</table>

1. Instantaneous, min and max data available
2. For each Forward Demand Data Item there is a corresponding Reverse Demand Data Item. For example, Rdmd Vld.

To retrieve Demand data, select the appropriate <FW DEMAND> or <REV DEMAND> Menu; then use the \( \uparrow \) and \( \downarrow \) keys to sequence through the Demand data items. To view the minimum and maximum values for a given Demand data item, first view the present value; then use the Max/Min key to display the respective maximum and minimum values recorded since the last reset.

Demand calculations are initialized at the time of system power up, when configuration items are changed, and on any power flow reversal. Un-initialized data items are presented as dashes (—) on the display screen. Demand values remain un-initialized until completion of the first subperiod. Power factor is stored whenever a new kVA maximum or minimum demand value is reached. These Power Factor values are reset when kVA max or kVA min values are reset.

5.5 Event Log - the <EVENT LOG> Menu

The MJ-4 can be set up to record meter data at the time of an “Event.” Events can include: power up, parameter changes, tap changes, etc. Use the <LOG SETUP> Menu to enable the Events you want logged. (See Section 4.5).

Table 5.5 describes the data that is to be logged whenever an Event occurs.

<table>
<thead>
<tr>
<th>Table 5.5 &lt;EVENT LOG&gt; Data Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event: Event number(^1)</td>
</tr>
<tr>
<td>Date: Date</td>
</tr>
<tr>
<td>Time: Time</td>
</tr>
<tr>
<td>Cause: Cause of Event</td>
</tr>
<tr>
<td>Vld: rms regulator load voltage</td>
</tr>
<tr>
<td>Vsrc: rms regulator source voltage</td>
</tr>
<tr>
<td>Ild: rms regulator load current</td>
</tr>
<tr>
<td>PF: Present Power Factor</td>
</tr>
<tr>
<td>KWld: Present Real power</td>
</tr>
<tr>
<td>KVAR: Present Reactive power</td>
</tr>
<tr>
<td>KVAld: Present Apparent power</td>
</tr>
<tr>
<td>Tap: Tap position</td>
</tr>
</tbody>
</table>

1. The Event number is a sequential number used for maintaining and referencing the <EVENT LOG>.
To access log data, view the <EVENT LOG> Menu with the Menu Selection keys; then use the < and > keys to sequence through the log entries.

New Events that occur while Events are displayed are saved, but not made available for viewing until you return to the Menu level and subsequently scroll into the <EVENT LOG> Menu again. Meter data for all of the Events can be retrieved via the display screen on the front panel. Data for the 200 most recent Events is stored and can also be retrieved via the front-panel Data Port or the Communication Port.

5.5.1 Viewing Event Data
To quickly go from viewing one Event to viewing the previous or next Event, use the < or > keys. For example, if the screen being viewed is [Event: 20], press the < key once to view the [Event: 19] screen. From the [Event: 19] screen, press the > key once to view the [Event: 20] screen again.

5.5.2 Clearing Individual Events from the Event Log
Since you can now view all of the <EVENT LOG> data from the front panel, or download it via the data port, it is unnecessary to delete individual <EVENT LOG> items. The MJ-4 no longer supports deleting individual log records. If the <EVENT LOG> memory is full, the oldest record is overwritten when a new event occurs.

5.6 Interval Log — the <INTERVAL LOG> Menu
The MJ-4 Control Panel can be set up to record data at the completion of a predefined interval of time. Use the <LOG SETUP> Menu to define the time interval and to activate Interval logging. (See Section 4.5).

Interval logging occurs when “seconds” is zero on the internal clock. For certain interval period selections, interval logging is tied to the time-of-day. For 15 and 30 minute interval settings, the MJ-4 logs data at even quarter and half-hour increments, respectively. For a one-hour setting, the MJ-4 logs data on the hour. For four and six-hour settings, the MJ-4 logs data synchronized to 12:00:00 midnight.

Table 5.6 describes the data that is logged at the conclusion of each interval.

<table>
<thead>
<tr>
<th>INTERV: Interval number1</th>
<th>DATE: Interval date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vld Secondary2 Load voltage — rms, Max, Min, Dmd</td>
<td></td>
</tr>
<tr>
<td>Vsrc Source voltage — rms</td>
<td></td>
</tr>
<tr>
<td>Ild Load current — rms, Max, Min, Dmd</td>
<td></td>
</tr>
<tr>
<td>PF Power Factor — Present, PFKVA max, PFKVA min</td>
<td></td>
</tr>
<tr>
<td>KWid Real power — Present, Max, Min, Demand</td>
<td></td>
</tr>
<tr>
<td>KVAld Apparent power — Present, Max, Min, Demand</td>
<td></td>
</tr>
<tr>
<td>Tap = Tap position</td>
<td></td>
</tr>
<tr>
<td>Tapmax = Maximum tap position</td>
<td></td>
</tr>
<tr>
<td>Tapmin = Minimum tap position</td>
<td></td>
</tr>
<tr>
<td>Total ops = Total tap changes</td>
<td></td>
</tr>
</tbody>
</table>

1. The Interval number is a sequential number used for maintaining and referencing the interval log.
2. Secondary only — even if PRI selected in Meter Volts data item.

If the specified interval elapses while you are viewing <INTERVAL LOG> data, the MJ-4 saves the new data, but it is not available for viewing until you return to the Menu level and subsequently scroll into the <INTERVAL LOG> Menu again. Data for all of the Intervals can be viewed from the <INTERVAL LOG> Menu. Data for the 800 most recent Intervals is stored and can also be retrieved through the front-panel Data Port or the Communication Port.

5.6.1 Viewing Interval Data
To quickly go from viewing one Interval to viewing the previous or next Interval, use the < or > keys. For example, if the screen being viewed is [Interval: 20], press the < key once to view the [Interval: 19] screen. From the [Interval: 19] screen, press the > key once to view the [Interval: 20] screen again.

5.6.2 Clearing Individual Intervals from the Interval Log
Since you can now view all of the <INTERVAL LOG> data from the front panel, or download it via the data port, it is unnecessary to delete individual <INTERVAL LOG> items. The MJ-4 no longer supports deleting individual log records. If the <INTERVAL LOG> memory is full, the oldest record is overwritten when a new interval log occurs.

5.6.3 Resetting Min/Max Values at Each Interval
In <LOG SETUP>, set ResLogMinMax to ON to reset min/max values at the start of each interval. With this feature enabled, MJ-4 logs the min/max values that occur during each interval.
5 Reading and Interpreting MJ-4A & MJ-4B Control Panel Data

5.7 Operation Counter Data - the <COUNTERS> Menu

Operation counters record the stepping operations of the regulator tap changer (see Table 5.7).

<table>
<thead>
<tr>
<th>Table 5.7: Counter Data Items</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Ops</strong></td>
</tr>
<tr>
<td><strong>Reset</strong></td>
</tr>
<tr>
<td><strong>Reset Time</strong></td>
</tr>
<tr>
<td><strong>Elapsed Ops</strong></td>
</tr>
<tr>
<td><strong>24 HR Ops</strong></td>
</tr>
<tr>
<td><strong>30 Day Ops</strong></td>
</tr>
<tr>
<td><strong>MTD Ops</strong></td>
</tr>
<tr>
<td><strong>Last Month</strong></td>
</tr>
<tr>
<td><strong>YTD Ops</strong></td>
</tr>
<tr>
<td><strong>Last Year</strong></td>
</tr>
<tr>
<td><strong>Tap</strong></td>
</tr>
<tr>
<td><strong>Tapmax</strong></td>
</tr>
<tr>
<td><strong>Tapmin</strong></td>
</tr>
</tbody>
</table>

1. To reset, use Cancel/Reset key.
2. To change value, use the Change/Scroll/Save keys.
3. Tap position is determined by the “dead reckoning” method (see below)
4. To view, use Max/Min key.

Dead Reckoning for Siemens Regulators

The control program keeps track of the regulator tap position by means of a “dead reckoning” procedure, analogous to navigational dead reckoning. Dead reckoning must start from a known position. MJ-4 dead-reckoning begins at Neutral (U12 active, if Tap Resync is ON) or when an operator inputs a tap position value. Subsequently, when the microprocessor requests a tap raise/lower (J/K), and the regulator makes the tap change (asserting Operations Count signal U10), the control program updates the tap position value. By this procedure, the MJ-4 maintains continuous tap position information.

If, for some reason, a tap change command is not confirmed within an appropriate period of time, a Message condition is raised and dead reckoning is discontinued until the tap changer once again signals Neutral. Similarly, a Message condition is activated if an Operation count signal is received when no tap change command was issued; or if the U12 PDS lead signals that the tap changer has passed through neutral at a time when the assumed dead-reckoning position is not neutral.

**Note:** For application on other manufacturer’s regulators and LTC apparatus, the MJ-4 implements a similar dead reckoning procedure for tap tracking. The details of the tap tracking approach for these applications are included in the Tap Tracking Application Note.
5.8 Alerts—the <Alert> Menu

Alerts represent exception conditions. A Alert condition may be presently active, or it may have been active at some earlier time. When a Alert occurs, the MJ-4 stores it in the <ALERT> Menu, and illuminates the Alert LED Indicator.

5.8.1 Viewing Alerts

If the Alert indicator is flashing, it denotes that a Alert has occurred. Use either the Alert fast path key or the Menu and Scroll keys to view the <Alert> Menu. Use the down arrow key to scroll through the Alerts.

If the Alert name is flashing, acknowledgment is required.

5.8.2 Acknowledging an Alert

To acknowledge the Alert, press the Cancel/Reset key. If the Alert condition is still active, the Alert name will stop flashing but the Alert indicator will remain on (steady) until the condition clears. If multiple Alerts have occurred, you can step through them, one at a time using the Alert key or the  and  keys. The Alert indicator will continue to flash until all Alerts have been acknowledged.

The conditions listed in Table 5.8 activate ALERT status. The conditions are listed in priority sequence from highest priority at the top to lowest priority at the bottom.

Table 5.8 Alert Data Items

<table>
<thead>
<tr>
<th>Alert Name</th>
<th>Description</th>
<th>Duration</th>
<th>Ack. Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Current</td>
<td>Low Current reading— Magnitude below 1% full scale.</td>
<td>Continuous</td>
<td>Auto-clear</td>
</tr>
<tr>
<td>Auto Inhibit</td>
<td>Automatic mode inhibited from either terminal block or communication link</td>
<td>Continuous</td>
<td>Auto-clear</td>
</tr>
<tr>
<td>Pseudo Manual</td>
<td>A remote tap raise/lower operation has been requested (via Communications Module)</td>
<td>Continuous</td>
<td>Auto-clear</td>
</tr>
<tr>
<td>Tap Track Error</td>
<td>The dead reckoning procedure has detected an inconsistency between its assumed tap changer position and the position signaled by the PDS.</td>
<td>Momentary</td>
<td>ACK required</td>
</tr>
<tr>
<td>Neutral Signal</td>
<td>The MJ-4 senses that the Neutral signal remains active though the tap change input indicates that the tap has moved from Neutral.</td>
<td>Momentary</td>
<td>ACK required</td>
</tr>
<tr>
<td>Tap Position ???</td>
<td>The MJ-4 does not know the present tap position (based on the dead reckoning algorithm).</td>
<td>Continuous</td>
<td>Auto-clear</td>
</tr>
<tr>
<td>Low PT Threshold</td>
<td>The MJ-4 detects a Vld voltage below the PT Threshold setting.</td>
<td>Continuous</td>
<td>Auto-clear</td>
</tr>
<tr>
<td>Over Current</td>
<td>The current exceeds the threshold determined by: I Load Max(%) x I FullLoad</td>
<td>Continuous</td>
<td>ACK required</td>
</tr>
<tr>
<td>NV RAM Reset</td>
<td>The non-volatile (battery-backed) Static RAM appears to have lost some or all of its data.</td>
<td>Momentary</td>
<td>ACK required</td>
</tr>
<tr>
<td>Low Battery</td>
<td>The back-up battery is below the minimum threshold and should be replaced.</td>
<td>Continuous</td>
<td>Auto-clear</td>
</tr>
<tr>
<td>High Voltage</td>
<td>Maximum PT voltage exceeded (145 Volts for U2 and/or P2)</td>
<td>Continuous</td>
<td>ACK required</td>
</tr>
<tr>
<td>Not in auto</td>
<td>Auto/Manual switch is in Manual</td>
<td>Continuous</td>
<td>Auto-clear</td>
</tr>
<tr>
<td>R Limit Reached</td>
<td>Raise Limit Reached. Tap position has reached or exceeded the value specified in “R Limit” item</td>
<td>Continuous</td>
<td>Auto-clear</td>
</tr>
<tr>
<td>L Limit Reached</td>
<td>Lower Limit Reached. Tap position has reached or exceeded the value specified in “L Limit” item</td>
<td>Continuous</td>
<td>Auto-clear</td>
</tr>
<tr>
<td>Self Test Fault</td>
<td>The MJ-4 self test found an error condition</td>
<td>Continuous</td>
<td>ACK required</td>
</tr>
</tbody>
</table>

Notes for Table 5.8:

1. Alert status is in effect if any Message condition is active. If the Alert status is the result of more than one condition, the Message Indicator will flash until all Alerts requiring acknowledgment have been acknowledged. Whenever the Alert Indicator is flashing, it is an indication that the contents of the <ALERT> Menu should be reviewed.
2. Continuous - Condition lasts indefinitely. (May persist after Alert is acknowledged.)
3. Momentary - Condition lasts briefly.
4. ACK required - The MJ-4 keeps the Alert active until you acknowledge it.
5. Auto-clear - The MJ-4 automatically clears the Alert when the condition ceases.
6. The Tap Track Error alert can be disabled, if desired. See Table 4.2 on page 17.
5.9 Harmonics Data— the <HARMONICS> Menu
Harmonics data are calculated for load voltage, source voltage, and load current. The <HARMONICS> Menu contains the data items listed in Table 5.9:

<table>
<thead>
<tr>
<th>DATA ITEM</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vld THD = NNN.N%</td>
<td>Load voltage total harmonic distortion</td>
</tr>
<tr>
<td>Vs THD = NNN.N%</td>
<td>Source voltage total harmonic distortion</td>
</tr>
<tr>
<td>Ild THD = NNN.N%</td>
<td>Load current total harmonic distortion</td>
</tr>
</tbody>
</table>

Use the Menu and Scroll keys to view the <HARMONICS> Menu. Use the ` and ¸ keys to step through the data items.

The first set of data items in the <HARMONICS> Menu are the three Total Harmonics Distortion values for: load voltage (Vld THD: NNN.N%), source voltage (Vs THD: NNN.N%), and load current (Ild THD: NNN.N%). The second set of data items in the <HARMONICS> Menu are Show Harm; and Show As:. These data items allow you to select the format of the data to be viewed:

- **Show Harm:**
  - Odd
  - Ev/Odd

- **Show As:**
  - %TOTAL
  - %FUND
  - RMS Val.

Use the ` and ¸ keys in the <HARMONICS> Menu to view the harmonics data. The harmonics data items appear after configuration items Show Harm and Show As. The harmonics data items always include the rms and % total values for the fundamental (i.e., the 1st harmonic).

Data for even harmonics is only shown if configuration item Show Harm is set for EV/OOD. Data for harmonics above the 1st harmonic are shown as % Total, % Fundamental, or rms depending on which is selected in the Show As configuration item.

5.10 Local Data Port— the <COMMUNICATIONS> Menu

The <COMMUNICATIONS> Menu contains Local Data Port status. See Section 4.7 for configuring <COMMUNICATIONS> Menu items, such as baud rate, parity, address, etc.

The <COMMUNICATIONS> Menu displays the status items listed in Table 5.10:

<table>
<thead>
<tr>
<th>DATA ITEM</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>GoodRX</td>
<td>A “good” message (no errors) has been received</td>
</tr>
<tr>
<td>Inact;</td>
<td>Data Port is inactive</td>
</tr>
<tr>
<td>LocCtl</td>
<td>MJ-4 is in local control (commlink control is inhibited)</td>
</tr>
<tr>
<td>FE RX</td>
<td>Framing Error in received message</td>
</tr>
<tr>
<td>OE RX</td>
<td>Overrun Error in received message</td>
</tr>
<tr>
<td>NE RX</td>
<td>Noise Error in received message</td>
</tr>
<tr>
<td>PE RX</td>
<td>Parity Error in received message</td>
</tr>
<tr>
<td>CSE RX</td>
<td>Checksum Error in received message</td>
</tr>
<tr>
<td>PTE RQ</td>
<td>Point Type Error (invalid point type requested)</td>
</tr>
<tr>
<td>CME RX</td>
<td>Command Error (invalid command) received</td>
</tr>
<tr>
<td>PNE RX</td>
<td>Point Number Error (invalid point number) received</td>
</tr>
</tbody>
</table>

5.11 VRC Status - the <REGULATOR> Menu

The VRC Status items indicate the present level of Voltage Reduction Control (VRC). The VRC Status item is indicated as:

\[ \text{VRC Stat} = XX.X\% M Y \]

where: XX.X% is the amount of voltage reduction (0.0% to 10.0%)

- M is the VRC Mode
  - L = Local
  - R = Remote
  - A = Auto (w/Remote Override)

- Y is the presently active VRC step
  - Local - not applicable
  - Remote - 1, 2, or 3
  - Auto - 1 or 2

This data item can be accessed using the VRC Select fast-path key.
6 MJ-4A & MJ-4B Control Panel Automatic Mode

This Chapter covers operating principles of the MJ-4 control program and describes the various functions performed by the microprocessor. It contains the information you may need when deciding between the various options described in Chapter 4 (Setting Up the MJ-4 Control Panel) and Chapter 5 (Reading and Interpreting MJ-4 Control Panel Data).

6.1 MJ-4A & MJ-4B Control Modes

6.1.1 Summary of the MJ-4A Control Modes

The regulator control function has four operating modes: local manual control, local automatic control, remote control, and Off. Manual control can only be performed locally. Select the operating mode with the Remote-Auto/Off/Manual switch as shown in Figure 6.1.

![Figure 6.1 Auto/Manual Switch (Shown in Off position)](image)

**Manual mode**

Place the Auto/Off/Manual Switch in the down position to activate the Manual mode. In Manual mode, you can use the Tap Raise/Lower switch (on the MJ-4A front panel) to control the tap position directly. Status information is available via the remote communications link, but the remote operator cannot change settings or otherwise operate the MJ-4A Control Panel.

**Off (By-Pass Position)**

No operation of the tap changer can occur: remotely, locally, or automatically.

**Auto-Remote mode**

With the Auto/Manual switch in the up position, if the Remote/Local key is pressed so that the Remote Disabled LED is off, the control Panel will be in the Auto-Remote mode. In this mode, the MJ-4A executes its automatic tap control algorithm. Status information is available via the remote communications link, but the remote operator cannot change settings or otherwise operate the MJ-4A Control Panel.

![Figure 6.1b Remote/Local and Auto/Manual Switches](image)

**Manual mode (By-Pass Position)**

Push the Auto/Manual Switch so that the Auto Disabled LED is illuminated to activate the Manual mode. In Manual mode, you can use the Tap Raise and Lower keys (on the MJ-4B front panel) to control the tap position directly.

**Automatic mode**

Push the Auto/Manual Switch so that the Auto Disabled LED is not illuminated to activate the Automatic mode. In Automatic mode, the MJ-4B executes its normal tap control algorithm.

**Remote Control Enabled**

Push the Remote / Local push button so that the Remote Disabled LED is not illuminated to enable remote control (Auto-Remote mode). In this mode, the MJ-4B executes its automatic tap control algorithms, unless overridden remotely. A remote operator can request a tap raise or lower via the communications link, change settings and remotely operate the control program. For direct control via terminal strip connections see Figure 2.4.

When the remote operator initiates the tap raise/lower, the MJ-4A enables its “Pseudo-Manual” operating mode. The Pseudo-Manual alert condition is activated, and local automatic operations are disabled until the remote-commanded tap raise/lower is completed.

The MJ-4A Control Panel remains in the Pseudo-Manual mode for a predefined time period after receipt of the last remote tap raise/lower command. When the time period has elapsed, if the MJ-4A Control Panel has Remote Auto Inhibit disabled, it resumes its normal automatic control operations. If Remote Auto Inhibit is enabled, it maintains its tap position until it receives another raise/lower command or until Remote Auto Inhibit is disabled.

**Auto-Local mode**

With the Auto/Manual switch in the up position, if the Remote/Local switch in the up position, if the Remote Disabled LED is on, the control Panel will be in the Auto-Local mode. In this mode, the MJ-4A executes its normal tap control algorithm. Status information is available via the remote communications link, but the remote operator cannot change settings or otherwise operate the MJ-4A Control Panel.
The MJ-4B Control Panel remains in the Pseudo-Manual mode for a predefined time period after receipt of the last remote tap raise/lower command. When the time period has elapsed, if the MJ-4B Control Panel is in Automatic mode, it resumes its normal automatic control operations. If the MJ-4B Control Panel is in Manual mode, it maintains its tap position until it receives another raise/lower command or until it is placed back into Automatic mode.

In this mode, status information is available via the remote communications link. In addition, the remote operator can change settings and remotely operate the control program.

Remote Control Disabled
With the panel remaining in Auto, Push the Remote/Local push button so that the Remote Disabled LED is illuminated to disable Remote control. Status information is available via the remote communications link, but the remote operator cannot change settings or otherwise operate the MJ-4B Control Panel.

The panel may also be allowed to work in Auto-Local mode wherein it will perform automatic control operations.

Table 6.1 summarizes the four operating modes.

### Table 6.1 Summary of Control Mode Operation MJ-4A and MJ-4B

<table>
<thead>
<tr>
<th>Switch Positions</th>
<th>Manual</th>
<th>Automatic</th>
</tr>
</thead>
</table>
| Remote Control Enabled | 1. Automatic Operation Disabled  
2. Comm link tap control override  
3. Comm Link Raise/Lowers Enabled  
5. Tap Raise and Lower Switches Enabled | 1. Automatic Operation Enabled  
2. Comm link tap control override  
3. Comm Link Raise/Lowers Enabled  
5. Tap Raise and Lower Switches Disabled |
| Remote Control Disabled | 1. Automatic Operation Disabled  
2. No comm link tap control override  
3. Comm Link Raise/Lowers Disabled  
4. Comm Link Auto/Manual control Disabled  
5. Tap Raise and Lower Switches Enabled | 1. Automatic Operation Enabled  
2. No comm link tap control override  
3. Comm Link Raise/Lowers Disabled  
4. Comm Link Auto/Manual control Disabled  
5. Tap Raise and Lower Switches Disabled |

### 6.2 Overview of Automatic Control Algorithm

The automatic control algorithm maintains the output voltage within its prescribed limits while following a control hierarchy.

Normal algorithm operation is as follows. When voltage falls outside the allowed range (defined by voltage level set point ± ½ bandwidth), the delay timer is started. If voltage is out of range at the end of the delay period, the tap change motor is energized. When the voltage is back within range, the tap change motor is deactivated. (Hysteresis is included to prevent oscillations.)

In automatic mode, the control program processor controls the tap changer motor. The control algorithm takes the following into account:

1. Calculated or monitored regulator output voltage
2. Voltage-level set point
3. Bandwidth set point
4. Resistance line drop compensation set point
5. Reactance line drop compensation set point
6. Voltage limit control set points
7. Voltage reduction control setpoints
8. Monitored load current
9. Load power factor
10. Power flow operating mode

Because coinciding events might introduce conflicts, an operational hierarchy must be established. This hierarchy is maintained when the unit is under automatic control. Manual mode always takes precedence over automatic control.

Conflicts are resolved according to the following priority scheme (from highest to lowest):

1. Automatic tap change inhibit (implemented with terminal strip jumpers or Comm Link command).
2. Current inhibit (determined by 1 % Threshold of configuration setting; as % of full scale CT rating).
3. Current Bias setting and Bias Percent (see Section 6.5.3)
4. Voltage Limit Control (defined in regulator settings).
5. Voltage Reduction Control.
6. “Normal” regulator control operation.
6.3 Voltage Sensing and Correction

Voltage Sensing
The control program monitors the regulator output voltage signal from one of the following sources:

- a voltage transformer, “VT” [also known as a potential transformer or “PT”], integral to the regulator, which is turns-ratio corrected to deliver 120 VAC at the nominal system voltage.
- the utility winding of the regulator, which generally requires correction to deliver 120 VAC at the nominal system voltage.

The control program senses regulator output (i.e., “load”) voltage depending on power flow operating mode (see Table 6.2):

Since the control program routinely senses both the voltage transformer and the utility winding, it is a straightforward process for the control program to select which source is “active” (depending on power flow mode and regulator design).

If a voltage transformer is not installed on the regulator, then the control will calculate the voltage on that side of the regulator based on the utility winding voltage and tap position.

Software Voltage Measurement Correction
The monitored output voltage is scaled appropriately to the nominal basis voltage in two steps. The first voltage scaling is performed through a step-down transformer. The second scaling takes place in the software algorithm after the voltage is converted to a numeric representation. Software scaling corrects the nominal input voltage level to the numeric representation of the basis voltage. The basis voltage value is user configurable. The choices are 115, 120 and 125 V. The default basis voltage is 120 V.

6.4 Voltage Limit Control
The voltage limit control (VLC) function monitors regulator output voltage and compares it to maximum and minimum voltage limit set points. If the VLC function is active, the control program inhibits tap changes that would cause the voltage to go above the VLC upper or below the VLC lower voltage. If VLC is activated while the voltage is outside of the VLC limit range, the tap position is incremented/decremented until the voltage is within the defined VLC range.

Limiting and/or runback may occur if one of the following happens:
1. The source voltage changes dramatically,
2. The load on the regulator changes significantly, or
3. The VLC function is enabled when the limit conditions are exceeded.

Note: The VLC function uses the Vld (i.e., the load voltage at the regulator) to determine whether or not to limit or runback. The VLC algorithm senses one regulator bushing for forward power flow, and the other regulator bushing for reverse power flow. (See Forward/Reverse Operation modes, below).

The maximum voltage limit set point is adjustable from 106.0 volts to 134.0 volts in 0.1 volt steps. The minimum voltage limit set point is adjustable from 106.0 volts to 134.0 volts in 0.1 volt steps. The control program will not allow these limits to be set so that they overlap one another.

If regulator output voltage falls outside limits, VLC acts to return regulator voltage within limits. Return begins immediately, (i.e., without regard to the time delay setting), while avoiding a hunting condition, (i.e., VLC will not force a tap change which would activate the basic control algorithm and force the regulator outside limits once again).

VLC activates when load voltage is within one volt of the upper/lower limit to prevent the voltage from going outside prescribed limits.

6.5 Reverse Power Flow
Systems where power flow reversals occur have unique regulation control requirements. For systems of this type, the MJ-4 senses the reversal and adjusts its operation accordingly. When power flow direction changes, the MJ-4A & MJ-4B control algorithm takes the following factors into account:

1. Power Flow direction,
2. Forward or Reverse operating mode, and
3. Power Flow Mode as selected from the <CONFIGURE> Menu. These factors are discussed in greater detail below:

6.5.1 Power Flow Direction
The microprocessor determines power flow direction by continually monitoring the real power (kW) reading and the real component of current. The real component of current represents the component of the current which is in phase with the load voltage signal.

The MJ-4 Control Panel indicates forward power flow when the real power (kW) is positive and the real component of current is greater than 1% of the full scale current.
Reverse power flow is indicated when the real power is negative and the real component of current is greater than 1% of the full scale current. To avoid excessive switching between Forward and Reverse Operation (defined below), the microprocessor delays five seconds after the occurrence of a current flow reversal before switching from forward to reverse, and vice-versa.

As an example, assume current is flowing in the forward direction. When load current magnitude drops through zero and increases to a magnitude that exceeds 1% rated current in the reverse direction, the microprocessor delays five seconds and then considers reverse power flow to be in effect. Reverse power flow remains in effect until current direction becomes forward once again and its magnitude exceeds 1% of rated current in the positive direction for five seconds. At that time, the microprocessor considers forward power flow conditions to have resumed.

Power flow direction is indicated on many of the metering screens. “F” indicates forward power flow; “R” indicates reverse power flow. “F” is shown when: \( kW > 0 \) and \( |I_{\text{real}}| > 1\% \) (of full scale) for 5 seconds minimum. “R” is shown when: \( kW < 0 \) and \( |I_{\text{real}}| > 1\% \) (of full scale) for 5 seconds minimum. If the real current magnitude is below the 1% threshold, the last known power flow direction remains in effect. If the real current magnitude is below the 1% threshold after power up or unit reset, the MJ-4 defaults to forward power flow operation.

It is possible for Reverse Power Flow conditions to occur in regulators with no source-side voltage input (e.g., no “Source-Side PT” for Siemens Inverted Regulators). In this case, the MJ-4 uses the calculated source-side voltage for performing reverse power flow regulation. See sections 5.1 and 5.2 for details on source-side voltage calculation.

When determining power flow direction, the system takes into account the current-to-voltage phase relationship associated with the system as specified in the <CONFIGURE> Menu (System, Utility Polarity, and I [current] Shift parameters).

### 6.5.2 Forward/Reverse Operation

The MJ-4 Control Panel accommodates power flow reversals by alternating between “Forward” and “Reverse” modes. Because the microprocessor monitors (or derives) the voltage on both sides of the regulator, it can reverse modes by simply reversing its definition of “source” and “load.”

- In Forward Operation mode, the microprocessor senses the “L” Bushing (or derives the “L” Bushing voltage from the “S” Bushing voltage and the knowledge of the tap position) to determine load voltage and controls the tap changer on the basis of the Forward setpoints (Voltage, Bandwidth, Time Delay, Line Drop Compensation). During Forward Operations, “forward” Meter data is displayed.

- In Reverse Operation mode, the microprocessor senses the “S” Bushing (or derives the “S” Bushing voltage from the “L” Bushing voltage and the knowledge of the tap position) to determine load voltage and controls the tap changer on the basis of the Reverse setpoints (Voltage, Bandwidth, Time Delay, Line Drop Compensation).

During Reverse Operations, “reverse” Meter data is displayed. The following parameters determine whether the tap change motor is energized to raise the tap position or to lower it:

1. Power flow direction,
2. Forward/reverse operation,
3. Out-of-band status,
4. Power flow mode (see below for details).

Tables 6.3 and 6.4 on the next page summarize the tap change direction for each Power Flow mode.

### 6.5.3 Current Bias and Bias Percent

This option is only in effect when the power flow mode is Bi-Directional. For this special operation, the Bias percent must be greater than the I Threshold%. Typically I Threshold % should be set to 0%.

The operation of this feature is described below, categorized into direction and magnitude of current flow.

Current is greater than the Bias percent (no change in prior functionality):

- Forward Power Flow: tap changes will occur based on the Load bushing voltage.
- Reverse Power Flow: tap changes will occur based on the Source bushing voltage.

Current is less than the Bias Percent (new functionality):

- None: no tap changes will occur.
- Fwd: tap changes will occur based on Load bushing voltage.
- Rev: tap changes will occur based on Source bushing voltage.
- NeutT: tap changer will run to Neutral Tap.
### 6.5.4 Power Flow Modes

The MJ-4 supports six Power Flow Modes: Forward Locked, Reverse Locked, Bidirectional, Neutral Reverse, Idle Reverse, and Co-generation. Your selection of one of these determines which algorithm the control program uses under reverse power flow conditions.

#### Table 6.3 Tap Changer Direction

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bi-Dir</td>
<td>F</td>
<td>●</td>
<td>●</td>
<td>Forward</td>
</tr>
<tr>
<td></td>
<td>R</td>
<td>●</td>
<td>●</td>
<td>Reverse</td>
</tr>
<tr>
<td>Neut R</td>
<td>F</td>
<td>●</td>
<td>●</td>
<td>Return to Neutral*</td>
</tr>
<tr>
<td>Idle R</td>
<td>F</td>
<td>●</td>
<td>●</td>
<td>Forward</td>
</tr>
<tr>
<td>Co-Gen</td>
<td>F</td>
<td>●</td>
<td>●</td>
<td>None (tap idles)</td>
</tr>
<tr>
<td></td>
<td>R (See Table 6.4)</td>
<td>●</td>
<td>●</td>
<td>Forward</td>
</tr>
<tr>
<td>F Lock</td>
<td>F</td>
<td>●</td>
<td>●</td>
<td>Forward</td>
</tr>
<tr>
<td></td>
<td>R</td>
<td>●</td>
<td>●</td>
<td>Forward</td>
</tr>
<tr>
<td>R Lock</td>
<td>R</td>
<td>●</td>
<td>●</td>
<td>Reverse</td>
</tr>
</tbody>
</table>

* If tap position is not known, Neut R operates same as Idle R.

#### Table 6.4 Tap Change Control Operation

<table>
<thead>
<tr>
<th></th>
<th>Forward</th>
<th>Reverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Vcomp” location</td>
<td>“L” Bushing</td>
<td>“S” Bushing</td>
</tr>
<tr>
<td>Out of Band High</td>
<td>Lower</td>
<td>Raise</td>
</tr>
<tr>
<td>Out of Band Low</td>
<td>Raise</td>
<td>Lower</td>
</tr>
<tr>
<td>Voltage Setpoint</td>
<td>Fwd Volts</td>
<td>Rev Volts</td>
</tr>
<tr>
<td>Bandwidth Setpoint</td>
<td>Fwd BW</td>
<td>Rev BW</td>
</tr>
<tr>
<td>Time Delay Setpoint</td>
<td>Fwd Delay</td>
<td>Rev Delay</td>
</tr>
<tr>
<td>Line Drop Compensation (R = Resistance, X = Reactance)</td>
<td>F*</td>
<td>R*</td>
</tr>
<tr>
<td></td>
<td>Fwd Comp (R)</td>
<td>Rev Comp (R)</td>
</tr>
<tr>
<td></td>
<td>Fwd Comp(X)</td>
<td>Rev Comp (X)</td>
</tr>
</tbody>
</table>

*For Co-gen mode when in Reverse Power Flow mode, use Forward Voltage, BW, and Time Delay setpoints, but use Reverse Line Drop Compensation values.
F LOCK (Forward Locked Mode)

This mode of operation is intended for use on systems where reverse power flow is not anticipated. Tap changes are inhibited under reverse power flow conditions.

In this mode, the controller always operates in forward mode. The tap changer operates unless reverse current magnitude exceeds the I Threshold % setpoint, at which time further tap changes are inhibited. The tap changer resumes operation when the reverse current drops below the I Threshold % setpoint.

In this mode, if power flow does reverse, Demand values are not computed.

View Pwr Flow: F LOCK on the <CONFIGURE> Menu.

R LOCK (Reverse Locked Mode)

This mode of operation is intended for use on systems where forward power flow is not anticipated. Tap changes are inhibited under forward power flow conditions.

In this mode, the controller always operates in reverse mode. The tap changer operates unless forward current magnitude exceeds the I Threshold % setpoint, at which time further tap changes are inhibited. The tap changer resumes operation when forward current magnitude drops below the I Threshold % setpoint.

In this mode, when power flow is Forward, Demand values are not calculated.

View Pwr Flow: R LOCK on the <CONFIGURE> Menu.

---

**Figure 6.2**  Forward Locked Mode

**Figure 6.3**  Reverse Locked Mode
**BI-DIR (Bi-directional mode)**

This mode of operation is intended for use on systems where reverse power flow is anticipated and voltage regulation is desired under either forward or reverse power flow conditions.

In this mode, the tap changer operates when current magnitude exceeds the $I$ Threshold % setpoint. The tap changer operates in forward mode when forward current magnitude exceeds the $I$ Threshold % setpoint, and in reverse mode when reverse current magnitude exceeds the $I$ Threshold % setpoint.

$I$ Threshold %, must be set to a minimum of 1%(when $I$ Dir Bias is not in use; i.e. $I$ Dir Bias = None). See Section 6.5.1 for more details.

When $I$ Dir Bias is in use, $I$ Threshold should be set to 0%.

View Pwr Flow: Bi-dir on the <CONFIGURE> Menu.

**IDLE R (Idle Reverse)**

This mode of operation is intended for use on systems where reverse power flow is an abnormal situation. Under reverse power flow conditions, the regulator idles at the last tap position.

In this mode, the controller always operates in forward mode. When forward current magnitude drops below the $I$ Threshold % setpoint, tap changes are inhibited and the regulator idles at the last tap position. Tap changer operation resumes when forward current magnitude exceeds the $I$ Threshold % setpoint.

Select Pwr Flow: IDLE R on the <CONFIGURE> Menu.

**Figure 6.4  Bi-directional Mode.**

**Figure 6.5  Idle Reverse Mode**
NEUT R (Neutral Reverse)
This mode of operation is intended for use on systems where reverse power flow is an abnormal situation.

In this mode, the controller always operates in the forward mode. When current magnitude drops below the forward I Threshold % setpoint, tap changes are inhibited. When the reverse current magnitude exceeds I Threshold % setpoint for ten seconds, the tap changer resumes operation and returns the tap changer to the neutral position without stopping. The tap changer then remains at the neutral position until forward current magnitude once again exceeds the I Threshold % setpoint.

If, while the tap changer is returning to neutral, the forward current magnitude increases above the I Threshold % setpoint, normal forward tap changer operation resumes.

Neutral Reverse mode is dependent upon the MJ-4 tap tracking algorithm. If the tap position is unknown to the microprocessor, the tap changer idles at the last held position.

View Pwr Flow: NEUT R on the <CONFIGURE> Menu.

CO-GEN (Co-generation)
This mode of operation is for use on systems where power flows from Utility to consumer at certain times and from consumer to Utility at other times. In this mode, the tap changer operates whenever current magnitude (either forward or reverse) exceeds the I Threshold % setpoint.

In this mode, the controller always operates in Forward mode. Forward Line Drop Compensation values are used when forward current magnitude exceeds the I Threshold % setpoint. Reverse Line Drop Compensation values are used when reverse current magnitude exceeds the I Threshold % setpoint. Tap changes are inhibited when current magnitude is between the I Threshold % setpoints.

View Pwr Flow: CO-GEN on the <CONFIGURE> Menu.

Figure 6.6 Neutral Reverse Mode

Figure 6.7 Co-generation Mode
7 Software for Communicating with the MJ-4A & MJ-4B Control Panel

7.1 Communications Software

Siemens has developed a Windows-based communications software application called MJXplorer. All configuration and data can be downloaded to a PC via the RS-232 Data Port located on the front of the MJ-4 Control Panel or through an optional Communication Module. Downloaded data can then be saved and imported to other commonly-used software, including spreadsheet applications.

In addition to downloading, MJXplorer software can modify configuration information and upload the information to the MJ-4 Control Panel. The MJXplorer software and operating instructions are available from Siemens. Contact your Siemens Power Transmission & Distribution representative for details.

Another program called DNP Configure can be used to define a custom set of DNP points for a control panel that has a communications module. This program is also available from Siemens. Contact your Siemens representative for details.

All software is available on the Siemens website listed in section 1.8.

7.2 Uploading New MJ-4A & MJ-4B Software

Siemens offers a software application, called MJXtra, for uploading new versions of software to the Control Panel.

Through a simple set of windows and pull-down menus, you confirm the communications settings and transmit the new software via the front-panel Data Port.
8 MJ-4A & MJ-4B Control Panel Basic Troubleshooting

8.1 Introduction
MJ-4 Control Panel service is primarily accomplished at the factory. However, certain basic procedures can be accomplished in the field. This chapter outlines a set of procedures whose major objectives are to:

1. Ensure that the fault is inside the MJ-4 (and not in external connections or connected equipment).
2. Ensure that the fault is not due to improper jumper arrangements or some other user-correctable condition.
3. Determine whether the fault can be locally repaired (e.g., by replacing a fuse).

Troubleshooting approaches depend upon the problem. Among other indicators, you should consider:

- Visual review of the unit.
- Alerts (see Table 8.1 below).

8.2 Visual Inspection
Check:

- Power and Sensing fuses
- External Source fuse (if External Source Terminals are used to power the unit)
- Fuse connectors not mated properly
- Jumpers not in their correct positions
- Terminal Strip connectors not mated properly
- Terminal Strip connector jumpers missing or screws not tightened properly

CAUTION
120 volts on terminal block, leads, and inside control panel housing. May result in minor or moderate injury including equipment damage. Disconnect all power sources before making connections to the terminal block or opening the control panel housing.

Table 8.1 Alert Messages

<table>
<thead>
<tr>
<th>Alert Name</th>
<th>What to Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Current</td>
<td>Check E1 and C2 wiring. Check calibration on the Current inputs.</td>
</tr>
<tr>
<td>Auto Inhibit</td>
<td>This alert does not indicate a fault condition. It indicates that Automatic Inhibit has been activated (either via the communications link or via the Automatic Inhibit Input terminals)</td>
</tr>
<tr>
<td>Tap Track Error</td>
<td>May indicate a temporary fault condition (failure to detect a transition on one of several input lines.) Check PDS signals J, K, U10 and U12.</td>
</tr>
<tr>
<td>Neutral Sig. Err</td>
<td>May indicate a temporary fault condition (failure to detect a transition on one of several input lines.) This alert could also indicate a problem with the Neutralite™ input signal. Check the Neutral (PDS-U12) and Operations Counter (PDS-U10) inputs.</td>
</tr>
<tr>
<td>Tap Pos ???</td>
<td>May indicate a temporary fault condition (failure to detect a transition within the allowed time period on one of several input lines.) Check the Neutral (PDS-U12) and Operations Counter (PDS-U10) inputs.</td>
</tr>
<tr>
<td>Low PT Thresh</td>
<td>This alert does not necessarily indicate an MJ-4 fault condition. Check to see whether this alert condition goes away when both U2 and P2 are above the PT Threshold.</td>
</tr>
<tr>
<td>Overcurrent</td>
<td>This alert does not (normally) indicate an MJ-4 fault condition. Ensure that this Alert goes away when an in-range current (0-200 mA) is applied at C2/E1.</td>
</tr>
<tr>
<td>NV RAM Reset</td>
<td>May indicate a temporary fault condition. If condition appears repeatedly, replace the unit.</td>
</tr>
<tr>
<td>Low Battery</td>
<td>Indicates that it is time to replace the Lithium Battery. If condition persists after a good battery is installed, check that the battery was installed properly. If fault persists, consult the factory.</td>
</tr>
<tr>
<td>High Voltage</td>
<td>May indicate a temporary system fault condition. If condition persists when in-range voltages (90-140 VAC) are applied to both PDS-U2 and PDS-P2 inputs, perform calibration.</td>
</tr>
<tr>
<td>Not in Auto</td>
<td>Indicates that Remote-Auto/Off/Manual switch is in Manual.</td>
</tr>
<tr>
<td>R Limit Reached, L Limit Reached</td>
<td>These alerts indicate that the tap position has reached or exceeded the pre-set threshold. These alerts may occur during normal operation due to system conditions. If these alerts occur when system conditions do not warrant it, their occurrence could indicate an MJ-4 failure. Verify the MJ-4 can automatically raise and lower tap position.</td>
</tr>
<tr>
<td>Self Test Fault</td>
<td>This alert indicates a failure of one or more MJ-4 self tests. Consult your Siemens representative for instructions.</td>
</tr>
</tbody>
</table>
8.3 Troubleshooting Based on Alert Messages

Alert messages can be used to help diagnose both system problems (ones which include both regulator and controller), and internal MJ-4 problems. Table 8.1 provides suggestions for troubleshooting an MJ-4 Control Panel using information from the <ALERTS> menu.

Note that faults identified as “temporary” may be due to transient conditions within the system and may not be internal MJ-4 faults.

8.4 Voltage and Current Calibration

The MJ-4 Metering functions are calibrated at the factory. Periodically check calibration, and, if needed, recalibrate the MJ-4:

8.4.1 Checking the U2 Voltage Calibration

Note: You can check the U2 voltage calibration while the panel is installed on a regulator.

To check U2 calibration, apply an AC voltage (in the range of 115 to 135 VAC) from U2 to E. Monitor the Voltage Calibration/Test Terminals with a true RMS voltmeter. View the “U2 Cal” screen on the MJ-4 (i.e., goto <DIAGNOSTICS> menu and press down arrow once to show “U2 Cal”). Verify that the “U2 Cal” reading matches the applied voltage (within ± 0.5 VAC) if calibration is off, recalibrate (see below.)

8.4.2 Checking the P2 Voltage Calibration

Note: If the regulator provides the “source” voltage signal, you can check the P2 voltage calibration while the panel is installed on the regulator. (If the regulator lacks a “source” voltage signal, then there is no need to calibrate the P2 input.)

To check P2 calibration, apply an AC voltage (in the range of 115 to 135 VAC) from P2 to E. Monitor the Voltage Calibration/Test Terminals with a true RMS voltmeter. View the “P2 Cal” screen on the MJ-4 (i.e., goto <DIAGNOSTICS> menu and press down arrow twice to show “P2 Cal”). Verify that the “P2 Cal” reading matches the applied voltage (within ± 0.5 VAC) if calibration is off, recalibrate (see below.)

8.4.3 Checking the Load Current Calibration

Note: To check the current calibration, remove the panel from the tap changer apparatus, connect an external ammeter, and apply an external AC current source.

To check C/C2 Low calibration, apply a nominal 5 mA AC current at C2/E1 and verify that “C/C2low” reads within ±0.2 mA of the applied value (as displayed on external Ammeter connected at C/C2.)

To check C/C2 Medium calibration, apply a nominal 80 mA AC current at C2/E1 and verify that “C/C2med” reads within ± 0.5 mA of the applied value (as displayed on external Ammeter connected at C/C2.)

To check C/C2 High calibration, apply a nominal 140 mA AC current at C2/E1 and verify that “C/C2high” reads within ± 0.7 mA of the applied value (as displayed on external Ammeter connected at C/C2.)

8.4.4 Calibrating the P2 Voltage

Connect an external true rms voltmeter at the front panel “Voltage Calibration/Test Terminal.” Apply the nominal calibration voltage (per Table 8.2.) Display the “P2 Cal” screen. To calibrate, press the Change key, then the ▶ or ◄ key to make the value shown on the MJ-4 display agree with the external voltmeter value. When the change is complete, press the Save key.

Note: If password protection is in effect, you must enter the password to enable calibration. The default password for the <DIAGNOSTICS> Menu is “3333.”

8.4.5 Calibrating the P2 Voltage

Connect an external true rms voltmeter at the front panel “Voltage Calibration/Test Terminal.” Apply the nominal calibration voltage (per Table 8.2.) Display the “P2 Cal” screen. To calibrate, press the Change key, then the ▶ or ◄ key to make the value shown on the MJ-4 display agree with the external voltmeter value. When the change is complete, press the Save key.

Note: If password protection is in effect, you must enter the password to enable calibration. The default password for the <DIAGNOSTICS> Menu is “3333.”

8.4.6 Calibrating the Load Current

Note: To calibrate the current, disconnect the panel from the tap changer apparatus. Remove on-board jumper J1 (see Figure J.1) and Terminal Strip jumper at P3B-11 & 12. Connect an external ammeter, and apply an external AC current source, per Table 8.2. After calibration, replace J1 and Terminal Strip jumper at P3B-11 & 12.

The Load Current (I) has three calibration set-points: C/C2 Low, C/C2 Medium, and C/C2 High. Calibrate all three setpoints with an external true rms ammeter connected at the rear panel (terminal strip contacts P3B-11 & 12.) Connect a (nominal) 0-200 mA AC current source at C/C2 (terminal strip contacts P2A-5 & 7.)

Apply the C/C2 Low calibration current (per Table 8.2). Use the Menu and Scroll keys to view the “C/C2low” screen. To calibrate, press the Change key, then the ▶ or ◄ key to make the value shown at the MJ-4 display agree with the external ammeter value. When the change is complete, press the Save key.
Note: If password protection is in effect, you must enter the password to enable calibration. The default password for the <DIAGNOSTICS> Menu is “3333.”

Repeat the above procedure for C/C2 Medium and C/C2 High. After calibration, replace J1 and Terminal Strip jumper at P3B-11 & 12.

### Table 8.2 Voltage and Current Calibration

<table>
<thead>
<tr>
<th>Signal to Calibrate</th>
<th>Test Signal Application Point</th>
<th>Test Signal Measurement Point</th>
<th>Nominal Calibration Signal Magnitude</th>
<th>Tolerance</th>
<th>MJ-4 Data Item &lt;DIAGNOSTICS&gt; Menu</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>U2</td>
<td>U2 to E (P2A-8 &amp; 6)</td>
<td>Voltage Calibration Terminals</td>
<td>120 VAC (RMS)</td>
<td>±0.5 VAC</td>
<td>U2 Cal</td>
<td>U2/P2 key = U2</td>
</tr>
<tr>
<td>P2</td>
<td>P2 to E (P2A-4 &amp; 6)</td>
<td>Voltage Calibration Terminals</td>
<td>120 VAC (RMS)</td>
<td>±0.5 VAC</td>
<td>P2 Cal</td>
<td>U2/P2 key = P2</td>
</tr>
<tr>
<td>C/C2 Low</td>
<td>C2 to E1 (P2A-5 &amp; 7)</td>
<td>C/C2</td>
<td>5 mA (RMS)</td>
<td>±0.2 mA</td>
<td>C/C2low</td>
<td>Note 1</td>
</tr>
<tr>
<td>C/C2 Medium</td>
<td>C2 to E1 (P2A-5 &amp; 7)</td>
<td>C/C2</td>
<td>80 mA (RMS)</td>
<td>±0.5 mA</td>
<td>C/C2med</td>
<td>Note 1</td>
</tr>
<tr>
<td>C/C2 High</td>
<td>C2 to E1 (P2A-5 &amp; 7)</td>
<td>C/C2</td>
<td>140 mA (RMS)</td>
<td>±0.7 mA</td>
<td>C/C2high</td>
<td>Note 1</td>
</tr>
</tbody>
</table>

Note 1: Prior to calibration, disconnect panel from regulator, and remove on-board jumper J1 (see Figure J.1) and Terminal Strip jumper at P3B-11 & 12. After calibration, replace J1 and Terminal Strip Jumper at P3B-11 & 12.

### 8.5 MJ-4A & MJ-4B Self Testing

After reset, the MJ-4 runs through an internal diagnostics routine. The start-up diagnostics routine includes a front panel indicator test—the LED indicators simultaneously flash three times so that an operator can verify them. During the LED test, the MJ-4 displays “Testing...” on the front panel screen.

The start-up diagnostics routine consists of several checks and internal tests, including a ROM (program memory) checksum calculation. The MJ-4 displays the results of the checksum test (PASS or FAIL) in the “Checksum=” item under the <DIAGNOSTICS> Menu.

A checksum failure indicates a problem with the unit. A checksum or other self-test failure will activate the “Self Test Fault” message. If this message occurs, contact your Siemens Power Transmission & Distribution representative for instructions.

### 8.6 Communications Module Troubleshooting

In the <DIAGNOSTICS> Menu, the MJ-4 Control Panel provides data items for testing the Communications Module and verifying its operation. Please refer to the MJ-4 Communications Module Installation Manual for verifying the Communications Module operations using the <DIAGNOSTICS> Menu data items.

### 8.7 Tap Tracking

When viewing this alert, press the left arrow key repeatedly. On the right side of the screen two character error codes will appear. There could be between one and four of these codes. Note that the codes could have been generated all at once or at any time since the alert was last cleared. The codes are:

- UX: occurs if algorithm can’t tell direction tap change occurred or if operation count increases without calling for a raise or lower
- RS: occurs when neutral signal is on and tap pos is not neutral; panel resets tap position to neutral if Tap Resync is turned on
- TF: occurs if Tap Resync is on and bad neutral signal and tap position combo persists for more than 10 seconds
- OD: occurs if “tap_chg_ctr” goes down to zero before a tap change occurs. tap_chg_ctr = R/LOnTime + TapChgT/O

Tap Changer control may be customized using the following settings from the <DIAGNOSTICS> menu.

- R/LOnTime: maximum time to keep the tap changer motor running before pausing for R/LOffTime.
- R/LOffTime: pause between tap changes for this amount of time.
- Fixed R/L On time: When in Auto mode, if this setting is “Y,” motor stays on for exactly R/L On time seconds.
- TapChgT/O: if the control runs the tap changer motor for R/LOnTime and no operations count occurs, then after this many more seconds a Tap Track Err OD alert is generated.
- TapIn: defines the operations count signal input line. TapInType: defines the operations counter type.
- TapInPulse: defines the minimum amount of time that an operations count signal must be present in order for the operations counter to increment (applies to Pulse type operations counters only).
- NeutralIn: defines the neutral signal input line.
- NeutralCount: number of Neutral positions (for LTC’s only).
Appendix A: Specifications

A Specifications

Operational Requirements

**Temperature**
- Operating: -40°C to +85°C
- Storage: -40°C to +85°C

**Humidity**
- Operating: Relative humidity of 5% to 95% non-condensing
- Storage: Relative humidity of 5% to 95% non-condensing (U2 and P2 range)

**Frequency**
- 80 to 145 volts RMS
- 45 to 65 Hz

**Accuracy**
- Metering accuracy*: ±0.5% over the -40°C to +85°C operating range.

**Electrical transient immunity**

The MJ-4A & MJ-4B Current Transformer (CT) withstands a sudden open circuit without damage to the control circuit. However, an open CT circuit can result in dangerously high voltage, and should be avoided.

The MJ-4A & MJ-4B Control Panel is impervious to electrical transients as defined by the following:

- **Surge:** ANSI/IEEE C37.90.1-2002
  - All PDS and terminal strip connections
- **High Energy Surge:** ANSI/IEEE C62.41-1980
  - U2 and P2 inputs only

Not susceptible to upset due to high radio frequency interference (RFI) defined by the following:

- **RFI Susceptibility:** ANSI/IEEE C37.90.2-1987
Appendix B: Physical Installation on Siemens Regulators

B Physical Installation on Siemens Regulators

Physical installation consists of placing the MJ-4 Control Panel in its weatherproof housing and connecting the Polarized Disconnect Switch to the regulator. Customer-supplied external connections to the terminal strip on the back of the unit are made as required. Begin by disconnecting and removing the panel you are replacing.

Switch Settings for MJ-4A (See Chapter 2)

As you prepare to install the MJ-4A Control Panel, the following switch settings should be observed:

- Normal/External power switch: OFF
- Auto/Manual switch: OFF
- Tap Raise and Lower switch: OFF

Switch Settings for MJ-4B (See Chapter 2)

As you prepare to install the MJ-4B Control Panel, the following switch settings should be observed:

- Normal/External power switch: OFF
- Auto/Manual switch: AUTO DISABLED
- Tap Raise and Lower switches: OFF

Polarized Disconnect Switch

A wing-nut-secured, ten-position, male Polarized Disconnect Switch (PDS) provides the interface to the regulator sensing and control circuits.

The PDS is compatible with previous generation AccuStat™ controllers. The PDS connections are:

- **U12**: High side of neutral position indicator switch. When closed to ground, indicates tap changer in neutral. (Turns on Neutralite).
- **P2**: AC side of Potential Transformer, if present.
- **C2**: High side of Current Transformer.
- **E**: Collective neutral return for the control panel, the Utility winding and PT winding.
- **E1**: Low side of Current Transformer.
- **U2**: AC high side of regulator Tertiary (Utility) winding. Provides:
  - Control Panel power source.
  - Voltage reference.
  - Voltage Phase reference for flow direction.
  - Power factor
- **J**: Output from the panel to Raise regulator tap position.
- **K**: Output from the panel to Lower regulator tap position.
- **U10**: High side of Op Counter switch. (Closes to ground E)
- **U11**: High side of regulator drag hands reset solenoid (returns to E)

Replacing Older Control Units with the MJ-4A & MJ-4B Control Panel

If the original control has modifications such as Auxiliary Transformer, Auxiliary CT, Reverse Power Flow Detector, Voltage Limit Control, or other accessories mounted in the enclosure, special engineering instructions will be required before the existing control is replaced.

**Note 1**: Some older controllers do not provide the necessary signals to support all MJ-4 functions. (i.e., tap position indication, operations counter, Neutralite, drag hands reset.)

**Note 2**: The control being replaced may incorporate a jumper between the P2 and U2 terminals on the female (stationary) portion of the PDS. If and only if this jumper is present:

1. Remove the jumper.
2. Remove the P2 lead from the P2 screw terminal. Reconnect the P2 lead to the U2 screw terminal, leaving the P2 terminal vacant.

**CAUTION**

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

Will result in severe internal damage.

To Prevent:

Do not connect the P2 and U2 leads to the same terminal.

**Note 3**: 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 adapter mounting kit is required. To make use of this adapter kit (Cat. No. 1670) the MJ-4 Control Panel must be installed complete with its enclosure.

**Note 4**: To replace panel types UJ-4 and UJ-5 with the MJ-4, replace the ten-pin male portion of the PDS Supplied with the MJ-4 Control Panel with the seven-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. For this installation, the MJ-4 will not track the tap position and will not update the operations counters.

**Note 5**: To replace controls other than those named, refer to the factory for special engineering instructions.

**Note 6**: Regardless of the panel type being replaced, the MJ-4 Control Panel must be configured to operate with the particular regulator on which it is being installed. (See Chapter 4).
Appendix B: Physical Installation on Siemens Regulators

Replacing existing MJ-4 Control Panels
To replace an already-installed MJ-4 Control Panel, the procedure is similar to that described above.

Polarized Disconnect Switch
Plug the PDS from the new MJ-4 into the female PDS in the control enclosure.

Terminal Strip Connector
External devices are wired to a terminal strip connector at the back of the MJ-4 Control Panel. See Appendix K for pin-outs and signal descriptions.

Field Maintenance:
The MJ-4 is a state-of-the-art controller utilizing complex circuits and sophisticated components for the detection, processing and display of regulator parameters and the precise control and operation of the tap changer. Field maintenance is not recommended as special equipment and instrumentation are required for the proper calibration, testing and checking of the controller operation. It is strongly recommended that MJ-4 controller repair, testing, and calibration be performed only by Siemens authorized repair facilities.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
</table>
| Hazardous voltage will be present on various control leads when regulator is energized.  
Could result in death or serious injury including equipment damage from contact with live line conductors.  
To prevent:  
Remove fuses before by-passing the regulator and leave the fuses out while the regulator is bypassed. |

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
</table>
| Use of unauthorized parts and/or unqualified personnel in the repair of this equipment could result in death or serious injury including electrical damage to equipment.  
To Prevent:  
Only authorized personnel should work on this equipment including installation, operation and maintenance. |
Figure C.1  ANSI Type 'A' (Straight) Regulator Control Diagram
Figure C.2  ANSI Type 'B' (Inverted) Regulator Control Diagram
Appendix D: Menu Parameters

D Menu Parameters

D.1 <CONFIGURE> Menu: Leading and Lagging Regulators

The following steps will help you determine which of the two regulators in a Delta configuration is “leading” and which is “lagging” on an open Delta installation:

1. Disable automatic control of tap changer as follows:
   - Set Raise/Lower tap switch to OFF.

2. Use the Configuration Keys to temporarily set both controllers to System type = WYE. This will be corrected in step 7.

3. Ensure that there is load current on the line. Load current must be of sufficient magnitude to cause a definite response of the line drop compensation circuit. Normally, 25% of the regulator setting will be adequate.

4. Adjust both front panel controls to the same settings:
   - Bandwidth: 2.0 V
   - Voltage Level: 120 V
   - Time Delay: 0 Seconds
   - Resistance Volts: 0 V
   - Reactance Volts (+): 12

5. Set the Remote/Auto/Manual switch to AUTO on both controllers.

6. Allow both regulators to run and come to rest in band. The regulator whose tap position is closest to maximum is the “lagging” regulator. The other regulator is the “leading” regulator.

Note: The amount of tap change excursion can be made more or less, if desired, by appropriate adjustment of the reactance volts setting.

7. Use the Configuration keys to set the System type to Delta Lead for the leading regulator and to Delta Lag for the lagging regulator, as determined in step 6.

D.2 <REGULATOR> Menu: Line Drop Compensation

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 the tables below, establish the conductor resistance and reactance per mile of feeder.

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

2. Determine compensation multiplier, k, as
   - Single phase
     \[ \frac{\text{Current Transformer Rating}}{\text{Voltage Transformer Ratio}} = k \]
   - Wye Connected
     \[ \frac{\text{Current Transformer Rating}}{\text{Voltage Transformer Ratio}} = k \]
   - Delta Connected
     \[ \frac{\text{Current Transformer Rating}}{\text{Voltage Transformer Ratio}} = k \]

Note: Multipliers for many common system voltages and regulator ratings are included in tables D.4 and D.5 below.

3. Determine the Line Drop Compensation Settings
   - Resistive Compensation Setting = \( k \times \text{line length (mi)} \times \text{resistance (ohms/mi)} \)
   - Reactive Compensation Setting = \( k \times \text{line length (mi)} \times \text{reactance (ohms/mi)} \)

EXAMPLE: The line is 3 miles long.

Resistance Setting = 6.67 x 3 x 0.592 = 12V
Reactance Setting = 6.67 x 3 x 0.692 = 14V
Appendix D: Menu Parameters

Table D.1  Line Drop Compensation Table - Distribution Line Resistance and Reactance

<table>
<thead>
<tr>
<th>Cond. Size</th>
<th>Res. at 50°C</th>
<th>Reactance (See Note 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCM 1000</td>
<td>.0685 .449 .484 .511 .533 .552 .568 .593 .595</td>
<td></td>
</tr>
<tr>
<td>MCM 750</td>
<td>.0888 .466 .501 .529 .550 .569 .585 .600 .612</td>
<td></td>
</tr>
<tr>
<td>MCM 600</td>
<td>.1095 .481 .516 .543 .565 .584 .600 .615 .627</td>
<td></td>
</tr>
<tr>
<td>MCM 500</td>
<td>.1303 .492 .527 .554 .576 .595 .611 .626 .638</td>
<td></td>
</tr>
<tr>
<td>MCM 400</td>
<td>.1619 .507 .542 .569 .591 .610 .626 .641 .653</td>
<td></td>
</tr>
<tr>
<td>MCM 300</td>
<td>.1845 .515 .550 .577 .599 .618 .634 .649 .661</td>
<td></td>
</tr>
<tr>
<td>MCM 250</td>
<td>.215 .525 .560 .587 .609 .628 .644 .659 .671</td>
<td></td>
</tr>
<tr>
<td>MCM 250</td>
<td>.257 .536 .571 .598 .620 .639 .655 .670 .682</td>
<td></td>
</tr>
<tr>
<td>MCM 200</td>
<td>.303 .546 .581 .603 .630 .649 .665 .680 .692</td>
<td></td>
</tr>
<tr>
<td>MCM 180</td>
<td>.382 .554 .589 .616 .638 .657 .673 .688 .700</td>
<td></td>
</tr>
<tr>
<td>MCM 160</td>
<td>.481 .581 .616 .643 .665 .684 .700 .715 .727</td>
<td></td>
</tr>
<tr>
<td>MCM 125</td>
<td>.607 .596 .630 .657 .679 .698 .714 .729 .741</td>
<td></td>
</tr>
<tr>
<td>MCM 100</td>
<td>.757 .609 .644 .671 .693 .712 .728 .743 .755</td>
<td></td>
</tr>
<tr>
<td>MCM 75</td>
<td>.964 .623 .658 .685 .707 .726 .742 .757 .769</td>
<td></td>
</tr>
<tr>
<td>MCM 50</td>
<td>1.518 .648 .683 .710 .732 .751 .767 .782 .794</td>
<td></td>
</tr>
<tr>
<td>MCM 40</td>
<td>2.41 .677 .712 .739 .761 .780 .796 .811 .823</td>
<td></td>
</tr>
<tr>
<td>MCM 35</td>
<td>3.80 .714 .749 .776 .798 .817 .833 .848 .860</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cond. Size</th>
<th>Res. at 50°C</th>
<th>Reactance (See Note 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCM 1200</td>
<td>1.0851 .421 .456 .483 .505 .524 .540 .555 .567</td>
<td></td>
</tr>
<tr>
<td>MCM 1000</td>
<td>1.128 .439 .474 .501 .523 .542 .555 .573 .585</td>
<td></td>
</tr>
<tr>
<td>MCM 850</td>
<td>1.173 .450 .485 .512 .534 .553 .569 .584 .596</td>
<td></td>
</tr>
<tr>
<td>MCM 750</td>
<td>1.185 .469 .504 .531 .553 .572 .588 .603 .615</td>
<td></td>
</tr>
<tr>
<td>MCM 600</td>
<td>1.216 .479 .514 .541 .563 .582 .598 .613 .625</td>
<td></td>
</tr>
<tr>
<td>MCM 500</td>
<td>1.259 .490 .525 .555 .574 .593 .609 .624 .636</td>
<td></td>
</tr>
<tr>
<td>MCM 400</td>
<td>1.306 .500 .535 .562 .584 .603 .619 .634 .646</td>
<td></td>
</tr>
<tr>
<td>MCM 300</td>
<td>1.385 .514 .549 .576 .598 .617 .633 .648 .660</td>
<td></td>
</tr>
<tr>
<td>MCM 250</td>
<td>1.592 .630 .665 .692 .714 .733 .749 .767 .776</td>
<td></td>
</tr>
<tr>
<td>MCM 200</td>
<td>1.723 .670 .705 .732 .754 .773 .789 .804 .816</td>
<td></td>
</tr>
<tr>
<td>MCM 150</td>
<td>1.895 .690 .725 .752 .774 .793 .809 .824 .836</td>
<td></td>
</tr>
<tr>
<td>MCM 100</td>
<td>1.12 .705 .740 .767 .789 .808 .824 .839 .851</td>
<td></td>
</tr>
<tr>
<td>MCM 75</td>
<td>1.69 .714 .749 .776 .798 .817 .833 .848 .860</td>
<td></td>
</tr>
<tr>
<td>MCM 50</td>
<td>2.57 .708 .743 .770 .792 .811 .827 .842 .854</td>
<td></td>
</tr>
<tr>
<td>MCM 40</td>
<td>3.98 .722 .757 .784 .806 .825 .841 .856 .868</td>
<td></td>
</tr>
</tbody>
</table>

Note: 1. 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 for copper wire are for concentric standard copper conductors. Reactance values for aluminum cable conductors are approximately correct.

The Siemens Line Drop Calculator software application simplifies the calculation of these parameters. Simply enter the system values and the application automatically calculates the resistive and reactive components for you. Enter these values in the <REGULATOR> menu, and the MJ-4 automatically compensates for the line drop when adjusting the output voltage of the regulator.

Contact your Siemens representative about obtaining this application. You may also download this application from the Siemens web site (see Section 1.8). After arriving at the website, select Products, and then the Voltage Regulator item. This application is available on the Download page.
Appendix D: Menu Parameters

D.3 <CONFIGURE> Menu: Transformer Polarity

The relative polarity between the Utility (Tertiary or TV) winding and the Current Transformer (CT) must be specified in the <CONFIGURE> Menu Utility Pol: parameter. This section describes the method for determining the correct specification (NORM or REV) from examination of the Regulator nameplate.

D.3.1 Single-Phase Regulators

D.3.1.1 Single-Phase Inverted Design Regulators (ANSI type B)

The Utility transformer polarity is always normal for Single-Phase Inverted Design Regulators. Specify Utility Pol:NORM.

D.3.1.2 Single-Phase Straight Design Regulators (ANSI type A) without forced air cooling

The Utility transformer polarity for Single-Phase Straight Design regulators can be determined from the regulator nameplate schematic diagram. The Utility winding taps are labeled Un – Ux, E2.

Table D.2 Line Drop Compensation Table - Compensation Multipliers

<table>
<thead>
<tr>
<th>Regulator Operating Data</th>
<th>Circuit Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating KV (Volt. Trans. Ratio)</td>
<td>Current Rating</td>
</tr>
<tr>
<td>19.9 (166/1)</td>
<td>50</td>
</tr>
<tr>
<td>100</td>
<td>1.20</td>
</tr>
<tr>
<td>167</td>
<td>2.40</td>
</tr>
<tr>
<td>200</td>
<td>2.40</td>
</tr>
<tr>
<td>14.4 (120/1)</td>
<td>50</td>
</tr>
<tr>
<td>100</td>
<td>1.67</td>
</tr>
<tr>
<td>200</td>
<td>3.34</td>
</tr>
<tr>
<td>300</td>
<td>5.01</td>
</tr>
<tr>
<td>400</td>
<td>6.68</td>
</tr>
<tr>
<td>13.8 (115/1)</td>
<td>50</td>
</tr>
<tr>
<td>100</td>
<td>1.74</td>
</tr>
<tr>
<td>150</td>
<td>2.61</td>
</tr>
<tr>
<td>200</td>
<td>3.48</td>
</tr>
<tr>
<td>7.62 (63.5/1)</td>
<td>50</td>
</tr>
<tr>
<td>75</td>
<td>2.36</td>
</tr>
<tr>
<td>100</td>
<td>3.15</td>
</tr>
<tr>
<td>150</td>
<td>4.72</td>
</tr>
<tr>
<td>219</td>
<td>7.87</td>
</tr>
<tr>
<td>328</td>
<td>12.60</td>
</tr>
<tr>
<td>438</td>
<td>12.60</td>
</tr>
<tr>
<td>548</td>
<td>12.60</td>
</tr>
<tr>
<td>7.2 (60/1)</td>
<td>50</td>
</tr>
<tr>
<td>75</td>
<td>2.50</td>
</tr>
<tr>
<td>100</td>
<td>3.34</td>
</tr>
<tr>
<td>150</td>
<td>5.00</td>
</tr>
<tr>
<td>219</td>
<td>8.34</td>
</tr>
<tr>
<td>328</td>
<td>13.33</td>
</tr>
<tr>
<td>438</td>
<td>13.33</td>
</tr>
<tr>
<td>548</td>
<td>13.33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Regulator Operating Data</th>
<th>Circuit Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating KV (Volt. Trans. Ratio)</td>
<td>Current Rating</td>
</tr>
<tr>
<td>4.16 (34.7/1)</td>
<td>100</td>
</tr>
<tr>
<td>150</td>
<td>8.64</td>
</tr>
<tr>
<td>200</td>
<td>11.53</td>
</tr>
<tr>
<td>250</td>
<td>20.20</td>
</tr>
<tr>
<td>334</td>
<td>20.20</td>
</tr>
<tr>
<td>500</td>
<td>40.40</td>
</tr>
<tr>
<td>625</td>
<td>40.40</td>
</tr>
<tr>
<td>668</td>
<td>40.40</td>
</tr>
<tr>
<td>835</td>
<td>40.40</td>
</tr>
<tr>
<td>2.5 (20/1)</td>
<td>100</td>
</tr>
<tr>
<td>200</td>
<td>20.00</td>
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<td>300</td>
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<td>400</td>
<td>40.00</td>
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<td>500</td>
<td>70.00</td>
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<td>668</td>
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<td>1000</td>
<td>140.00</td>
</tr>
<tr>
<td>1250</td>
<td>140.00</td>
</tr>
<tr>
<td>1332</td>
<td>140.00</td>
</tr>
<tr>
<td>1665</td>
<td>140.00</td>
</tr>
</tbody>
</table>
Appendix D: Menu Parameters

If the Un - - Ux taps are to the left of E2 with no taps to the right of E2, and the polarity mark is on one of the U taps, specify Utility Pol: NORM. (See Figure D.1.)

![Figure D.1](image)

Figure D.1 Single-Phase Straight Design - Taps to the Left of E2

If the Un - - Ux taps are to the right of the E2, and the polarity mark is on the E2 tap, specify Utility Pol: REV. (See Figure D.2.)

![Figure D.2](image)

Figure D.2 Single-Phase Straight Design - Taps to the Right of E2

D.3.1.3 Single-Phase Straight design regulators (ANSI type A) with forced air cooling

For these regulators, the Utility winding not only provides power to the controller — it also provides power for the forced air fan(s). The E2 tap is located between the Un - - Ux terminals on the regulator’s nameplate schematic. The U5 tap is normally used for fan voltage and can be either to the left or to the right of E2. To determine whether the polarity is ‘normal’ or ‘reverse’, you must examine both the schematic diagram and the connection table on the nameplate. From the connection table, determine the tap to which U2 should be connected.

- If the tap to which U2 is connected and the polarity mark are to the left of E2 on the schematic, set Utility-Pol:NORM.
- If the tap to which U2 is connected is to the right of E2 on the schematic, set UtilityPol:REV.

Examples

For both of the examples on the next page, use the nameplate connection table shown in Table D.3:

Table D.3 Nameplate for Single-Phase Straight Regulator with Cooling Fan

<table>
<thead>
<tr>
<th>Single Phase Straight Regulator with Cooling Fan</th>
<th>Load Volts +/-10%</th>
<th>Volt Tran Sec Conn P2 to</th>
<th>Control Panel P to P14 to</th>
<th>Basis Volts</th>
<th>Aux Volts Motor Conn U2 to Volts</th>
<th>Fan Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>14400</td>
<td>P3 - 120</td>
<td>20</td>
<td>120</td>
<td>U3</td>
<td>U3 U7 240</td>
</tr>
<tr>
<td></td>
<td>13200</td>
<td>P4 - 120</td>
<td>20</td>
<td>120</td>
<td>U4</td>
<td>U53 U7 242</td>
</tr>
<tr>
<td></td>
<td>7200</td>
<td>P5 - 120</td>
<td>20</td>
<td>120</td>
<td>U6</td>
<td>U6 U8 240</td>
</tr>
</tbody>
</table>

From the table, the system load voltage is 7200 volts; therefore, U2 would be connected to U6. Now check the connection diagram:
EXAMPLE 1 (ref: Table D.3)

In Figure D.3 below, U6 is to the left of E2. If your regulator nameplate looks like this, the proper specification is Utility Pol:NORM.

![Figure D.3 U6 to the Left of E2](image)

EXAMPLE 2 (ref: Table D.3)

In Figure D.4 below, U6 is to the right of E2. If your regulator nameplate looks like this, the proper specification is Utility Pol:REV.

![Figure D.4 U6 to the Right of E2](image)

D.3.2 Three-Phase Regulators

Three-phase regulators may have either one or multiple utility windings.

D.3.2.1 Single Utility Winding

A single utility winding provides power for the control, the motor and the cooling fan. This utility winding may have the polarity mark at the Un — Ux terminals or at the U5 terminal, as shown in the examples of Figure D.5.

![Figure D.5 Three-Phase Regulator with a Single Utility Winding](image)

To determine whether the polarity is ‘Normal’ or ‘Reverse,’ examine the connection table and schematic diagram.

- If U2 is connected to a “U” terminal which is to the left of E2, then UtilityPol:NORM (see Figure D.6).
- If U2 is connected to a “U” terminal which is to the right of E2, then UtilityPol:REV (see Figure D.7).
Appendix D: Menu Parameters

D.3.2.2 Multiple Utility Windings

Regulators with more than one utility winding utilize the “A” phase utility winding for control and motor power, and the “B” and “C” phase windings for fan(s) power. For this case, use the Single phase procedure, defined above for the “A” phase winding.

Figure D.6  U2 Connects to a “U” Terminal (U7 or U8) Which is to the Left of E2

Figure D.7  U2 Connects to a “U” Terminal (U7 or U8) Which is to the Right of E2
Appendix E: Hazards of Bypassing a Regulator off Neutral

E Hazards of Bypassing a Regulator off Neutral

Proper regulator bypassing procedure is of critical importance. Regulators that are not in the neutral position when bypassed frequently fail. This failure is the result of extremely high circulating current inside the regulator caused by what is effectively a short circuit being placed across the series winding. The result of such a failure can be catastrophic.

Methods of Determining Neutral Tap Position

Since the tap changing mechanism is submerged in a tank full of oil, some external means of determining tap position is mandatory. Methods most commonly used include:

- The regulator tap Position Indicator provides first line indication of the neutral position. On modern regulators, the tap changing mechanism drives the regulator Position Indicator through gears or flexible shafts to provide an accurate, reliable indication of the regulator tap position.

- The MJ-4A & MJ-4B Control Panel is equipped with a neutral indicating light (Neutralite). A switch mounted on the tap changing mechanism actuates the light circuit. The circuit is activated when the regulator is in the neutral position. A test switch on the MJ-4A & MJ-4B Control Panel can be used to verify proper operation of the Neutralite.

The Position Indicator and the Neutralite should all indicate neutral before you attempt to bypass the regulator.

Methods other than the ones described above are also used; however, the ones described above are the most common and are recommended.

The regulator must be placed in neutral before bypassing. If there is any doubt as to the location of neutral, the line should be dropped before bypassing the regulator.

Deactivating the Control Panel Before Bypassing

Consult your voltage regulator instruction manual for bypassing instructions.

To eliminate the possibility of inadvertent (and possibly catastrophic) tap operations during bypassing operations, it is mandatory that you completely disable the control panel.

Disable the MJ-4A control panel as follows:

1. Disconnect the Polarized Disconnect Switch (PDS).
   
   or

2. Remove all MJ-4A fuses (Power, Sensing, and External Power); place MJ-4A power switch in Off position; place Remote/Off/Manual switch in Off position; and place the Tap Raise/Lower switch in Off position.

Disable the MJ-4B control panel as follows:

1. Disconnect the Polarized Disconnect Switch (PDS)
   
   or

2. Push Auto/Manual switch until Auto Disabled LED is ON, and leave the Raise and Lower keys in Off position.

Remove all MJ-4B fuses (Power, Sensing, and External Power); place MJ-4B power switch in Off position.

DANGER

Operating regulator while bypassing will result in explosion.

Will cause death, serious injury or property damage.

Place regulator in neutral position before bypassing and disable control panel.
F Communications Module Installation

The MJ-4 Communications Module is mounted directly to the Main Processor board. There are two versions of the Communications Module:

- Fiber Optic Communications Module, shown in Figure F.1.
- RS-232/485 Communications Module, shown in Figure F.2.

Refer to the MJ-4 Communications Module Installation Manual (Siemens Manual # 21-115-527-024 for complete information on installing and testing the Communications Module.
### Menu Structure Quick Reference

#### Table G.1 Navigating the Menu and Fast-Path Keys

<table>
<thead>
<tr>
<th>&lt;METER&gt;</th>
<th>&lt;FW DEMAND&gt;</th>
<th>&lt;REV DEMAND&gt;</th>
<th>&lt;COUNTERS&gt;</th>
<th>&lt;REGULATOR&gt;</th>
<th>&lt;CONFIGURE&gt;</th>
<th>&lt;ADV CONFIGURE&gt;</th>
<th>&lt;ALERTS&gt;</th>
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<td>R Diff Vld</td>
<td>Total Ops</td>
<td>Fwd Volts</td>
<td>Tap Chngr</td>
<td>Meter Volts</td>
<td>1st Alert</td>
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<td>F Diff Vs</td>
<td>R Diff Vs</td>
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<td>Fwd BW</td>
<td>Type</td>
<td>I Threshold %</td>
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<td>I Shift</td>
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<td>R Diff Ild</td>
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<td>Fwd Comp (X)</td>
<td>DeltaPav</td>
<td>I Load Max</td>
<td>Neutral sig. err.</td>
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<td>F Diff PF</td>
<td>R Diff PF</td>
<td>24 Hr Ops</td>
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<td>R Diff KVA</td>
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<td>Rev Comp (R)</td>
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<td>Format (Date)</td>
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<td></td>
<td>YTD Ops</td>
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### Additional Information
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### Appendix G: Menu Structure Quick Reference

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H MJ-4A & MJ-4B Firmware Versions


## Appendix I: Terminal Strip Wiring

### Terminal Strip Wiring

*Figure I.1 Terminal Strip Connections for Siemens Regulator*

*Figure I.1 below shows the external connections for the MJ terminal strip when connected to a Siemens Regulator.*
J  MJ-4A & MJ-4B Jumpers and Battery Replacement

J.1  MJ-4A & MJ-4B Jumpers

The locations of the MJ-4 jumpers and battery are shown in the drawing below. The table on the next page describes the jumpers and the default settings.

![MJ-4A & MJ-4B Jumpers Diagram]

Figure J.1   MJ-4A & MJ-4B Jumpers.
Appendix J: MJ-4A & MJ-4B Jumpers and Battery Replacement

Table J.1  MJ-4A & MJ-4B Jumper Descriptions and Default Connections

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<tr>
<th>Jumper</th>
<th>Default Shunt Location</th>
<th>Description</th>
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<tr>
<td>J1</td>
<td>Out</td>
<td>This jumper shorts signals C&amp;C2 (P3B-11&amp;12). J1 is a redundant jumper, since MJ-4 ships from the factory with a terminal strip jumper across P3B-11&amp;12. With either jumper installed, the terminal strip, the CT current path for the regulator is complete. Removing both the terminal strip jumper and the J1 jumper allow for an external &quot;auxiliary apparatus&quot; (e.g., an external current meter) to be connected in the CT current path. Caution: Open circuiting the C&amp;C2 connections may damage the regulator Current Transformer (CT). Keep C&amp;C2 shorted unless connected to an appropriate external current-handling device.</td>
</tr>
<tr>
<td>J9</td>
<td>In</td>
<td>J9 determines the signal path for the &quot;External Source&quot; power. With J9 installed, the External Source signal comes from the Yellow banana plug on the front panel. With J9 removed, the External Source signal comes from &quot;J412&quot; (P3B-9). Caution: Do not connect AC sources to both &quot;J412&quot; and the External Source (yellow) banana plug while J9 is installed. Be sure that J9 jumper is un-installed before making an AC Source connection to J412.</td>
</tr>
<tr>
<td>J22</td>
<td>1-2</td>
<td>Selects DCE/DTE for MJ-4 data port. (See also J23.) 1-2: DCE (default) 2-3: DTE</td>
</tr>
<tr>
<td>J23</td>
<td>1-2</td>
<td>Selects DCE/DTE for MJ-4 data port. (See also J22.) 1-2: DCE (default) 2-3: DTE</td>
</tr>
</tbody>
</table>

Note: The following jumpers are not installed: J2 (factory use only) JP9 (microprocessor reset for factory use).

J.2 Battery Replacement

This section provides instructions for replacing the MJ-4 battery.

Note: Replace the MJ-4 battery within 1 month of an active "Low Battery" message to avoid data loss.

To replace the MJ-4 battery, you will:

1. Remove the MJ-4 rear cover,
2. Remove and replace the coin-cell battery,
3. Close up the unit and reconnecting power.

Replacement Battery

Radio Shack carries replacement batteries for the MJ-4. The battery is a 3 volt coin-cell type Lithium cell, Panasonic BR2032 or equivalent.

Replacement Procedure

During the following procedure, use proper Electro-Static Discharge (ESD) precautions. If possible, use an ESD wrist strap. If no wrist strap is available, touch a grounded surface before beginning. (Two accessible ground points are the screw jacks of the Data Port connector.)

1. Turn off power to the MJ-4 and disconnect the PDS jack (the 10-contact connector with the two wing-nuts.)
2. Remove the MJ-4 from the weather-proof enclosure (i.e., lift it off of the hinges.)
3. Remove the side screws from the unit. (There are 4.)
4. Curl back the cable clamp on the back of the unit and remove the cable bundle from the reusable cable clamp.
5. Lift and move the rear cover away from the front panel.
6. Remove the coin-cell battery (BT1) from its socket. See Figure J.1 on the previous page for battery location.
7. Put the new coin-cell battery in the battery socket, making sure you have the proper orientation ("+" side up.)
8. Close the unit by reversing the steps outlined above.
9. Turn the power on and verify that the unit comes up and displays the <METER> menu heading. If the unit fails to come up, retrace the above steps to make sure that the battery has been properly oriented and inserted.
10. After replacing the battery, verify the Low Battery Message is no longer active.

What is Backed Up?

There are two types of memory on the control: an EPROM where all of the settings/configuration are stored, which does not require power to retain information, and the battery backed static RAM where the time/date, min/max values, tap position, data logs, and DNP Configure points are stored. The MJ-4 Panel has a Super capacitor, which ensures data in non-volatile memory be retained when the battery has to be replaced. Data is lost only when both the capacitor is fully discharged and the battery is dead.

Siemens Energy, Inc.
## Appendix K: Terminal Strip Connections

### K Terminal Strip Connections

Table K.1 below describes the connections for terminal strip P2A.

### Table K.1 Connections for Terminal Strip P2A

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<th>Pin Number</th>
<th>Signal Name</th>
<th>Description</th>
<th>I/O / Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HS</td>
<td>For Cooper Regulators Only. &quot;Hold Switch&quot; connection. Applies power to tap changer to complete tap change after &quot;Hold Switch&quot; contact makes.</td>
<td>Power</td>
</tr>
<tr>
<td>2</td>
<td>U112</td>
<td>For Cooper Regulators Only. Neutral Position Indication. When closed to AC hot, indicates tap changer is in neutral position. Turns on Neutralite.</td>
<td>Input</td>
</tr>
<tr>
<td>3</td>
<td>U12*</td>
<td>High side of neutral position indicator. When closed to AC ground (&quot;E&quot;), indicates tap changer is in neutral position. Turns on Neutralite.</td>
<td>Input</td>
</tr>
<tr>
<td>4</td>
<td>P2*</td>
<td>Potential Transformer output (if present).</td>
<td>Input</td>
</tr>
<tr>
<td>5</td>
<td>C2*</td>
<td>High side of Current Transformer. [C2 terminal at P3B-12 is normally externally jumpered to C at P3B-11.]</td>
<td>Input</td>
</tr>
<tr>
<td>6</td>
<td>E*</td>
<td>Neutral return for Control Panel, PT, and Utility winding. Chassis ground.</td>
<td>Ground</td>
</tr>
<tr>
<td>7</td>
<td>E1*</td>
<td>Low side of Current Transformer.</td>
<td>Ground</td>
</tr>
<tr>
<td>8</td>
<td>U2*</td>
<td>High side of Utility (Tertiary) winding. Control Panel derives &quot;Normal&quot; power from this signal. Provides voltage phase reference for power flow direction.</td>
<td>Power/Sense</td>
</tr>
<tr>
<td>9</td>
<td>J*</td>
<td>Terminal J - Tap Changer Motor Raise signal.</td>
<td>Output</td>
</tr>
<tr>
<td>10</td>
<td>K*</td>
<td>Terminal K - Tap Changer Motor Lower signal.</td>
<td>Output</td>
</tr>
<tr>
<td>11</td>
<td>U10*</td>
<td>High side of Operation Counter switch. Closes to E. Indicates when a tap change has occurred.</td>
<td>Input</td>
</tr>
<tr>
<td>12</td>
<td>U11*</td>
<td>High side of Regulator Drag Hands Reset solenoid. Returns to E. Used to reset the drag hands of the Tap Position Dial mounted on the regulator.</td>
<td>Output</td>
</tr>
</tbody>
</table>

* indicates standard “Polarized Disconnect Switch (PDS)” signals. For Siemens regulators, these ten signals connect to the corresponding pins of the PDS connector block.
Table K.2 below describes the connections for terminal strip P2B. See Table 2.5 for complete descriptions of these terminal connections. See Figure 2.3 for simplified schematic drawing of remote control connections.

**Table K.2  Connections for Terminal Strip P2B**

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Signal Name</th>
<th>Description</th>
<th>I/O / Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BAL</td>
<td>This signal is actually E, (AC return.) The intended application of this signal is in conjunction with +P to permit the MJ-4 sense voltages to be adjusted by the value present on an external transformer winding. The transformer winding is inserted into the MJ-4 circuit at +P and BAL.</td>
<td>Ground</td>
</tr>
<tr>
<td>2</td>
<td>+P</td>
<td>This signal connects to one side (the &quot;ground&quot; side) of the MJ-4 sense transformers. See description for BAL.</td>
<td>Input</td>
</tr>
<tr>
<td>3</td>
<td>J21</td>
<td>This signal connects to the J Relay output of the MJ-4. Normally, this signal is jumped to J22 to complete the MJ-4 Raise motor circuit. Alternatively, a relay (or switch contacts) can be connected across the J21/J22 contacts to provide external control over the MJ-4 automatic Raise motor circuit.</td>
<td>Output</td>
</tr>
<tr>
<td>4</td>
<td>J22</td>
<td>This signal is wired to J [P2A-9]. J22 is normally jumped to J21. Alternately, J22 can be connected to an external motor control signal.</td>
<td>Input</td>
</tr>
<tr>
<td>5</td>
<td>U_REM (R)</td>
<td>This signal gets AC power from U6 when the Remote-Auto/Off/Manual switch is in the Remote/Auto position. This signal is provided so that external relay contacts can be connected from Rem R to J22 (the Raise motor control signal). <strong>MJ-4A ONLY</strong></td>
<td>Power</td>
</tr>
<tr>
<td>6</td>
<td>U_REM (L)</td>
<td>This signal gets AC power from U6 when the Remote-Auto/Off/Manual switch is in the Remote/Auto position. This signal is provided so that external relay contacts can be connected from Rem L to K22 (the Lower motor control signal). <strong>MJ-4A ONLY</strong></td>
<td>Power</td>
</tr>
<tr>
<td>7</td>
<td>K22</td>
<td>This signal connects internally to the K signal (Lower motor control). This signal is normally jumped to K21, but it can be connected to an external motor control signal.</td>
<td>Input</td>
</tr>
<tr>
<td>8</td>
<td>K21</td>
<td>This signal connects to the K Relay output of the MJ-4. Normally, this signal is jumped to K22 to complete the MJ-4 Lower motor circuit. Alternatively, a relay (or switch contacts) can be connected across the K21/K22 contacts to provide external control over the MJ-4 automatic Lower motor circuit.</td>
<td>Output</td>
</tr>
<tr>
<td>9</td>
<td>U7</td>
<td>This circuit provides AC power to K7, which provides power to the J and K relays. The J and K relays implement the MJ-4’s automatic tap control operations. This signal is normally jumped to U6, but it can be connected to an external AC source. [Alternatively, an external relay contact can be placed between the U6 and U7 contacts for external control of the MJ-4 automatic tap operations.]</td>
<td>Power</td>
</tr>
<tr>
<td>10 &amp; 11</td>
<td>U6</td>
<td>This signal provides AC power for both Remote and Manual tap control operations. This circuit provides AC power to the common of the Tap Raise/Lower switch when the Remote-Auto/Off/Manual switch is in the Manual position. This circuit provides the AC power to the Rem R and Rem L terminal block contacts when the Remote-Auto/Off/Manual switch is in the Remote position. It is normally jumped to U at the terminal block, but it can be connected to an external AC source. [Alternatively, an external relay contact can be placed between the U and U6 contacts for external control of the MJ-4 manual and remote operations.]</td>
<td>Power</td>
</tr>
<tr>
<td>12</td>
<td>U</td>
<td>This is the signal from U2, after the power switch (assuming the switch is in the &quot;Normal&quot; position.) This signal is normally jumped to U6 at the terminal block unless an external circuit is used to feed U6.</td>
<td>Power</td>
</tr>
</tbody>
</table>
## Appendix K: Terminal Strip Connections

Table K.3 below describes the connections for terminal strip P3A

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Signal Name</th>
<th>Description</th>
<th>I/O / Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 &amp; 2</td>
<td>INHIB OUT+ &amp; INHIB OUT-</td>
<td>Inhibit Out is activated (closed) whenever the MJ-4 automatic mode operation is inhibited by either the Automatic Inhibit Input or by Communication link.</td>
<td>Relay Output</td>
</tr>
<tr>
<td>3</td>
<td>AUXOUT C</td>
<td>Common contact of Auxiliary Relay.</td>
<td>Output</td>
</tr>
<tr>
<td>4</td>
<td>AUXOUT NO</td>
<td>Normally-open contact of Auxiliary Relay.</td>
<td>Output</td>
</tr>
<tr>
<td>5 &amp; 6</td>
<td>AUXIN+ &amp; AUXIN-</td>
<td>Auxiliary input contact pair. For future definition.</td>
<td>Contact Closure Input</td>
</tr>
<tr>
<td>7</td>
<td>MAN_STAT</td>
<td>When closed to R/M COM it indicates that the MJ-4A is in the Manual Operating Mode. The RA/O/M switch is in the Manual position. <strong>MJ-4A ONLY</strong></td>
<td>Switch Closure Output</td>
</tr>
<tr>
<td>8</td>
<td>R/M COM</td>
<td>Common contact of the SPDT Remote-Automatic/Off/Manual (RA/O/M) switch. [Use with Man_stat and Rem_stat.] <strong>MJ-4A ONLY</strong></td>
<td>Switch Closure Output</td>
</tr>
<tr>
<td>9</td>
<td>REM_STAT</td>
<td>When closed to R/M COM it indicates that the MJ-4A is in the Remote Operating Mode. The RA/O/M switch is in the Remote-Auto position. <strong>MJ-4A ONLY</strong></td>
<td>Switch Closure Output</td>
</tr>
<tr>
<td>10 &amp; 11</td>
<td>ICIRC+ &amp; ICIRC-</td>
<td>Reserved for Circulating Current Input signal pair. (0 - 640 mA, AC.)</td>
<td>Current Input</td>
</tr>
<tr>
<td>12</td>
<td>P2SW</td>
<td>P2 signal after the Power Switch. Used for externally monitoring the P2 voltage signal.</td>
<td>Output</td>
</tr>
</tbody>
</table>

Table K.4 below describes the connections for terminal strip P3B

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Signal Name</th>
<th>Description</th>
<th>I/O / Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>J30</td>
<td>Spare connection for future application.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>AUXOUT NC</td>
<td>Normally-closed contact of Auxiliary Output Relay. (See P3A-3.)</td>
<td>Relay Output</td>
</tr>
<tr>
<td>3 &amp; 4</td>
<td>INHIB IN+ &amp; INHIB IN-</td>
<td>INHIB IN directly disables the MJ-4 motor control relays. Through the microprocessor, this signal asserts Automatic Inhibit of motor Raise/Lower operations, and activates the Auto Inhibit Indicator.</td>
<td>Contact closure Input</td>
</tr>
<tr>
<td>5 &amp; 6</td>
<td>VRC1+ &amp; VRC1-</td>
<td>These contacts are used to activate VRC (both MJ-3A™ mode and MJ-X mode). They are also used for External Line Drop Compensation Polarity Control.</td>
<td>Contact closure Input</td>
</tr>
<tr>
<td>7 &amp; 8</td>
<td>VRC2+ &amp; VRC2-</td>
<td>These contacts are used to activate VRC Enable 2 for MJ-X mode. They are also used for Alternate functions: Alternate Time Delay and Low External Battery.</td>
<td>Contact closure Input</td>
</tr>
<tr>
<td>9</td>
<td>J412</td>
<td>Alternate signal source for “External Power” if jumper J9 is removed. See Table J.1.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>C8_66A</td>
<td>Reserved for future application.</td>
<td></td>
</tr>
<tr>
<td>11 &amp; 12</td>
<td>C &amp; C2</td>
<td>C &amp; C2 (P3B-11&amp;12) provide access to the regulator current path for connecting auxiliary apparatus (e.g., an external current meter.) The current ranges from 0 to 640 mA nominal, into a low impedance load. C&amp;C2 have redundant jumpers. As shipped from the factory, there is a jumper across the terminal strip pins, and there is an on-board jumper “J1”. [Both the terminal strip jumper and on-board jumper (J1) need to be removed if external equipped is connected.] <strong>Caution: Open circuiting the C&amp;C2 connections may damage the regulator Current Transformer (CT). Keep C&amp;C2 shorted unless connected to an appropriate external current-handling device.</strong></td>
<td>Current</td>
</tr>
</tbody>
</table>
Appendix L: MJ-4A & MJ-4B Operating Procedures

Use the following instructions as a quick reference for performing many of the standard MJ-4 operating procedures.

View Instantaneous Load Voltage (Vld)
1. Press Menu key twice
2. Press Down Arrow once
3. Read voltage (Vld) on display

View/Reset Max/Min Values
1. View Meter value or tap position
2. Press Max/Min key once
3. Read maximum value on display
4. To reset maximum value on display, press Cancel Reset key once
5. Press Max/Min key again
6. Read minimum value on display
7. To reset minimum value on display, press Cancel Reset key once

View/Set Forward Voltage Level Value
1. Press Voltage Level Fast-Path key
2. Read Voltage Level on display
3. Press Change key - right hand digit will flash
4. Press Left Arrow key to move left on display or Right Arrow key to move right on display
5. Press Up/Down Arrow key to increase or decrease desired voltage on display - flashing digit will change
6. Press Save key to save the new Voltage Level

View/Set Bandwidth Value
1. Press Bandwidth Fast-Path key
2. Read Bandwidth on display
3. Press Change key - right hand digit will flash
4. Press Left Arrow key to move left on display or Right Arrow key to move right on display
5. Press Up/Down Arrow key to increase or decrease desired bandwidth on display - flashing digit will change
6. Press Save key to save the new Bandwidth setting

View/Set Time Delay Value
1. Press Time Delay Fast-Path key
2. Read time delay on display
3. Press Change key - right hand digit will flash
4. Press Left Arrow key to move left on display or Right Arrow key to move right on display
5. Press Up/Down Arrow key to increase or decrease time delay on display - flashing digit will change
6. Press Save key to save the new time delay value

View/Set Line Drop Compensation Values
1. Press Resistance Fast-Path key
2. Read resistive compensation voltage (R) on display
3. Press Change key - right hand digit will flash
4. Press Left Arrow key to move left on display or Right Arrow key to move right on display
5. Press Up/Down Arrow key to increase or decrease compensation voltage on display - flashing digit will change
6. Press Save key to save the new resistive compensation voltage value
7. Press Resistive Fast-Path key again
8. Read Reverse resistive compensation voltage (R) on display
9. Repeat steps 3 to 6 above to set the resistive compensation voltage
10. Press Reactance Fast-Path key
11. Read the Forward reactive compensation voltage (X) on display
12. Repeat steps 3 to 6 above to set the Forward reactive compensation voltage
13. Press Reactance Fast-Path key again
14. Read Reverse reactive compensation voltage (X) on display
15. Repeat steps 3 to 6 above to set the Reverse reactive compensation voltage

View Operation Counter Values
1. Press Operation Counter Select Fast-Path key (Op Count)
2. Read Total Ops count on display
Appendix L: MJ-4A & MJ-4B Operating Procedures

3. Press Op Count key repeatedly to step through remaining counter values

View Messages
1. Press Messages Fast-Path key
2. Read and note active message on display
3. Press Messages key repeatedly to step through remaining active messages
4. While viewing message, press Cancel Reset key to acknowledge message
5. Note: Acknowledging message does not clear the fault that caused the message

Configure the Control Panel
1. Press Menu key twice
2. Press Right Arrow key five times to view the <CONFIGURE> menu
3. Press Up/Down Arrow key to display the desired item.
4. Press Change key
5. Press Left Arrow or Right Arrow to step through digits in numeric values
6. Press Up/Down Arrow to toggle through text choices or to increase or decrease numeric values
7. Press Save key to save the new value
8. Repeat steps 3 through 7 for all desired configuration items

View/Set the Clock (Time and Date)
1. Press Menu key twice
2. Press Right Arrow key six times to view the <ADV CONFIGURE> menu
3. Press Down Arrow until the TIME item is displayed.
4. Press Change key - the left hand digit will flash
5. Press Up/Down Arrow key to increase or decrease the value
6. Press Right Arrow to step to next digit
7. When all of the digits are set, press Right Arrow key until A or P is flashing
8. Press Up/Down Arrow key to toggle between A and P
9. Press Save key to save the new time
10. Press Down Arrow key to display the DATE item
11. Press Change key - the left hand digit will flash
12. Press Up/Down Arrow key to increase or decrease the value
13. Press Right Arrow to step to the next digit to be changed
14. Press Save key to save the new date

Using a Voltmeter to Calibrate U2 or P2
Note: Do not use voltage readings at the Voltage Calibration (Test) terminals as an indication of the regulated load voltage
1. Connect true-rms-reading voltmeter to Voltage Calibration (Test) terminals
2. Press U2 P2 key to display U2 (or P2) Cal item on the display.
3. If voltmeter reading is not the same as U2 (or P2) Cal item, press Change
4. At password prompt, press Up/Down Arrow key to enter first digit of password (See Manual Chapter 4)
5. Press Right Arrow key to step through remaining digits and enter values
6. Press Save key to submit password
7. If password is correct, press Change key - right hand digit will flash
8. Press Up/Down Arrow key to increase or decrease value until U2 (or P2) Cal value is equal to the voltmeter value
9. Press Save key to save the new calibration value
10. See Manual Chapter 6 for additional calibration procedures

Set Tap Position
1. Display Tap= in <COUNTERS> menu
2. Press Change key
3. Press Up/Down Arrow key until reading matches regulator Position Indicator value
4. Press Save key to save new value.
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