Inductive Components Manufacturing, Inc.

UVR-1 Universal Voltage Regulator Control

Operation Manual

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Manual Organization

This manual describes the UVR-1 Universal Voltage Regulator Control, its operation, and communications protocol interface. Certain conventions are used in the text to denote various items:

Every UVR-1 data item (status, measurement, setpoint, command, etc.) has a unique data item identifier, which is used to refer to the data item throughout the manual. Data item identifiers are shown in a special sans serif font. For example, source voltage is shown as "SrcV". These may be in bold in the Database Reference section.

Most data items are accessible through the user interface menu. Their menu names indicate their category and subcategory (if it exists), and are shown in a fixed font (as are menu values and prompts). For example, the menu name shown for source voltage is "`Meas..Basic.SrcVolts`".

Front panel control and indicator names are shown in a special bold font, for example "**SCROLL** knob".

In this manual, data item identifiers and menu names are shown when each data item is introduced. Elsewhere, data items are generally referred to by their data item identifiers. Unless otherwise specified, data items are settable to the resolution (number of decimal places) shown in this manual.

Additional information is contained in the following manuals:

The ***UVR-1 DNP3 Communications Supplement*** contains information specific to UVR-1 support for the DNP3 communications protocol, including a complete listing of the DNP-accessible data items.

The ***UVR-1 DNP3 Configuration/Interoperability Guide*** contains detailed DNP3 interface information and the UVR-1 factory default point list.

The ***UVR-1 Utility Suite Manual, DNP Point Map section*** describes how to use the DNP Point Map program to customize the DNP3 point list and reporting criteria for UVR-1 data items.

The ***UVR-1 Utility Suite Manual, Configuration Utility section*** describes how to use the UVR-1 configuration utility to simplify configuration of UVR-1 controls, as well as for data readout.

The ***UVR-1 Utility Suite Manual, Firmware Loader section*** describes how to use the Firmware Loader utility to upgrade the UVR-1 operating firmware and factory defaults.

The ***UVR-1 Utility Suite Manual, Data Logging section*** describes how to use the Data Logging program to display UVR-1 data log files in both graphical (strip-chart) and tabular formats.

The ***UVR-1 Utility Suite Manual, Contact Log section*** describes how to use the Contact Log program to display UVR-1 tapchanger contact wear log files in both graphical and tabular formats.

Installation Guides are provided with wiring harnesses and control cabinets supplied by ICMI for most common voltage regulators, covering all wiring details.

A manual is provided with each optional UVR-1 Daughter Board Communications Module, available from ICMI. It describes typical interface applications and communication architectures.

The ***UVR-1 XIO Port Interface Guide*** is supplied with the optional XIO Port Interface Board and XIO Port Input-only Interface Board, available exclusively from ICMI. It describes typical interface applications for the various XIO functions.

Various ***XIO Port Function Application Notes*** describe how to use particular XIO port functions. XIO port functions are unique and may be added during the evolution of each control. Individual application notes are issued for each functional group.

The ***UVR-1 Communications Configurations Application Note*** describes how the UVR-1 can be configured for various communications architectures, including the use of multiple controls and gateways.

Features and Specifications

The UVR-1 Universal Voltage Regulator Control is a microprocessor-based step voltage regulator control with an integrated remote monitoring and control capability supporting multiple communications protocols. The control uses waveform sampling and digital signal processing to accurately measure and compute system parameters. The UVR-1 is compatible with most single-phase and 3-phase step voltage regulators from various manufacturers. The differences in regulator types (i.e. operation counter, neutral switch, holding switch, motor polarity, phasing) are handled through UVR-1 configuration selections. The UVR-1 can be ordered in panel and harness configurations that fit existing regulator control cabinets. The UVR-1 provides the maintenance/retrofit/upgrade marketplace with a flexible, functional step voltage regulator control including the widely used DNP3 communications protocol.

Regulation Features:

- **Bandcenter** - load center set voltage, adjustable from 100.0 to 135.0 V with 0.1 V resolution.
- **Bandwidth** - load center voltage bandwidth, adjustable from 1.0 to 6.0 V with 0.1 V resolution.
- **Time Delay** - time delay before tap change, adjustable from 5 to 180 sec. with 1 sec. resolution.
- **Line Drop Compensation** - allows for correction of load center voltage due to voltage drop (or rise) caused by transmission lines or other devices.
  - Resistive Compensation - voltage change, at rated CT current, due to the resistive portion of the line impedance between the voltage regulator and the load center, adjustable from -72.0 to +72.0 V with 0.1 V resolution.
  - Reactive Compensation - voltage change, at rated CT current, due to the reactive portion of the line impedance between the voltage regulator and the load center, adjustable from -72.0 to +72.0 V with 0.1 V resolution.
- **Reverse Power Flow Detection/Operation** - reverse power flow is detected by monitoring the phase angle of the load current relative to the voltage, as well as the real current component.
  - Separate setpoints and metering data are maintained for reverse power flow (mode dependent).
  - Current threshold for reverse power flow mode determination, adjustable from 1% to 10% of rated load current with 1% resolution.
  - Source-side sensing transformer not required.
- **Multiple Modes of Operation:**
  - Locked Forward - Regulation and metering based on forward power flow. Average and demand metering operate only during forward power flow, and tap changes do not occur during reverse operation.
  - Locked Reverse - Regulation and metering based on reverse power flow. Average and demand metering operate only during reverse power flow, and tap changes do not occur during forward operation.
  - Idle Reverse - Regulation and metering based on power flow direction, but tap changes do not occur during reverse operation.
  - Bi-directional - Regulation and metering based on power flow direction.
  - Neutral Reverse - Regulation and metering based on power flow direction, but regulator returns to neutral position during reverse operation.
  - Co-generation - Regulation and metering based on forward power flow, except that during reverse power flow, the reverse line drop compensation settings are used and min/max values are stored in the reverse data items.

- **Multiple Regulation Algorithm/Timer Modes**
  - Sequential - When the load center voltage exceeds either band edge, the time delay is initiated. After the time delay has expired, the appropriate raise or lower operations are performed with an inter-tap delay between them, until the load center voltage is in-band. If the load center voltage returns to within the band edges during the time delay period, the timer is reset.
  - Time-Integrating Sequential - When the load center voltage exceeds either band edge, the timer (initially 0) is incremented each second. If the timer meets or exceeds the time delay, the appropriate raise or lower operations are performed with an inter-tap delay between them, until the load center voltage is in-band. If the load center voltage returns to within the band edges during the time delay period, the timer is decremented each second until it reaches 0.
  - Voltage-Averaging - When the load center voltage exceeds either band edge, the time delay is initiated. The load center voltage is monitored and averaged over the delay. After the time delay has expired, the computed number of raise or lower operations is performed (up to 5, with no inter-tap delay) to bring the load center voltage to the bandcenter. If the load center voltage returns to within the band edges for 10 continuous seconds during the time delay period, the timer is reset.
- **Voltage Limiting** - monitors the regulator load voltage to protect customers near the regulator.
  - High Limit - the regulator load voltage is not allowed above this setting. Tapchanger raise operations are inhibited 1 volt below this setting. Adjustable from 95.0 to 135.0 V in 0.1 V increments, or can be disabled.
  - Low Limit - the regulator load voltage is not allowed below this setting. Tapchanger lower operations are inhibited 1 volt above this setting. Adjustable from 95.0 to 135.0 V in 0.1 V increments, or can be disabled.
  - Auto-Runback - If either of the voltage limits are exceeded for a minimum time period (adjustable from 1 to 30 sec.), the control will automatically return the regulator load voltage to within the voltage limits.
- **Voltage Reduction** - lowers the effective bandcenter voltage by one of three percentages selectable by external inputs†, or by an explicit percentage set locally or remotely. All percentages adjustable from 0.0% to 10.0% with 0.1% resolution.
- **Tap Position Limits for Increased Load Capability** - raise and lower tap position limits, independently adjustable from positions 8 to 16 raise and 8 to 16 lower, respectively.
- **Load Current Limit** - load current exceeding this limit inhibits the automatic control algorithm and can cause an alert. Adjustable from 100 to 440 mA CT secondary current (higher with less measurement accuracy).
- **Automatic Control Algorithm Inhibit** - the automatic control algorithm can be inhibited for manual, auxiliary (external)†, or direct remote control of the regulator.
- **Tap Position Indication** - current tap position is tracked based on the neutral position indicator and acknowledgement of completed tap changes from the operation counter or holding switch. The tap position is maintained in non-volatile memory, and can be set to match existing physical tap position.
- **Electronic Draghands** - resettable electronic tap position draghands, along with the time and date of each min/max, are kept in non-volatile memory.
- **Operation Counter** - two digital operation counters, one resettable, are kept in non-volatile memory. The non-resettable counter may be set to match an existing operation counter for replacement applications.
- **External Raise and Lower Inputs and Outputs†** - external motor control signals that can be used to gang multiple regulator controls for master-slave transformer paralleling applications.
- **External Alert Input and Output†** - external alert source, and an indication that one or more of several selectable alert conditions has occurred.

Additional Control Features:

- **Auxiliary Programmable I/O†** - eight individually programmable signals may be assigned to dedicated control functions or general purpose use.
- **Heater Control Output†** - used to control a heater based on a selectable ambient temperature.
- **Cooling Device Control Output†** - used to control a cooling device based on a selectable ambient temperature.
- **Quick Access Data Display** - present values of the selected data log data items can be displayed using just the scroll knob.
- **Data Logging** - up to 7 user-selectable data items may be logged on a periodic basis, and displayed or read out via the front panel PC port. A portion of the most recent data log records are stored in non-volatile memory.

- **Internal Clock/Calendar with Powerfail Backup** - used for timestamping min/max, log, and communications protocol data. Powerfail backup maintains clock/calendar for up to 3 days without AC power.
- **Ambient Temperature Monitor** - present and min/max ambient temperature monitoring.
- **Non-volatile Parameter Storage** - all configuration parameters are stored in non-volatile memory.
- **3 User Parameter Profiles with Selectable Date Activation** - 3 user-customizable profiles for storage of UVR-1 parameters. These can be loaded directly, and/or the date activation feature allows any of these to be automatically loaded on any of 4 user-selectable dates each year.
- **Factory Defaults for All Parameters** - UVR-1 can be reset to factory defaults from front panel.
- **Self Test and Equipment Protection** - comprehensive control self test, and safeguards against equipment damage due to conditions such as voltage transients, low tapchanger motor voltage, and stuck switches.
- **Tapchanger Contact Wear Log and Alert** - data related to tapchanger contact wear may be logged, and accessed via the protocol, displayed, or read out via the front panel PC port. The data is stored in non-volatile memory. In addition, thresholds can be set to cause an alert.

Compatibility:
- The UVR-1 is designed to be directly compatible with the following single-phase step voltage regulators:
  - **General Electric** - ML 32 Step Voltage Regulator.
  - **Siemens** - JFR Regulators.
  - **Howard** - SVR-1 Regulator.
  - **CPS/McGraw Edison** - VR-32 Regulator, spring drive models 170 and 928 and direct drive models 660 and 770.
- The UVR-1 can be used to control most other regulators, including those without a neutral switch. Polarity selection for neutral switch, operation counter switch, and motor control.
- Simplified voltage regulation algorithm for regulators without a valid operation counter or holding switch signal.
- Source-side sensing transformer not required.
- Ratio-correcting transformers are not required for control operation. Adjustable base voltage.
- Configurable parameters allow setup with all commonly available step voltage regulators.
- Configurable phasing correction for use with 1-phase and 3-phase wye and delta power systems.
- Special DNP3 points for drop-in compatibility with Georgia Power regulator controls.

Communications:
- **Remote Monitoring and Control** - All configuration parameters, setpoints, status, and measurements can be read and/or written remotely if enabled. The unit serial number is remotely readable. The UVR-1 is designed to support multiple protocols.
- **DNP3 Protocol** - Subset Definition Level 2 Slave Device with report by exception.
- **Protocol Port** - serial EIA-232, EIA-485, or daughter board interface selectable. Configurable baud rate (300, 600, 1200, 2400, 4800, 9600, 19200, or 38400), parity (even, odd, or none), stop bits (1 or 2), protocol mode, and transmission delay (0 to 5000 ms).
- **Daughter Board Interface** - allows optional daughter board to be used to support additional communications interfaces such as fiber-optic or modem. Optional daughter boards are available from ICMI.
- **Communications Gateway** - The UVR-1 can serve as a communications gateway, permitting a different host-side (SCADA master) interface for multi-dropped and loop configurations.
- **Front Panel PC Port** - serial EIA-232 port for UVR-1 maintenance and configuration, as well as for data readout.

Metering:
- **Load Voltage** (direct sensing)
- **Load Current** (direct sensing)
- **Control Input Voltage**
- **Source Voltage**
- **Load Center Voltage**
- **Power Factor and Phase Angle**

- **Load VA, W, and VAr Power Values**
- **Line Frequency**
- **Harmonics for Load Voltage and Load Current** - % THD, and % of fundamental for 3rd through 13th odd harmonics.
- **Demand Metering** - thermal demand values for load current, VA, W, and VAr, for both forward and reverse power flow. Demand interval adjustable from 1 to 120 min. with 1 min. resolution.
- **Min/Max Metering** - min and max values for average load, source, and load center voltage, max values for all demand quantities, and power factor at max VA, along with the time and date of each min/max, are stored in non-volatile memory. Separate min/max values are maintained for forward and reverse power flow. These values are independently resettable.
- **Energy Metering** - forward and reverse WHr, and forward and reverse VArHr leading and lagging, along with their time and date of last reset, are stored in non-volatile memory. These values are reset as a group.
- Primary power and energy values may be displayed as 1-phase or 3-phase quantities.

Accuracy:

- 0.3% basic accuracy (tested per IEEE C57.15-1999), excluding VT and CT errors.

Operational Requirements:

- **Temperature** - -40 to +85 °C (-20 to +70 °C for LCD display).
- **Humidity** - maximum relative humidity of 95% non-condensing.
- **Power Supply/Sense Voltage** - 80 to 145 Vrms (referenced to ground).
- **Power Supply Current** - 65 mA rms typical (7.8 VA typical burden to VT, excluding motor current).
- **CT Secondary Current** - 0 to 1000 mA rms (0 to 400 mA for stated accuracy). 0.16 VA burden to CT at rated CT secondary current of 200 mA.
- **Frequency** - 45 to 65 Hz (50 and 60 Hz nominal operation).

Standards Compliance:

- ANSI/IEEE C57.15-1999, Standard Requirements, Terminology, and Test Code for Step-Voltage Regulators.
- ANSI/IEEE C37.90.2 (1987-1995), Radio Frequency Interference (RFI) Immunity.
- IEC 61000-4-2 (1995-2001), Electrostatic Discharge (ESD) Immunity.
- ANSI/IEEE C37.90.1-2002, Oscillatory SWC Immunity.
- ANSI/IEEE C37.90.1-2002, Fast Transient SWC Immunity.
- Certified as a DNP3-2001 Subset Level 2 compliant IED by Advanced Control Systems, Inc.
- Navy Military Specification I-46058 conformal coating protection for global weather climates.

User Interface:

- Menu driven with intuitive, easy to use panel controls.
- 2 line x 20 character alphanumeric display.
- Multiple display types - LCD with backlight (standard), or optional vacuum fluorescent for extreme climates.
- User-specified circuit ID string.
- Single level security code, with log of last 16 times that security Read/Write/Execute was enabled.

LED Indicator Lamps:

- **High Band** - On indicates load center voltage above high band edge.
  Flashing indicates same, but corrective tap changes inhibited due to operating mode.
- **In Band** - indicates load center voltage within band edges.
- **Low Band** - On indicates load center voltage below low band edge.
  Flashing indicates same, but corrective tap changes inhibited due to operating mode.
- **High Limit** - On indicates regulator load voltage above high limit setpoint (auto-runback pending).
  Flashing indicates raise operations inhibited near high limit setpoint.
- **Low Limit** - On indicates regulator load voltage below low limit setpoint (auto-runback pending).
  Flashing indicates lower operations inhibited near low limit setpoint.

- **Voltage Reduction** - indicates that the selected voltage reduction setting is non-zero.
- **Reverse Power** - indicates reverse power flow detected.
- **Alert -** indicates that one or more of several selectable alert conditions has occurred.
- **Neutral Position Indicator** - indicates regulator is at the neutral tap position.

Panel Features:

- **Voltmeter Terminals** - the UVR-1 control input voltage, which normally represents the regulator load terminal voltage.
- **External Source Terminals** - used to apply a ground-referenced external 120 VAC source to the UVR-1. Reverse-polarity protected by an internal replaceable fuse (6A, GMA-6A type).
- **Fuses** - separate replaceable fuses for Control (2A, ABC-2 type) and Motor Power (6A max., MDA-6 or MDA-6¼ type standard).
- **Main Power Switch** - controls power and inputs to the UVR-1.
  - Internal Source - Control power/load voltage input is from PS terminal, motor power is from MS terminal.
  - Off - Control power/load voltage input and motor power are disconnected.
  - External Source - Control power/load voltage input and motor power are from external source terminals.
- **Motor Control Switches**:
  - Auto/Off/Manual Switch:
    - Auto - routes the motor power selected with the Main Power switch to the UVR-1 and allows the UVR-1 to control tapchanger operation based on programmed settings.
    - Off - disconnects power from the tapchanger motor, disabling automatic and manual control.
    - Manual - routes the motor power selected with the Main Power switch to the Raise/Lower switch, disabling automatic control.
  - Raise/Lower Switch:
    - Raise - allows a local operator to manually run the tapchanger in the raise direction.
    - Lower - allows a local operator to manually run the tapchanger in the lower direction.
- **Draghand Reset Switch** - used to reset the draghands on the mechanical position indicator to the current tap position.
- **Local/Remote Switch:**
  - Local - Enables the following UVR-1 parameter access and control:
    - User Interface and PC port: Read/Write access
    - Remote: Read-only access
    - Auxiliary (external†) control: disabled
  - Remote - Enables the following UVR-1 parameter access and control:
    - User Interface and PC port: Read-only access
    - Remote: Read/Write access
    - Auxiliary (external†) control: enabled when Auto/Off/Manual switch is in Auto position

Configuration and Utility Software:

- **Protocol Configuration Utility** - Microsoft Windows®-compatible program used to customize the point map and its attributes.
- **Device Configuration Utility** - Microsoft Windows®-compatible program used to configure all UVR-1 parameters and setpoints. Can also be used to read data from the control.
- **Data Log Analysis Package** - Microsoft Windows®-compatible program used to display UVR-1 data log files in both graphical (strip-chart) and tabular formats.
- **Contact Wear Log Analysis Package** - Microsoft Windows®-compatible program used to display UVR-1 tapchanger contact wear log files in both graphical and tabular formats.

Maintenance and Upgrade Path:

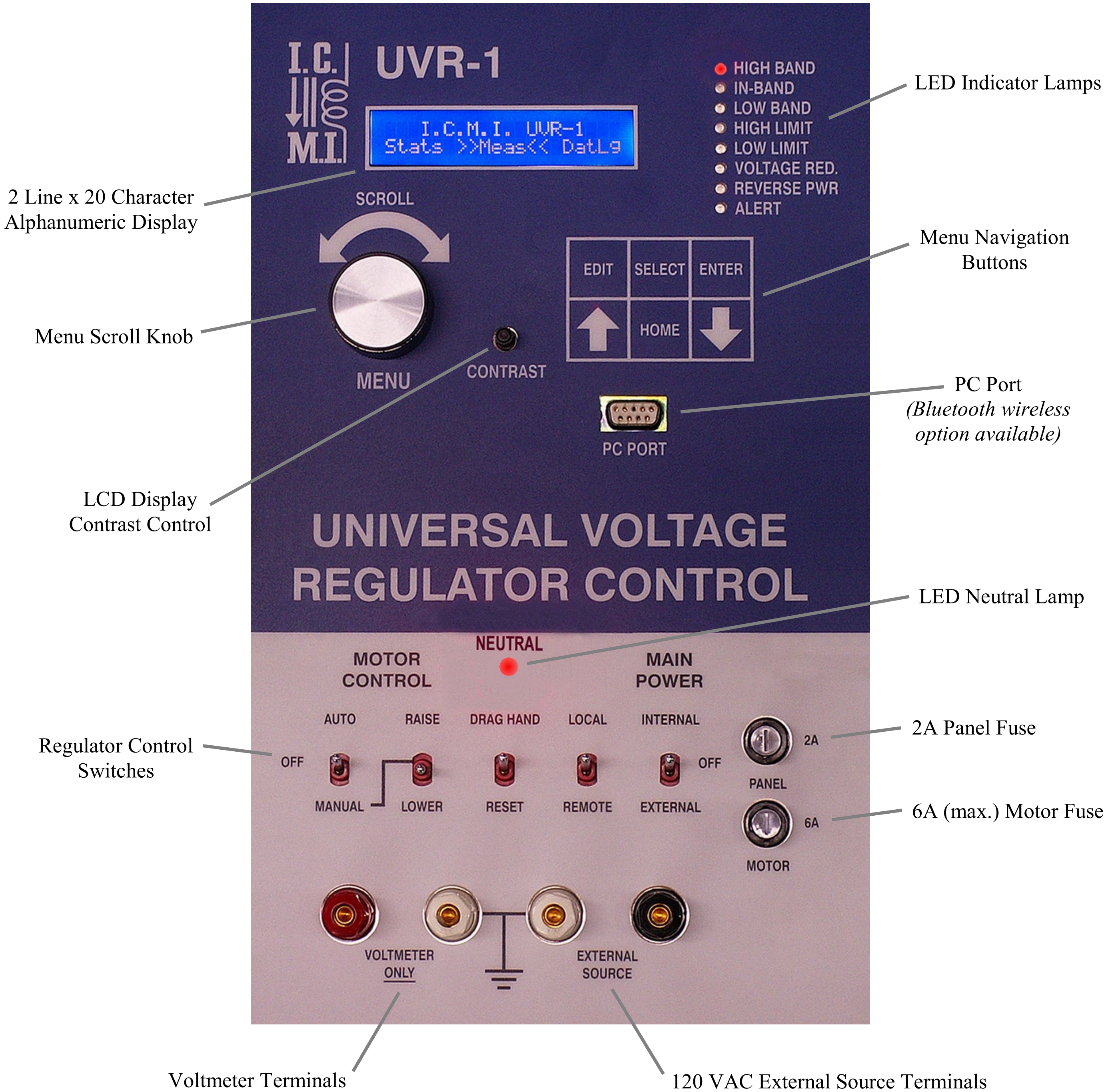
The front panel PC Port allows for firmware revisions as features are added or enhanced. The UVR-1 control is designed to accommodate additional data acquisition and control functions in the future. These functions may include event recording and protocols other than DNP3. As additional features are released, firmware and/or hardware revisions will be announced. The main processing circuit board inside the UVR-1 is designed to be replaceable with more powerful processors and larger program and data spaces. This provides a cost-effective upgrade path, insuring the flexibility of the UVR-1 and protecting the original investment.

Options:

- BlueTooth PC interface
- Hardened EIA-485 daughter board interface
- Fiber-optic daughter board interface
- Fiber-optic plus modem daughter board interface
- Fiber-optic plus ethernet daughter board interface
- XIO port interface board
- XIO port input-only interface board
- Battery backup
- Heater assembly

†Requires optional XIO Port Interface Board (or XIO Port Input-only Interface Board if only input functions are needed), available exclusively from ICMI.

User Interface



<u>WARNING</u>: Do not connect a 120 VAC source to these terminals, as this could cause a hazardous backfeed condition at the voltage regulator bushings.

<u>WARNING</u>: Polarity is critical. Do not reverse Line and Ground leads.

Alphanumeric Display

The 2 line x 20 character alphanumeric display is used for local monitoring and control of the UVR-1. Data items are accessed through an easy to use menu system. The LCD display is backlit for easy visibility in all conditions. An optional vacuum fluorescent display is available for extreme climates.

LCD Display Contrast Control

The **CONTRAST** control is used to adjust the LCD display contrast for maximum visibility.

LED Indicator Lamps

The LED indicator lamps provide immediate visual status of critical regulation conditions. See the Voltage Regulation section (p. 24) for details.

Menu Scroll Knob

The **SCROLL** knob allows easy and rapid selection of items and values from the menu system.

Menu Navigation Buttons

The menu navigation buttons are used in conjunction with the **SCROLL** knob for moving through the menu structure and editing data item values. See the Menu System section (p. 18) for details.

Regulator Control Switches

The regulator control switches allow local control of basic UVR-1 and regulator operation. See the Basic Operation section (p. 22) for details.

LED Neutral Lamp

The **NEUTRAL** lamp indicates that the tapchanger is in the neutral position. It is a direct indication of the tapchanger neutral switch status.

Fuses

There are two front panel fuses: the **PANEL** (2A, ABC-2 type) fuse protects the UVR-1 power supply and control circuitry, and the **MOTOR** (6A, MDA-6 or MDA-6¼ type standard) fuse protects the tapchanger motor and accessory outputs (RAP and AP terminals). The 6A (max.) **MOTOR** fuse rating can be adjusted based on the particular regulator and accessory equipment used with the UVR-1.

Voltmeter Terminals

The **VOLTMETER** terminals allow the UVR-1 control input voltage (from the VT or **EXTERNAL SOURCE** terminals) to be monitored with an external voltmeter or oscilloscope. Since the UVR-1 can display this measurement, the **VOLTMETER** terminals are generally used to check calibration of the UVR-1.

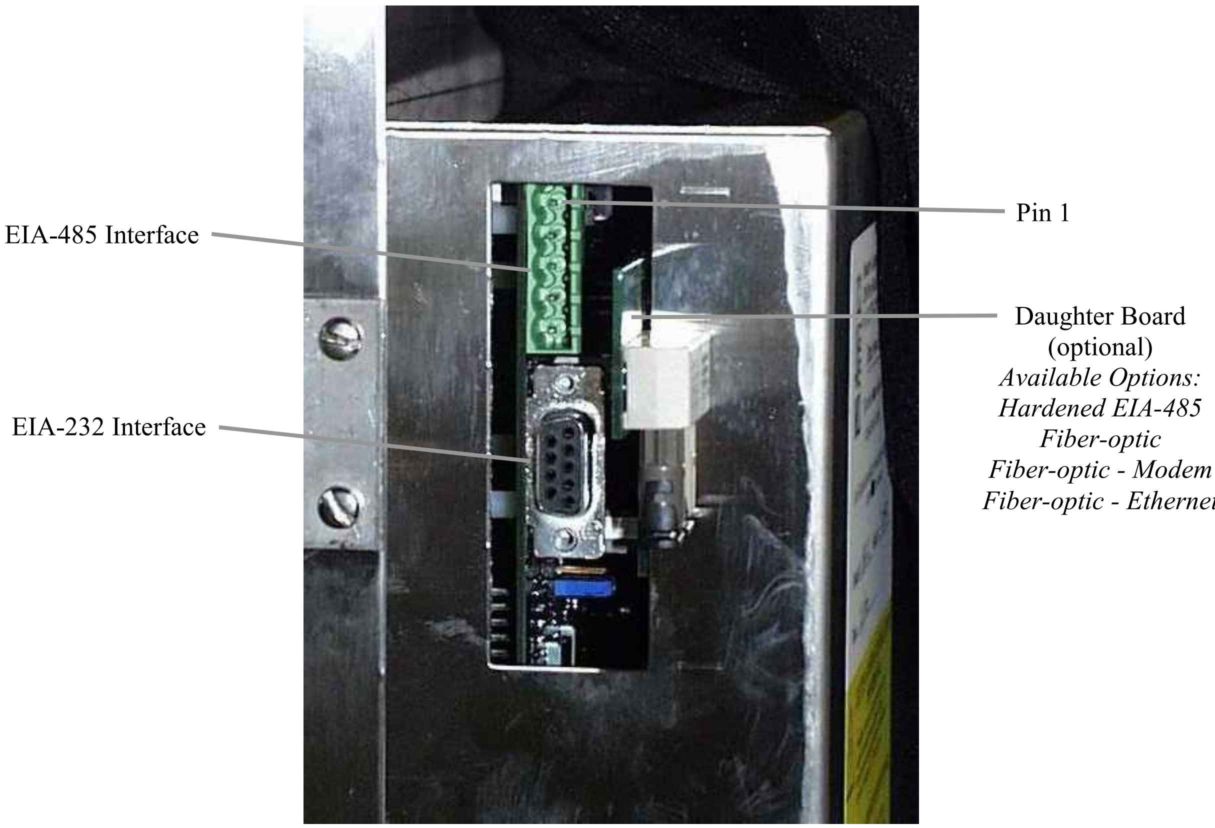
WARNING: The **VOLTMETER** terminals should never be used to supply power to the UVR-1. This could cause a connected regulator transformer to be energized, resulting in hazardous voltages at its primary terminals.

120 VAC External Source Terminals

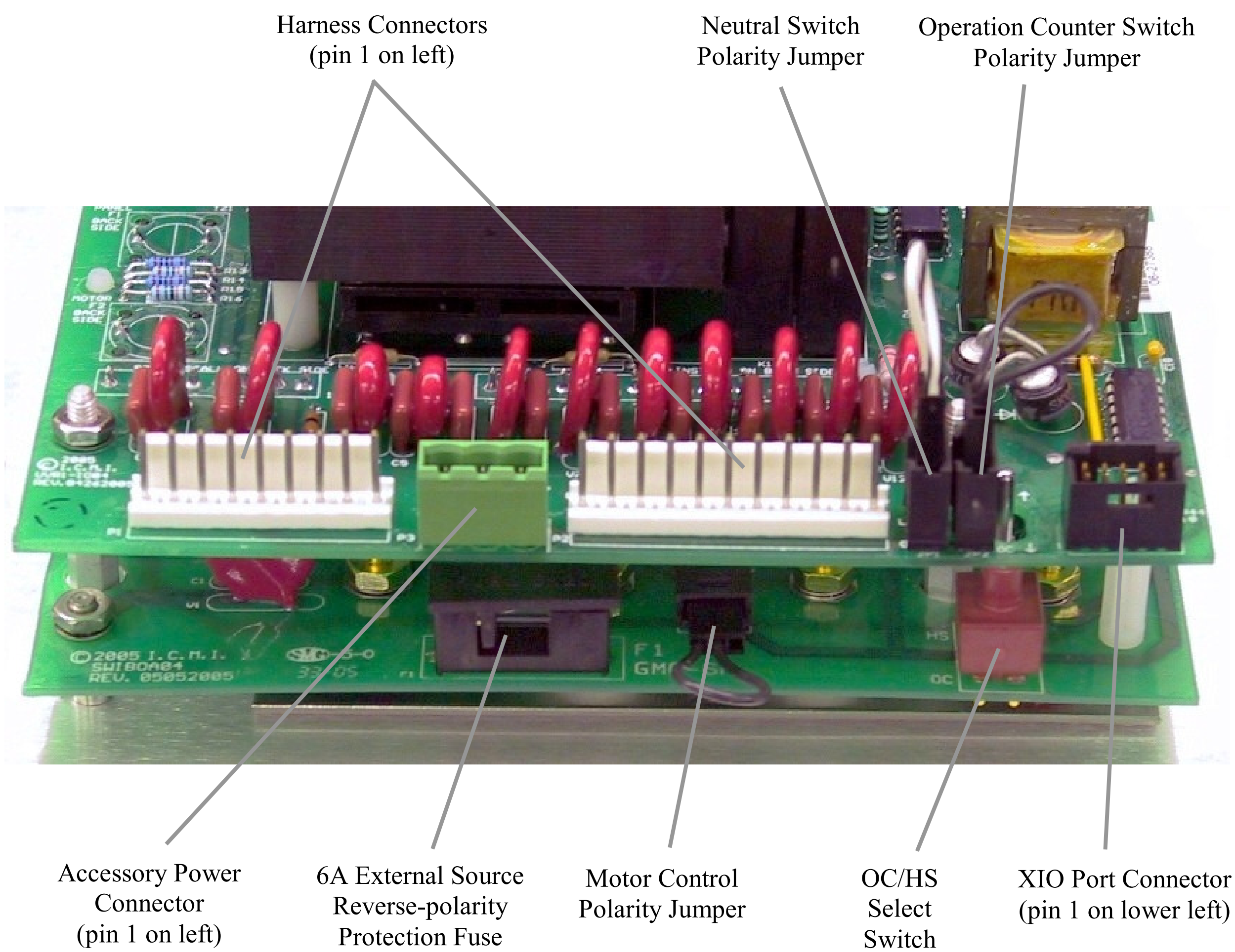
The **EXTERNAL SOURCE** terminals allow the UVR-1 and motor power to be supplied by a source other than the usual regulator windings. The external source must be 120 VAC, and proper polarity must be observed. There is an internal replaceable fuse (6A, GMA-6A type) to protect against reverse polarity. The **MAIN POWER** switch must be in the **EXTERNAL** position to use power from the external source.

External Interfaces

Protocol Port



Rear Panel Connectors and Settings



This section contains functional descriptions of the UVR-1 external interfaces. For detailed interfacing information, including connector pin-outs and signal characteristics, see the External Interface Reference section (p. 68).

Protocol Port

The UVR-1 protocol port, located on the side panel, is used for remote communications (for remote monitoring and control). Three electrical interfaces are supported, EIA-232, EIA-485, and a daughter board interface. EIA-232 is point-to-point, while EIA-485 can support multiple devices on a shared communications line. The optional daughter board interface can support a variety of other communications media. Interface selection and all serial communication parameters are configurable. See the appropriate UVR-1 Communications Supplement document for details on particular protocols.

PC Port

The front panel PC port can be connected to a PC for configuration and maintenance of the UVR-1, as well as for data readout. See the Configuration section (p. 56) and Maintenance section (p. 65) for procedures which use this port, and the *UVR-1 Utility Suite Manual, Configuration Utility section* for data readout information.

Harness Connectors

Most connections between the UVR-1 and the voltage regulator are through the harness connectors on the back of the control. A wiring harness for each particular regulator can be ordered from ICMI. See the External Interface Reference section (p. 68) for signal definitions.

Accessory Power Connector

Power for accessory equipment is available at the accessory power connector on the back of the control. See the External Interface Reference section (p. 68) for signal definitions.

XIO Port Connector

The XIO port provides a number of special-purpose and general-purpose input/output signals for the UVR-1, which are available at the XIO port connector. These low-level logic signals are interfaced to external equipment via I/O modules on the XIO Port Interface Board, or by optocouplers on the XIO Port Input-only Interface Board. The cable supplied with the board is plugged into the XIO port connector, on the back of the UVR-1. These optional circuit boards and interconnecting cables are available exclusively from ICMI, and are described in the *UVR-1 XIO Port Interface Guide* included with the board.

Neutral Switch Polarity Jumper

This jumper selects the neutral switch polarity (current-limited) at the NS terminal, either line (L, up) or ground (G, down). Set the jumper to connect the center and selected polarity positions. For example, if the neutral switch closes to ground, the polarity jumper should be set to line. When the neutral switch is closed, the control indicates neutral position.

Operation Counter Switch Polarity Jumper

This jumper selects the operation counter switch polarity (current-limited) at the OC terminal, either line (L, up) or ground (G, down). Set the jumper to connect the center and selected polarity positions. For example, if the operation counter switch closes to ground, the polarity jumper should be set to line. Transitions of the operation counter switch (as configured) cause the UVR-1 operation counters to increment.

Motor Control Polarity Jumper

This jumper selects the motor control polarity, either line (left) or ground (right). Set the jumper to connect the center and selected polarity positions. This polarity is applied to the motor winding through the raise or lower relay or switch.

OC/HS Select Switch

This switch selects whether the completion of a tap change is signaled by an operation counter switch (OC) or holding switch (HS). It must be set based on whichever signal is available from the particular tapchanger. If neither signal is valid, it should be set to OC.

External Source Reverse-polarity Protection Fuse

This fuse (6A, GMA-6A type) protects against the user connecting a 120 VAC source to the **EXTERNAL SOURCE** terminals with the polarity reversed.

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Menu System

The UVR-1 data item values can be set and monitored from the front panel user interface or remotely. An intuitive menu system makes it easy to observe measurements or change settings. The menu system is organized into functional categories and subcategories, within which the individual data items are grouped. A top-level view of the categories is also provided, called the “home menu.” This makes the menu system easy to navigate. The menu system is operated using the following user-interface controls:

SCROLL knob — Scrolls through menu categories, subcategories, or data items at a given menu level, in a circular fashion. In edit mode, used to adjust numeric values based on the current step value, to select from a list, or to select the character in the active character position.

SELECT button — Selects the currently displayed category or subcategory, opening the next level down in the menu structure. In edit mode, resets a resettable value and exits from edit mode, or sets a non-resettable value to its factory default value and stays in edit mode.

Down Arrow button — Selects the currently displayed category or subcategory, opening the next level down in the menu structure. In edit mode, decreases the current step value for numeric values or moves one character to the right.

Up Arrow button — Closes the currently displayed subcategory or data item, moving up one level in the menu structure. Does not return to the home menu. In edit mode, increases the current step value for numeric values or moves one character to the left.

HOME button — Returns to the home menu. In edit mode, discards changes before returning to the home menu.

EDIT button — Enters edit mode for a particular value. If already in edit mode, exits from edit mode, discarding changes.

ENTER button — Executes commands. In edit mode, accepts changes and exits from edit mode.

Navigation

Normally, the circuit ID string (CktID) is displayed on the top line, and the home menu on the bottom line. The home menu consists of a circular list of categories, with the centered category considered the “current” one. The **SCROLL** knob “rotates” the category list through the center position, indicated by >>   <<. To open the currently selected category, press the **SELECT** or **Down Arrow** button. At this point, the category and its first subcategory or data item name are displayed on the top line. A trailing ellipsis “...” indicates that another level exists below the current menu level. The bottom line is used to display data item values and prompts. The **SCROLL** knob and **Up Arrow** and **Down Arrow** buttons can be used to navigate the menu structure, as described above.

If a subcategory exists, the desired subcategory can be selected (using the **SCROLL** knob) and opened by pressing the **SELECT** or **Down Arrow** button. At this point, the name of the first data item is displayed on the top line, and its value or a prompt is displayed below. For each timestamped data item, the local date and time of timestamp are displayed alternately at two-second intervals, along with the value. For alerts, the active alerts are displayed sequentially at one-second intervals. For data items representing commands, a prompt is displayed.

Editing and Commands

If a data item is editable, pressing the **EDIT** button will cause the item name to flash, indicating that you are in edit mode (the UVR-1 must be in Local mode and the security code must have been entered at `Maint.Security Level`). At this point, the value can be changed using the **SCROLL** knob and the **Up Arrow**, **Down Arrow**, and **SELECT** buttons.

For numeric values, turning the **SCROLL** knob clockwise increases the value, and turning it counterclockwise decreases the value. Initially, the step value is the data item's unit of resolution (starting in its rightmost digit). The **Up Arrow** and **Down Arrow** buttons cause the value to be changed in coarser or finer steps, respectively. This usually is equivalent to the **Up Arrow** and **Down Arrow** buttons moving one digit to the left or right, respectively. A blinking cursor indicates the active position. The value will never be allowed outside of its legal range.

For character string values, the **SCROLL** knob selects the character in the active character position (initially the leftmost character). The **Up Arrow** and **Down Arrow** buttons move one character to the left or right, respectively. A blinking cursor indicates the active position.

For date/time values, turning the **SCROLL** knob clockwise increases the field value, and turning it counterclockwise decreases the value (initially by the coarsest step). The **Up Arrow** and **Down Arrow** buttons cause the value to be changed in coarser or finer steps, respectively. This usually is equivalent to the **Up Arrow** and **Down Arrow** buttons moving one digit to the left or right, respectively. A blinking cursor indicates the active position. The value will never be allowed outside of its legal range. Each field (e.g. day, hour) is independent, except that the day of the month will be limited to a valid value based on the month and year. For this reason, the year and month should be set before the day of the month.

The **SELECT** button can be used to restore a data item to its factory default value. Once the desired value is selected, press the **ENTER** button to accept the new value and exit edit mode. To exit edit mode without saving the new value, press the **EDIT** or **HOME** button.

If a data item is resettable, pressing the **EDIT** button will cause the item name to flash, indicating that you are in edit mode. At this point, the value can be reset using the **SELECT** button, exiting edit mode. To exit edit mode before resetting the value, press the **EDIT** or **HOME** button.

If a data item represents a command, a prompt will be displayed. If you wish to execute the command, press the **ENTER** button. At this point, "`Command Executed`" appears if the action was successful.

Security

A single level security code (Sc1, default "****") is available to protect control settings from being changed by an unauthorized local operator. In the Maintenance category, SecurityLevel must be set to Read/Write/Execute to allow control settings to be written or commands to be given. Once this is done, the security code (Sc1) can be changed just like any other setting. If SecurityLevel is set to Read Only, all control settings (except Sc1), status, and measurements are viewable, but no control settings can be written, and commands are disallowed. The only exceptions are that the resettable operation counter, CntOperR, can be reset, and the min/max (MinMaxRs) and energy (EnergyRs) group resets can be executed. When SecurityLevel is set to Read/Write/Execute, it will revert to Read Only if no user interface activity occurs for 15 minutes. Note that access through the PC port or remote communications protocol does not require a security code.

UVR-1 Menu Overview

- Stats
  - TapCh
    - TapPos
    - OpCount
    - ResOpCnt
  - Mode
    - AInhibit
    - CommBlk
    - VRed Lvl
    - VRed Pct
  - Cntct
    - Eng *dsg*
    - Brk *dsg*
  - XIO
    - Pos 1
    - Pos 2
    - Pos 3
    - Pos 4
    - Pos 5
    - Pos 6
    - Pos 7
    - Pos 8
  - Alerts
- Meas
  - Basic
    - LoadCtrV
    - Ld Volts
    - SrcVolts
    - Ld Amps
    - PriLCtrV
    - PriLoadV
    - PriSrcV
    - PriLoadA
    - PwrFactr
    - Hz
    - PriVA
    - PriWatts
    - PriVAr
    - CtlVIn
    - Temp
    - PhaseAng
  - VHarm
    - THD
    - 3rd
    - 5th
    - 7th
    - 9th
    - 11th
    - 13th
  - AHarm
    - THD
    - 3rd
    - 5th
    - 7th
    - 9th
    - 11th
    - 13th
  - Dmd
    - LoadA
    - VA
    - Watts
    - VAr
  - Enrgy
    - F WH
    - R WH
    - F VArHLd
    - F VArHLg
    - R VArHLd
    - R VArHLg
- DatLg*
  - Slot1
  - Slot2
  - Slot3
  - Slot4
  - Slot5
  - Slot6
  - Slot7
- Mn/Mx
  - FAvg
    - HiLdCtrV
    - LoLdCtrV
    - Hi LoadV
    - Lo LoadV
    - Hi SrcV
    - Lo SrcV
  - RAvg
    - HiLdCtrV
    - LoLdCtrV
    - Hi LoadV
    - Lo LoadV
    - Hi SrcV
    - Lo SrcV
  - FDmd
    - Hi LoadA
    - Hi VA
    - Hi Watts
    - Hi VAr
    - PF @HiVA
  - RDmd
    - Hi LoadA
    - Hi VA
    - Hi Watts
    - Hi VAr
    - PF @HiVA
  - Basic
    - Hi Temp
    - Lo Temp
  - DrHnd
    - HiTapPos
    - LoTapPos
- Cntrl
  - Reset
    - MnMx All
    - Average
    - Demand
    - Basic
    - Draghand
    - Energy
    - Cntcts
    - Cntct *ds*
  - Mode
    - VRC Blk
    - VRed
    - Timer
    - VLimit
    - RevPwr
    - CntctLog
  - Alert
    - CommBlk
    - RptTpPos
    - AInhibit
    - AutoSw
    - TapCh TO
    - LostTPos
    - ExtAlert
    - Blk HiV
    - Blk LowV
    - Volt Red
    - Rev Powr
    - Low Cur
    - Blk TapL
    - Blk TapR
    - BeloRevA
    - LowMotrV
    - BlkLoadA
    - ChkCntct
  - DatLg
    - Slot 1
    - Slot 2
    - Slot 3
    - Slot 4
    - Slot 5
    - Slot 6
    - Slot 7

* The data log / quick access data display (`DatLg`) menu behaves uniquely. See the Data Logging section (p. 44) for details.

- SetPt
  - Mode
    - VRedMd 1
    - VRedSt1X
    - VRedSt2X
    - VRedSt3X
    - Htr Temp
    - Clr Temp
  - Fwd
    - Bandctr
    - Bandwid
    - TimeDly
    - LDC R
    - LDC X
  - Rev
    - Bandctr
    - Bandwid
    - TimeDly
    - LDC R
    - LDC X
    - RevCur
  - VLim
    - RunBkHiV
    - RunBkLoV
    - RunBkDly
  - Meter
    - Avg Int
    - Dmd Calc
    - Dmd Int
    - PPwrDisp
    - DatLgInt
  - TapCh
    - TapBlkR
    - TapBlkL
    - RptTP Hi
    - RptTP Lo
  - Cntct
    - ChkEngS
    - ChkEngM
    - ChkBrkS
    - ChkBrkM
- Cnfig
  - TapCh
    - OpCntInc
    - MotVSrc
    - MotVNeut
    - MotVTh
    - TapTmout
    - InTapDly
    - TapPos
    - OpCnt
    - CntctTyp
    - NeutrlSw
  - Reg
    - SysCfg
    - BaseV
    - SystemV
    - SystemHz
    - FullLdA
    - Phasing
    - RegType
    - VTCfg
    - VTRatio
    - CTRatio
    - RegRange
    - IntReg
    - LimLoadA
    - PwrScale
  - XIO-*n*
    - Function
    - ActivLvl
    - DefOutpt
    - RBE
  - Cntrl
    - Lcl Time
    - SysYrBas
    - LclTOff
    - TSYrBase
    - TSFormat
    - CktIdNum
    - CktIdTxt
    - Dev Addr
    - Security
  - PrPrt
    - Mode
    - BaudRate
    - FrameTyp
    - Tx Delay
  - PcPrt
    - BaudRate
- Prof
  - SaveUserProf 1
  - LoadUserProf 1
  - SaveUserProf 2
  - LoadUserProf 2
  - SaveUserProf 3
  - LoadUserProf 3
  - LoadFacDefs
  - DAP-*x*
    - DateTime
    - ProfNum
- Maint
  - Security Level
  - Serial Number
  - Reg Serial Num
  - User ID
  - Clear DatLg
  - Reprogram
  - SecEn
    - *n*
  - Code
    - Registry
    - Boot Blk
    - App Code
    - Protocol
  - BdID
    - Main Brd
    - Display
    - I/O Brd
    - Switch
  - Diag

Basic Operation

The basic operation of the UVR-1 is controlled by the front panel switches. The Regulator Control Modes section (following) describes the interaction of the switches with other factors, and how they affect the control mode.

The **MAIN POWER** switch controls power and voltage inputs to the UVR-1 and has three positions:

- **INTERNAL** Control power/load voltage input is from PS terminal, motor power is from MS terminal.
- **OFF** Control power/load voltage input and motor power are disconnected.
- **EXTERNAL** Control power/load voltage input and motor power are from **EXTERNAL SOURCE** terminals.

The **AUTO/OFF/MANUAL** motor control switch selects the basic mode of operation of the UVR-1, and is a factor in the selection of the regulator control mode. It has three positions:

- **AUTO** Routes the motor power selected with the **MAIN POWER** switch to the UVR-1 and allows the UVR-1 to control tapchanger operation based on programmed settings.
- **OFF** Disconnects power from the tapchanger motor, disabling automatic and manual control.
- **MANUAL** Routes the motor power selected with the **MAIN POWER** switch to the **RAISE/LOWER** switch, disabling automatic control.

The **RAISE/LOWER** motor control switch operates the tapchanger during manual control (**AUTO/OFF/MANUAL** switch in **MANUAL**), or during Auto+Local mode when AutoInhibit is active (pseudo-manual). It has two momentary positions:

- **RAISE** Connects motor power to the tapchanger raise winding, running the tapchanger in the raise direction (entirely manual). Logically used to cause a raise operation in Auto+Local mode when AutoInhibit is active (momentary actuation initiates complete tap change managed by the control).
- **LOWER** Connects motor power to the tapchanger lower winding, running the tapchanger in the lower direction (entirely manual). Logically used to cause a lower operation in Auto+Local mode when AutoInhibit is active (momentary actuation initiates complete tap change managed by the control).

The **DRAGHAND RESET** momentary switch is used to reset the draghands on the mechanical position indicator to the current tap position. It does not affect the electronic draghands.

The **LOCAL/REMOTE** switch selects the source of control of the UVR-1, and is a factor in the selection of the regulator control mode. It has two positions:

- **LOCAL** Selects local control of the UVR-1 through the user interface or PC port.
- **REMOTE** Selects remote control of the UVR-1 through the communications protocol, and enables auxiliary (external) control in Auto+Remote mode.

Regulator Control Modes

The basic regulator control mode is set by the **AUTO/OFF/MANUAL** and **LOCAL/REMOTE** panel switches. In addition, the Auto+Remote mode allows the regulator tapchanger motor to be controlled by the auto-control algorithm, remote commands, or auxiliary (external) inputs, depending on certain data items. See the table below for descriptions of each mode. Note that the PC port is allowed the same access and control as the user interface.

<table>
<tr><th></th><th>LOCAL</th><th>REMOTE</th></tr>
<tr><td>OFF</td><td>No motor power.
User interface parameter access and control.
Remote read-only parameter access.</td><td>No motor power.
User interface read-only parameter access.
Remote parameter access and control.</td></tr>
<tr><td>MANUAL</td><td>Motor controlled by RAISE/LOWER switch.
User interface parameter access and control.
Remote read-only parameter access.</td><td>Motor controlled by RAISE/LOWER switch.
User interface read-only parameter access.
Remote parameter access and control.</td></tr>
<tr><td>AUTO</td><td>Motor controlled by auto-control algorithm.
User interface parameter access and control.
Remote read-only parameter access.</td><td>Motor controlled by auto-control algorithm.
User interface read-only parameter access.
Remote parameter access and control.</td></tr>
<tr><td>AuxAutoInhibit active -- overrides VRCBlk</td><td rowspan="2">Motor logically controlled by RAISE/LOWER switch (pseudo-manual).
User interface parameter access and control.
Remote read-only parameter access.</td><td>Motor controlled by auxiliary (external) inputs.
User interface read-only parameter access.
Remote parameter access and control.</td></tr>
<tr><td>VRCBlk active</td><td>Motor controlled by remote commands.
User interface read-only parameter access.
Remote parameter access and control.</td></tr>
</table>

VRCBlk can be used to inhibit the auto-control algorithm during setup, or for direct local or remote control of the tapchanger. Its effect (via AutoInhibit) on the action of the **RAISE/LOWER** switch is described above under “Basic Operation”.

Auxiliary (external) control is available in Auto+Remote mode. Auxiliary control inhibits the auto-control algorithm and disables remote control of the tapchanger motor. Three XIO port inputs are used for this purpose:

AuxAutoInhibit	While active, enables auxiliary control and forces AutoInhibit active unconditionally.
AuxRaise	Inactive-to-active transition issues raise command.
AuxLower	Inactive-to-active transition issues lower command.

In conjunction with the SyncRaise and SyncLower XIO port outputs, these inputs can be used to gang multiple regulator controls for master-slave transformer paralleling applications. See the *XIO Port Function Application Notes, SyncRaise / SyncLower Output Functions* and *Auxiliary Function Group* for more details.

Regulator Control Mode Status

- Auto/Off/ManualSw indicates the position of the **AUTO/OFF/MANUAL** panel switch (either **AUTO** or **OFF/MANUAL**). It can cause an alert when in the **OFF/MANUAL** state.
- Local/RemoteSw indicates the position of the **LOCAL/REMOTE** panel switch.
- AutoInhibit is active whenever either VRCBlk or the XIO AuxAutoInhibit input is active, which inhibits the auto-control algorithm. This condition can also cause an alert.
- CommBlk is active whenever the XIO AuxAutoInhibit input is active, blocking remote control of the tapchanger motor. This condition can also cause an alert.

Voltage Regulation

The UVR-1 provides powerful and flexible voltage regulation capabilities. This section describes the operating modes, control capabilities, status indications, and setpoints which apply to voltage regulation.

Voltage Regulation Algorithm

In general, voltage regulation is accomplished by monitoring the regulator load voltage, compensating for line drop, and comparing the result to a desired set voltage. If the voltage is above or below the set voltage by a certain margin (bandwidth/2), a time delay is started. If the voltage remains outside of the band edges, the regulator tapchanger motor is run to raise or lower the voltage by one or more steps. Steps are performed until the voltage is within the band edges. Several setpoints control the algorithm, and are discussed in detail below.

The following five items have separate setpoints for forward and reverse regulation and metering, listed in that order. For co-generation mode, the reverse line drop compensation setpoints are used during reverse power flow. See the Power Flow Modes section (p. 28) for a detailed discussion of forward and reverse operation.

Bandcenter (FBctr or RBctr)
Load center voltage to which the control will regulate (normalized to BaseV). The load center is a theoretical location at which the voltage is to be regulated, defined as an electrical distance from the regulator by the line drop compensation settings. Load center voltage is the regulator load voltage adjusted for voltage drop (or rise) due to transmission system impedance (line drop compensation).

Bandwidth (FBwid or RBwid)
Total voltage range (at the load center) around the bandcenter, which the control will consider in-band (normalized to BaseV). If the load center voltage is in-band, the control takes no corrective action. The band edges are symmetrical about the bandcenter. For example, if the bandcenter is 120.0 V and the bandwidth is 4.0 V, the high band edge is 122.0 V and the low band edge is 118.0 V.

Time Delay (FTimDel or RTimDel)
Time delay from recognition of out-of-band condition to tap change initiation. The exact behavior of the timer and voltage regulation algorithm is based on TmrMode.

Line Drop Compensation Resistive Component (FLDCR or RLDCR)
Voltage change, at rated CT current, due to the resistive portion of the line impedance between the voltage regulator and the load center (normalized to BaseV). This is the portion of the line voltage drop (or rise) which is in phase with the line current. See Appendix A (p. 117) for details on how to calculate this setpoint.

Line Drop Compensation Reactive Component (FLDCX or RLDCX)
Voltage change, at rated CT current, due to the reactive portion of the line impedance between the voltage regulator and the load center (normalized to BaseV). This is the portion of the line voltage drop (or rise) which is in quadrature with the line current. See Appendix A (p. 117) for details on how to calculate this setpoint.

Voltage Regulation Status

- InBand is active when the load center voltage is within the band edges.
- The **IN-BAND** lamp indicates that the load center voltage is within the band edges.
- HighBandEdge is active when the load center voltage is above the high band edge.
- The **HIGH BAND** lamp indicates that the load center voltage is above the high band edge. During this condition, it flashes if corrective tap changes are inhibited due to operating mode (see the Power Flow Modes section (p. 28) for details).
- LowBandEdge is active when the load center voltage is below the low band edge.

- The **LOW BAND** lamp indicates that the load center voltage is below the low band edge. During this condition, it flashes if corrective tap changes are inhibited due to operating mode (see the Power Flow Modes section (p. 28) for details).

Timer Modes

TmrMode determines the behavior of the timer and voltage regulation algorithm when an out-of-band condition is detected. Each mode is described below.

Sequential
When the load center voltage exceeds either band edge, the time delay is initiated. After the time delay has expired, the appropriate raise or lower operations are performed until the load center voltage is in-band. An inter-tap delay is inserted between steps if more than one tap step is required to return the voltage in-band. If the load center voltage returns to within the band edges during the time delay period, the timer is reset, and normal in-band monitoring proceeds.

Time-Integrating Sequential
When the load center voltage exceeds either band edge, the timer (initially 0) is incremented each second. If the timer meets or exceeds the time delay, the appropriate raise or lower operations are performed until the load center voltage is in-band. An inter-tap delay is inserted between steps if more than one tap step is required to return the voltage in-band. If the load center voltage returns to within the band edges during the time delay period, the timer is decremented each second. If the timer reaches 0, normal in-band monitoring proceeds. If the timer has not decremented to 0 when the load center voltage again exceeds the same band edge, the timer resumes counting up from its current value. If the other band edge is exceeded, the timer is reset before being incremented.

Voltage-Averaging
When the load center voltage first exceeds either band edge, the time delay is initiated. The load center voltage is monitored and averaged over the delay. The average is used to compute the number of raise or lower operations necessary to bring the load center voltage back to the bandcenter. After the time delay has expired, the computed number of raise or lower operations is performed (up to 5, with no inter-tap delay). If the load center voltage returns to within the band edges for 10 continuous seconds during the time delay period, the timer is reset, and normal in-band monitoring proceeds. If the other band edge is exceeded during the delay, the time delay is restarted.

Simplified Voltage Regulation

If there is no valid operation counter or holding switch signal (CntOperIncr selection), a simplified voltage regulation algorithm must be used. The voltage-averaging timer mode is not supported, and if selected, behaves as the sequential timer mode. There is no inter-tap delay. Once the tapchanger motor starts running, it stays on until the load center voltage is in-band. During a lower operation, hysteresis is used to prevent hunting near the upper band edge due to voltage drop caused by the motor load. Similarly, during a voltage limiting runback, the tapchanger is run continuously until the load terminal voltage is within the limits, with hysteresis at the high voltage limit. The following functions are also not supported: tap position tracking, tap position limits and reporting, operation counters, tap change timeout, contact wear logging, remote, auxiliary, or pseudo-manual tapchanger control, SyncRaise and SyncLower XIO port outputs, source-side calculations, and reverse regulation and metering.

Voltage Limiting

The voltage at the load terminal of the regulator is monitored to protect against overvoltage/undervoltage conditions. Note that voltage limiting is based on the voltage at the regulator terminal, not the load center. Separate high and low limits can be set and selectively enabled. If line or load conditions cause the limits to be exceeded, the control automatically causes the regulator to perform tap changes to return the load terminal voltage to within the limits. Voltage limiting is active whenever the auto-control algorithm is active and not inhibited and tap changing is not inhibited, and has higher priority than any other automatic operations. To prevent undesirable tap changes, voltage limiting is disabled for 8 seconds after power flow reversals, mode changes, and certain parameter changes.

Voltage Limiting Mode (VLimitMode)
This selects which limits are enabled: no voltage limiting, low voltage limit, high voltage limit, or both.

High Limit (RnbkHV)
The regulator load terminal voltage (normalized to BaseV) is not allowed above this setting. Tapchanger raise operations are inhibited anytime the load voltage is greater than this setting minus 1 V ("grey zone").

Low Limit (RnbkLV)
The regulator load terminal voltage (normalized to BaseV) is not allowed below this setting. Tapchanger lower operations are inhibited anytime the load voltage is less than this setting plus 1 V ("grey zone").

Auto-Runback
If the line or load characteristics change or the limit settings are changed, and either of the voltage limits is exceeded for a specified time period (RnbkDly), the control will automatically perform tap changes to return the regulator load terminal voltage to within the limits. Auto-runback takes place immediately following RnbkDly, without the time delay normally associated with tap changes. Once the voltage is within the limits, normal regulation timing resumes. The grey zones are implemented to prevent excessive tap changes around the limit points.

Voltage Limiting Status

- BlkHV is active whenever tapchanger raise operations are blocked due to the load voltage being within or above the high limit grey zone. This condition can also cause an alert.
- The **HIGH LIMIT** lamp flashes whenever the load voltage is in the high limit grey zone, and is on steadily when the load voltage is above the high limit setpoint.
- BlkLV is active whenever tapchanger lower operations are blocked due to the load voltage being within or below the low limit grey zone. This condition can also cause an alert.
- The **LOW LIMIT** lamp flashes whenever the load voltage is in the low limit grey zone, and is on steadily when the load voltage is below the low limit setpoint.

Voltage limiting status items are only updated when a tap change is not in progress.

Reverse Regulation

During reverse regulation, the load is on the source terminal side of the regulator. In this case, in the discussion above, the term "load terminal" should be replaced with "source terminal", and the terms "raise" and "lower" should be interchanged.

Tap Position Limits

For increased load capability, the regulator tap position may be limited to less than the full range. Separate raise and lower tap position limits may be set, and apply anytime the UVR-1 is in Auto mode. These limits are independent of, but should not exceed, any mechanical limits. The reporting limits and status indications below apply regardless of regulator control mode.

Raise Tap Position Limit (TapBlkR)
Raise operations are not permitted when the present tap position is at or above this limit. If the limit is set below the present tap position, only lower operations will be permitted until the tap position is inside the limit.

Lower Tap Position Limit (TapBlkL)
Lower operations are not permitted when the present tap position is at or below this limit. If the limit is set above the present tap position, only raise operations will be permitted until the tap position is inside the limit.

Raise Tap Position Report Limit (RptTapPosR)
When the present tap position exceeds this limit, RptTapPos will be active and can cause an alert.

Lower Tap Position Report Limit (RptTapPosL)
When the present tap position exceeds this limit, RptTapPos will be active and can cause an alert.

Tap Position Limit Status

- BlkTapR is active when raise operations are blocked due to TapBlkR, and can also cause an alert.
- BlkTapL is active when lower operations are blocked due to TapBlkL, and can also cause an alert.
- RptTapPos is active when the present tap position is outside of the tap position report limits, and can also cause an alert.

Load Current Limit

The load current limit (LimLoadA, at CT secondary) prevents automatic operation during an overcurrent condition. Its main purpose is for protecting the regulator tapchanger from excessive wear. It cannot be disabled, but its range extends beyond the maximum current able to be sensed accurately by the UVR-1. CT secondary current (as measured) exceeding LimLoadA inhibits the auto-control algorithm. It does not set the AutoInhibit data item.

BlkLoadA is active whenever the load current limit is exceeded, and can also cause an alert. It is only updated when a tap change is not in progress.

Voltage Reduction Modes

Voltage reduction can be used to reduce load center voltage by a selected percentage, effectively lowering the bandcenter setpoint. Implementation of voltage reduction has been found, when used for short periods, to commensurately reduce the system load. This may be implemented as a means to briefly reduce the load during critical periods of inadequate generation.

VRedMode is the voltage reduction mode. Mode 1 uses a single voltage reduction setpoint. Mode 2 allows XIO port inputs to select from among three voltage reduction setpoints (or none). Voltage reduction can range from 0.0% to 10.0%.

Mode 0: Voltage reduction disabled.

Mode 1: Voltage reduction enabled, VRedMode1 is used as the percent voltage reduction setpoint.

Mode 2: Voltage reduction enabled, XIO VRed1 and VRed0 inputs are used to select the percent voltage reduction setpoint (level):

VRed1	VRed0	Setpoint
inactive	inactive	none (0%)
inactive	active	VRedStep1X
active	inactive	VRedStep2X
active	active	VRedStep3X

Mode 3: Reserved.

Mode 4: Voltage reduction enabled, VRedStep2X is used as the percent voltage reduction setpoint (for compatibility with other regulator controls, not recommended for general use).

Voltage Reduction Status

- VoltageReduction is active if voltage reduction is enabled (even if the percent voltage reduction is 0), and can also cause an alert.
- The **VOLTAGE RED.** lamp indicates that the percent voltage reduction is non-zero.
- VRedLevel indicates the voltage reduction level due to the XIO port inputs (used only in mode 2).
- VRedPct is the percent voltage reduction currently in effect (setpoint value).

Power Flow Modes

The UVR-1 has multiple modes of operation (RevPwr), to support several expected power flow situations. The available modes are summarized below:

Locked Forward	Regulation and metering based on forward power flow. Average and demand metering operate only during forward power flow, and tap changes do not occur during reverse operation.
Locked Reverse	Regulation and metering based on reverse power flow. Average and demand metering operate only during reverse power flow, and tap changes do not occur during forward operation.
Idle Reverse	Regulation and metering based on power flow direction, but tap changes do not occur during reverse operation.
Bi-directional	Regulation and metering based on power flow direction.
Neutral Reverse	Regulation and metering based on power flow direction, but regulator returns to neutral position during reverse operation.
Co-generation	Regulation and metering based on forward power flow, except that during reverse power flow, the reverse line drop compensation settings are used and min/max values are stored in the reverse data items.

Reverse power flow is detected by monitoring the phase angle of the load current relative to the voltage, as well as the real current component. Separate setpoints are maintained for forward and reverse regulation and metering. Separate average and demand min/max metering data are maintained for forward and reverse metering. Exceptions are detailed in the power flow mode descriptions below. A source-side sensing transformer is not required. See the Metering section (p. 37) for more details.

Regulation and metering are based on power flow mode and power flow direction, with a ±1% rated load current hysteresis about zero. Operation is based on power flow mode, power flow direction, and real load current magnitude exceeding a user-specified threshold (RevCur). Three terms related to power flow direction must now be defined:

Reverse operation	a general term meaning that the UVR-1 is operating differently due to reverse power flow.
Reverse regulation	voltage regulation when the power flow through the regulator is in the direction of the load (L) terminal to the source (S) terminal. This may occur due to a switching condition on the line as may be required for service, or as the result of a remote generator back-feeding the line. Regulation direction always corresponds to metering direction.
Reverse metering	metering when source and load measurements refer to the opposite regulator terminals.

Source-side calculations and reverse regulation and metering are not supported for closed delta nor series transformer regulator configurations, nor during simplified voltage regulation. In these cases, the power flow modes are modified as follows:

- Regulation and metering are based on forward power flow.
- For Idle Reverse and Neutral Reverse, during reverse power flow, the reverse line drop compensation settings are used and min/max values are stored in the reverse data items.

- Locked Reverse and Bi-directional are not supported, and if selected, behave as Co-generation.

Except for this, the descriptions and power flow diagrams for each power flow mode below show the exact criteria for the operation, regulation, and metering directions.

A ±1% rated load current hysteresis about zero and the RevCur threshold are used to prevent frequent operating mode changes due to power flow reversals at low current.

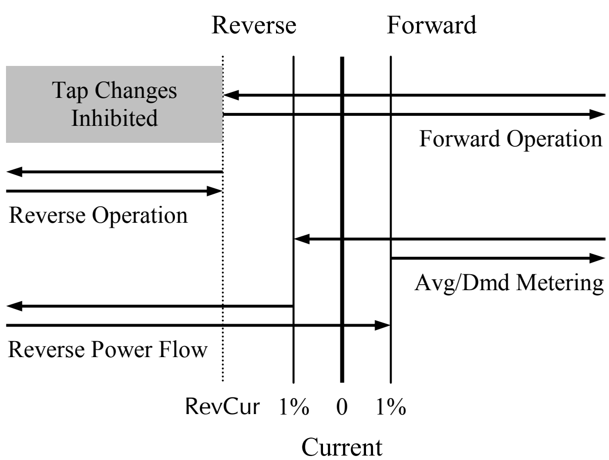
There are several status indications related to power flow direction:

- RevOperate is active during reverse operation, and inactive during forward operation.
- RevMeter is active during reverse metering, and inactive during forward metering.
- RevPowerFlow indicates reverse power flow detected (with a hysteresis of ±1% rated load current), and can also cause an alert.
- The **REVERSE PWR** lamp indicates reverse power flow detected (with a hysteresis of ±1% rated load current).
- BelowRevCur is active when real load current magnitude is below the RevCur threshold, and can also cause an alert. It is enabled only in certain power flow modes, indicating that tap changes are inhibited.
- LowCurrent is active when real load current magnitude is below 1% of rated load current, and can also cause an alert.

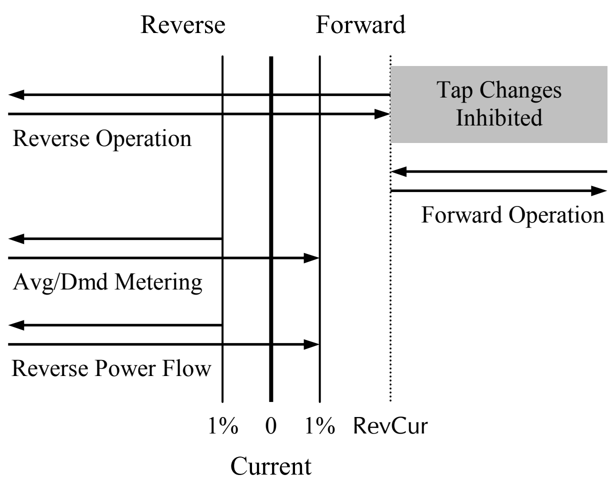
See the following descriptions and power flow diagrams for details of each power flow mode:

Locked Forward

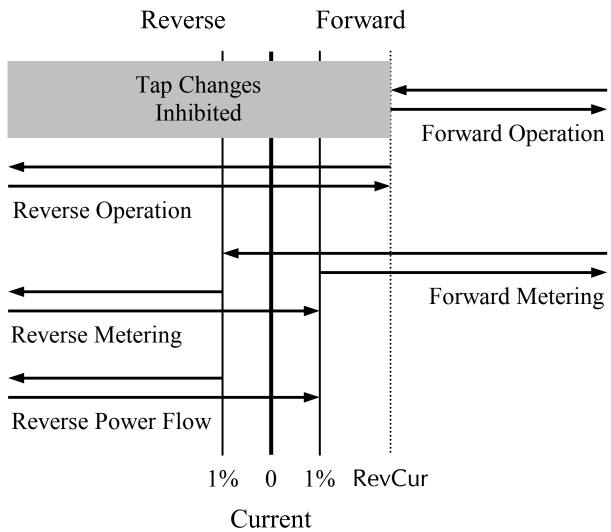
This mode is intended for use on systems where reverse power flow is not expected. Forward regulation and metering are used regardless of power flow direction. Tap changes are inhibited when reverse current exceeds the RevCur threshold. The **HIGH BAND** or **LOW BAND** lamp flashes if out-of-band while tap changes are inhibited. RevPowerFlow and the **REVERSE PWR** lamp indicate reverse power flow (if it occurs). Average and demand metering operate only during forward power flow. Metering and operation transitions are not performed until the power flow has been stable (LowCurrent inactive) for 5 seconds.



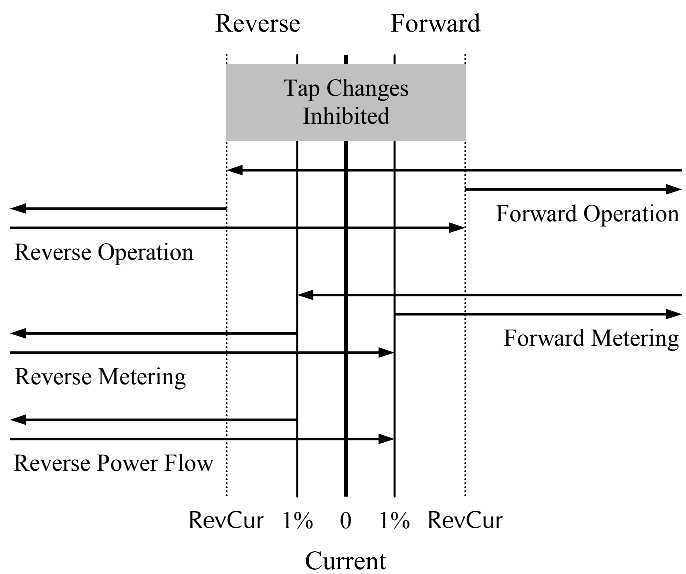
Locked Reverse
This mode is intended for use on systems where forward power flow is not expected. Reverse regulation and metering are used regardless of power flow direction. Tap changes are inhibited when forward current exceeds the RevCur threshold. The **HIGH BAND** or **LOW BAND** lamp flashes if out-of-band while tap changes are inhibited. RevPowerFlow and the **REVERSE PWR** lamp indicate reverse power flow. Average and demand metering operate only during reverse power flow. Metering and operation transitions are not performed until the power flow has been stable (LowCurrent inactive) for 5 seconds.



Idle Reverse
This mode is intended for use on systems where reverse power flow is due a remote synchronous generator with its own voltage excitation control. Regulation and metering are based on power flow direction. Tap changes are inhibited during reverse operation. The **HIGH BAND** or **LOW BAND** lamp flashes if out-of-band while tap changes are inhibited. RevPowerFlow and the **REVERSE PWR** lamp indicate reverse power flow. Regulation, metering, and operation transitions are not performed until the power flow has been stable (LowCurrent inactive) for 5 seconds.

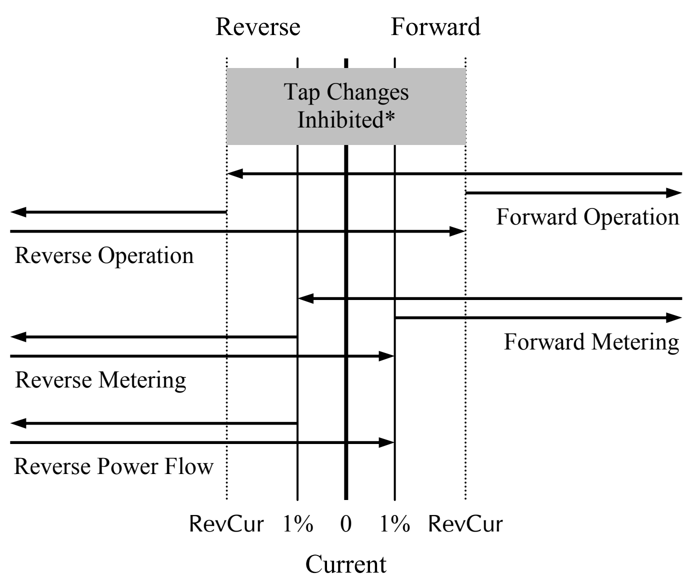


Bi-directional
This mode is intended for use on systems where reverse power flow is expected, but the system remains radial, as is often encountered when the utility is performing field service which temporarily results in the power flow reversal. Regulation and metering are based on power flow direction. Tap changes are inhibited and BelowRevCur is active when real load current magnitude is below the RevCur threshold. The **HIGH BAND** or **LOW BAND** lamp flashes if out-of-band while tap changes are inhibited. RevPowerFlow and the **REVERSE PWR** lamp indicate reverse power flow. Regulation, metering, and operation transitions are not performed until the power flow has been stable (LowCurrent inactive) for 5 seconds.



Neutral Reverse

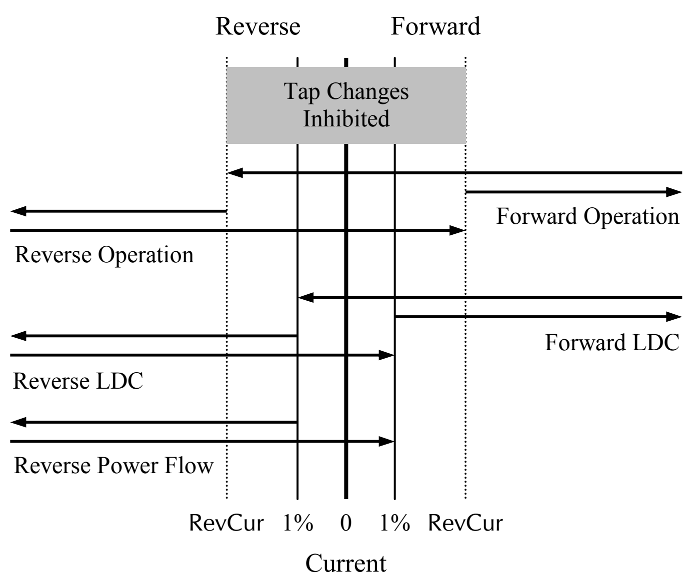
This mode is similar to Idle Reverse except that the regulator is automatically returned to the neutral tap position during reverse operation. In reverse operation, tap changes begin when the real load current magnitude exceeds the RevCur threshold for 10 continuous seconds. Regulation and metering are based on power flow direction. Tap changes are inhibited and BelowRevCur is active when real load current magnitude is below the RevCur threshold. However, once the regulator has begun tapping towards neutral during reverse operation, it will not stop based on this condition. Voltage limiting is inactive during reverse operation. The **HIGH BAND** or **LOW BAND** lamp flashes if out-of-band while tap changes are inhibited or during reverse operation. RevPowerFlow and the **REVERSE PWR** lamp indicate reverse power flow. Regulation, metering, and operation transitions are not performed until the power flow has been stable (LowCurrent inactive) for 5 seconds.



*unless return-to-neutral tap sequence is in progress.

Co-generation

This mode is intended for use with those co-generation applications that use induction generators which have no means of excitation control and therefore cannot regulate the distribution voltage. In this circumstance, the voltage must continue to be held by the regulator. The load center (location at which the bandcenter voltage is held) may be at the regulator load (L) terminal or at some remote point, such as at the co-generator location, as determined by the line drop compensation setpoints. Different load center locations can be produced by using different line drop compensation settings. This is accomplished by using forward regulation and metering regardless of power flow direction, but using the reverse line drop compensation setpoints during reverse power flow. Tap changes are inhibited and BelowRevCur is active when real load current magnitude is below the RevCur threshold. The **HIGH BAND** or **LOW BAND** lamp flashes if out-of-band while tap changes are inhibited. RevPowerFlow and the **REVERSE PWR** lamp indicate reverse power flow. During reverse power flow, min/max values are stored in the reverse data items. Regulation, metering, and operation transitions are not performed until the power flow has been stable (LowCurrent inactive) for 5 seconds.



Tapchanger Control and Status

The voltage regulator tapchanger motor can be controlled directly, either locally, through auxiliary (external) control, or by remote control. See the Regulator Control Modes section (p. 23) for details. Three commands are used for remote (protocol) control of the tapchanger motor:

- Raise causes the tapchanger motor to run in the raise direction until one tap change is complete.
- Lower causes the tapchanger motor to run in the lower direction until one tap change is complete.
- Raise/Lower is a single point that uses a paired trip or close operation to cause a raise or lower tap change, respectively (see protocol-specific manuals).

The current tap position is tracked by the UVR-1, based on the neutral switch (if present) and acknowledgement of completed tap changes from the operation counter or holding switch. The tap position is maintained in non-volatile memory, and can be set to match the physical tap position. Two digital operation counters, one resettable, are maintained in non-volatile memory. The non-resettable counter may be set to match an existing operation counter on the tapchanger.

There are several tapchanger status indications, applicable to all regulator control modes:

- TapPos is the internally tracked tap position. It can be set to reflect the physical tap position.
- CntOper is the internal operation counter, which keeps track of the total number of tap changes. It can be set to reflect the current value of an existing operation counter.
- CntOperR is a resettable operation counter, specifically intended for counting the number of tap changes since it was last reset by the OpRs command. It can be reset without entering the security code.
- RaiseCommand is active while the tapchanger motor is running in the raise direction.
- LowerCommand is active while the tapchanger motor is running in the lower direction.
- NeutralTapPos is active when the tapchanger is in the neutral tap position, as signaled by the neutral switch.
- TapChTimeout becomes active when a tap change timeout (TapTimeout exceeded) has occurred, and stays active until a tap change has been completed successfully (as indicated by the operation counter or holding switch). An alert can be caused when this is active.
- TapPosKnown is active when the tap position is known by the UVR-1, and inactive if the tap position is in question. The tap position is normally tracked internally by the UVR-1, but can be lost if the neutral switch signal doesn't occur when the internally tracked tap position goes to neutral, a tap change timeout occurs, a tap change complete indication occurs when the internally tracked tap position would be beyond ±16 or without a valid direction, etc. When the tap position is lost, an alert can be caused, and tap changes are inhibited while reverse metering (since tap position is needed to calculate source-side quantities or to return to neutral). Tap position becomes known when it is explicitly set or when the neutral switch signal occurs.
- LowMotorV is active when the tapchanger motor voltage is below the MotorVThres threshold, indicating that the motor may not be able to successfully perform a tap change. This condition inhibits all control-initiated tap changes, and can also cause an alert. It is only updated when a tap change is not in progress.

Alerts

For convenience in monitoring, the UVR-1 provides a general alert status indication in addition to a set of specific alert status indications. Masks that can be individually enabled allow any of a set of specific conditions to cause alerts. In addition to the internally monitored conditions, one or more XIO inputs can be used as an external source of an alert when configured as an ExtAlert input. An XIO output can be used to indicate the general alert status when configured as an Alert output. The list of alert conditions is shown below.

CommBlk active
RptTapPos active
AutoInhibit active in Auto mode
Auto/Off/ManualSw not auto
TapChTimeout active
TapPosKnown inactive
XIO ExtAlert active
BlkHV active
BlkLV active
VoltageReduction enabled
RevPowerFlow reverse
LowCurrent active
BlkTapL active
BlkTapR active
BelowRevCur active
LowMotorV active
BlkLoadA active
ChkCntct active

The following data items are used to control and monitor the alert status:

- AlertMask1 and AlertMask2 comprise masks for the above conditions, any of which may be set to enable their respective alerts. In the menu system, these can be found in the `Cntrl.Alert...` sub-category.
- AlertStatus1 and AlertStatus2 comprise the specific alert status indications. Each specific alert is active only when enabled by its alert mask and its alert condition is true. In the menu system `Stats.Alerts...` sub-category, the active alerts are displayed sequentially at one-second intervals.
- Alert is the general alert status indication, active whenever at least one of the specific alerts is active.
- The **ALERT** lamp indicates the general alert status.

Metering

The UVR-1 has a comprehensive metering system. Load terminal voltage and current are directly sensed, including their harmonics. All other quantities are calculated or internally maintained. Min/max quantities are stored separately based on power flow direction and power flow mode (see the Power Flow Modes section (p. 28) for details). The following is a summary of the available measurements. A detailed list of measurements and their descriptions is presented at the end of this section.

Basic Measurements

- Control input voltage.
- Source, load, and load center voltages, both primary and normalized to BaseV.
- Load current, both primary and CT secondary level.
- Power factor and line frequency.
- Load VA, W, and VAr power values.
- Harmonics for load voltage and current: % THD, and % of fundamental for 3rd through 13th odd harmonics.
- UVR-1 ambient air temperature.
- Phase angle.

Primary power and energy values may be displayed as 1-phase or total 3-phase (assumed balanced) quantities, as selected by PriPwrDis. When L terminal current is below 1% of rated load current, phase angle, power factor, power values, and current harmonics are zeroed.. Source-side calculations and reverse metering are not supported for closed delta nor series transformer regulator configurations, nor during simplified voltage regulation. Source-side values will be forced to zero and displayed as "-----" in these cases.

Demand Metering

Demand values are calculated for primary load current, VA, W, and VAr, for both forward and reverse metering. The thermal demand calculation simulates the delayed response of thermal or mechanical equipment as they absorb electrical energy, and transient variations are averaged out. The demand value is a moving integral which reaches 90% of its final value after one demand interval in response to a step function. The demand interval (DmdInt) is adjustable from 1 to 120 minutes.

Average Metering

Average values are calculated for load center, load, and source voltage (normalized to BaseV), for both forward and reverse metering, and are used only for recording min/max values and data logging. The average calculation reduces the chance of transient variations affecting the min/max and data log values. The average interval (AvgInterval) is adjustable from 1 to 120 seconds.

Accumulation of Average and Demand Values

Upon a UVR-1 reset, relevant configuration parameter change, or power flow reversal, average and demand values (other than min/max values) are cleared, and there is a 3-minute delay before accumulation of these values begins. This is to allow the power system to stabilize after a power flow reversal or power outage. These values are then set to their corresponding instantaneous values and begin accumulating. Their min/max values do not begin updating until the first average or demand interval completes. MeterAccum is active while average and demand values are being accumulated. For demand values accessed through the menu system, the Fwd, Rev, or Inv (invalid, i.e.

MeterAccum inactive) annunciators indicate whether demand values are valid, and whether they are being accumulated into the forward or reverse min/max quantities.

Min/Max Metering

Minimum and maximum values for all average quantities and ambient temperature, maximum values for all demand quantities, and power factor at max. VA demand, along with the time and date of each min/max, are stored in non-volatile memory. Maximum demand values for W and VAr are determined by comparing their absolute values, then storing their signed values. In general, min/max values are stored separately for both forward and reverse metering. In co-generation mode, values are stored based on power flow direction, even though metering is always forward (see the Power Flow Modes section (p. 28) for details). The values are independently resettable (except for power factor), or may be reset as a group for average min/max values (AvgRs), demand min/max values (DmdRs), or basic values (BasicRs).

Additionally, electronic tap position draghands are maintained, along with the time and date of the minimum and maximum. These values are stored in non-volatile memory, and are resettable (DragRs) without affecting the mechanical draghands.

All of the above values may be reset as a group using MinMaxRs (`Cntrl.Reset.MnMx All`), which does not require entering the security code.

On the menu system, the displayed data item legend implies the units for the numeric value. The scaling for power values appears with the numeric value. Timestamps are displayed as local time in '`mm/dd/yyyy`', '`hh:mm:ss`' format. The date and time are displayed alternately at two-second intervals, along with the value.

Min/max values are only reset by explicit commands (local or remote). Reset is defined as setting a quantity's min/max value to its present value. If a min/max value is reset while its current value is invalid, both its value and timestamp will be zero (menu display 00:00:00, Jan. 1, TSYearBase, displayed as local time) until it is first updated. All changes to min/max values are written into non-volatile memory each hour or upon reset, so that no more than one hour's data can be lost due to a power failure.

Energy Metering

Forward and reverse WHr, and forward and reverse VArHr leading and lagging, along with their time and date of last reset, are stored in non-volatile memory. These values are unsigned, and are reset as a group using EnergyRs (`Cntrl.Reset.Energy`), which does not require entering the security code. Reset is only by explicit command (local or remote). Energy values are updated every second, and written into non-volatile memory every 2 hours or upon reset, so that no more than 2 hours' data can be lost due to a power failure.

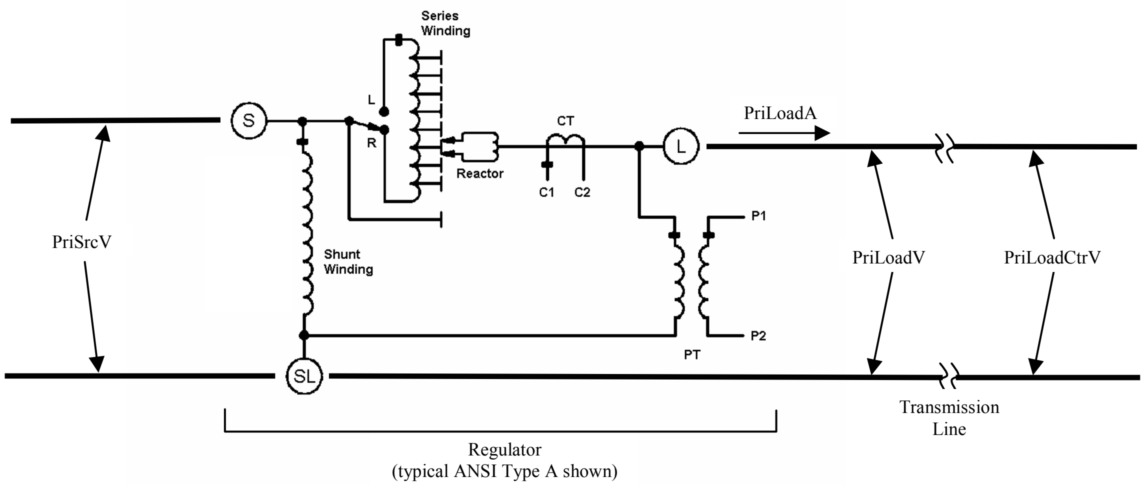
WHr quantities are accumulated separately for forward and reverse power flow. VArHr quantities are accumulated separately for each quadrant (see Sign Conventions below), based on the power flow direction and whether the power factor is leading or lagging.

On the menu system, the displayed data item legend implies the units for the numeric value. The range (`k`, `M`, `G`, `T`) appears with the numeric value. The time and date of last reset is displayed as local time in '`mm/dd/yyyy`', '`hh:mm:ss`' format. The date and time are displayed alternately at two-second intervals, along with the value.

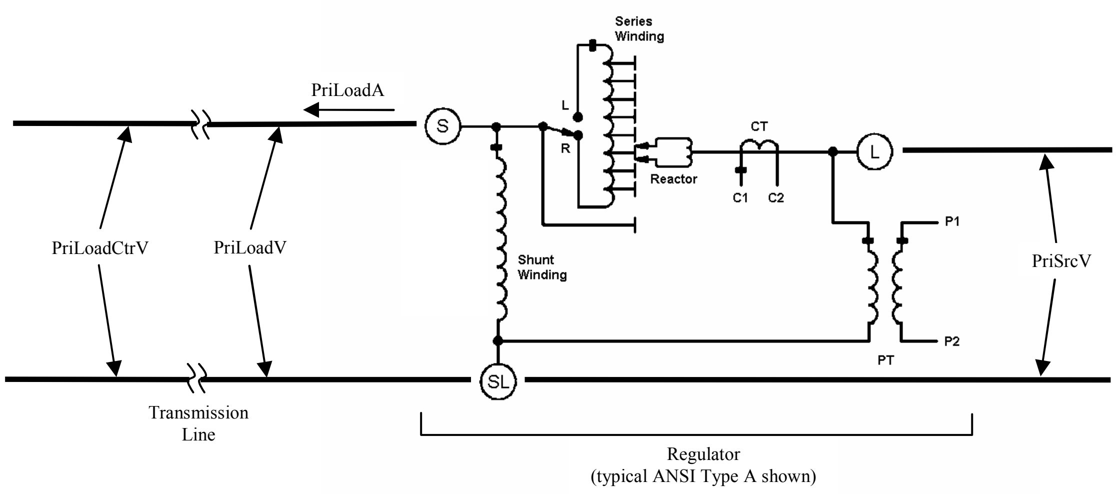
Metering Data

Certain source and load voltage designations below are marked with an asterisk (‘*’). During reverse metering, the regulator terminals to which these refer are interchanged. See the diagrams below and the Power Flow Modes section (p. 28) for details.

UVR-1 Measurements (Forward Metering/Regulation)



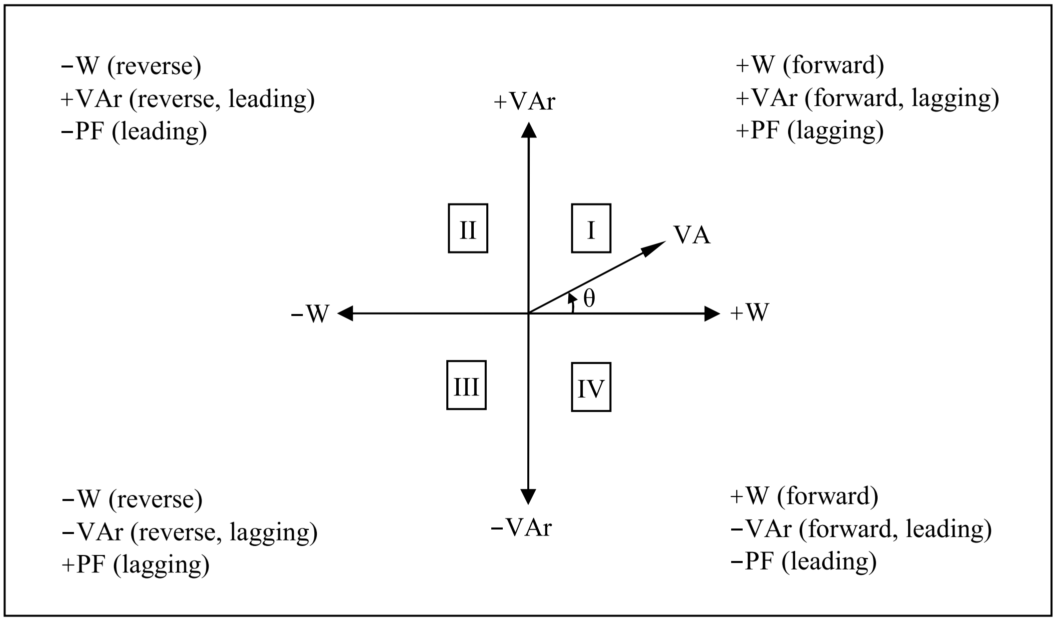
UVR-1 Measurements (Reverse Metering/Regulation)



Directly sensed by UVR-1:

- CtlVIn is generally the PT secondary voltage (P1-P2, may have intervening RCT(s)). It is used to calculate all voltages.
- CTmA is the CT secondary current (C1-C2, mA). It is used to calcuate all currents.

Sign Conventions



- Quadrants I and IV are forward power flow, II and III are reverse power flow.
- Power quantities are signed according to the diagram above, regardless of metering direction.
- The phase angle is θ. Power factor (leading or lagging) is referred to the load (based on power flow direction), and may be displayed signed, or unsigned with lead or lag indication.
- VArHr quantities are accumulated separately for each quadrant based on the power flow direction and whether the power factor is leading or lagging.

Basic Measurements

LoadCtrV	Load center voltage (BaseV base). This is the voltage (normalized to BaseV) at the calculated load center (theoretical location of customer load), taking into account line drop and power flow direction. This voltage is what the UVR-1 regulates.
LoadV	Load* voltage (BaseV base). This is the voltage (normalized to BaseV) at either the L regulator terminal (forward metering) or S regulator terminal (reverse metering).
SrcV	Source* voltage (BaseV base). This is the voltage (normalized to BaseV) at either the S regulator terminal (forward metering) or L regulator terminal (reverse metering).
LoadA	Load current (CT secondary level). This value multiplied by the CT ratio equals the primary load current at the L regulator terminal (forward metering) or S regulator terminal (reverse metering). For example, given a CT ratio of 2500 (500 : 0.2 A), 100 mA * 2500 = 250 A.
PriLoadCtrV	Load center voltage (primary). This is the voltage at the calculated load center (theoretical location of customer load), taking into account line drop and power flow direction.
PriLoadV	Load* voltage (primary). This is the voltage at either the L regulator terminal (forward metering) or S regulator terminal (reverse metering).
PriSrcV	Source* voltage (primary). This is the voltage at either the S regulator terminal (forward metering) or L regulator terminal (reverse metering).

PriLoadA	Load current (primary), at the L regulator terminal (forward metering) or S regulator terminal (reverse metering).
PF	Power factor.
Hz	Power line frequency fundamental.
PriVA	Apparent power load at the L regulator terminal (forward metering) or S regulator terminal (reverse metering).
PriW	Real power load at the L regulator terminal (forward metering) or S regulator terminal (reverse metering).
PriVAr	Reactive power load at the L regulator terminal (forward metering) or S regulator terminal (reverse metering).
CtlVIn	Voltage at UVR-1 control input (**VOLTMETER** terminals).
SysTemp	UVR-1 control enclosure ambient temperature.
PhaseAng	Phase angle between fundamental input voltage and current.

Voltage Harmonic Measurements

THDLoadV	Load voltage THD (% of fundamental).
HD3LoadV	Load voltage 3rd harmonic distortion (% of fundamental).
HD5LoadV	Load voltage 5th harmonic distortion (% of fundamental).
HD7LoadV	Load voltage 7th harmonic distortion (% of fundamental).
HD9LoadV	Load voltage 9th harmonic distortion (% of fundamental).
HD11LoadV	Load voltage 11th harmonic distortion (% of fundamental).
HD13LoadV	Load voltage 13th harmonic distortion (% of fundamental).

Current Harmonic Measurements

THDLoadA	Load current THD (% of fundamental).
HD3LoadA	Load current 3rd harmonic distortion (% of fundamental).
HD5LoadA	Load current 5th harmonic distortion (% of fundamental).
HD7LoadA	Load current 7th harmonic distortion (% of fundamental).
HD9LoadA	Load current 9th harmonic distortion (% of fundamental).
HD11LoadA	Load current 11th harmonic distortion (% of fundamental).
HD13LoadA	Load current 13th harmonic distortion (% of fundamental).

Demand Measurements

DmdLoadA	Load current demand.
DmdVA	Apparent power load demand.
DmdW	Real power load demand.
DmdVAr	Reactive power load demand.

Energy Measurements

FWHrs	FPF real energy.
RWHrs	RPF real energy.
FVArHrsLd	FPF reactive energy leading.
FVArHrsLg	FPF reactive energy lagging.
RVArHrsLd	RPF reactive energy leading.
RVArHrsLg	RPF reactive energy lagging.
TEnergyRst	Time of last energy reset.

Forward Average Measurements (Min/Max)

HiFAvgLoadV	Max. FPF average load voltage (BaseV base).
THiFAvgLoadV	Time of HiFAvgLoadV.
LoFAvgLoadV	Min. FPF average load voltage (BaseV base).
TLoFAvgLoadV	Time of LoFAvgLoadV.
HiFAvgSrcV	Max. FPF average source voltage (BaseV base).
THiFAvgSrcV	Time of HiFAvgSrcV.
LoFAvgSrcV	Min. FPF average source voltage (BaseV base).
TLoFAvgSrcV	Time of LoFAvgSrcV.
HiFAvgLoadCtrV	Max. FPF average load center voltage (BaseV base).
THiFAvgLoadCtrV	Time of HiFAvgLoadCtrV.
LoFAvgLoadCtrV	Min. FPF average load center voltage (BaseV base).
TLoFAvgLoadCtrV	Time of LoFAvgLoadCtrV.

Reverse Average Measurements (Min/Max)

HiRAvgLoadV	Max. RPF average load* voltage (BaseV base).
THiRAvgLoadV	Time of HiRAvgLoadV.
LoRAvgLoadV	Min. RPF average load* voltage (BaseV base).
TLoRAvgLoadV	Time of LoRAvgLoadV.
HiRAvgSrcV	Max. RPF average source* voltage (BaseV base).
THiRAvgSrcV	Time of HiRAvgSrcV.
LoRAvgSrcV	Min. RPF average source* voltage (BaseV base).
TLoRAvgSrcV	Time of LoRAvgSrcV.
HiRAvgLoadCtrV	Max. RPF average load center voltage (BaseV base).
THiRAvgLoadCtrV	Time of HiRAvgLoadCtrV.
LoRAvgLoadCtrV	Min. RPF average load center voltage (BaseV base).
TLoRAvgLoadCtrV	Time of LoRAvgLoadCtrV.

Forward Demand Measurements (Min/Max)

HiFDmdLoadA	Max. FPF load current demand.
THiFDmdLoadA	Time of HiFDmdLoadA.
HiFDmdVA	Max. FPF apparent power load demand.
THiFDmdVA	Time of HiFDmdVA.
HiFDmdW	Max. FPF real power load demand.
THiFDmdW	Time of HiFDmdW.
HiFDmdVAr	Max. FPF reactive power load demand.
THiFDmdVAr	Time of HiFDmdVAr.
HiFVAPF	Power factor at maximum FPF apparent power load demand.

Reverse Demand Measurements (Min/Max)

HiRDmdLoadA	Max. RPF load current demand.
THiRDmdLoadA	Time of HiRDmdLoadA.
HiRDmdVA	Max. RPF apparent power load demand.
THiRDmdVA	Time of HiRDmdVA.
HiRDmdW	Max. RPF real power load demand.
THiRDmdW	Time of HiRDmdW.
HiRDmdVAr	Max. RPF reactive power load demand.
THiRDmdVAr	Time of HiRDmdVAr.
HiRVAPF	Power factor at maximum RPF apparent power load demand.

Basic Measurements (Min/Max)

HiSysTemp	Max. control ambient temperature.
THiSysTemp	Time of HiSysTemp.
LoSysTemp	Min. control ambient temperature.
TLoSysTemp	Time of LoSysTemp.

Tap Position Draghands

HiTapPos	High tap position draghand.
THiTapPos	Time of HiTapPos.
LoTapPos	Low tap position draghand.
TLoTapPos	Time of LoTapPos.

Data Logging

The UVR-1 data logging capability is intended for local accumulation of a history of data item values, which can later be viewed on the display or read out via the front panel PC port. Up to 7 user-selectable data items may be logged on a selectable periodic basis. Over 3580 records can be logged, each containing up to 7 data item values and a timestamp. The most recent 768 data log records are stored in non-volatile memory, so that they can be recovered in the event of a power failure. The data log works on a first-in, first-out basis, i.e. once it is full, the oldest record is deleted to make room for each new record. Data logging is disabled by default, and should be disabled whenever it is not being used, to prolong the life of the non-volatile memory.

The data logging interval (DatLgInt) is selected from a list. The data logging intervals, along with the corresponding log time coverages, are shown in the following table.

Data Logging Interval (minutes)	Log Time Coverage (total)	Log Time Coverage (non-volatile)
disabled (data logging disabled)		
1	59.7 hours	12.8 hours
2	5.0 days	25.6 hours
3	7.5 days	38.4 hours
4	9.9 days	51.2 hours
5	12.4 days	64.0 hours
6	14.9 days	76.8 hours
10	24.9 days	5.3 days
12	29.8 days	6.4 days
15	37.3 days	8.0 days
20	50 days	10.7 days
30	75 days	16 days
60	149 days	32 days
120	298 days	64 days
180	448 days	96 days
240	597 days	128 days

The data items available for logging are summarized in the following table. Any of these may be assigned to each of the 7 "slots" in the data log (DatLgSlot1 - DatLgSlot7).

Menu Legend	Data Log Display Legend	Data Item
Empty	Empty	nothing recorded in this slot
LoadCtrV	LoadCtrV	LoadCtrV
Ld Volts	Ld Volts	LoadV
SrcVolts	SrcVolts	SrcV
Ld Amps	LoadA mA	LoadA
PriLCtrV	PriLCtrV	PriLoadCtrV
PriLoadV	PriLoadV	PriLoadV
PriSrcV	PriSrcV	PriSrcV
PriLoadA	PriLoadA	PriLoadA
PwrFactr	PwrFactr	PF
Hz	Hz	Hz
PriVA	PriVA	PriVA
PriWatts	PriWatts	PriW
PriVAr	PriVAr	PriVAr
CtlVIn	CtlVIn	CtlVIn
SysTemp	SysTemp	SysTemp
PhaseAng	PhaseAng	PhaseAng
AvgLCtrV	AvgLCtrV	AvgLoadCtrV
AvgLoadV	AvgLoadV	AvgLoadV
AvgSrcV	AvgSrcV	AvgSrcV
DmdLoadA	DmdLoadA	DmdLoadA
DmdVA	DmdVA	DmdVA
DmdWatts	DmdWatts	DmdW
DmdVAr	DmdVAr	DmdVAr
VHrmTHD	VH %THD	THDLoadV
VHrm3rd	VH %3rd	HD3LoadV
VHrm5th	VH %5th	HD5LoadV
VHrm7th	VH %7th	HD7LoadV
VHrm9th	VH %9th	HD9LoadV
VHrm11th	VH %11th	HD11LoadV
VHrm13th	VH %13th	HD13LoadV
AHrmTHD	AH %THD	THDLoadA
AHrm3rd	AH %3rd	HD3LoadA
AHrm5th	AH %5th	HD5LoadA
AHrm7th	AH %7th	HD7LoadA
AHrm9th	AH %9th	HD9LoadA
AHrm11th	AH %11th	HD11LoadA
AHrm13th	AH %13th	HD13LoadA
TapPos	TapPos	TapPos
OpCount	OpCount	CntOper
ResOpCnt	ResOpCnt	CntOperR

Notes:
- Only the least significant 15 bits of operations counters are logged (0 - 32767).
- The menu legend is used when selecting the data item for a data log slot, and in the quick access data display.

The data logging interval and/or data items to be logged can be changed at any time, and will be reflected in the subsequent data log records.

The most convenient way to view the data log is to read it out into a PC, then use the UVR-1 Data Logging program, a Microsoft Windows®-compatible program which displays UVR-1 data log files in both graphical (strip-chart) and tabular formats. See the *UVR-1 Utility Suite Manual, Data Logging section* for details. Note that the file format is comma-delimited, so these files can easily be imported into applications such as Word® or Excel®.

The data log can also be viewed on the front panel display using the UVR-1 menu system. This feature operates even if data logging is currently disabled (DatLgInt = disabled). Entering the data log display is a two-step process. First, select the DatLg category from the home menu. This enters the quick access data display (see below). Then, press the **SELECT** or **Down Arrow** button again to enter the data log display. The most recent data log item is displayed in the following [example] format:

```
DatLg.Slot1.VH %THD
  12:05:00      1.2
```

If the data log is empty, DatLg.Slots.Empty will be displayed. Note that the displayed data item legend implies the units for the numeric value. The scaling for power values appears with the numeric value. The example shows the time portion of the timestamp, but the date is available by using the **SELECT** button (see below). Timestamps are displayed as local time in 'mm/dd/yyyy', 'hh:mm:ss' format.

At this display, the following controls can be used to navigate through the data log display:

SCROLL knob	Scrolls through data log entries (in slot/record order) in a chronological circular fashion.
SELECT button	Toggles between displaying the date or time for a given data log entry.
Down Arrow button	Locks the display into the current slot, to make scrolling through a single data item's history easier. This is indicated by a caret ('^') replacing the period just after the slot number.
Up Arrow button	Unlocks the current slot. If already unlocked, returns to the quick access data display.

The **HOME** button returns to the home menu (as always), and the **EDIT** and **ENTER** buttons do nothing.

Quick Access Data Display

The present values of the selected data log data items can be displayed using just the **SCROLL** knob. This feature operates even if data logging is disabled (DatLgInt = disabled). Select the DatLg category from the home menu to enter the quick access data display. The data item for slot 1 is displayed in the following [example] format:

```
DatLg.Slot1:VHrmTHD
         1.2 % fund.
```

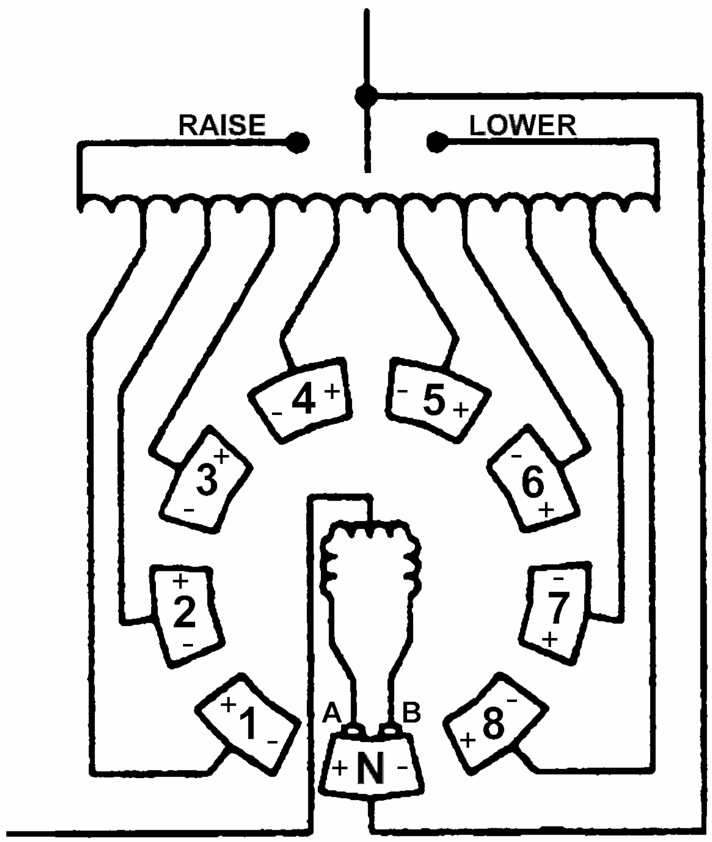
The quick access data display is indicated by a colon replacing the period just after the slot number. Note that the format of the second line is the same as if the data item was viewed from its usual place in the menu system.

Within this display, use the **SCROLL** knob to select which slot's data item to view. From this display, press the **SELECT** or **Down Arrow** button again to enter the data log display, the **Up Arrow** button to close the currently displayed data item and move up one level in the menu structure (does not return to the home menu), or the **HOME** button to return to the home menu (the **EDIT** and **ENTER** buttons do nothing).

Tapchanger Contact Wear Log

The UVR-1 allows statistics to be logged which allow tapchanger contact wear to be estimated for maintenance scheduling. This data can be viewed on the display, accessed via the protocol, or read out via the front panel PC port. The log is stored in non-volatile memory so that it can be recovered in the event of a power failure. Tapchanger contact wear logging is disabled by default, and should be disabled whenever it is not being used, to prolong the life of the non-volatile memory. The configuration parameter that controls this is CntctLog.

Contact Nomenclature for All Voltage Regulator Tapchangers



For stationary contact edges involved in a tap transition:

- Contact edge designator consists of two characters, possibly followed by a suffix.
- First character (N, 1..8) signifies the contact, second character (+ or -) specifies the edge.
- For double-blade contacts, suffix (A or B) specifies blade that engages movable contact with same designator.

For movable contacts on tapchangers with single-blade stationary contact assemblies:

- 'A' designates the contact closest to stationary contact 1 at neutral.
- 'B' designates the contact closest to stationary contact 8 at neutral.

For movable contacts on tapchangers with double-blade stationary contact assemblies:

- 'A' generally designates the front contact (farthest from stationary contact assembly stud).
- 'B' generally designates the rear contact (closest to stationary contact assembly stud).

For all movable contacts, ‘A’ leads ‘B’ during a raise operation, and ‘B’ leads ‘A’ during a lower operation.

CntctType specifies whether the stationary contacts are the single-blade or double-blade type.

The nomenclature above is used in the documentation, the UVR-1 menu system, and the UVR-1 Contact Log program. The UVR-1 data item IDs use different designators since they can refer to both contact types.

Contact Wear Accumulations Based on Tap Transition (reversing switch in RAISE position)

Tapchanger Operation	Tap Transition	Stationary Contact Transition (single-blade)	Stationary Contact Transition (double-blade)	Movable Contact
Raise	0 ⇒ 1	N+ ⇒ 1-	N+A ⇒ 1-A	A
	1 ⇒ 2	N+ ⇒ 1-	N+B ⇒ 1-B	B
	2 ⇒ 3	1+ ⇒ 2-	1+A ⇒ 2-A	A
	3 ⇒ 4	1+ ⇒ 2-	1+B ⇒ 2-B	B
	4 ⇒ 5	2+ ⇒ 3-	2+A ⇒ 3-A	A
	5 ⇒ 6	2+ ⇒ 3-	2+B ⇒ 3-B	B
	6 ⇒ 7	3+ ⇒ 4-	3+A ⇒ 4-A	A
	7 ⇒ 8	3+ ⇒ 4-	3+B ⇒ 4-B	B
	8 ⇒ 9	4+ ⇒ 5-	4+A ⇒ 5-A	A
	9 ⇒ 10	4+ ⇒ 5-	4+B ⇒ 5-B	B
	10 ⇒ 11	5+ ⇒ 6-	5+A ⇒ 6-A	A
	11 ⇒ 12	5+ ⇒ 6-	5+B ⇒ 6-B	B
	12 ⇒ 13	6+ ⇒ 7-	6+A ⇒ 7-A	A
	13 ⇒ 14	6+ ⇒ 7-	6+B ⇒ 7-B	B
	14 ⇒ 15	7+ ⇒ 8-	7+A ⇒ 8-A	A
	15 ⇒ 16	7+ ⇒ 8-	7+B ⇒ 8-B	B
Lower	16 ⇒ 15	8- ⇒ 7+	8-B ⇒ 7+B	B
	15 ⇒ 14	8- ⇒ 7+	8-A ⇒ 7+A	A
	14 ⇒ 13	7- ⇒ 6+	7-B ⇒ 6+B	B
	13 ⇒ 12	7- ⇒ 6+	7-A ⇒ 6+A	A
	12 ⇒ 11	6- ⇒ 5+	6-B ⇒ 5+B	B
	11 ⇒ 10	6- ⇒ 5+	6-A ⇒ 5+A	A
	10 ⇒ 9	5- ⇒ 4+	5-B ⇒ 4+B	B
	9 ⇒ 8	5- ⇒ 4+	5-A ⇒ 4+A	A
	8 ⇒ 7	4- ⇒ 3+	4-B ⇒ 3+B	B
	7 ⇒ 6	4- ⇒ 3+	4-A ⇒ 3+A	A
	6 ⇒ 5	3- ⇒ 2+	3-B ⇒ 2+B	B
	5 ⇒ 4	3- ⇒ 2+	3-A ⇒ 2+A	A
	4 ⇒ 3	2- ⇒ 1+	2-B ⇒ 1+B	B
	3 ⇒ 2	2- ⇒ 1+	2-A ⇒ 1+A	A
	2 ⇒ 1	1- ⇒ N+	1-B ⇒ N+B	B
	1 ⇒ 0	1- ⇒ N+	1-A ⇒ N+A	A

Contact Wear Accumulations Based on Tap Transition (reversing switch in LOWER position)

Tapchanger Operation	Tap Transition	Stationary Contact Transition (single-blade)	Stationary Contact Transition (double-blade)	Movable Contact
Lower	0 ⇒ -1	N- ⇒ 8+	N-B ⇒ 8+B	B
	-1 ⇒ -2	N- ⇒ 8+	N-A ⇒ 8+A	A
	-2 ⇒ -3	8- ⇒ 7+	8-B ⇒ 7+B	B
	-3 ⇒ -4	8- ⇒ 7+	8-A ⇒ 7+A	A
	-4 ⇒ -5	7- ⇒ 6+	7-B ⇒ 6+B	B
	-5 ⇒ -6	7- ⇒ 6+	7-A ⇒ 6+A	A
	-6 ⇒ -7	6- ⇒ 5+	6-B ⇒ 5+B	B
	-7 ⇒ -8	6- ⇒ 5+	6-A ⇒ 5+A	A
	-8 ⇒ -9	5- ⇒ 4+	5-B ⇒ 4+B	B
	-9 ⇒ -10	5- ⇒ 4+	5-A ⇒ 4+A	A
	-10 ⇒ -11	4- ⇒ 3+	4-B ⇒ 3+B	B
	-11 ⇒ -12	4- ⇒ 3+	4-A ⇒ 3+A	A
	-12 ⇒ -13	3- ⇒ 2+	3-B ⇒ 2+B	B
	-13 ⇒ -14	3- ⇒ 2+	3-A ⇒ 2+A	A
	-14 ⇒ -15	2- ⇒ 1+	2-B ⇒ 1+B	B
	-15 ⇒ -16	2- ⇒ 1+	2-A ⇒ 1+A	A
Raise	-16 ⇒ -15	1+ ⇒ 2-	1+A ⇒ 2-A	A
	-15 ⇒ -14	1+ ⇒ 2-	1+B ⇒ 2-B	B
	-14 ⇒ -13	2+ ⇒ 3-	2+A ⇒ 3-A	A
	-13 ⇒ -12	2+ ⇒ 3-	2+B ⇒ 3-B	B
	-12 ⇒ -11	3+ ⇒ 4-	3+A ⇒ 4-A	A
	-11 ⇒ -10	3+ ⇒ 4-	3+B ⇒ 4-B	B
	-10 ⇒ -9	4+ ⇒ 5-	4+A ⇒ 5-A	A
	-9 ⇒ -8	4+ ⇒ 5-	4+B ⇒ 5-B	B
	-8 ⇒ -7	5+ ⇒ 6-	5+A ⇒ 6-A	A
	-7 ⇒ -6	5+ ⇒ 6-	5+B ⇒ 6-B	B
	-6 ⇒ -5	6+ ⇒ 7-	6+A ⇒ 7-A	A
	-5 ⇒ -4	6+ ⇒ 7-	6+B ⇒ 7-B	B
	-4 ⇒ -3	7+ ⇒ 8-	7+A ⇒ 8-A	A
	-3 ⇒ -2	7+ ⇒ 8-	7+B ⇒ 8-B	B
	-2 ⇒ -1	8+ ⇒ N-	8+A ⇒ N-A	A
	-1 ⇒ 0	8+ ⇒ N-	8+B ⇒ N-B	B

Data Collected

Stationary contact edges — 18 (single-blade) or 36 (double-blade) accumulators each for:

- Engaging contact edge operation count (ops)
- Breaking contact edge (current^2)*operations (A^2*ops)

Movable contacts — 2 accumulators each for:

- Contact operation count (ops)
- Contact (current^2)*operations (A^2*ops)

Engaging Contact Edge Operation Count Accumulators

Data Item ID	Menu Legend (single-blade)	Menu Legend (double-blade)
Engage_N1	Stats.Cntct.Eng 1-	Stats.Cntct.Eng 1-A
Engage_12	Stats.Cntct.Eng 2-	Stats.Cntct.Eng 2-A
Engage_23	Stats.Cntct.Eng 3-	Stats.Cntct.Eng 3-A
Engage_34	Stats.Cntct.Eng 4-	Stats.Cntct.Eng 4-A
Engage_45	Stats.Cntct.Eng 5-	Stats.Cntct.Eng 5-A
Engage_56	Stats.Cntct.Eng 6-	Stats.Cntct.Eng 6-A
Engage_67	Stats.Cntct.Eng 7-	Stats.Cntct.Eng 7-A
Engage_78	Stats.Cntct.Eng 8-	Stats.Cntct.Eng 8-A
Engage_8N	Stats.Cntct.Eng N-	Stats.Cntct.Eng N-A
Engage_N8	Stats.Cntct.Eng 8+	Stats.Cntct.Eng 8+A
Engage_87	Stats.Cntct.Eng 7+	Stats.Cntct.Eng 7+A
Engage_76	Stats.Cntct.Eng 6+	Stats.Cntct.Eng 6+A
Engage_65	Stats.Cntct.Eng 5+	Stats.Cntct.Eng 5+A
Engage_54	Stats.Cntct.Eng 4+	Stats.Cntct.Eng 4+A
Engage_43	Stats.Cntct.Eng 3+	Stats.Cntct.Eng 3+A
Engage_32	Stats.Cntct.Eng 2+	Stats.Cntct.Eng 2+A
Engage_21	Stats.Cntct.Eng 1+	Stats.Cntct.Eng 1+A
Engage_1N	Stats.Cntct.Eng N+	Stats.Cntct.Eng N+A
Engage_N1B		Stats.Cntct.Eng 1-B
Engage_12B		Stats.Cntct.Eng 2-B
Engage_23B		Stats.Cntct.Eng 3-B
Engage_34B		Stats.Cntct.Eng 4-B
Engage_45B		Stats.Cntct.Eng 5-B
Engage_56B		Stats.Cntct.Eng 6-B
Engage_67B		Stats.Cntct.Eng 7-B
Engage_78B		Stats.Cntct.Eng 8-B
Engage_8NB		Stats.Cntct.Eng N-B
Engage_N8B		Stats.Cntct.Eng 8+B
Engage_87B		Stats.Cntct.Eng 7+B
Engage_76B		Stats.Cntct.Eng 6+B
Engage_65B		Stats.Cntct.Eng 5+B
Engage_54B		Stats.Cntct.Eng 4+B
Engage_43B		Stats.Cntct.Eng 3+B
Engage_32B		Stats.Cntct.Eng 2+B
Engage_21B		Stats.Cntct.Eng 1+B
Engage_1NB		Stats.Cntct.Eng N+B
Engage_A	Stats.Cntct.Eng A	Stats.Cntct.Eng A
Engage_B	Stats.Cntct.Eng B	Stats.Cntct.Eng B

Breaking Contact Edge (Current^2)*Operations Accumulators

Data Item ID	Menu Legend (single-blade)	Menu Legend (double-blade)
Break_N1	Stats.Cntct.Brk N+	Stats.Cntct.Brk N+A
Break_12	Stats.Cntct.Brk 1+	Stats.Cntct.Brk 1+A
Break_23	Stats.Cntct.Brk 2+	Stats.Cntct.Brk 2+A
Break_34	Stats.Cntct.Brk 3+	Stats.Cntct.Brk 3+A
Break_45	Stats.Cntct.Brk 4+	Stats.Cntct.Brk 4+A
Break_56	Stats.Cntct.Brk 5+	Stats.Cntct.Brk 5+A
Break_67	Stats.Cntct.Brk 6+	Stats.Cntct.Brk 6+A
Break_78	Stats.Cntct.Brk 7+	Stats.Cntct.Brk 7+A
Break_8N	Stats.Cntct.Brk 8+	Stats.Cntct.Brk 8+A
Break_N8	Stats.Cntct.Brk N-	Stats.Cntct.Brk N-A
Break_87	Stats.Cntct.Brk 8-	Stats.Cntct.Brk 8-A
Break_76	Stats.Cntct.Brk 7-	Stats.Cntct.Brk 7-A
Break_65	Stats.Cntct.Brk 6-	Stats.Cntct.Brk 6-A
Break_54	Stats.Cntct.Brk 5-	Stats.Cntct.Brk 5-A
Break_43	Stats.Cntct.Brk 4-	Stats.Cntct.Brk 4-A
Break_32	Stats.Cntct.Brk 3-	Stats.Cntct.Brk 3-A
Break_21	Stats.Cntct.Brk 2-	Stats.Cntct.Brk 2-A
Break_1N	Stats.Cntct.Brk 1-	Stats.Cntct.Brk 1-A
Break_N1B		Stats.Cntct.Brk N+B
Break_12B		Stats.Cntct.Brk 1+B
Break_23B		Stats.Cntct.Brk 2+B
Break_34B		Stats.Cntct.Brk 3+B
Break_45B		Stats.Cntct.Brk 4+B
Break_56B		Stats.Cntct.Brk 5+B
Break_67B		Stats.Cntct.Brk 6+B
Break_78B		Stats.Cntct.Brk 7+B
Break_8NB		Stats.Cntct.Brk 8+B
Break_N8B		Stats.Cntct.Brk N-B
Break_87B		Stats.Cntct.Brk 8-B
Break_76B		Stats.Cntct.Brk 7-B
Break_65B		Stats.Cntct.Brk 6-B
Break_54B		Stats.Cntct.Brk 5-B
Break_43B		Stats.Cntct.Brk 4-B
Break_32B		Stats.Cntct.Brk 3-B
Break_21B		Stats.Cntct.Brk 2-B
Break_1NB		Stats.Cntct.Brk 1-B
Break_A	Stats.Cntct.Brk A	Stats.Cntct.Brk A
Break_B	Stats.Cntct.Brk B	Stats.Cntct.Brk B

Breaking values are displayed in thousands of (A^2)*operations (‘kA^2*ops’) by the menu system.

Internal Calculation Examples

TapPos 0 ⇒ 1 (raise, movable contact A goes from stationary contact edge N+ to 1- (single-blade)):

Add 1 to stationary contact engaging contact edge operation count accumulator designated '1-'.
Add (contact current value)^2 just before transition to stationary contact breaking contact edge (current^2)*operations accumulator designated 'N+'.
Add 1 to movable contact operation count accumulator designated 'A'.
Add (contact current value)^2 just before transition to movable contact (current^2)*operations accumulator designated 'A'.

TapPos -8 ⇒ -9 (lower, rear movable contact B goes from rear stationary contact edge 5-B to 4+B (double-blade)):

Add 1 to stationary contact engaging contact edge operation count accumulator designated '4+B'.
Add (contact current value)^2 just before transition to stationary contact breaking contact edge (current^2)*operations accumulator designated '5-B'.
Add 1 to movable contact operation count accumulator designated 'B'.
Add (contact current value)^2 just before transition to movable contact (current^2)*operations accumulator designated 'B'.

Notes

- Wear due to arcing (proportional to current^2) occurs predominantly on stationary contact breaking contact edge.
- Wear due to impact occurs predominantly on stationary contact engaging contact edge.
- Only the edges involved in the transition incur wear for stationary contacts.
- Both types of wear occur on movable contact.
- Contact wear is logged only when the tap position is known.
- Contact wear log is saved once per day to non-volatile memory. Resets of the accumulators are updated immediately in non-volatile memory.
- Contact wear on series transformer type voltage regulators is calculated based on the load current, and will need to be scaled manually. For example, if the tapchanger current is 1/3 of the load current, the wear indications for breaking contact edges should be multiplied by 1/9 (the square of that fraction, to scale load current^2 to the tapchanger current^2).

Data Display

The most convenient way to view the tapchanger contact wear log is to read it out into a PC, then use the UVR-1 Contact Log program, a Microsoft Windows®-compatible program which displays UVR-1 contact wear log files in both graphical and tabular formats. See the *UVR-1 Utility Suite Manual, Contact Log section* for details.

To view the log data on the front panel display using the UVR-1 menu system, select the `Stats.Cntct` subcategory. The **SCROLL** knob can then be used to scroll through the contact wear accumulators.

Tapchanger Contact Wear Accumulator Resets

Accumulators are not writeable, but are resettable by replaceable contact, or all accumulators may be reset as a group. The reset command data items, menu legends, and the accumulators reset by each are detailed in the following table:

Reset Command Data Item ID	Menu Legend (single-blade)	Menu Legend (double-blade)	Data Item IDs Reset
CntctRs_N	`Cntrl.Reset.Cntct N`	`Cntrl.Reset.Cntct NA`	Engage_1N Engage_8N Break_N1 Break_N8
CntctRs_1	`Cntrl.Reset.Cntct 1`	`Cntrl.Reset.Cntct 1A`	Engage_21 Engage_N1 Break_12 Break_1N
CntctRs_2	`Cntrl.Reset.Cntct 2`	`Cntrl.Reset.Cntct 2A`	Engage_32 Engage_12 Break_23 Break_21
CntctRs_3	`Cntrl.Reset.Cntct 3`	`Cntrl.Reset.Cntct 3A`	Engage_43 Engage_23 Break_34 Break_32
CntctRs_4	`Cntrl.Reset.Cntct 4`	`Cntrl.Reset.Cntct 4A`	Engage_54 Engage_34 Break_45 Break_43
CntctRs_5	`Cntrl.Reset.Cntct 5`	`Cntrl.Reset.Cntct 5A`	Engage_65 Engage_45 Break_56 Break_54
CntctRs_6	`Cntrl.Reset.Cntct 6`	`Cntrl.Reset.Cntct 6A`	Engage_76 Engage_56 Break_67 Break_65
CntctRs_7	`Cntrl.Reset.Cntct 7`	`Cntrl.Reset.Cntct 7A`	Engage_87 Engage_67 Break_78 Break_76
CntctRs_8	`Cntrl.Reset.Cntct 8`	`Cntrl.Reset.Cntct 8A`	Engage_N8 Engage_78 Break_8N Break_87

Reset Command Data Item ID	Menu Legend (single-blade)	Menu Legend (double-blade)	Data Item IDs Reset
CntctRs_NB		Cntrl.Reset.Cntct NB	Engage_1NB Engage_8NB Break_N1B Break_N8B
CntctRs_1B		Cntrl.Reset.Cntct 1B	Engage_21B Engage_N1B Break_12B Break_1NB
CntctRs_2B		Cntrl.Reset.Cntct 2B	Engage_32B Engage_12B Break_23B Break_21B
CntctRs_3B		Cntrl.Reset.Cntct 3B	Engage_43B Engage_23B Break_34B Break_32B
CntctRs_4B		Cntrl.Reset.Cntct 4B	Engage_54B Engage_34B Break_45B Break_43B
CntctRs_5B		Cntrl.Reset.Cntct 5B	Engage_65B Engage_45B Break_56B Break_54B
CntctRs_6B		Cntrl.Reset.Cntct 6B	Engage_76B Engage_56B Break_67B Break_65B
CntctRs_7B		Cntrl.Reset.Cntct 7B	Engage_87B Engage_67B Break_78B Break_76B
CntctRs_8B		Cntrl.Reset.Cntct 8B	Engage_N8B Engage_78B Break_8NB Break_87B
CntctRs_A	Cntrl.Reset.Cntct A	Cntrl.Reset.Cntct A	Engage_A Break_A
CntctRs_B	Cntrl.Reset.Cntct B	Cntrl.Reset.Cntct B	Engage_B Break_B
CntctRs	Cntrl.Reset.Cntcts	Cntrl.Reset.Cntcts	all Engage_*dsg* all Break_*dsg*

Tapchanger Contact Wear Alert

The tapchanger contact wear accumulators can be monitored to cause an alert for maintenance scheduling. There are 4 contact wear thresholds. If the wear accumulator for any contact or edge exceeds the corresponding threshold, ChkCntct is active, and can also cause an alert.

Stationary contact edge thresholds

- ChkCntctEngS is the engaging contact edge operation count threshold.
- ChkCntctBrkS is the breaking contact edge (current^2)*operations threshold.

Movable contact thresholds

- ChkCntctEngM is the contact operation count threshold.
- ChkCntctBrkM is the contact (current^2)*operations threshold.

Breaking thresholds are entered in thousands of (A^2)*operations (‘`kA^2*ops`’) from the menu system.

Configuration

Initial UVR-1 Configuration

The factory defaults for UVR-1 data items contain reasonable values, but do not represent any particular regulator installation. Therefore, it is mandatory that all configuration parameters, setpoints, and control values be set based on your particular installation before using the UVR-1 to control voltage regulation. **The VRCBlk operating mode control value is defaulted to "inhibit auto-control" to prevent automatic UVR-1 operation until it is specifically set to "normal". This should be done only after all other data item values have been set.**

Automatic UVR-1 Configuration

To facilitate configuration management, and to speed configuration of multiple units, a Microsoft Windows®-compatible program is supplied with the UVR-1. It allows most writable UVR-1 data items to be set conveniently at a PC, and to be saved in files. Thus, various configurations can be saved and kept on file for reference or later updates. In addition, when the PC is connected via a serial port to the UVR-1 PC Port, these data items can be downloaded into the UVR-1 in a fraction of the time required to set them manually from the front panel. A control's existing configuration data can also be read, edited, or saved. See the *UVR-1 Utility Suite Manual, Configuration Utility section* for further information.

Protocol Configuration

A Microsoft Windows®-compatible program is supplied with the UVR-1 to allow configuration of the UVR-1 remote communications protocol. The point list, a list of data items that are accessible to a remote operator or SCADA system, can be customized to consist of subsets of the available data items, and the reporting order (point numbers), reporting priority, and reporting deadbands of the data items can also be specified. Points can be reported by polling or by a report by exception mechanism. Report by exception allows data items to be reported only if they change beyond a specified deadband, greatly reducing the required communications bandwidth. The customized point list information can be saved in files, allowing various configurations to be managed. When the PC is connected via a serial port to the UVR-1 PC Port, the protocol configuration can be read from or downloaded into the UVR-1. See the appropriate protocol configuration program section of the *UVR-1 Utility Suite Manual* for further information.

Configuration Parameters

Certain configuration parameters are dependent upon the system configuration. The table below summarizes all common configurations:

System Configuration	VTCfg and SystemV Entry	Phasing	Power Display (PriPwrDis)	Effective Regulation Range (+/-, typical)	Source-side Capability
1-phase regulator	L-G	0	1-phase	10%	Yes
wye, 3 1-phase regulators	L-G (Note 1)	all 0	1-phase	10%	Yes
open delta, 2 1-phase regulators	L-L	30, 330	3-phase	10%	Yes
closed delta, 3 1-phase regulators	L-L	all 30 or 330	3-phase (Note 2)	15.3%	No
3-phase regulator (wye), VT L-G	L-G (Note 1)	30**n*	3-phase	10%	Yes
3-phase regulator (wye), VT L-L	L-L	30**n*	3-phase	10%	Yes

Notes:
1. The engineer may be used to expressing SystemV as a L-L value in these cases, but the L-G value must be entered for the UVR-1. Note that L-G means L-SL for an ungrounded system.
2. This power (and energy) calculation assumes the CT primary current equals the line current (5% max. error).
3. The power (and energy) display is most meaningful when set as indicated in the table, and is calculated assuming that the load is balanced as to magnitude and power factor. The internal and transmitted values are always 1-phase. For highest accuracy with 3 1-phase regulators in a wye configuration, the 3 1-phase readings should be summed to get the 3-phase quantity.
4. Though not shown in the table, the UVR-1 does not support source-side capability for regulators with series transformers.

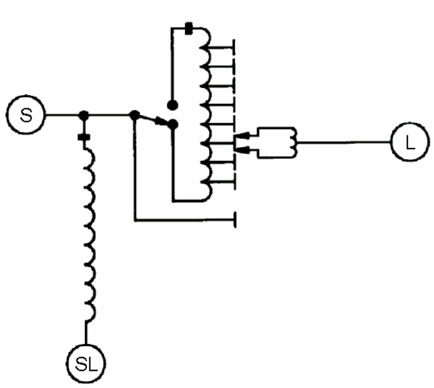
Two fundamental configuration parameters, regulator configuration and phasing, will be discussed below. Following these, all UVR-1 configuration parameters not discussed elsewhere are listed. They are grouped into several subcategories: tapchanger, regulator, regulator control, XIO port, protocol port, and PC port.

Regulator Configuration

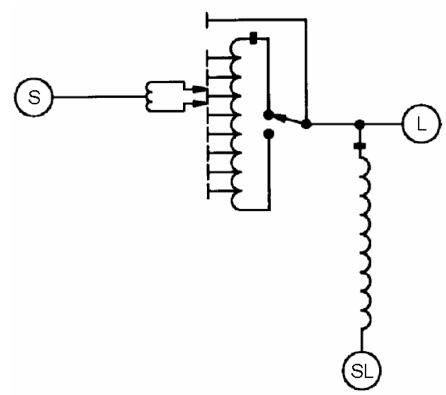
RegType selects a straight (ANSI type A), inverted (ANSI type B), or series transformer regulator configuration, depending on the regulator model. The series transformer configuration is used only when the through current rating of the regulator exceeds that of the tapchanger. Source-side calculations and reverse regulation and metering are not supported for the series transformer configuration.

There are two basic types of step-voltage regulators recognized in ANSI/IEEE C57.15. These are properly identified as “Type A” and “Type B”, although they are also often spoken of as “Straight” for Type A and “Inverted” for Type B. The 1986 revision of C57.15 formally recognized these types, and the “Type A” or “Type B” designation now appears on the nameplate.

Even if not explicitly stated, the type can easily be discerned from the circuit schematic on the nameplate using the figures and descriptions below:



Type A "Straight"



Type B "Inverted"

Type A: The source terminal is connected directly to the shunt winding of the regulator. The series winding is connected to the shunt winding and, in turn, via taps, to the load terminal.

Type B: The source terminal is connected, via taps, to the series winding of the regulator. The series winding is connected to the shunt winding, which is connected directly to the load terminal.

Phasing

Phasing is used to accomodate the regulator installation within a particular power system. It is used to correct the phasing between the control input voltage and the CT secondary current. This is required for proper operation of line drop compensation and for proper system parameter calculations for display.

For 3-phase regulators, Phasing should be adjusted in 30 degree increments until the displayed power factor is most sensible, or is closest to the system power factor read by an independent meter (assuming a balanced load).

Single-phase step-voltage regulators are suitable for use on any of three recognized 3-phase system applications:

- Grounded Wye – The most common system in the U.S. The VT is connected line-to-ground and the CT is measuring the line current on the same phase. The signals from the internal VT and CT are in phase at unity load power factor. Phasing should be set to zero (0º) for this configuration.

- Open Delta – The VT is connected line-to-line and the CT is measuring the line current. There will be an inherent 30º phase shift between the voltage and current signals. There are two regulators involved; the signal from the internal CT is shifted to retard (or "lag") in phase on one of the regulators and the signal from the internal CT is shifted to advance (or "lead") in phase on the other regulator. Phasing of ±30º (note: -30º = 330º) must be set for the regulator controls. The user must determine which of the controls is to be set "plus" and which "minus". Unfortunately, it is not likely that this can be determined by simply knowing to which phase each regulator is connected.

  The proper selection of the sign is facilitated by operator recognition of what is realistically to be expected for the system power factor, and the fact that the relative 60º shift will dramatically affect the displayed power factor. The simplest solution is to enter 30º for Phasing of one control and 330º (-30º) for Phasing of the other. If the displayed power factors appear to be correct, the proper selection was made. If the displayed power factors are dramatically in error, the improper selection was made and the settings must be swapped. The following illustration of the mathematics may be helpful:

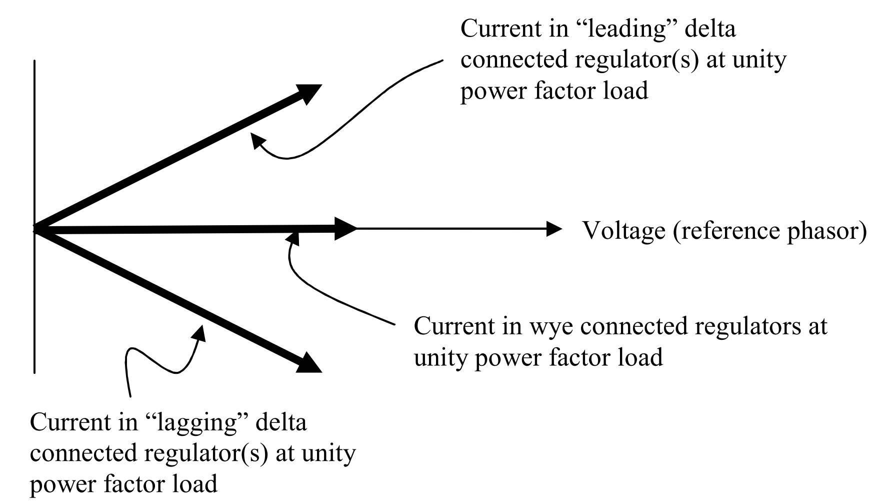
Suppose the true power factor is 0.95 lag.

It may be calculated that the phasing, i.e. the angle by which the current lags the voltage, is arccosine (0.95) = 18.2º.

For the "lagging" regulator, the CT signal *lags* relative to the VT signal by 30º which is *added* to 18.2º so the *apparent phasing* is 48.2º and the *apparent power factor* is displayed as cosine (48.2º) = 0.67 lag. Phasing should be set to 30º on this regulator control.

For the "leading" regulator, the CT signal *leads* relative to the VT signal by 30º which is *subtracted* from 18.2º so the *apparent phasing* is -11.8º and the *apparent power factor* is displayed as cosine (-11.8º) = 0.98 lead. Phasing should be set to 330º (-30º) on this regulator control.

Note: The Phasing setting on the UVR-1 is the angle by which the system current intrinsically *lags* the system voltage. This is 30º in a "lagging" regulator and 330º in a "leading" regulator. This is equivalent to the angle by which the current phasor must be *advanced* in order to bring the signals in-phase. The figure below may give additional insight:



- Closed Delta – The VT is connected line-to-line and the CT is measuring the approximate line current (5% max. error). As with open delta, there will be an inherent 30º phase shift between the voltage and current signals. For the phasing consideration the difference between open delta and closed delta is that there are three regulators and all are "lagging" *or* all are "leading". To find the correct phase shift empirically, it is useful to set Phasing to 30º on one control and 330º on another. Of these two, the control which then displays the apparently correct power factor has been configured correctly. Phasing on all controls must then be set to the correct value just determined.

Tapchanger

- CntOperIncr selects what operation counter switch action is necessary to increment the operation counters. A transition (from open-to-closed or closed-to-open) or a complete pulse can be selected, depending on the regulator model. If a holding switch is used, complete pulse should be selected. There is also a selection to indicate that there is no valid operation counter or holding switch signal, which forces the use of a simplified voltage regulation algorithm (see Simplified Voltage Regulation (p. 25)).
- MotorVSrc selects the source for the tapchanger motor power, based on whether it is derived from the voltage at the S or L regulator terminal.
- MotorVNeut specifies the nominal voltage applied to the tapchanger motor at the neutral tap position. This can be calculated as ((SystemV) / (VT or utility winding ratio)).

- MotorVThres specifies the motor voltage below which to disable tap changes. This should be the minimum voltage necessary for the tapchanger motor to operate reliably. Motor voltage derived from the S regulator terminal is not monitored for closed delta nor series transformer regulator configurations, nor during simplified voltage regulation.
- TapTimeout specifies the time limit for a tap change to complete, before a failure is recorded. This is dependent on the tapchanger motor, and may be determined from the regulator specsheet or empirically. A reasonable margin (several seconds) should be added to the nominal tap change time to get this value.
- InterTapDly specifies the time between tap changes during a multi-tap sequence. It should be set to the default of 2.0 seconds unless the equipment configuration requires a longer time.
- TapPosSet is the data item used to remotely set the current tap position.
- CntOperSet is the data item used to remotely set the internal operation counter.
- NeutralSwPres specifies whether or not a neutral switch is present. If it is not, the neutral switch input will be ignored when tracking current tap position.

Regulator

- SystemCfg selects the regulator system configuration as installed, either single-phase/wye/open delta, or closed delta. Source-side calculations and reverse regulation and metering are not supported for the closed delta configuration.
- BaseV specifies the system base voltage, to which the control input voltage is normalized before it is used by the UVR-1. The base voltage has traditionally been chosen to match the output of a ratio-correcting transformer (RCT), but since the UVR-1 does not require a RCT, any value which operators are familiar working with can be chosen. The factory default of 120 V (specified by C57.15) is recommended, but other values (e.g. 125 V) are sometimes used. The formula for the normalized control input voltage is BaseV * (CtlVIn / (SystemV / VTRatio)). For example, with a system voltage of 6900 V and a VT ratio of 60:1, the nominal VT secondary voltage is 115 V. A control input voltage of 108 V, normalized to 120 V base voltage, would therefore be 120 * (108 / 115) = 112.7 V. The nominal control input voltage of 115 V would of course be normalized to 120 V.
- SystemV specifies the nominal load-side primary system voltage, dependent on the power system. It should always equal CtlVIn (nominal) * VTRatio.
- SystemHz specifies the nominal line frequency. The UVR-1 will work on either 50 or 60 Hz systems.
- FullLoadA specifies the rated load current as stated on the regulator nameplate. If this parameter is changed, all contact wear accumulators should be reset.
- VTCfg selects the VT (PT or utility winding) configuration, either line to line or line to ground, depending on the regulator installation.
- VTRatio specifies the overall VT turns ratio (primary load voltage / secondary load voltage), based on the regulator nameplate. This includes the PT or utility winding, and any RCTs that may be present.
- CTRatio specifies the CT turns ratio (primary load current / secondary load current), as stated on the regulator nameplate. For convenience, the CT primary current rating is entered from the menu, assuming a 0.2 A secondary rating.
- RegRange specifies the rated (nominal) regulation range for the regulator (assuming use in a single-phase or wye configuration). Most regulators have a range of 10.0% boost or buck. The effective range will be calculated automatically by the control.
- IntReg specifies the internal regulation of the voltage regulator as a percentage. This is the percent voltage drop at rated load current and voltage at tap position 16 raise due to the internal impedance of the voltage regulator. If not available from the manufacturer, see Appendix B (p. 123) for a simple method of determining this value. The default value of 0.40% is a reasonable estimate for most regulators. For closed delta or series transformer regulator configurations, or during simplified voltage regulation, this parameter is not used.
- LimLoadA specifies the load current limit (at CT secondary), above which the auto-control algorithm will be inactive. This is used to protect the regulator tapchanger from operating during high current conditions, such as to avoid an arc-over of the tapchanger contacts if the load current exceeds the tapchanger rating (about 2 times the transformer rating). The formula for LimLoadA is (primary load current limit (A) / CTRatio) * 1000. For example, if a primary load current limit of 600 A is desired, and the CT ratio is 2500 (500 : 0.2 A), LimLoadA should be set to (600 / 2500) * 1000 = 240 mA.

- PwrScale specifies the scaling for power values. It should be set as low as possible (to maximize resolution), while still exceeding the highest expected 1-phase power value and regulator VA rating (per phase). The demand min/max and energy values should be reset if this is changed.

Regulator Control

- ClockTOD is the internally-maintained date and time, used for remote (protocol) reporting. It and LocalTimeOffset are used to generate the local time. ClockTOD is set indirectly by setting the local time, or directly by remote control. A powerfail backup circuit maintains the clock/calendar for up to 3 days without AC power. If the clock/calendar is invalid upon powerup, it is set to the default (later of TSYearBase or 1970).
- LocalTimeOffset specifies the difference between the internal clock and local displayed time. It should generally be set before setting the local time. Subsequent Daylight Saving Time or time zone changes can then be accomplished simply by changing LocalTimeOffset.
- BaseTime is required for the communications protocol. The factory default must not be changed.
- TSYearBase specifies the beginning year for the 32-bit timestamp, used for marking the time of min/max quantities. The timestamp is calculated as seconds past January 1, TSYearBase, and has a 136 year range, thus the factory default value of TSYearBase should not generally need to be changed (if it is, it must not be set before BaseTime nor beyond the current local time). Changing TSYearBase clears all timestamped data items and logs.
- TSFormat specifies the format of the 32-bit timestamp for remote reporting, either binary seconds or packed date/time bitfields. This can be set to the format most useable by remote control / SCADA software.
- CktIDNum specifies the circuit ID number, as determined by the utility.
- CktID specifies the circuit ID string, a 20-character description of the circuit, displayed by the UVR-1.
- DevAddress specifies the unique address of this UVR-1 for use by the communications protocol. It is set to the unit serial number (SerialNum) modulo 65520 before being shipped from the factory. DevAddress is only required to be unique among all IEDs on a common communications path (bus, loop, network, etc.).
- Sc1 is the level 1 access code, used as a security password for control settings.

XIO Port

The XIO port on the rear of the panel is an 8-position general-purpose port used for various inputs and outputs. Each input or output is used with an I/O module or optocoupler on an optional XIO port interface board to interface to external equipment. If an XIO port interface board is not used with this control, the XIO port parameters below must be configured to the default settings, or unpredictable operation may result. The port is configured by several parameters:

XIOFunctionPos*n*: There are 8 separate data items, one for each position on the XIO port. Each data item indicates the desired function for position *n* (1-8). The available functions and their meanings are listed below:

simple input (or unused)	general purpose input which can be read locally or remotely
simple output	general purpose output which can be set locally or remotely
ExtAlert input	external alert, can be configured to cause an alert.
Alert output	indicates Alert condition
AuxAutoInhibit input	used for auxiliary regulator control (see Regulator Control Modes (p. 23))
AuxRaise input	used for auxiliary regulator control (see Regulator Control Modes (p. 23))
AuxLower input	used for auxiliary regulator control (see Regulator Control Modes (p. 23))
VRed1 input	used for XIO voltage reduction (see Voltage Reduction Modes (p. 27))
VRed0 input	used for XIO voltage reduction (see Voltage Reduction Modes (p. 27))
Heater output	can be used to turn on a heater in the control enclosure for environmental control, active whenever ambient temperature is below HeaterTemp.
Cooling Device output	can be used to turn on a cooling device, active whenever ambient temperature is above CoolerTemp.
SyncRaise output	used to command an auxiliary raise on other regulator controls for ganged operation.
SyncLower output	used to command an auxiliary lower on other regulator controls for ganged operation.

XIOActiveLevel: 8-position item indicating whether each position's active level is energized or de-energized (state of I/O module or optocoupler).

XIODefOut: 8-position item indicating whether each position's default state (at UVR-1 power-on) is active or inactive. Affects only positions configured as simple outputs.

XIORBEMask: 8-position item indicating whether the corresponding XIOInRBE position should be disabled (forced to inactive) to prevent it from causing a communications protocol report by exception.

Access to the port is provided in multiple ways, using the following data items:

XIOInRBE: 8-position item indicating the state of all input positions and control state (not electrical sensing) of all output positions, unless masked by XIORBEMask.

XIOIn: 8-position item indicating the state of all input positions and control state (not electrical sensing) of all output positions.

XIOInPos*n*: There are 8 separate data items, one for each position on the XIO port. Each data item indicates the state of the input or control state (not electrical sensing) of the output at position *n* (1-8).

XIOOut: 8-position item used to control the state of all positions configured as simple outputs.

XIOOutPos*n*: There are 8 separate data items, one for each position on the XIO port. Each data item is used to control the state of position *n* (1-8) when configured as a simple output.

Protocol Port

The protocol port is configured with the following parameters, determined by the communications architecture of the remote control / SCADA system. The interface mode must be selected, and the serial communications settings must be specified.

- ProtMode selects the protocol port interface configuration and handshaking (see below).
- ProtBaud specifies the baud rate.
- ProtFrameType specifies the number of data bits, parity (if any), and the number of stop bits.
- ProtTxDly specifies the protocol transmission delay. This can be used to assure a minimum time delay between the receipt of a protocol message and the transmission of the response, such as for line turnaround on a half-duplex link.

The protocol port can be configured for point-to-point as well as multi-dropped or loop configurations. For the latter, one UVR-1 can be configured as a gateway to a different host-side (SCADA master) interface if required. For example, several devices may be multi-dropped using a 4-wire EIA-485 bus, with one acting as a gateway using an internal modem on a daughter board to communicate with the SCADA master over a single telephone line. The available configurations (ProtMode) are:

EIA-232, no handshake, no flow control
EIA-485 2-wire
EIA-485 4-wire, with EIA-232 host interface
EIA-485 4-wire, with daughter board host interface
EIA-485 4-wire
daughter board interface, no handshake, no flow control
daughter board loop, with EIA-232 host interface
daughter board loop
fiber-optic loop, with modem host, both on daughter board

Host interface refers to the gateway device host-side interface. EIA-485 and daughter board loop configurations can support multiple devices, with or without a gateway. Loop configurations are generally used for fiber-optic interfaces.

For further information, see the *UVR-1 Communications Configurations Application Note*, which describes how the UVR-1 can be configured for various communications architectures, including the use of multiple controls and gateways.

PC Port

Only the baud rate (PCBaud) is configurable for the PC port, which must match the port setting on the PC used for configuration or maintenance. The other parameters are fixed at 8 data bits, no parity, and 1 stop bit.

User Profiles

There are 3 user-customizable profiles for storage of UVR-1 control parameters. They are initially set to the factory default settings. The current UVR-1 control parameters can be loaded from or saved to any of the three profiles, making it easy to change between different control setups. This could be in response to special power flow situations, seasonal differences, etc. The profiles are accessed locally via individual menu commands, or remotely via the UserDefs data item. Calibration constants and parameters which affect the remote communications protocol are not included in the profiles, and are unchanged by loading different profiles.

While not generally necessary, the UVR-1 control parameters can also be restored to the factory defaults. This can only be done with a menu or PC configuration utility command, and does not affect calibration or the user-customizable profiles. It does clear all timestamped data items and logs.

CAUTION: Loading of a user profile or factory defaults replaces the current UVR-1 parameters; therefore, if the current parameters are important, they must be saved to a user profile or external PC configuration file before they are overwritten by the load.

Date Activation

The date activation feature allows any of the user profiles to be automatically loaded on any of 4 user-selectable dates each year. There are 4 entries, designated A, B, C, and D (to reduce confusion with user profile numbers), each of which consists of an activation date/time and a user profile number to be loaded. The following parameters are required:

Local date and time of user profile activation, consisting of month, day, hour, and minute. The date and time are separate data items, but are entered together in ‘`mm/dd hh:mm`’ format when using the menu system.

Data Item ID	Menu Legend
ProfDate_A	`Prof..DAP-A.DateTime`
ProfDate_B	`Prof..DAP-B.DateTime`
ProfDate_C	`Prof..DAP-C.DateTime`
ProfDate_D	`Prof..DAP-D.DateTime`
ProfTime_A	`Prof..DAP-A.DateTime`
ProfTime_B	`Prof..DAP-B.DateTime`
ProfTime_C	`Prof..DAP-C.DateTime`
ProfTime_D	`Prof..DAP-D.DateTime`

Date-activated user profile number. For each activation date/time, a particular user profile (1 - 3) can be specified. A user profile number of 0 signifies no change.

Data Item ID	Menu Legend
ProfNum_A	`Prof..DAP-A.ProfNum`
ProfNum_B	`Prof..DAP-B.ProfNum`
ProfNum_C	`Prof..DAP-C.ProfNum`
ProfNum_D	`Prof..DAP-D.ProfNum`

To prevent unintentional user profile loading during configuration of these parameters, it is suggested that ProfNum_*x* be set to 0, then ProfDate_*x* and ProfTime_*x* be set, then ProfNum_*x* be set to the desired user profile number.

Note that if the clock/calendar is valid upon powerup, the “current” (most recent) date-activated user profile is loaded if it is different than the last one loaded. This handles the most common powerfail situations seamlessly.

Maintenance

Security Level

The security level must be set to enable or prevent setting of parameters or execution of commands. See the Menu System section (p. 18) for details.

Serial Number

The UVR-1 unit serial number (SerialNum) is the number shown on the control back panel. It can be read locally or remotely to uniquely identify the control. This is generally only necessary for maintenance, but may also be useful for remote configuration. It can also be changed from the menu by factory-qualified service personnel.

Voltage Regulator Serial Number

The voltage regulator serial number (VRegSN) can be stored and read locally to identify the voltage regulator which the UVR-1 controls. It is a 20-character string. This may be useful for tracking during maintenance.

User Defined ID

A user-defined ID (UserID) can be stored and read locally as an additional identifier associated with the UVR-1. It is a 20-character string. This may be used, for example, to track associated equipment during maintenance.

Clear Data Log

This command (ClearDatLg) can be used to clear the data log. This should only need to be done when reconfiguring the UVR-1 for another regulator.

UVR-1 Programming

The UVR-1 operating firmware, factory defaults, control configuration, and protocol configuration are stored in flash memory. They can be programmed in the field by connecting a PC via a serial port to the UVR-1 PC Port. The PC programs described in the Configuration section (p. 56) support this process for configuration. A Microsoft Windows®-compatible program is supplied with the UVR-1 to allow the user to update the UVR-1 operating firmware and factory defaults, as updates become available. See the *UVR-1 Utility Suite Manual, Firmware Loader section* for further information.

Security Level Enable Log

A log is kept of the times that SecurityLevel Read/Write/Execute was enabled. The local date and time of each enable is displayed in '`mm/dd/yyyy hh:mm:ss`' format. SecEn_*n* is the 16-entry security level enable log. '*n*' designates the entry number, 1 being the most recent. This log is read-only.

To view the log data on the front panel display using the UVR-1 menu system, select the `Maint.SecEn` subcategory. The **SCROLL** knob can then be used to scroll through the log entries.

UVR-1 Firmware Version Numbers

The version numbers of the UVR-1 operating firmware modules can be read locally for maintenance purposes. The modules are the registry (RegVersion), boot code (BootVersion), application code (AppVersion), and protocol code (ProtVersion).

UVR-1 Board ID Numbers

The ID numbers of the UVR-1 circuit boards can be read locally for maintenance purposes. These are the main board (MainBoardID), display board (DisplayBoardID), I/O board (IOBoardID), and switch board (SwitchBoardID). All ID numbers except the main board's can be changed from the menu by factory-qualified service personnel.

Diagnostics

The Diagnostics menu subcategory provides access to diagnostic data and functions for use only by factory personnel, and its contents may vary.

Calibration

Calibration Procedure

The UVR-1 regulator control is factory-calibrated, and field calibration should not normally be necessary. In the event that re-calibration is required, the UVR-1 is calibrated by adjusting the values of four data items:

CtlVIn — Set **AUTO/OFF/MANUAL** switch to **OFF**. Connect a clean (<0.1% THD), stable, 120 Vrms, 60 Hz AC (1 A minimum) power supply to the **EXTERNAL SOURCE** terminals, and set the **MAIN POWER** switch to **EXTERNAL**. Using edit mode, set CtlVIn to the voltage read on an accurate (0.1%) AC voltmeter connected to the **VOLTMETER** terminals.

LoadA — Connect a clean (<0.1% THD), stable, 200 mA rms, 60 Hz AC current source in series with an accurate (0.1%) AC ammeter to the control's CT input (IL+ and IL-) terminals (80 mV rms voltage burden due to the control). Using edit mode, set LoadA to the current read on the ammeter.

PhaseAng — Using the above voltage and current sources, set the phase of the current source equal to that of the voltage source (exactly in-phase). Make sure Phasing is set to 0 degrees. Using edit mode, set PhaseAng to 0.0 degrees.

SysTemp — Using edit mode, set SysTemp to the ambient temperature near the control as read on an accurate (1 °C) thermometer in a temperature-stable environment.

External Interface Reference

Harness Connectors

Most connections between the UVR-1 and the voltage regulator are through the harness connectors. Their signal definitions are shown below.

Terminal Number	Terminal Label	Signal Description (direction relative to UVR-1)
P1-1	PS	panel power source input
P1-3	MS	motor power source input
P1-5	GND	common return for all signals except the CT
P1-7	IL-	regulator CT return*
P1-9	IL+	regulator CT input
P2-1	DHR	regulator draghand reset output
P2-3	L	tapchanger lower motor winding output
P2-5	R	tapchanger raise motor winding output
P2-7	NS	tapchanger neutral switch input
P2-9	OC	tapchanger operation counter switch input
P2-11	HS	tapchanger holding switch input

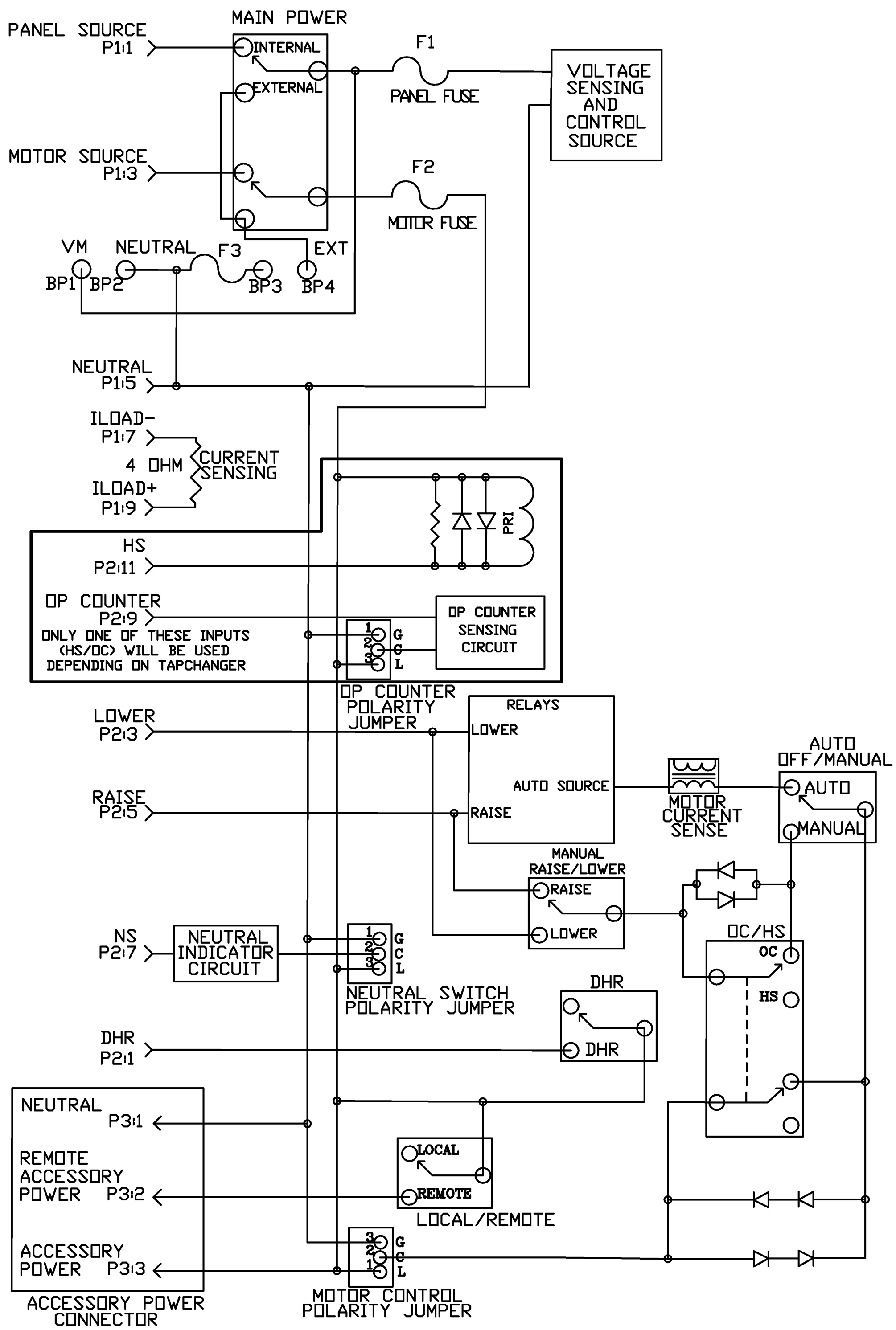
* IL- must be connected to GND in the control cabinet or harness.

Accessory Power Connector

Power for accessory equipment is available at the accessory power connector. Its signal definitions are shown below.

Terminal Number	Terminal Label	Signal Description (direction relative to UVR-1)
P3-1	GND	common return for all signals except the CT*
P3-2	RAP	remote accessory power, supplies power from MS through **MOTOR** fuse in Remote mode
P3-3	AP	accessory power, supplies power from MS through **MOTOR** fuse

UVR-1 Electrical Connections



Protocol Port

Three electrical interfaces, EIA-232, EIA-485, and a daughter board interface, may be selected for the protocol port. When the UVR-1 is used as a gateway, up to two of these may be in use at the same time.

The EIA-232 interface is configured as DTE (female DB9), allowing it to be connected to a modem with a straight cable, or connected to a PC serial port with a null-modem cable. The connector pinout is shown below.

Pin Number	Signal Name	Direction relative to UVR-1
1	DCD	input
2	RXD	input
3	TXD	output
4	DTR	output
5	GND	ground
6	DSR	input
7	RTS	output
8	CTS	input
9	RI	input

The EIA-485 interface is configured as half-duplex (2-wire mode) or full-duplex (4-wire mode), using a 5-pin male connector. The mating connector is supplied with the UVR-1. Both ends of each 485+/485- communications line pair should be terminated with 120 ohm resistors. The connector pinout is shown below (Tx = transmit output, Rx = receive input, relative to UVR-1).

Pin Number	Signal Function (2-wire mode)	Signal Function (4-wire mode)	Comments
1	485+ Tx/Rx	485+ Tx	positive = 1 (mark)
2	485- Tx/Rx	485- Tx	negative = 1 (mark)
3	not used	485+ Rx	positive = 1 (mark)
4	not used	485- Rx	negative = 1 (mark)
5	GND	GND	ground

The daughter board interface provides for a variety of optional interfaces for the protocol port, such as a fiber-optic interface and/or a modem. See the appropriate Daughter Board Communications Module manual for details.

For further information, see the *UVR-1 Communications Configurations Application Note*, which describes how the UVR-1 can be configured for various communications architectures, including the use of multiple controls and gateways.

PC Port

The front panel PC port is an EIA-232 interface configured as DCE (female DB9), allowing it to be directly connected to a PC serial port, or connected to a modem with a null-modem cable. The connector pinout is shown below.

Pin Number	Signal Name	Direction relative to UVR-1
1	DCD	not connected
2	RXD	output
3	TXD	input
4	DTR	internally connected to pin 6
5	GND	ground
6	DSR	internally connected to pin 4
7	RTS	internally connected to pin 8
8	CTS	internally connected to pin 7
9	RI	not connected

XIO Port Connector

The XIO Port Interface Board (which holds the XIO port I/O modules) or XIO Port Input-only Interface Board is connected via a ribbon cable to the UVR-1 XIO connector. These optional circuit boards and interconnecting cables are available exclusively from ICMI. See the *UVR-1 XIO Port Interface Guide* for details.

Database Reference

Data items are organized alphabetically. For each data item, its data item identifier and menu legend or access mechanism (if applicable) are shown along with the valid values for the item. Factory default values (if applicable) are in bold type. If needed, a concise description follows.

General Notes:

- All voltage and current quantities are fundamental RMS values unless otherwise noted.
- All calculations are based on fundamental values unless otherwise noted.
- XIO port positions 1 - 8 correspond to byte-wide bit field bits 0 - 7, respectively.
- 32-bit timestamp is defined as seconds past 00:00:00, January 1st, TSYearBase (1970 default). If timestamp is zero, indicates that min/max values are invalid.
- All average and demand calculations are restarted on setpoint change or metering reversal.
- Certain source and load voltage designations below are marked with an asterisk ('*'). During reverse regulation and metering, the regulator terminals to which these refer are interchanged.

Alert (ALERT lamp) normal alert active

AlertMask1 (Cntrl.Alert.CommBlk)	bit 0	CommBlk active
(Cntrl.Alert.RptTpPos)	bit 1	RptTapPos active
(Cntrl.Alert.AInhibit)	bit 2	AutoInhibit active in auto
(Cntrl.Alert.AutoSw)	bit 8	Auto/Off/ManualSw not auto
(Cntrl.Alert.TapCh TO)	bit 12	TapChTimeout active
(Cntrl.Alert.LostTPos)	bit 13	TapPosKnown inactive

Bit field, bit set enables alert if corresponding condition is true **(2004h)**.

AlertMask2 (Cntrl.Alert.ExtAlert)	bit 1	XIO ExtAlert active
(Cntrl.Alert.Blk HiV)	bit 3	BlkHV active
(Cntrl.Alert.Blk LowV)	bit 4	BlkLV active
(Cntrl.Alert.Volt Red)	bit 5	VoltageReduction enabled
(Cntrl.Alert.Rev Powr)	bit 6	RevPowerFlow reverse
(Cntrl.Alert.Low Cur)	bit 8	LowCurrent active
(Cntrl.Alert.Blk TapL)	bit 9	BlkTapL active
(Cntrl.Alert.Blk TapR)	bit 10	BlkTapR active
(Cntrl.Alert.BeloRevA)	bit 11	BelowRevCur active
(Cntrl.Alert.LowMotrV)	bit 12	LowMotorV active
(Cntrl.Alert.BlkLoadA)	bit 13	BlkLoadA active
(Cntrl.Alert.ChkCntct)	bit 14	ChkCntct active

Bit field, bit set enables alert if corresponding condition is true **(3000h)**.

AlertStatus1 (Stats.Alerts)	bit 0	CommBlk active
	bit 1	RptTapPos active
	bit 2	AutoInhibit active in auto
	bit 8	Auto/Off/ManualSw not auto
	bit 12	TapChTimeout active
	bit 13	TapPosKnown inactive

Bit field, bit set indicates alert is active (enabled and condition is true).

AlertStatus2 (`Stats.Alerts`)

bit 1	XIO ExtAlert active
bit 3	BlkHV active
bit 4	BlkLV active
bit 5	VoltageReduction enabled
bit 6	RevPowerFlow reverse
bit 8	LowCurrent active
bit 9	BlkTapL active
bit 10	BlkTapR active
bit 11	BelowRevCur active
bit 12	LowMotorV active
bit 13	BlkLoadA active
bit 14	ChkCntct active

Bit field, bit set indicates alert is active (enabled and condition is true).

AppVersion (`Maint.Code..App Code`) 0.01 - 655.35
UVR-1 application code version number.

Auto/Off/ManualSw (**AUTO/OFF/MANUAL** switch) off, manual auto
Off: no motor power, auto-control algorithm inactive
Manual: routes motor power through **RAISE/LOWER** switch, bypassing control, auto-control algorithm inactive
Auto: motor actuated by control, auto-control algorithm active

AutoInhibit (`Stats.Mode..AInhibit`) normal auto-control algorithm inhibited
Active due to VRCBlk or XIO AuxAutoInhibit input.

AvgInterval (`SetPt.Meter.Avg Int`) 1 - 120 sec **(30 sec)**
Interval over which to average present measurement data.

AvgLoadCtrV (data log) 0.0 - 145.0 V
Average load center voltage (BaseV base).

AvgLoadV (data log) 0.0 - 145.0 V
Average load voltage (BaseV base).

AvgRs (`Cntrl.Reset.Average`) reset all min/max average values (command)

AvgSrcV (data log) 0.0 - 145.0 V
Average source voltage (BaseV base).

BaseTime (`Cnfig.Cntrl.SysYrBas`) 1900 - present year (2099 max.) **(1970)**
Base year for protocol time.

BaseV (`Cnfig.Reg...BaseV`) 100 - 135 V **(120 V)**
System base voltage.

BasicRs (`Cntrl.Reset.Basic`) reset all min/max basic measurement values (command)

BelowRevCur (Alert selection) normal load current below RevCur threshold

BlkHV (**HIGH LIMIT** lamp) normal high voltage limiting active
High load* voltage limit grey zone reached.

BlkLoadA (Alert selection) normal auto-control load current limit exceeded

BlkLV (**LOW LIMIT** lamp) normal low voltage limiting active
Low load* voltage limit grey zone reached.

BlkTapL (Alert selection) normal lower tap position limit reached

BlkTapR (Alert selection) normal raise tap position limit reached

BootVersion (`Maint.Code..Boot Blk`) 0.01 - 655.35
UVR-1 boot code version number.

Break_*dsg* (`Stats.Cntct.Brk` *dsg*) 0 - 4,294,967,295 kA^2*ops **(0 kA^2*ops)**
Breaking contact edge (current^2)*operations accumulators. '*dsg*' designates one of 20 or 38 contact edges, depending on CntctType. See table in Tapchanger Contact Wear Log section (p. 47).

ChkCntct (Alert selection) normal contact wear threshold exceeded

ChkCntctBrkM (`SetPt.Cntct.ChkBrkM`) 0 - 4,294,967,295 kA^2*ops **(4,294,967,295 kA^2*ops)**
Breaking contact (current^2)*operations alert threshold for moving contacts.

ChkCntctBrkS (`SetPt.Cntct.ChkBrkS`) 0 - 4,294,967,295 kA^2*ops **(4,294,967,295 kA^2*ops)**
Breaking contact edge (current^2)*operations alert threshold for stationary contacts.

ChkCntctEngM (`SetPt.Cntct.ChkEngM`) 0 - 999,999 ops **(999,999 ops)**
Engaging contact operation count alert threshold for moving contacts.

ChkCntctEngS (`SetPt.Cntct.ChkEngS`) 0 - 999,999 ops **(999,999 ops)**
Engaging contact edge operation count alert threshold for stationary contacts.

CktID (`Cnfig.Cntrl.CktIdTxt`) 20-character string **(all spaces)**
Circuit ID string.

CktIDNum (`Cnfig.Cntrl.CktIdNum`) 0 - 32,767 **(0)**
Circuit ID number.

ClearDatLg (`Maint.Clear DatLg`) clear data log (command)

ClockTOD (`Cnfig.Cntrl.Lcl Time`) milliseconds past 00:00:00, January 1st, BaseTime
(max(TSYearBase, 1970) - BaseTime in ms)
Time format used by UVR-1 for date and time keeping.

CntctLog (`Cntrl.Mode..CntctLog`) **disabled** enabled
Tapchanger contact wear logging control.

CntctRs (`Cntrl.Reset.Cntcts`) reset all contact wear accumulators (command)
See table in Tapchanger Contact Wear Log section (p. 47).

CntctRs_*ds* (`Cntrl.Reset.Cntct` *ds*) reset selected contact wear accumulators (command)
Reset contact wear accumulators for selected contact. '*ds*' designates one of 11 or 20 contacts, depending on CntctType. See table in Tapchanger Contact Wear Log section (p. 47).

CntctType (`Cnfig.TapCh.CntctTyp`) **single-blade** double-blade
Tapchanger contact type.

CntOper (`Stats.TapCh.OpCount`) 0 - 999,999 **(0)**
Operation counter.

CntOperIncr (`Cnfig.TapCh.OpCntInc`) **complete pulse**
each transition
OC/HS invalid

Operation counter switch state change necessary to increment operation counters.

CntOperR (`Stats.TapCh.ResOpCnt`) 0 - 999,999 **(0)**

Resettable operation counter.

CntOperSet (`Cnfig.TapCh.OpCnt`) 0 - 999,999

Set operation counter CntOper (momentary).

CommBlk (`Stats.Mode..CommBlk`) normal remote control of tapchanger motor blocked

Active due to XIO AuxAutoInhibit input.

CoolerTemp (`SetPt.Mode..Clr Temp`) -20 - 85 °C **(85 °C)**

Temperature above which cooling device will turn on.

CtlVIn (`Meas..Basic.CtlVIn`) 0.0 - 145.0 V

Voltage at control input.

CTRatio (`Cnfig.Reg...CTRatio`) 1 - 32,767 **(1,000)**

CT turns ratio, primary load current / control input current.

DatLgInt (`SetPt.Meter.DatLgInt`) **disabled**
1 min
2 min
3 min
4 min
5 min
6 min
10 min
12 min
15 min
20 min
30 min
60 min
120 min
180 min
240 min

Data logging interval.

DatLgSlot1 (`Cntrl.DatLg.Slot 1`) empty
LoadCtrV
LoadV
SrcV
LoadA
PriLoadCtrV
PriLoadV
PriSrcV
PriLoadA
PF
Hz
PriVA
PriW
PriVAr
CtlVIn
SysTemp
PhaseAng
AvgLoadCtrV
AvgLoadV
AvgSrcV
DmdLoadA
DmdVA
DmdW
DmdVAr
THDLoadV
HD3LoadV
HD5LoadV
HD7LoadV
HD9LoadV
HD11LoadV
HD13LoadV
THDLoadA
HD3LoadA
HD5LoadA
HD7LoadA
HD9LoadA
HD11LoadA
HD13LoadA
TapPos
CntOper
CntOperR

Data item selected for data log slot 1 (default **AvgLoadCtrV**).

DatLgSlot2 (`Cntrl.DatLg.Slot 2`) (see DatLgSlot1)

Data item selected for data log slot 2 (default **LoadA**).

DatLgSlot3 (`Cntrl.DatLg.Slot 3`) (see DatLgSlot1)

Data item selected for data log slot 3 (default **DmdVA**).

DatLgSlot4 (`Cntrl.DatLg.Slot 4`) (see DatLgSlot1)

Data item selected for data log slot 4 (default **THDLoadV**).

DatLgSlot5 (`Cntrl.DatLg.Slot 5`) (see DatLgSlot1)

Data item selected for data log slot 5 (default **THDLoadA**).

DatLgSlot6 (`Cntrl.DatLg.Slot 6`) (see DatLgSlot1)
Data item selected for data log slot 6 (default **PF**).

DatLgSlot7 (`Cntrl.DatLg.Slot 7`) (see DatLgSlot1)
Data item selected for data log slot 7 (default **TapPos**).

DevAddress (`Cnfig.Cntrl.Dev Addr`) 0 - 65,519 **(0)**
Device address for protocol use.

DisplayBoardID (`Maint.BdID..Display`) 1 - 999,999,999
UVR-1 display board ID number (factory-assigned).

Dmd (`SetPt.Meter.Dmd Calc`) **thermal**
Demand calculation type.

DmdInt (`SetPt.Meter.Dmd Int`) 1 - 120 minutes **(30 minutes)**
Demand interval.

DmdLoadA (`Meas..Dmd...LoadA`) 0.0 - 3,276.7 A
Load current demand.

DmdRs (`Cntrl.Reset.Demand`) reset all min/max demand values (command)

DmdVA (`Meas..Dmd...VA`) 0.0 - 3,276.7 MVA
Apparent power load demand (scaling determined by PwrScale).

DmdVAr (`Meas..Dmd...VAr`) -3,276.8 - 3,276.7 MVAr
Reactive power load demand (scaling determined by PwrScale).

DmdW (`Meas..Dmd...Watts`) -3,276.8 - 3,276.7 MW
Real power load demand (scaling determined by PwrScale).

DragRs (`Cntrl.Reset.Draghand`) reset tap position draghands (command)
Set HiTapPos and LoTapPos to TapPos (independent of mechanical draghands).

EnergyRs (`Cntrl.Reset.Energy`) reset all energy values (command)

Engage_*dsg* (`Stats.Cntct.Eng` *dsg*) 0 - 999,999 ops **(0 ops)**
Engaging contact edge operation count accumulators. '*dsg*' designates one of 20 or 38 contact edges, depending on CntctType. See table in Tapchanger Contact Wear Log section (p. 47).

FBctr (`SetPt.Fwd...Bandctr`) 100.0 - 135.0 V **(120.0 V)**
FPF load center voltage bandcenter (BaseV base).

FBwid (`SetPt.Fwd...Bandwid`) 1.0 - 6.0 V **(2.0 V)**
FPF load center voltage bandwidth (BaseV base).

FLDCR (`SetPt.Fwd...LDC R`) -72.0 - 72.0 V **(0.0 V)**
FPF line drop compensation model resistive component (BaseV base).

FLDCX (`SetPt.Fwd...LDC X`) -72.0 - 72.0 V **(0.0 V)**
FPF line drop compensation model reactive component (BaseV base).

FTimDel (`SetPt.Fwd...TimeDly`) 5 - 180 sec **(30 sec)**
FPF time delay before tap change.

FullLoadA (`Cnfig.Reg...FullLdA`) 0.0 - 3,276.7 A **(200.0 A)**
Rated load current.

FVArHrsLd (`Meas..Enrgy.F VArHLd`) 0 - 1,431,655,765 kVArHr
FPF reactive energy leading.

FVArHrsLg (`Meas..Enrgy.F VArHLg`) 0 - 1,431,655,765 kVArHr
FPF reactive energy lagging.

FWHrs (`Meas..Enrgy.F WH`) 0 - 1,431,655,765 kWHr
FPF real energy.

HD11LoadA (`Meas..AHarm.11th`) 0.0 - 100.0 %
Load current 11th harmonic distortion (% of fundamental).

HD11LoadV (`Meas..VHarm.11th`) 0.0 - 100.0 %
Load voltage 11th harmonic distortion (% of fundamental).

HD13LoadA (`Meas..AHarm.13th`) 0.0 - 100.0 %
Load current 13th harmonic distortion (% of fundamental).

HD13LoadV (`Meas..VHarm.13th`) 0.0 - 100.0 %
Load voltage 13th harmonic distortion (% of fundamental).

HD3LoadA (`Meas..AHarm.3rd`) 0.0 - 100.0 %
Load current 3rd harmonic distortion (% of fundamental).

HD3LoadV (`Meas..VHarm.3rd`) 0.0 - 100.0 %
Load voltage 3rd harmonic distortion (% of fundamental).

HD5LoadA (`Meas..AHarm.5th`) 0.0 - 100.0 %
Load current 5th harmonic distortion (% of fundamental).

HD5LoadV (`Meas..VHarm.5th`) 0.0 - 100.0 %
Load voltage 5th harmonic distortion (% of fundamental).

HD7LoadA (`Meas..AHarm.7th`) 0.0 - 100.0 %
Load current 7th harmonic distortion (% of fundamental).

HD7LoadV (`Meas..VHarm.7th`) 0.0 - 100.0 %
Load voltage 7th harmonic distortion (% of fundamental).

HD9LoadA (`Meas..AHarm.9th`) 0.0 - 100.0 %
Load current 9th harmonic distortion (% of fundamental).

HD9LoadV (`Meas..VHarm.9th`) 0.0 - 100.0 %
Load voltage 9th harmonic distortion (% of fundamental).

HeaterTemp (`SetPt.Mode..Htr Temp`) -40 - 40 °C **(-40 °C)**
Temperature below which heater will turn on.

HiFAvgLoadCtrV (`Mn/Mx.FAvg..HiLdCtrV`) 0.0 - 145.0 V
Max. FPF average load center voltage (BaseV base).

HiFAvgLoadV (`Mn/Mx.FAvg..Hi LoadV`) 0.0 - 145.0 V
Max. FPF average load voltage (BaseV base).

HiFAvgSrcV (`Mn/Mx.FAvg..Hi SrcV`) 0.0 - 145.0 V
Max. FPF average source voltage (BaseV base).

HiFDmdLoadA (`Mn/Mx.FDmd..Hi LoadA`) 0.0 - 3,276.7 A
Max. FPF load current demand.

HiFDmdVA (`Mn/Mx.FDmd..Hi VA`) 0.0 - 3,276.7 MVA
Max. FPF apparent power load demand (scaling determined by PwrScale).

HiFDmdVAr (`Mn/Mx.FDmd..Hi VAr`) -3,276.8 - 3,276.7 MVAr
Max. FPF reactive power load demand (scaling determined by PwrScale).

HiFDmdW (`Mn/Mx.FDmd..Hi Watts`) -3,276.8 - 3,276.7 MW
Max. FPF real power load demand (scaling determined by PwrScale).

HiFVAPF (`Mn/Mx.FDmd..PF @HiVA`) -1.00 - 1.00
Power factor at maximum FPF apparent power load demand (- = lead, + = lag).

HighBandEdge (**HIGH BAND** lamp) inactive active
Load center voltage out-of-band high when active.

HiLoRs1

(`Mn/Mx.FAvg..Hi LoadV`)	bit 0	HiFAvgLoadV
(`Mn/Mx.FAvg..Lo LoadV`)	bit 1	LoFAvgLoadV
(`Mn/Mx.FAvg..Hi SrcV`)	bit 2	HiFAvgSrcV
(`Mn/Mx.FAvg..Lo SrcV`)	bit 3	LoFAvgSrcV
(`Mn/Mx.FAvg..HiLdCtrV`)	bit 6	HiFAvgLoadCtrV
(`Mn/Mx.FAvg..LoLdCtrV`)	bit 7	LoFAvgLoadCtrV

16-bit wide bit field, used to reset min/max values (command).

HiLoRs2

(`Mn/Mx.FDmd..Hi LoadA`)	bit 7	HiFDmdLoadA
(`Mn/Mx.FDmd..Hi VA`)	bit 11	HiFDmdVA and HiFVAPF
(`Mn/Mx.FDmd..Hi Watts`)	bit 13	HiFDmdW

16-bit wide bit field, used to reset min/max values (command).

HiLoRs3

(`Mn/Mx.FDmd..Hi VAr`)	bit 0	HiFDmdVAr
(`Mn/Mx.RDmd..Hi LoadA`)	bit 8	HiRDmdLoadA
(`Mn/Mx.RDmd..Hi VA`)	bit 12	HiRDmdVA and HiRVAPF
(`Mn/Mx.RDmd..Hi Watts`)	bit 14	HiRDmdW

16-bit wide bit field, used to reset min/max values (command).

HiLoRs4

(`Mn/Mx.RDmd..Hi VAr`)	bit 1	HiRDmdVAr
(`Mn/Mx.RAvg..Hi LoadV`)	bit 5	HiRAvgLoadV
(`Mn/Mx.RAvg..Lo LoadV`)	bit 6	LoRAvgLoadV
(`Mn/Mx.RAvg..Hi SrcV`)	bit 7	HiRAvgSrcV
(`Mn/Mx.RAvg..Lo SrcV`)	bit 8	LoRAvgSrcV
(`Mn/Mx.RAvg..HiLdCtrV`)	bit 11	HiRAvgLoadCtrV
(`Mn/Mx.RAvg..LoLdCtrV`)	bit 12	LoRAvgLoadCtrV

16-bit wide bit field, used to reset min/max values (command).

HiLoRs5 (Mn/Mx.Basic.Hi Temp) bit 6 HiSysTemp
(Mn/Mx.Basic.Lo Temp) bit 7 LoSysTemp
16-bit wide bit field, used to reset min/max values (command).

HiRAvgLoadCtrV (Mn/Mx.RAvg..HiLdCtrV) 0.0 - 145.0 V
Max. RPF average load center voltage (BaseV base).

HiRAvgLoadV (Mn/Mx.RAvg..Hi LoadV) 0.0 - 145.0 V
Max. RPF average load* voltage (BaseV base).

HiRAvgSrcV (Mn/Mx.RAvg..Hi SrcV) 0.0 - 145.0 V
Max. RPF average source* voltage (BaseV base).

HiRDmdLoadA (Mn/Mx.RDmd..Hi LoadA) 0.0 - 3,276.7 A
Max. RPF load current demand.

HiRDmdVA (Mn/Mx.RDmd..Hi VA) 0.0 - 3,276.7 MVA
Max. RPF apparent power load demand (scaling determined by PwrScale).

HiRDmdVAr (Mn/Mx.RDmd..Hi VAr) -3,276.8 - 3,276.7 MVAr
Max. RPF reactive power load demand (scaling determined by PwrScale).

HiRDmdW (Mn/Mx.RDmd..Hi Watts) -3,276.8 - 3,276.7 MW
Max. RPF real power load demand (scaling determined by PwrScale).

HiRVAPF (Mn/Mx.RDmd..PF @HiVA) -1.00 - 1.00
Power factor at maximum RPF apparent power load demand (- = lead, + = lag).

HiSysTemp (Mn/Mx.Basic.Hi Temp) -50 - 150 °C
Max. control ambient temperature.

HiTapPos (Mn/Mx.DrHnd.HiTapPos) -16 - 16
High tap position draghand (- = lower, + = raise).

Hz (Meas..Basic.Hz) 45.00 - 65.00 Hz
Power line frequency fundamental.

InBand (**IN-BAND** lamp) inactive active
Load center voltage in-band when active.

InterTapDly (Cnfig.TapCh.InTapDly) 2.0 - 60.0 sec **(2.0 sec)**
Time between tap changes during a multi-tap sequence.

IntReg (Cnfig.Reg...IntReg) 0.00 - 2.55 % **(0.40 %)**
Internal regulation of the voltage regulator.

IOBoardID (Maint.BdID..I/O Brd) 1 - 999,999,999
UVR-1 I/O board ID number (factory-assigned).

LimLoadA (Cnfig.Reg...LimLoadA) 100 - 560 mA **(440 mA)**
Load current limit (measured at CT secondary), above which auto-control algorithm will be inactive.

LoadA (Meas..Basic.Ld Amps) 0.0 - 560.0 mA
Load current (CT secondary level).

LoadCtrV (Meas..Basic.LoadCtrV) 0.0 - 145.0 V
Load center voltage (BaseV base).

LoadV (Meas..Basic.Ld Volts) 0.0 - 145.0 V
Load* voltage (BaseV base).

Local/RemoteSw (**LOCAL/REMOTE** switch) local remote
Local: local control of configuration and setpoints, remote read-only, XIO Aux control disabled
Remote: remote control of configuration and setpoints, local read-only, XIO Aux control enabled

LocalTimeOffset (Cnfig.Cntrl.LclTOff) -1,440 - 1,440 minutes **(0 minutes)**
Offset added to ClockTOD to generate local time.

LoFAvgLoadCtrV (Mn/Mx.FAvg..LoLdCtrV) 0.0 - 145.0 V
Min. FPF average load center voltage (BaseV base).

LoFAvgLoadV (Mn/Mx.FAvg..Lo LoadV) 0.0 - 145.0 V
Min. FPF average load voltage (BaseV base).

LoFAvgSrcV (Mn/Mx.FAvg..Lo SrcV) 0.0 - 145.0 V
Min. FPF average source voltage (BaseV base).

LoRAvgLoadCtrV (Mn/Mx.RAvg..LoLdCtrV) 0.0 - 145.0 V
Min. RPF average load center voltage (BaseV base).

LoRAvgLoadV (Mn/Mx.RAvg..Lo LoadV) 0.0 - 145.0 V
Min. RPF average load* voltage (BaseV base).

LoRAvgSrcV (Mn/Mx.RAvg..Lo SrcV) 0.0 - 145.0 V
Min. RPF average source* voltage (BaseV base).

LoSysTemp (Mn/Mx.Basic.Lo Temp) -50 - 150 °C
Min. control ambient temperature.

LoTapPos (Mn/Mx.DrHnd.LoTapPos) -16 - 16
Low tap position draghand (- = lower, + = raise).

LowBandEdge (**LOW BAND** lamp) inactive active
Load center voltage out-of-band low when active.

LowCurrent (Alert selection) normal load current below 1% of rated load current

Lower (**RAISE/LOWER** switch) issue lower command (command)

LowerCommand idle lower command in progress
Active while motor running in lower direction.

LowMotorV (Alert selection) normal motor voltage below MotorVThres threshold

MainBoardID (Maint.BdID..Main Brd) 1 - 999,999,999
UVR-1 main board ID number (factory-assigned).

MeterAccum (Demand meas. annunciator) inactive active
Metering min/max value accumulation status.

MinMaxRs (`Cntrl.Reset.MnMx All`) reset all min/max values and tap position draghands (command)

MotorVNeut (`Cnfig.TapCh.MotVNeut`) 90 - 135 V **(120 V)**
Motor voltage at neutral tap position.

MotorVSrc (`Cnfig.TapCh.MotVSrc`) S **L**
Motor voltage source.

MotorVThres (`Cnfig.TapCh.MotVTh`) 80 - 110 V **(90 V)**
Motor voltage below which to disable tap changes.

NeutralSwPres (`Cnfig.TapCh.NeutrlSw`) **present** none
Neutral switch availability.

NeutralTapPos (**NEUTRAL** lamp) off neutral neutral switch closed (active)
Active while in neutral tap position, as signaled by the neutral switch.

OpRs (`Stats.TapCh.ResOpCnt`) reset resettable operation counter (command)
Set CntOprR to 0.

PCBaud (`Cnfig.PcPrt.BaudRate`) 300, 600, 1200, 2400, 4800, **9600**, 19200, 38400, or 57600
PC port baud rate.

PF (`Meas..Basic.PwrFactr`) -1.00 - 1.00
Power factor (- = lead, + = lag).

PhaseAng (`Meas..Basic.PhaseAng`) -179.9 - 180.0 degrees
Angle by which fundamental input current lags fundamental input voltage.

Phasing (`Cnfig.Reg...Phasing`) 0 - 359 degrees **(0 degrees)**
Angle by which current lags voltage at 1.00 PF and FPF.

PriLoadA (`Meas..Basic.PriLoadA`) 0.0 - 3,276.7 A
Load current.

PriLoadCtrV (`Meas..Basic.PriLCtrV`) 0 - 163,835 V
Load center voltage (5 V units).

PriLoadV (`Meas..Basic.PriLoadV`) 0 - 163,835 V
Load* voltage (5 V units).

PriPwrDis (`SetPt.Meter.PPwrDisp`) **1-phase** 3-phase
Power and energy quantities display selection.

PriSrcV (`Meas..Basic.PriSrcV`) 0 - 163,835 V
Source* voltage (5 V units).

PriVA (`Meas..Basic.PriVA`) 0.0 - 3,276.7 MVA
Apparent power load (scaling determined by PwrScale).

PriVAr (`Meas..Basic.PriVAr`) -3,276.8 - 3,276.7 MVAr
Reactive power load (scaling determined by PwrScale).

PriW (`Meas..Basic.PriWatts`) -3,276.8 - 3,276.7 MW
Real power load (scaling determined by PwrScale).

ProfDate_*x* (`Prof..DAP-x.DateTime`) month (**1** - 12) | day (**1** - 31)
Local date of user profile activation. '*x*' specifies one of 4 date-activated user profile entries (A - D).

ProfNum_*x* (`Prof..DAP-x.ProfNum`) 0 - 3 (**0**)
Date-activated user profile number (0 signifies no change). '*x*' specifies one of 4 date-activated user profile entries (A - D).

ProfTime_*x* (`Prof..DAP-x.DateTime`) 0 - 1,439 minutes past midnight (**0**)
Local time of user profile activation. '*x*' specifies one of 4 date-activated user profile entries (A - D).

ProgramFlash (`Maint.Reprogram`) program flash memory through front panel PC Port (command)

ProtBaud (`Cnfig.PrPrt.BaudRate`) 300, 600, 1200, 2400, 4800, **9600**, 19200, or 38400
Protocol port baud rate.

ProtFrameType (`Cnfig.PrPrt.FrameTyp`)
8, N, 1
8, N, 2
8, E, 1
8, O, 1

Protocol port frame type (number of data bits, parity, number of stop bits). Parity is generated but not checked (N = none, E = even, O = odd).

ProtMode (`Cnfig.PrPrt.Mode`)
EIA-232, noHS, noFC
EIA-485 2-wire
485 4-wire, 232 host
485 4-wire, DB host
485 4-wire
DB, noHS, noFC
DB loop, 232 host
DB loop
FO loop, modem host

Protocol port mode (HS = handshake, FC = flow control, 485 = EIA-485, 232 = EIA-232, DB = daughter board, FO = fiber-optic). Host refers to the gateway device host-side interface.

ProtTxDly (`Cnfig.PrPrt.Tx Delay`) 0 - 5,000 ms **(0 ms)**
Protocol transmission delay.

ProtVersion (`Maint.Code..Protocol`) 0.01 - 655.35
UVR-1 protocol code version number.

PwrScale (`Cnfig.Reg...PwrScale`)
3,276.7 k (scaling resolution 0.1 k)
32.767 M (scaling resolution 0.001 M)
327.67 M (scaling resolution 0.01 M)
3,276.7 M (scaling resolution 0.1 M)

Power values scaling, selected by range magnitude limit.

Raise (**RAISE/LOWER** switch) issue raise command (command)

Raise/Lower (**RAISE/LOWER** switch) issue a raise or lower command (command)
Use a paired trip or close operation to cause a raise or lower command, respectively.

RaiseCommand idle raise command in progress
Active while motor running in raise direction.

RBctr (`SetPt.Rev...Bandctr`) 100.0 - 135.0 V **(120.0 V)**
RPF load center voltage bandcenter (BaseV base).

RBwid (`SetPt.Rev...Bandwid`) 1.0 - 6.0 V **(2.0 V)**
RPF load center voltage bandwidth (BaseV base).

RegRange (`Cnfig.Reg...RegRange`) 2.5 - 20.0 % **(10.0 %)**
Rated (nominal) regulation range for the regulator.

RegType (`Cnfig.Reg...RegType`) **straight (ANSI type A)**
inverted (ANSI type B)
series transformer
Regulator configuration.

RegVersion (`Maint.Code..Registry`) 0.01 - 655.35
UVR-1 registry version number.

RevCur (`SetPt.Rev...RevCur`) 1 - 10 % **(1 %)**
Current threshold (percent of rated load current) for reverse operation switching.

RevMeter forward reverse
Metering direction.

RevOperate forward reverse
Control operation direction.

RevPowerFlow (**REVERSE PWR** lamp) forward reverse
Power flow direction.

RevPwr (`Cntrl.Mode..RevPwr`) **Locked forward**
Locked reverse
Idle reverse
Bi-directional
Neutral reverse
Co-generation
Power flow mode.

RLDCR (`SetPt.Rev...LDC R`) -72.0 - 72.0 V **(0.0 V)**
RPF line drop compensation model resistive component (BaseV base).

RLDCX (`SetPt.Rev...LDC X`) -72.0 - 72.0 V **(0.0 V)**
RPF line drop compensation model reactive component (BaseV base).

RnbkDly (`SetPt.VLim..RunBkDly`) 1 - 30 sec **(2 sec)**
Time delay before runback will occur.

RnbkHV (`SetPt.VLim..RunBkHiV`) 95.0 - 135.0 V **(135.0 V)**
High load* voltage limit (BaseV base), above which runback will occur.

RnbkLV (`SetPt.VLim..RunBkLoV`) 95.0 - 135.0 V **(95.0 V)**
Low load* voltage limit (BaseV base), below which runback will occur.

RptTapPos (Alert selection) normal tap position report limit exceeded

RptTapPosL (SetPt.TapCh.RptTP Lo) -16 - 16 **(-16)**
Lower tap position report limit, below which RptTapPos will be set (- = lower, + = raise).

RptTapPosR (SetPt.TapCh.RptTP Hi) -16 - 16 **(16)**
Raise tap position report limit, above which RptTapPos will be set (- = lower, + = raise).

RTimDel (SetPt.Rev...TimeDly) 5 - 180 sec **(30 sec)**
RPF time delay before tap change.

RVArHrsLd (Meas..Enrgy.R VArHLd) 0 - 1,431,655,765 kVArHr
RPF reactive energy leading.

RVArHrsLg (Meas..Enrgy.R VArHLg) 0 - 1,431,655,765 kVArHr
RPF reactive energy lagging.

RWHrs (Meas..Enrgy.R WH) 0 - 1,431,655,765 kWHr
RPF real energy.

Sc1 (Cnfig.Cntrl.Security) 4-character string **("****")**
Level 1 access code.

SecEn_*n* (Maint.SecEn.*n*) 32-bit timestamp
16-entry security level enable log. '*n*' designates entry number, 1 being the most recent.

SecurityLevel (Maint.Security Level) **Read Only** Read/Write/Execute (requires Sc1 entry)
Set security level. Read/Write/Execute allows local changes to UVR-1 values and command execution, Read Only does not.

SerialNum (Maint.Serial Number) 1 - 999,999,999
UVR-1 unit serial number (factory-assigned).

SrcV (Meas..Basic.SrcVolts) 0.0 - 145.0 V
Source* voltage (BaseV base).

SwitchBoardID (Maint.BdID..Switch) 1 - 999,999,999
UVR-1 switch board ID number (factory-assigned).

SystemCfg (Cnfig.Reg...SysCfg) **single-phase/wye/open delta** closed delta
Regulator system configuration as installed.

SystemHz (Cnfig.Reg...SystemHz) 45 - 65 Hz **(60 Hz)**
Nominal system frequency.

SysTemp (Meas..Basic.Temp) -50 - 150 °C
Control ambient temperature.

SystemV (Cnfig.Reg...SystemV) 0 - 163,835 V **(7200 V)**
Load-side system voltage (5 V units).

TapBlkL (SetPt.TapCh.TapBlkL) -16 - -8 **(-16)**
Lower tap position limit, at and below which lower operations will be blocked (- = lower).

TapBlkR (`SetPt.TapCh.TapBlkR`) 8 - 16 **(16)**
Raise tap position limit, at and above which raise operations will be blocked (+ = raise).

TapChTimeout (Alert selection) normal last tap change timed out

TapPos (`Stats.TapCh.TapPos`) -16 - 16 **(0)**
Tap position (- = lower, + = raise).

TapPosKnown (Alert selection) inactive active
Active when tap position is known.

TapPosSet (`Cnfig.TapCh.TapPos`) -16 - 16
Set current tap position TapPos (- = lower, + = raise) (momentary).

TapTimeout (`Cnfig.TapCh.TapTmout`) 1 - 30 sec **(30 sec)**
Time limit for tap change, before failure recorded.

TEnergyRst (`Meas..Enrgy...`) 32-bit timestamp
Time of last energy reset.

THDLoadA (`Meas..AHarm.THD`) 0.0 - 100.0 %
Load current THD (% of fundamental).

THDLoadV (`Meas..VHarm.THD`) 0.0 - 100.0 %
Load voltage THD (% of fundamental).

THiFAvgLoadCtrV (`Mn/Mx.FAvg..HiLdCtrV`) 32-bit timestamp
Time of HiFAvgLoadCtrV.

THiFAvgLoadV (`Mn/Mx.FAvg..Hi LoadV`) 32-bit timestamp
Time of HiFAvgLoadV.

THiFAvgSrcV (`Mn/Mx.FAvg..Hi SrcV`) 32-bit timestamp
Time of HiFAvgSrcV.

THiFDmdLoadA (`Mn/Mx.FDmd..Hi LoadA`) 32-bit timestamp
Time of HiFDmdLoadA.

THiFDmdVA (`Mn/Mx.FDmd..Hi VA`) 32-bit timestamp
Time of HiFDmdVA.

THiFDmdVAr (`Mn/Mx.FDmd..Hi VAr`) 32-bit timestamp
Time of HiFDmdVAr.

THiFDmdW (`Mn/Mx.FDmd..Hi Watts`) 32-bit timestamp
Time of HiFDmdW.

THiRAvgLoadCtrV (`Mn/Mx.RAvg..HiLdCtrV`) 32-bit timestamp
Time of HiRAvgLoadCtrV.

THiRAvgLoadV (`Mn/Mx.RAvg..Hi LoadV`) 32-bit timestamp
Time of HiRAvgLoadV.

THiRAvgSrcV (`Mn/Mx.RAvg..Hi SrcV`) 32-bit timestamp
Time of HiRAvgSrcV.

THiRDmdLoadA (`Mn/Mx.RDmd..Hi LoadA`) 32-bit timestamp
Time of HiRDmdLoadA.

THiRDmdVA (`Mn/Mx.RDmd..Hi VA`) 32-bit timestamp
Time of HiRDmdVA.

THiRDmdVAr (`Mn/Mx.RDmd..Hi VAr`) 32-bit timestamp
Time of HiRDmdVAr.

THiRDmdW (`Mn/Mx.RDmd..Hi Watts`) 32-bit timestamp
Time of HiRDmdW.

THiSysTemp (`Mn/Mx.Basic.Hi Temp`) 32-bit timestamp
Time of HiSysTemp.

THiTapPos (`Mn/Mx.DrHnd.HiTapPos`) 32-bit timestamp
Time of HiTapPos.

TLoFAvgLoadCtrV (`Mn/Mx.FAvg..LoLdCtrV`) 32-bit timestamp
Time of LoFAvgLoadCtrV.

TLoFAvgLoadV (`Mn/Mx.FAvg..Lo LoadV`) 32-bit timestamp
Time of LoFAvgLoadV.

TLoFAvgSrcV (`Mn/Mx.FAvg..Lo SrcV`) 32-bit timestamp
Time of LoFAvgSrcV.

TLoRAvgLoadCtrV (`Mn/Mx.RAvg..LoLdCtrV`) 32-bit timestamp
Time of LoRAvgLoadCtrV.

TLoRAvgLoadV (`Mn/Mx.RAvg..Lo LoadV`) 32-bit timestamp
Time of LoRAvgLoadV.

TLoRAvgSrcV (`Mn/Mx.RAvg..Lo SrcV`) 32-bit timestamp
Time of LoRAvgSrcV.

TLoSysTemp (`Mn/Mx.Basic.Lo Temp`) 32-bit timestamp
Time of LoSysTemp.

TLoTapPos (`Mn/Mx.DrHnd.LoTapPos`) 32-bit timestamp
Time of LoTapPos.

TmrMode (`Cntrl.Mode..Timer`) **sequential**
time-integrating sequential
voltage-averaging
Tap change timer mode.

TSFormat (`Cnfig.Cntrl.TSFormat`) **binary seconds** packed date/time bitfields
32-bit timestamp remote reporting format.

TSYearBase (`Cnfig.Cntrl.TSYrBase`) 1900 - present year (>= BaseTime, 2099 max.) **(1970)**
Beginning year for 32-bit timestamp.

UserID (`Maint.User ID`) 20-character string **(all spaces)**
User-defined ID.

UserProfs (`Prof..LoadUserProf 3`) load user profile 3
(`Prof..LoadUserProf 2`) load user profile 2
(`Prof..LoadUserProf 1`) load user profile 1
(`Prof..SaveUserProf 1`) save user profile 1
(`Prof..SaveUserProf 2`) save user profile 2
(`Prof..SaveUserProf 3`) save user profile 3
Load/save UVR-1 parameters from/to user profile (command).

VLimitMode (`Cntrl.Mode..VLimit`) **no voltage limit**
low voltage limit active
high voltage limit active
both voltage limits active
Voltage limiting mode.

VoltageReduction (**VOLTAGE RED.** lamp) normal voltage reduction enabled
Active if VRedMode not mode 0 (lamp on when percent voltage reduction is non-zero).

VRCBlk (`Cntrl.Mode..VRC Blk`) normal **inhibit auto-control algorithm**
Auto-control algorithm inhibit. *Note: All UVR-1 values should be set before selecting normal.*

VRCRs (`Prof..LoadFacDefs`) reset all UVR-1 values to factory defaults (command)
Restore all factory defaults (including protocol configuration, and clears timestamped items and logs).

VRedLevel (`Stats.Mode..VRed Lvl`) normal
XIO voltage reduction step 1
XIO voltage reduction step 2
XIO voltage reduction step 3
Voltage reduction level due to XIO VRed1 and VRed0 inputs (used only for VRedMode mode 2).

VRedMode (`Cntrl.Mode..VRed`) **no voltage reduction**
voltage reduction by local or remote control (uses VRedMode1)
voltage reduction by XIO
voltage reduction by local or remote control (uses VRedStep2X)
Voltage reduction mode.

VRedMode1 (`SetPt.Mode..VRedMd 1`) 0.0 - 10.0 % **(0.0 %)**
Voltage reduction level for VRedMode mode 1.

VRedPct (`Stats.Mode..VRed Pct`) 0.0 - 10.0 %
Voltage reduction (percent) currently in effect.

VRedStep1X (`SetPt.Mode..VRedSt1X`) 0.0 - 10.0 % **(0.0 %)**
Voltage reduction level for XIO step 1.

VRedStep2X (`SetPt.Mode..VRedSt2X`) 0.0 - 10.0 % **(0.0 %)**
Voltage reduction level for XIO step 2 and for VRedMode mode 4.

VRedStep3X (`SetPt.Mode..VRedSt3X`) 0.0 - 10.0 % **(0.0 %)**
Voltage reduction level for XIO step 3.

VRegSN (`Maint.Reg Serial Num`) 20-character string **(all spaces)**
Voltage regulator serial number.

VTCfg (`Cnfig.Reg...VTCfg`) line to line **line to ground**
VT configuration.

VTRatio (`Cnfig.Reg...VTRatio`) 1.0 - 3,276.7 **(60.0)**
VT turns ratio, primary load voltage / control input voltage.

XIOActiveLevel (`Cnfig.XIO-`*n*`.ActivLvl`) **energized** de-energized
Byte-wide bit field, active level of each XIO port position.

XIODefOut (`Cnfig.XIO-`*n*`.DefOutpt`) **inactive** active
Byte-wide bit field, powerup default state of each XIO port position configured as a simple output.

XIOFunctionPos*n* (`Cnfig.XIO-`*n*`.Function`) **simple input (or unused)**
simple output
ExtAlert input
Alert output
AuxAutoInhibit input
AuxRaise input
AuxLower input
VRed1 input
VRed0 input
Heater output
SyncRaise output
SyncLower output
Cooling Device output
Function to assign to XIO port position *n* (1-8).

XIOIn (`Stats.XIO...Pos` *n*) inactive active
Byte-wide bit field, reads input state or output control state of each XIO port position.

XIOInPos*n* (`Stats.XIO...Pos` *n*) inactive active
Reads input state or output control state of XIO port position *n* (1-8).

XIOInRBE inactive active
Byte-wide bit field, reads input state or output control state of each XIO port position, masked by XIORBEMask.

XIOOut (`Stats.XIO...Pos` *n*) **inactive** active
Byte-wide bit field, controls state of each XIO port position configured as a simple output.

XIOOutPos*n* (`Stats.XIO...Pos` *n*) **inactive** active
Controls state of XIO port position *n* (1-8) when configured as a simple output.

XIORBEMask (`Cnfig.XIO-`*n*`.RBE`) **disabled** enabled
Byte-wide bit field, used to control XIOInRBE for reporting.

Menu Reference

Status Menu

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
Stats...	**Status**		read-only unless otherwise specified
Stats.TapCh...	**Tapchanger**		
Stats.TapCh.TapPos	TapPos	-16 - 16	
Stats.TapCh.OpCount	CntOper	0 - 999999	
Stats.TapCh.ResOpCnt	CntOperR	0 - 999999	resettable
Stats.Mode...	**Operating Mode**		
Stats.Mode..AInhibit	AutoInhibit	inactive	
		active	auto-control algorithm inhibited
Stats.Mode..CommBlk	CommBlk	inactive	
		active	remote control of tapchanger motor blocked
Stats.Mode..VRed Lvl	VRedLevel	normal	
		XIO VRed step 1	XIO voltage reduction step 1
		XIO VRed step 2	XIO voltage reduction step 2
		XIO VRed step 3	XIO voltage reduction step 3
Stats.Mode..VRed Pct	VRedPct	0.0 - 10.0 %	
Stats.Cntct...	**Tapchanger Contact Wear Log**		'*dsg*' designates one of 20 or 38 contact edges, depending on CntctType.
Stats.Cntct.Eng *dsg*	Engage_*dsg*	0 - 999999 ops	
Stats.Cntct.Brk *dsg*	Break_*dsg*	0 - 4294967295 kA^2*ops	
Stats.XIO...	**XIO Port**		reads XIOIn, writes XIOOut simple outputs
Stats.XIO...Pos 1	XIOIn/XIOOut bit 0	inactive [function name]	
		active [function name]	
Stats.XIO...Pos 2	XIOIn/XIOOut bit 1	inactive [function name]	
		active [function name]	
Stats.XIO...Pos 3	XIOIn/XIOOut bit 2	inactive [function name]	
		active [function name]	
Stats.XIO...Pos 4	XIOIn/XIOOut bit 3	inactive [function name]	
		active [function name]	
Stats.XIO...Pos 5	XIOIn/XIOOut bit 4	inactive [function name]	
		active [function name]	
Stats.XIO...Pos 6	XIOIn/XIOOut bit 5	inactive [function name]	
		active [function name]	
Stats.XIO...Pos 7	XIOIn/XIOOut bit 6	inactive [function name]	
		active [function name]	
Stats.XIO...Pos 8	XIOIn/XIOOut bit 7	inactive [function name]	
		active [function name]	

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
`Stats.Alerts`	**Alerts**		active alerts displayed sequentially
	AlertStatus1 bit 0	`Comm Block`	CommBlk active
	AlertStatus1 bit 1	`Rpt Tap Pos`	RptTapPos active
	AlertStatus1 bit 2	`Auto Inhibit`	AutoInhibit active in auto
	AlertStatus1 bit 8	`Not in Auto`	Auto/Off/ManualSw not auto
	AlertStatus1 bit 12	`Tap Change Timeout`	TapChTimeout active
	AlertStatus1 bit 13	`Lost Tap Pos`	TapPosKnown inactive
	AlertStatus2 bit 1	`External Alert`	XIO ExtAlert active
	AlertStatus2 bit 3	`High Voltage Limit`	BlkHV active
	AlertStatus2 bit 4	`Low Voltage Limit`	BlkLV active
	AlertStatus2 bit 5	`Voltage Reduction`	VoltageReduction enabled
	AlertStatus2 bit 6	`Reverse Power Flow`	RevPowerFlow reverse
	AlertStatus2 bit 8	`Below Low Current`	LowCurrent active
	AlertStatus2 bit 9	`Low Tap Limit`	BlkTapL active
	AlertStatus2 bit 10	`High Tap Limit`	BlkTapR active
	AlertStatus2 bit 11	`Below Rev Current`	BelowRevCur active
	AlertStatus2 bit 12	`Low Motor Voltage`	LowMotorV active
	AlertStatus2 bit 13	`Overcurrent Limit`	BlkLoadA active
	AlertStatus2 bit 14	`Check Contacts`	ChkCntct active

Measurements Menu

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
Meas...	**Measurements**		read-only unless otherwise specified
Meas..Basic...	**Basic**		
Meas..Basic.LoadCtrV	LoadCtrV	0.0 - 145.0 volts	
Meas..Basic.Ld Volts	LoadV	0.0 - 145.0 volts	
Meas..Basic.SrcVolts	SrcV	0.0 - 145.0 volts	
Meas..Basic.Ld Amps	LoadA	0.0 - 560.0 mA	writable for calibration
Meas..Basic.PriLCtrV	PriLoadCtrV	0 - 163835 volts	
Meas..Basic.PriLoadV	PriLoadV	0 - 163835 volts	
Meas..Basic.PriSrcV	PriSrcV	0 - 163835 volts	
Meas..Basic.PriLoadA	PriLoadA	0.0 - 3276.7 amps	
Meas..Basic.PwrFactr	PF	0.00 - 1.00 lead or lag	
Meas..Basic.Hz	Hz	45.00 - 65.00 Hz	
Meas..Basic.PriVA	PriVA	0.0 - 9830.1 MVA	scaling determined by PwrScale
Meas..Basic.PriWatts	PriW	-9830.4 - 9830.1 MW	scaling determined by PwrScale
Meas..Basic.PriVAr	PriVAr	-9830.4 - 9830.1 MVAr	scaling determined by PwrScale
Meas..Basic.CtlVIn	CtlVIn	0.0 - 145.0 volts	writable for calibration
Meas..Basic.Temp	SysTemp	-50 - 150 degrees C	writable for calibration
Meas..Basic.PhaseAng	PhaseAng	-179.9 - 180.0 degrees	writable for calibration
Meas..VHarm...	**Voltage Harmonics**		
Meas..VHarm.THD	THDLoadV	0.0 - 100.0 % fund.	
Meas..VHarm.3rd	HD3LoadV	0.0 - 100.0 % fund.	
Meas..VHarm.5th	HD5LoadV	0.0 - 100.0 % fund.	
Meas..VHarm.7th	HD7LoadV	0.0 - 100.0 % fund.	
Meas..VHarm.9th	HD9LoadV	0.0 - 100.0 % fund.	
Meas..VHarm.11th	HD11LoadV	0.0 - 100.0 % fund.	
Meas..VHarm.13th	HD13LoadV	0.0 - 100.0 % fund.	
Meas..AHarm...	**Current Harmonics**		
Meas..AHarm.THD	THDLoadA	0.0 - 100.0 % fund.	
Meas..AHarm.3rd	HD3LoadA	0.0 - 100.0 % fund.	
Meas..AHarm.5th	HD5LoadA	0.0 - 100.0 % fund.	
Meas..AHarm.7th	HD7LoadA	0.0 - 100.0 % fund.	
Meas..AHarm.9th	HD9LoadA	0.0 - 100.0 % fund.	
Meas..AHarm.11th	HD11LoadA	0.0 - 100.0 % fund.	
Meas..AHarm.13th	HD13LoadA	0.0 - 100.0 % fund.	
Meas..Dmd...	**Demand**		Fwd, Rev, or Inv (invalid) annunciator indicates min/max storage location and validity.
Meas..Dmd...LoadA	DmdLoadA	0.0 - 3276.7 amps	
Meas..Dmd...VA	DmdVA	0.0 - 9830.1 MVA	scaling determined by PwrScale
Meas..Dmd...Watts	DmdW	-9830.4 - 9830.1 MW	scaling determined by PwrScale
Meas..Dmd...VAr	DmdVAr	-9830.4 - 9830.1 MVAr	scaling determined by PwrScale

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
Meas..Enrgy...	**Energy**		Auto-ranging display. Timestamps are local date/time in format: mm/dd/yyyy hh:mm:ss
Meas..Enrgy.F WH	FWHrs	0 k - 4.295 T	WHr
	TEnergyRst	[date/time]	
Meas..Enrgy.R WH	RWHrs	0 k - 4.295 T	WHr
	TEnergyRst	[date/time]	
Meas..Enrgy.F VArHLd	FVArHrsLd	0 k - 4.295 T	VArHr
	TEnergyRst	[date/time]	
Meas..Enrgy.F VArHLg	FVArHrsLg	0 k - 4.295 T	VArHr
	TEnergyRst	[date/time]	
Meas..Enrgy.R VArHLd	RVArHrsLd	0 k - 4.295 T	VArHr
	TEnergyRst	[date/time]	
Meas..Enrgy.R VArHLg	RVArHrsLg	0 k - 4.295 T	VArHr
	TEnergyRst	[date/time]	

Min/Max Menu

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
Mn/Mx...	**Min/Max**		Individually resettable unless otherwise specified. Timestamps are local date/time in format: mm/dd/yyyy hh:mm:ss
Mn/Mx.FAvg...	**Forward Average Measurements**		
Mn/Mx.FAvg..HiLdCtrV	HiFAvgLoadCtrV	0.0 - 145.0	V
	THiFAvgLoadCtrV	[date/time]	
Mn/Mx.FAvg..LoLdCtrV	LoFAvgLoadCtrV	0.0 - 145.0	V
	TLoFAvgLoadCtrV	[date/time]	
Mn/Mx.FAvg..Hi LoadV	HiFAvgLoadV	0.0 - 145.0	V
	THiFAvgLoadV	[date/time]	
Mn/Mx.FAvg..Lo LoadV	LoFAvgLoadV	0.0 - 145.0	V
	TLoFAvgLoadV	[date/time]	
Mn/Mx.FAvg..Hi SrcV	HiFAvgSrcV	0.0 - 145.0	V
	THiFAvgSrcV	[date/time]	
Mn/Mx.FAvg..Lo SrcV	LoFAvgSrcV	0.0 - 145.0	V
	TLoFAvgSrcV	[date/time]	
Mn/Mx.RAvg...	**Reverse Average Measurements**		
Mn/Mx.RAvg..HiLdCtrV	HiRAvgLoadCtrV	0.0 - 145.0	V
	THiRAvgLoadCtrV	[date/time]	
Mn/Mx.RAvg..LoLdCtrV	LoRAvgLoadCtrV	0.0 - 145.0	V
	TLoRAvgLoadCtrV	[date/time]	
Mn/Mx.RAvg..Hi LoadV	HiRAvgLoadV	0.0 - 145.0	V
	THiRAvgLoadV	[date/time]	
Mn/Mx.RAvg..Lo LoadV	LoRAvgLoadV	0.0 - 145.0	V
	TLoRAvgLoadV	[date/time]	
Mn/Mx.RAvg..Hi SrcV	HiRAvgSrcV	0.0 - 145.0	V
	THiRAvgSrcV	[date/time]	
Mn/Mx.RAvg..Lo SrcV	LoRAvgSrcV	0.0 - 145.0	V
	TLoRAvgSrcV	[date/time]	

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
Mn/Mx.FDmd...	**Forward Demand Measurements**		
Mn/Mx.FDmd..Hi LoadA	HiFDmdLoadA	0.0 - 3276.7	A
	THiFDmdLoadA	[date/time]	
Mn/Mx.FDmd..Hi VA	HiFDmdVA	0.0 - 9830.1 M	VA, reset also resets HiFVAPF, scaling determined by PwrScale
	THiFDmdVA	[date/time]	
Mn/Mx.FDmd..Hi Watts	HiFDmdW	-9830.4 - 9830.1 M	W, scaling determined by PwrScale
	THiFDmdW	[date/time]	
Mn/Mx.FDmd..Hi VAr	HiFDmdVAr	-9830.4 - 9830.1 M	VAr, scaling determined by PwrScale
	THiFDmdVAr	[date/time]	
Mn/Mx.FDmd..PF @HiVA	HiFVAPF	0.00 - 1.00 ld or lg	reset with HiFDmdVA
	THiFDmdVA	[date/time]	not reset here
Mn/Mx.RDmd...	**Reverse Demand Measurements**		
Mn/Mx.RDmd..Hi LoadA	HiRDmdLoadA	0.0 - 3276.7	A
	THiRDmdLoadA	[date/time]	
Mn/Mx.RDmd..Hi VA	HiRDmdVA	0.0 - 9830.1 M	VA, reset also resets HiRVAPF, scaling determined by PwrScale
	THiRDmdVA	[date/time]	
Mn/Mx.RDmd..Hi Watts	HiRDmdW	-9830.4 - 9830.1 M	W, scaling determined by PwrScale
	THiRDmdW	[date/time]	
Mn/Mx.RDmd..Hi VAr	HiRDmdVAr	-9830.4 - 9830.1 M	VAr, scaling determined by PwrScale
	THiRDmdVAr	[date/time]	
Mn/Mx.RDmd..PF @HiVA	HiRVAPF	0.00 - 1.00 ld or lg	reset with HiRDmdVA
	THiRDmdVA	[date/time]	not reset here
Mn/Mx.Basic...	**Basic Measurements**		
Mn/Mx.Basic.Hi Temp	HiSysTemp	-50 - 150 deg C	
	THiSysTemp	[date/time]	
Mn/Mx.Basic.Lo Temp	LoSysTemp	-50 - 150 deg C	
	TLoSysTemp	[date/time]	
Mn/Mx.DrHnd...	**Tap Position Draghands**		common reset by DragRs, not individually resettable
Mn/Mx.DrHnd.HiTapPos	HiTapPos	-16 - 16	
	THiTapPos	[date/time]	
Mn/Mx.DrHnd.LoTapPos	LoTapPos	-16 - 16	
	TLoTapPos	[date/time]	

Control Menu

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
`Cntrl...`	**Control**		
`Cntrl.Reset...`	**Resets**		all commands with confirmation
`Cntrl.Reset.MnMx All`	MinMaxRs	`'ENTER' to reset`	reset all min/max values and tap position draghands
`Cntrl.Reset.Average`	AvgRs	`'ENTER' to reset`	reset all min/max average values
`Cntrl.Reset.Demand`	DmdRs	`'ENTER' to reset`	reset all min/max demand values
`Cntrl.Reset.Basic`	BasicRs	`'ENTER' to reset`	reset all min/max basic measurement values
`Cntrl.Reset.Draghand`	DragRs	`'ENTER' to reset`	reset tap position draghands
`Cntrl.Reset.Energy`	EnergyRs	`'ENTER' to reset`	reset all energy values
`Cntrl.Reset.Cntcts`	CntctRs	`'ENTER' to reset`	reset all contact wear accumulators
`Cntrl.Reset.Cntct` *ds*	CntctRs_*ds*	`'ENTER' to reset`	Reset contact wear accumulators for selected contact. '*ds*' designates one of 11 or 20 contacts, depending on CntctType.

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
Cntrl.Mode...	**Operating Mode**		
Cntrl.Mode..VRC Blk	VRCBlk	normal	
		inhibit auto-control	inhibit auto-control algorithm
Cntrl.Mode..VRed	VRedMode	no voltage reduction	
		Local/Remote Level 1	voltage reduction by local or remote control, using VRedMode1
		Local/Remote Level 2	voltage reduction by local or remote control, using VRedStep2X
		by XIO input only	voltage reduction by XIO
Cntrl.Mode..Timer	TmrMode	sequential	
		time-integrating seq	
		voltage-averaging	
Cntrl.Mode..VLimit	VLimitMode	no voltage limit	
		low voltage limit	low voltage limit active
		high voltage limit	high voltage limit active
		both voltage limits	both voltage limits active
Cntrl.Mode..RevPwr	RevPwr	Locked forward	
		Locked reverse	
		Idle reverse	
		Bi-directional	
		Neutral reverse	
		Co-generation	
Cntrl.Mode..CntctLog	CntctLog	disabled	
		enabled	

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
Cntrl.Alert...	**Alert Mask**		
Cntrl.Alert.CommBlk	AlertMask1 bit 0	disabled	
		enabled	CommBlk active
Cntrl.Alert.RptTpPos	AlertMask1 bit 1	disabled	
		enabled	RptTapPos active
Cntrl.Alert.AInhibit	AlertMask1 bit 2	disabled	
		enabled	AutoInhibit active in auto
Cntrl.Alert.AutoSw	AlertMask1 bit 8	disabled	
		enabled	Auto/Off/ManualSw not auto
Cntrl.Alert.TapCh TO	AlertMask1 bit 12	disabled	
		enabled	TapChTimeout active
Cntrl.Alert.LostTPos	AlertMask1 bit 13	disabled	
		enabled	TapPosKnown inactive
Cntrl.Alert.ExtAlert	AlertMask2 bit 1	disabled	
		enabled	XIO ExtAlert active
Cntrl.Alert.Blk HiV	AlertMask2 bit 3	disabled	
		enabled	BlkHV active
Cntrl.Alert.Blk LowV	AlertMask2 bit 4	disabled	
		enabled	BlkLV active
Cntrl.Alert.Volt Red	AlertMask2 bit 5	disabled	
		enabled	VoltageReduction enabled
Cntrl.Alert.Rev Powr	AlertMask2 bit 6	disabled	
		enabled	RevPowerFlow reverse
Cntrl.Alert.Low Cur	AlertMask2 bit 8	disabled	
		enabled	LowCurrent active
Cntrl.Alert.Blk TapL	AlertMask2 bit 9	disabled	
		enabled	BlkTapL active
Cntrl.Alert.Blk TapR	AlertMask2 bit 10	disabled	
		enabled	BlkTapR active
Cntrl.Alert.BeloRevA	AlertMask2 bit 11	disabled	
		enabled	BelowRevCur active
Cntrl.Alert.LowMotrV	AlertMask2 bit 12	disabled	
		enabled	LowMotorV active
Cntrl.Alert.BlkLoadA	AlertMask2 bit 13	disabled	
		enabled	BlkLoadA active
Cntrl.Alert.ChkCntct	AlertMask2 bit 14	disabled	
		enabled	ChkCntct active

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
Cntrl.DatLg...	**Data Log Slot Assignments**		repeat for '*n*' = 1 - 7, for data log slots 1 - 7, respectively
Cntrl.DatLg.Slot *n*	DatLgSlot*n*	Empty	nothing recorded in this slot
		LoadCtrV	LoadCtrV
		Ld Volts	LoadV
		SrcVolts	SrcV
		Ld Amps	LoadA
		PriLCtrV	PriLoadCtrV
		PriLoadV	PriLoadV
		PriSrcV	PriSrcV
		PriLoadA	PriLoadA
		PwrFactr	PF
		Hz	Hz
		PriVA	PriVA
		PriWatts	PriW
		PriVAr	PriVAr
		CtlVIn	CtlVIn
		SysTemp	SysTemp
		PhaseAng	PhaseAng
		AvgLCtrV	AvgLoadCtrV
		AvgLoadV	AvgLoadV
		AvgSrcV	AvgSrcV
		DmdLoadA	DmdLoadA
		DmdVA	DmdVA
		DmdWatts	DmdW
		DmdVAr	DmdVAr
		VHrmTHD	THDLoadV
		VHrm3rd	HD3LoadV
		VHrm5th	HD5LoadV
		VHrm7th	HD7LoadV
		VHrm9th	HD9LoadV
		VHrm11th	HD11LoadV
		VHrm13th	HD13LoadV
		AHrmTHD	THDLoadA
		AHrm3rd	HD3LoadA
		AHrm5th	HD5LoadA
		AHrm7th	HD7LoadA
		AHrm9th	HD9LoadA
		AHrm11th	HD11LoadA
		AHrm13th	HD13LoadA
		TapPos	TapPos
		OpCount	CntOper
		ResOpCnt	CntOperR

Setpoints Menu

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
SetPt...	**Setpoints**		
SetPt.Mode...	**Operating Mode**		
SetPt.Mode..VRedMd 1	VRedMode1	0.0 - 10.0 %	
SetPt.Mode..VRedSt1X	VRedStep1X	0.0 - 10.0 %	
SetPt.Mode..VRedSt2X	VRedStep2X	0.0 - 10.0 %	
SetPt.Mode..VRedSt3X	VRedStep3X	0.0 - 10.0 %	
SetPt.Mode..Htr Temp	HeaterTemp	-40 - 40 degrees C	
SetPt.Mode..Clr Temp	CoolerTemp	-20 - 85 degrees C	
SetPt.Fwd...	**Forward Regulation**		
SetPt.Fwd...Bandctr	FBctr	100.0 - 135.0 volts	
SetPt.Fwd...Bandwid	FBwid	1.0 - 6.0 volts	
SetPt.Fwd...TimeDly	FTimDel	5 - 180 sec	
SetPt.Fwd...LDC R	FLDCR	-72.0 - 72.0 volts	
SetPt.Fwd...LDC X	FLDCX	-72.0 - 72.0 volts	
SetPt.Rev...	**Reverse Regulation**		
SetPt.Rev...Bandctr	RBctr	100.0 - 135.0 volts	
SetPt.Rev...Bandwid	RBwid	1.0 - 6.0 volts	
SetPt.Rev...TimeDly	RTimDel	5 - 180 sec	
SetPt.Rev...LDC R	RLDCR	-72.0 - 72.0 volts	
SetPt.Rev...LDC X	RLDCX	-72.0 - 72.0 volts	
SetPt.Rev...RevCur	RevCur	1 - 10 %	
SetPt.VLim...	**Voltage Limiting**		
SetPt.VLim..RunBkHiV	RnbkHV	95.0 - 135.0 volts	
SetPt.VLim..RunBkLoV	RnbkLV	95.0 - 135.0 volts	
SetPt.VLim..RunBkDly	RnbkDly	1 - 30 sec	

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
SetPt.Meter...	**Metering**		
SetPt.Meter.Avg Int	AvgInterval	1 - 120 sec	
SetPt.Meter.Dmd Calc	Dmd	thermal	
SetPt.Meter.Dmd Int	DmdInt	1 - 120 min	minutes
SetPt.Meter.PPwrDisp	PriPwrDis	1-phase	
		3-phase	
SetPt.Meter.DatLgInt	DatLgInt	disabled	data logging disabled
		1 min	minutes
		2 min	minutes
		3 min	minutes
		4 min	minutes
		5 min	minutes
		6 min	minutes
		10 min	minutes
		12 min	minutes
		15 min	minutes
		20 min	minutes
		30 min	minutes
		60 min	minutes
		120 min	minutes
		180 min	minutes
		240 min	minutes
SetPt.TapCh...	**Tapchanger**		
SetPt.TapCh.TapBlkR	TapBlkR	8 - 16	
SetPt.TapCh.TapBlkL	TapBlkL	-16 - -8	
SetPt.TapCh.RptTP Hi	RptTapPosR	-16 - 16	
SetPt.TapCh.RptTP Lo	RptTapPosL	-16 - 16	
SetPt.Cntct...	**Tapchanger Contact Wear Alert**		
SetPt.Cntct.ChkEngS	ChkCntctEngS	0 - 999999 ops	
SetPt.Cntct.ChkEngM	ChkCntctEngM	0 - 999999 ops	
SetPt.Cntct.ChkBrkS	ChkCntctBrkS	0 - 4294967295 kA^2*ops	
SetPt.Cntct.ChkBrkM	ChkCntctBrkM	0 - 4294967295 kA^2*ops	

Configuration Parameters Menu

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
Cnfig...	**Configuration Parameters**		
Cnfig.TapCh...	**Tapchanger**		
Cnfig.TapCh.OpCntInc	CntOperIncr	complete pulse	
		each transition	
		OC/HS invalid	
Cnfig.TapCh.MotVSrc	MotorVSrc	S	
		L	
Cnfig.TapCh.MotVNeut	MotorVNeut	90 - 135 volts	
Cnfig.TapCh.MotVTh	MotorVThres	80 - 110 volts	
Cnfig.TapCh.TapTmout	TapTimeout	1 - 30 sec	
Cnfig.TapCh.InTapDly	InterTapDly	2.0 - 60.0 sec	
Cnfig.TapCh.TapPos	TapPosSet	-16 - 16	momentary
Cnfig.TapCh.OpCnt	CntOperSet	0 - 999999	momentary
Cnfig.TapCh.CntctTyp	CntctType	single-blade	
		double-blade	
Cnfig.TapCh.NeutrlSw	NeutralSwPres	present	
		none	
Cnfig.Reg...	**Regulator**		
Cnfig.Reg...SysCfg	SystemCfg	1-ph/wye/open delta	
		closed delta	
Cnfig.Reg...BaseV	BaseV	100 - 135 volts	
Cnfig.Reg...SystemV	SystemV	0 - 163835 volts	
Cnfig.Reg...SystemHz	SystemHz	45 - 65 Hz	
Cnfig.Reg...FullLdA	FullLoadA	0.0 - 3276.7 amps	
Cnfig.Reg...Phasing	Phasing	0 - 359 degrees	
Cnfig.Reg...RegType	RegType	ANSI type A straight	
		ANSI type B inverted	
		series transformer	
Cnfig.Reg...VTCfg	VTCfg	line to line	
		line to ground	
Cnfig.Reg...VTRatio	VTRatio	1.0 - 3276.7 : 1	
Cnfig.Reg...CTRatio	CTRatio	0.2 - 6553.4 : 0.2 A	
Cnfig.Reg...RegRange	RegRange	2.5 - 20.0 %	
Cnfig.Reg...IntReg	IntReg	0.00 - 2.55 %	
Cnfig.Reg...LimLoadA	LimLoadA	100 - 560 mA	
Cnfig.Reg...PwrScale	PwrScale	3276.7 k	range magnitude limit
		32.767 M	range magnitude limit
		327.67 M	range magnitude limit
		3276.7 M	range magnitude limit

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
Cnfig.XIO-*n*...	**XIO Port**		repeat for '*n*' = 1 - 8, for XIO port positions 1 - 8, respectively
Cnfig.XIO-*n*.Function	XIOFunctionPos*n*	simple input	or unused
		simple output	
		ExtAlert input	
		Alert output	
		AuxAutoInhibit input	
		AuxRaise input	
		AuxLower input	
		VRed1 input	
		VRed0 input	
		Heater output	
		SyncRaise output	
		SyncLower output	
		Cooler output	
Cnfig.XIO-*n*.ActivLvl	XIOActiveLevel	energized	
		de-energized	
Cnfig.XIO-*n*.DefOutpt	XIODefOut	inactive	
		active	
Cnfig.XIO-*n*.RBE	XIORBEMask	disabled	
		enabled	report on change of XIOInRBE
Cnfig.Cntrl...	**Regulator Control**		
Cnfig.Cntrl.Lcl Time	ClockTOD	[date/time]	local date/time in format: mm/dd/yyyy hh:mm:ss
Cnfig.Cntrl.SysYrBas	BaseTime	1900 - 2099	present year max.
Cnfig.Cntrl.LclTOff	LocalTimeOffset	-1440 - 1440 min	minutes
Cnfig.Cntrl.TSYrBase	TSYearBase	1900 - 2099	>= BaseTime, present year max.
Cnfig.Cntrl.TSFormat	TSFormat	32-bit seconds	binary seconds
		protocol specific	packed date/time bitfields
Cnfig.Cntrl.CktIdNum	CktIDNum	0 - 32767	
Cnfig.Cntrl.CktIdTxt	CktID	[20-character string]	
Cnfig.Cntrl.Dev Addr	DevAddress	0 - 65519	
Cnfig.Cntrl.Security	Sc1	[4-character string]	displayed as "****" if SecurityLevel is Read Only

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
Cnfig.PrPrt...	**Protocol Port**		
Cnfig.PrPrt.Mode	ProtMode	EIA-232, noHS, noFC	
		EIA-485 2-wire	
		485 4-wire, 232 host	
		485 4-wire, DB host	
		485 4-wire	
		DB, noHS, noFC	
		DB loop, 232 host	
		DB loop	
		FO loop, modem host	
Cnfig.PrPrt.BaudRate	ProtBaud	300	
		600	
		1200	
		2400	
		4800	
		9600	
		19200	
		38400	
Cnfig.PrPrt.FrameTyp	ProtFrameType	8, N, 1	parity generated, not checked
		8, N, 2	parity generated, not checked
		8, E, 1	parity generated, not checked
		8, O, 1	parity generated, not checked
Cnfig.PrPrt.Tx Delay	ProtTxDly	0 - 5000 ms	
Cnfig.PcPrt...	**PC Port**		
Cnfig.PcPrt.BaudRate	PCBaud	300	
		600	
		1200	
		2400	
		4800	
		9600	
		19200	
		38400	
		57600	

User Profiles Menu

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
Prof...	**User Profiles**		all commands with confirmation
Prof..SaveUserProf 1	UserProfs	‘ENTER’ to load	save user profile 1
Prof..LoadUserProf 1	UserProfs	‘ENTER’ to load	load user profile 1
Prof..SaveUserProf 2	UserProfs	‘ENTER’ to load	save user profile 2
Prof..LoadUserProf 2	UserProfs	‘ENTER’ to load	load user profile 2
Prof..SaveUserProf 3	UserProfs	‘ENTER’ to load	save user profile 3
Prof..LoadUserProf 3	UserProfs	‘ENTER’ to load	load user profile 3
Prof..LoadFacDefs	VRCRs	‘ENTER’ to load	reset all UVR-1 values to factory defaults
Prof..DAP-*x*	**Date Activation**		repeat for ‘*x*’ = A, B, C, D
Prof..DAP-*x*.DateTime	ProfDate_*x* ProfTime_*x*	[date/time]	local date/time in format: mm/dd hh:mm
Prof..DAP-*x*.ProfNum	ProfNum_*x*	0 - 3	0 signifies no change

Maintenance Menu

Menu Legend	Category, Subcategory, or Data Item Identifier	Menu Value or Prompt	Comments
Maint...	**Maintenance**		commands have confirmation
Maint.Security Level	SecurityLevel	Read Only	disallow local changes to UVR-1 values and command execution
		Read/Write/Execute Enter Code: ****	if entry matches Sc1, allow local changes to UVR-1 values and command execution
Maint.Serial Number	SerialNum	1 - 999999999	factory-assigned
Maint.Reg Serial Num	VRegSN	[20-character string]	
Maint.User ID	UserID	[20-character string]	
Maint.Clear DatLg	ClearDatLg	'ENTER' to clear	clear data log (command)
Maint.Reprogram	ProgramFlash	'ENTER' to reprogram	program flash memory through front panel PC Port (command)
Maint.SecEn...	**Security Level Enable Log**		Read-only. Timestamps are local date/time in format: mm/dd/yyyy hh:mm:ss
Maint.SecEn.*n*	SecEn_*n*	[date/time]	repeat for '*n*' = 1 - 16, 1 = most recent
Maint.Code...	**Firmware Version Numbers**		read-only
Maint.Code..Registry	RegVersion	0.01 - 655.35	
Maint.Code..Boot Blk	BootVersion	0.01 - 655.35	
Maint.Code..App Code	AppVersion	0.01 - 655.35	
Maint.Code..Protocol	ProtVersion	0.01 - 655.35	
Maint.BdID...	**Board ID Numbers**		factory-assigned
Maint.BdID..Main Brd	MainBoardID	1 - 999999999	read-only
Maint.BdID..Display	DisplayBoardID	1 - 999999999	
Maint.BdID..I/O Brd	IOBoardID	1 - 999999999	
Maint.BdID..Switch	SwitchBoardID	1 - 999999999	
Maint.Diag...	**Diagnostics**		access to diagnostic data and functions for factory personnel only

Data Item Cross-Reference

Category, Subcategory, or Data Item Identifier	Menu Legend or Access Mechanism	Remotely Accessible	User Profile
Status	`Stats...`		
Operating Mode	`Stats.Mode...`		
Auto/Off/ManualSw	**AUTO/OFF/MANUAL** switch	✓	
Local/RemoteSw	**LOCAL/REMOTE** switch	✓	
AutoInhibit	`Stats.Mode..AInhibit`	✓	
CommBlk	`Stats.Mode..CommBlk`	✓	
VoltageReduction	**VOLTAGE RED.** lamp (on when active)	✓	
VRedLevel	`Stats.Mode..VRed Lvl`	✓	
VRedPct	`Stats.Mode..VRed Pct`	✓	
RevMeter		✓	
MeterAccum	Demand measurements annunciator	✓	
Tapchanger Command			
RaiseCommand		✓	
LowerCommand		✓	
Regulation			
InBand	**IN-BAND** lamp	✓	
LowBandEdge	**LOW BAND** lamp	✓	
HighBandEdge	**HIGH BAND** lamp	✓	
BlkHV	**HIGH LIMIT** lamp	✓	
BlkLV	**LOW LIMIT** lamp	✓	
BlkTapR	Alert selection	✓	
BlkTapL	Alert selection	✓	
BlkLoadA	Alert selection	✓	
RevOperate		✓	
RevPowerFlow	**REVERSE PWR** lamp	✓	
BelowRevCur	Alert selection	✓	
LowCurrent	Alert selection	✓	
Tapchanger	`Stats.TapCh...`		
TapPos	`Stats.TapCh.TapPos`	✓	
NeutralTapPos	**NEUTRAL** lamp	✓	
TapChTimeout	Alert selection	✓	
TapPosKnown	Alert selection	✓	
RptTapPos	Alert selection	✓	
LowMotorV	Alert selection	✓	
CntOper	`Stats.TapCh.OpCount`	✓	
CntOperR	`Stats.TapCh.ResOpCnt`	✓	
ChkCntct	Alert selection	✓	
Tapchanger Contact Wear Log	`Stats.Cntct...`		
Engage_*dsg*	`Stats.Cntct.Eng` *dsg*	✓	
Break_*dsg*	`Stats.Cntct.Brk` *dsg*	✓	

Category, Subcategory, or Data Item Identifier		Menu Legend or Access Mechanism	Remotely Accessible	User Profile
XIO Port		Stats.XIO...		
XIOIn	bit 0	Stats.XIO...Pos 1	✓	
	bit 1	Stats.XIO...Pos 2		
	bit 2	Stats.XIO...Pos 3		
	bit 3	Stats.XIO...Pos 4		
	bit 4	Stats.XIO...Pos 5		
	bit 5	Stats.XIO...Pos 6		
	bit 6	Stats.XIO...Pos 7		
	bit 7	Stats.XIO...Pos 8		
XIOInPos1		Stats.XIO...Pos 1	✓	
XIOInPos2		Stats.XIO...Pos 2	✓	
XIOInPos3		Stats.XIO...Pos 3	✓	
XIOInPos4		Stats.XIO...Pos 4	✓	
XIOInPos5		Stats.XIO...Pos 5	✓	
XIOInPos6		Stats.XIO...Pos 6	✓	
XIOInPos7		Stats.XIO...Pos 7	✓	
XIOInPos8		Stats.XIO...Pos 8	✓	
XIOInRBE	bit 0		✓	
	bit 1			
	bit 2			
	bit 3			
	bit 4			
	bit 5			
	bit 6			
	bit 7			
Alerts				
AlertStatus1	bit 0	Stats.Alerts: Comm Block	✓	
	bit 1	Stats.Alerts: Rpt Tap Pos		
	bit 2	Stats.Alerts: Auto Inhibit		
	bit 8	Stats.Alerts: Not in Auto		
	bit 12	Stats.Alerts: Tap Change Timeout		
	bit 13	Stats.Alerts: Lost Tap Pos		
AlertStatus2	bit 1	Stats.Alerts: External Alert	✓	
	bit 3	Stats.Alerts: High Voltage Limit		
	bit 4	Stats.Alerts: Low Voltage Limit		
	bit 5	Stats.Alerts: Voltage Reduction		
	bit 6	Stats.Alerts: Reverse Power Flow		
	bit 8	Stats.Alerts: Below Low Current		
	bit 9	Stats.Alerts: Low Tap Limit		
	bit 10	Stats.Alerts: High Tap Limit		
	bit 11	Stats.Alerts: Below Rev Current		
	bit 12	Stats.Alerts: Low Motor Voltage		
	bit 13	Stats.Alerts: Overcurrent Limit		
	bit 14	Stats.Alerts: Check Contacts		
Alert		ALERT lamp	✓	

Category, Subcategory, or Data Item Identifier	Menu Legend or Access Mechanism	Remotely Accessible	User Profile
Measurements	Meas...		
Basic	Meas..Basic...		
LoadCtrV	Meas..Basic.LoadCtrV	✓	
LoadV	Meas..Basic.Ld Volts	✓	
SrcV	Meas..Basic.SrcVolts	✓	
LoadA	Meas..Basic.Ld Amps	✓	
PriLoadCtrV	Meas..Basic.PriLCtrV	✓	
PriLoadV	Meas..Basic.PriLoadV	✓	
PriSrcV	Meas..Basic.PriSrcV	✓	
PriLoadA	Meas..Basic.PriLoadA	✓	
PF	Meas..Basic.PwrFactr	✓	
Hz	Meas..Basic.Hz	✓	
PriVA	Meas..Basic.PriVA	✓	
PriW	Meas..Basic.PriWatts	✓	
PriVAr	Meas..Basic.PriVAr	✓	
CtlVIn	Meas..Basic.CtlVIn	✓	
SysTemp	Meas..Basic.Temp	✓	
PhaseAng	Meas..Basic.PhaseAng		
Voltage Harmonics	Meas..VHarm...		
THDLoadV	Meas..VHarm.THD	✓	
HD3LoadV	Meas..VHarm.3rd	✓	
HD5LoadV	Meas..VHarm.5th	✓	
HD7LoadV	Meas..VHarm.7th	✓	
HD9LoadV	Meas..VHarm.9th	✓	
HD11LoadV	Meas..VHarm.11th	✓	
HD13LoadV	Meas..VHarm.13th	✓	
Current Harmonics	Meas..AHarm...		
THDLoadA	Meas..AHarm.THD	✓	
HD3LoadA	Meas..AHarm.3rd	✓	
HD5LoadA	Meas..AHarm.5th	✓	
HD7LoadA	Meas..AHarm.7th	✓	
HD9LoadA	Meas..AHarm.9th	✓	
HD11LoadA	Meas..AHarm.11th	✓	
HD13LoadA	Meas..AHarm.13th	✓	
Average			
AvgLoadCtrV	data log item		
AvgLoadV	data log item		
AvgSrcV	data log item		
Demand	Meas..Dmd...		
DmdLoadA	Meas..Dmd...LoadA	✓	
DmdVA	Meas..Dmd...VA	✓	
DmdW	Meas..Dmd...Watts	✓	
DmdVAr	Meas..Dmd...VAr	✓	

Category, Subcategory, or Data Item Identifier	Menu Legend or Access Mechanism	Remotely Accessible	User Profile
Energy	Meas..Enrgy...		
FWHrs	Meas..Enrgy.F WH	✓	
RWHrs	Meas..Enrgy.R WH	✓	
FVArHrsLd	Meas..Enrgy.F VArHLd	✓	
FVArHrsLg	Meas..Enrgy.F VArHLg	✓	
RVArHrsLd	Meas..Enrgy.R VArHLd	✓	
RVArHrsLg	Meas..Enrgy.R VArHLg	✓	
TEnergyRst	Meas..Enrgy...	✓	
Min/Max	Mn/Mx...		
Forward Average Measurements	Mn/Mx.FAvg...		
HiFAvgLoadV	Mn/Mx.FAvg..Hi LoadV	✓	
THiFAvgLoadV	Mn/Mx.FAvg..Hi LoadV	✓	
LoFAvgLoadV	Mn/Mx.FAvg..Lo LoadV	✓	
TLoFAvgLoadV	Mn/Mx.FAvg..Lo LoadV	✓	
HiFAvgSrcV	Mn/Mx.FAvg..Hi SrcV	✓	
THiFAvgSrcV	Mn/Mx.FAvg..Hi SrcV	✓	
LoFAvgSrcV	Mn/Mx.FAvg..Lo SrcV	✓	
TLoFAvgSrcV	Mn/Mx.FAvg..Lo SrcV	✓	
HiFAvgLoadCtrV	Mn/Mx.FAvg..HiLdCtrV	✓	
THiFAvgLoadCtrV	Mn/Mx.FAvg..HiLdCtrV	✓	
LoFAvgLoadCtrV	Mn/Mx.FAvg..LoLdCtrV	✓	
TLoFAvgLoadCtrV	Mn/Mx.FAvg..LoLdCtrV	✓	
Reverse Average Measurements	Mn/Mx.RAvg...		
HiRAvgLoadV	Mn/Mx.RAvg..Hi LoadV	✓	
THiRAvgLoadV	Mn/Mx.RAvg..Hi LoadV	✓	
LoRAvgLoadV	Mn/Mx.RAvg..Lo LoadV	✓	
TLoRAvgLoadV	Mn/Mx.RAvg..Lo LoadV	✓	
HiRAvgSrcV	Mn/Mx.RAvg..Hi SrcV	✓	
THiRAvgSrcV	Mn/Mx.RAvg..Hi SrcV	✓	
LoRAvgSrcV	Mn/Mx.RAvg..Lo SrcV	✓	
TLoRAvgSrcV	Mn/Mx.RAvg..Lo SrcV	✓	
HiRAvgLoadCtrV	Mn/Mx.RAvg..HiLdCtrV	✓	
THiRAvgLoadCtrV	Mn/Mx.RAvg..HiLdCtrV	✓	
LoRAvgLoadCtrV	Mn/Mx.RAvg..LoLdCtrV	✓	
TLoRAvgLoadCtrV	Mn/Mx.RAvg..LoLdCtrV	✓	
Forward Demand Measurements	Mn/Mx.FDmd...		
HiFDmdLoadA	Mn/Mx.FDmd..Hi LoadA	✓	
THiFDmdLoadA	Mn/Mx.FDmd..Hi LoadA	✓	
HiFDmdVA	Mn/Mx.FDmd..Hi VA	✓	
THiFDmdVA	Mn/Mx.FDmd..Hi VA, Mn/Mx.FDmd..PF @HiVA	✓	
HiFDmdW	Mn/Mx.FDmd..Hi Watts	✓	
THiFDmdW	Mn/Mx.FDmd..Hi Watts	✓	
HiFDmdVAr	Mn/Mx.FDmd..Hi VAr	✓	
THiFDmdVAr	Mn/Mx.FDmd..Hi VAr	✓	
HiFVAPF	Mn/Mx.FDmd..PF @HiVA	✓	

Category, Subcategory, or Data Item Identifier	Menu Legend or Access Mechanism	Remotely Accessible	User Profile
Reverse Demand Measurements	`Mn/Mx.RDmd...`		
HiRDmdLoadA	`Mn/Mx.RDmd..Hi LoadA`	✓	
THiRDmdLoadA	`Mn/Mx.RDmd..Hi LoadA`	✓	
HiRDmdVA	`Mn/Mx.RDmd..Hi VA`	✓	
THiRDmdVA	`Mn/Mx.RDmd..Hi VA`, `Mn/Mx.RDmd..PF @HiVA`	✓	
HiRDmdW	`Mn/Mx.RDmd..Hi Watts`	✓	
THiRDmdW	`Mn/Mx.RDmd..Hi Watts`	✓	
HiRDmdVAr	`Mn/Mx.RDmd..Hi VAr`	✓	
THiRDmdVAr	`Mn/Mx.RDmd..Hi VAr`	✓	
HiRVAPF	`Mn/Mx.RDmd..PF @HiVA`	✓	
Basic Measurements	`Mn/Mx.Basic...`		
HiSysTemp	`Mn/Mx.Basic.Hi Temp`	✓	
THiSysTemp	`Mn/Mx.Basic.Hi Temp`	✓	
LoSysTemp	`Mn/Mx.Basic.Lo Temp`	✓	
TLoSysTemp	`Mn/Mx.Basic.Lo Temp`	✓	
Tap Position Draghands	`Mn/Mx.DrHnd...`		
HiTapPos	`Mn/Mx.DrHnd.HiTapPos`	✓	
THiTapPos	`Mn/Mx.DrHnd.HiTapPos`	✓	
LoTapPos	`Mn/Mx.DrHnd.LoTapPos`	✓	
TLoTapPos	`Mn/Mx.DrHnd.LoTapPos`	✓	
Control	`Cntrl...`		
Tapchanger			
Raise	**RAISE/LOWER** switch	✓	
Lower	**RAISE/LOWER** switch	✓	
Raise/Lower	**RAISE/LOWER** switch	✓	

Category, Subcategory, or Data Item Identifier		Menu Legend or Access Mechanism	Remotely Accessible	User Profile
Resets		Cntrl.Reset...		
MinMaxRs		Cntrl.Reset.MnMx All	✓	
AvgRs		Cntrl.Reset.Average	✓	
DmdRs		Cntrl.Reset.Demand	✓	
BasicRs		Cntrl.Reset.Basic	✓	
DragRs		Cntrl.Reset.Draghand	✓	
EnergyRs		Cntrl.Reset.Energy	✓	
CntctRs		Cntrl.Reset.Cntcts	✓	
CntctRs_*ds*		Cntrl.Reset.Cntct *ds*	✓	
OpRs		Stats.TapCh.ResOpCnt	✓	
HiLoRs1	bit 0	Mn/Mx.FAvg..Hi LoadV	✓	
	bit 1	Mn/Mx.FAvg..Lo LoadV		
	bit 2	Mn/Mx.FAvg..Hi SrcV		
	bit 3	Mn/Mx.FAvg..Lo SrcV		
	bit 6	Mn/Mx.FAvg..HiLdCtrV		
	bit 7	Mn/Mx.FAvg..LoLdCtrV		
HiLoRs2	bit 7	Mn/Mx.FDmd..Hi LoadA	✓	
	bit 11	Mn/Mx.FDmd..Hi VA		
	bit 13	Mn/Mx.FDmd..Hi Watts		
HiLoRs3	bit 0	Mn/Mx.FDmd..Hi VAr	✓	
	bit 2	Mn/Mx.FDmd..PF @HiVA		
	bit 8	Mn/Mx.RDmd..Hi LoadA		
	bit 12	Mn/Mx.RDmd..Hi VA		
	bit 14	Mn/Mx.RDmd..Hi Watts		
HiLoRs4	bit 1	Mn/Mx.RDmd..Hi VAr	✓	
	bit 3	Mn/Mx.RDmd..PF @HiVA		
	bit 5	Mn/Mx.RAvg..Hi LoadV		
	bit 6	Mn/Mx.RAvg..Lo LoadV		
	bit 7	Mn/Mx.RAvg..Hi SrcV		
	bit 8	Mn/Mx.RAvg..Lo SrcV		
	bit 11	Mn/Mx.RAvg..HiLdCtrV		
	bit 12	Mn/Mx.RAvg..LoLdCtrV		
HiLoRs5	bit 6	Mn/Mx.Basic.Hi Temp	✓	
	bit 7	Mn/Mx.Basic.Lo Temp		
Operating Mode		Cntrl.Mode...		
VRCBlk		Cntrl.Mode..VRC Blk	✓	✓
VRedMode		Cntrl.Mode..VRed	✓	✓
TmrMode		Cntrl.Mode..Timer	✓	✓
VLimitMode		Cntrl.Mode..VLimit	✓	✓
RevPwr		Cntrl.Mode..RevPwr	✓	✓
CntctLog		Cntrl.Mode..CntctLog	✓	✓

Category, Subcategory, or Data Item Identifier		Menu Legend or Access Mechanism	Remotely Accessible	User Profile
XIO Port		Stats.XIO...		
XIOOut	bit 0	Stats.XIO...Pos 1	✓	
	bit 1	Stats.XIO...Pos 2		
	bit 2	Stats.XIO...Pos 3		
	bit 3	Stats.XIO...Pos 4		
	bit 4	Stats.XIO...Pos 5		
	bit 5	Stats.XIO...Pos 6		
	bit 6	Stats.XIO...Pos 7		
	bit 7	Stats.XIO...Pos 8		
XIOOutPos1		Stats.XIO...Pos 1	✓	
XIOOutPos2		Stats.XIO...Pos 2	✓	
XIOOutPos3		Stats.XIO...Pos 3	✓	
XIOOutPos4		Stats.XIO...Pos 4	✓	
XIOOutPos5		Stats.XIO...Pos 5	✓	
XIOOutPos6		Stats.XIO...Pos 6	✓	
XIOOutPos7		Stats.XIO...Pos 7	✓	
XIOOutPos8		Stats.XIO...Pos 8	✓	
Alert Mask		Cntrl.Alert...		
AlertMask1	bit 0	Cntrl.Alert.CommBlk	✓	✓
	bit 1	Cntrl.Alert.RptTpPos		
	bit 2	Cntrl.Alert.AInhibit		
	bit 8	Cntrl.Alert.AutoSw		
	bit 12	Cntrl.Alert.TapCh TO		
	bit 13	Cntrl.Alert.LostTPos		
AlertMask2	bit 1	Cntrl.Alert.ExtAlert	✓	✓
	bit 3	Cntrl.Alert.Blk HiV		
	bit 4	Cntrl.Alert.Blk LowV		
	bit 5	Cntrl.Alert.Volt Red		
	bit 6	Cntrl.Alert.Rev Powr		
	bit 8	Cntrl.Alert.Low Cur		
	bit 9	Cntrl.Alert.Blk TapL		
	bit 10	Cntrl.Alert.Blk TapR		
	bit 11	Cntrl.Alert.BeloRevA		
	bit 12	Cntrl.Alert.LowMotrV		
	bit 13	Cntrl.Alert.BlkLoadA		
	bit 14	Cntrl.Alert.ChkCntct		
Data Log		Cntrl.DatLg...		
DatLgSlot1		Cntrl.DatLg.Slot 1		✓
DatLgSlot2		Cntrl.DatLg.Slot 2		✓
DatLgSlot3		Cntrl.DatLg.Slot 3		✓
DatLgSlot4		Cntrl.DatLg.Slot 4		✓
DatLgSlot5		Cntrl.DatLg.Slot 5		✓
DatLgSlot6		Cntrl.DatLg.Slot 6		✓
DatLgSlot7		Cntrl.DatLg.Slot 7		✓

Category, Subcategory, or Data Item Identifier	Menu Legend or Access Mechanism	Remotely Accessible	User Profile
Setpoints	SetPt...		
Operating Mode	SetPt.Mode...		
VRedMode1	SetPt.Mode..VRedMd 1	✓	✓
VRedStep1X	SetPt.Mode..VRedSt1X	✓	✓
VRedStep2X	SetPt.Mode..VRedSt2X	✓	✓
VRedStep3X	SetPt.Mode..VRedSt3X	✓	✓
HeaterTemp	SetPt.Mode..Htr Temp	✓	✓
CoolerTemp	SetPt.Mode..Clr Temp	✓	✓
Forward Regulation	SetPt.Fwd...		
FBctr	SetPt.Fwd...Bandctr	✓	✓
FBwid	SetPt.Fwd...Bandwid	✓	✓
FTimDel	SetPt.Fwd...TimeDly	✓	✓
FLDCR	SetPt.Fwd...LDC R	✓	✓
FLDCX	SetPt.Fwd...LDC X	✓	✓
Reverse Regulation	SetPt.Rev...		
RBctr	SetPt.Rev...Bandctr	✓	✓
RBwid	SetPt.Rev...Bandwid	✓	✓
RTimDel	SetPt.Rev...TimeDly	✓	✓
RLDCR	SetPt.Rev...LDC R	✓	✓
RLDCX	SetPt.Rev...LDC X	✓	✓
RevCur	SetPt.Rev...RevCur	✓	✓
Voltage Limiting	SetPt.VLim...		
RnbkHV	SetPt.VLim..RunBkHiV	✓	✓
RnbkLV	SetPt.VLim..RunBkLoV	✓	✓
RnbkDly	SetPt.VLim..RunBkDly	✓	✓
Metering	SetPt.Meter...		
AvgInterval	SetPt.Meter.Avg Int	✓	✓
Dmd	SetPt.Meter.Dmd Calc	✓	✓
DmdInt	SetPt.Meter.Dmd Int	✓	✓
PriPwrDis	SetPt.Meter.PPwrDisp	✓	✓
DatLgInt	SetPt.Meter.DatLgInt		✓
Tapchanger	SetPt.TapCh...		
TapBlkR	SetPt.TapCh.TapBlkR	✓	✓
TapBlkL	SetPt.TapCh.TapBlkL	✓	✓
RptTapPosR	SetPt.TapCh.RptTP Hi	✓	✓
RptTapPosL	SetPt.TapCh.RptTP Lo	✓	✓
Tapchanger Contact Wear Alert	SetPt.Cntct...		
ChkCntctEngS	SetPt.Cntct.ChkEngS	✓	✓
ChkCntctEngM	SetPt.Cntct.ChkEngM	✓	✓
ChkCntctBrkS	SetPt.Cntct.ChkBrkS	✓	✓
ChkCntctBrkM	SetPt.Cntct.ChkBrkM	✓	✓

Category, Subcategory, or Data Item Identifier	Menu Legend or Access Mechanism	Remotely Accessible	User Profile
Configuration Parameters	Cnfig...		
Tapchanger	Cnfig.TapCh...		
CntOperIncr	Cnfig.TapCh.OpCntInc	✓	✓
MotorVSrc	Cnfig.TapCh.MotVSrc	✓	✓
MotorVNeut	Cnfig.TapCh.MotVNeut	✓	✓
MotorVThres	Cnfig.TapCh.MotVTh	✓	✓
TapTimeout	Cnfig.TapCh.TapTmout	✓	✓
InterTapDly	Cnfig.TapCh.InTapDly	✓	✓
TapPosSet	Cnfig.TapCh.TapPos	✓	
CntOperSet	Cnfig.TapCh.OpCnt	✓	
CntctType	Cnfig.TapCh.CntctTyp	✓	✓
NeutralSwPres	Cnfig.TapCh.NeutrlSw	✓	✓
Regulator	Cnfig.Reg...		
SystemCfg	Cnfig.Reg...SysCfg	✓	✓
BaseV	Cnfig.Reg...BaseV	✓	✓
SystemV	Cnfig.Reg...SystemV	✓	✓
SystemHz	Cnfig.Reg...SystemHz		✓
FullLoadA	Cnfig.Reg...FullLdA	✓	✓
Phasing	Cnfig.Reg...Phasing	✓	✓
RegType	Cnfig.Reg...RegType	✓	✓
VTCfg	Cnfig.Reg...VTCfg	✓	✓
VTRatio	Cnfig.Reg...VTRatio	✓	✓
CTRatio	Cnfig.Reg...CTRatio	✓	✓
RegRange	Cnfig.Reg...RegRange	✓	✓
IntReg	Cnfig.Reg...IntReg	✓	✓
LimLoadA	Cnfig.Reg...LimLoadA	✓	✓
PwrScale	Cnfig.Reg...PwrScale	✓	✓
XIO Port	Cnfig.XIO-*n*...		
XIOFunctionPos1	Cnfig.XIO-1.Function	✓	
XIOFunctionPos2	Cnfig.XIO-2.Function	✓	
XIOFunctionPos3	Cnfig.XIO-3.Function	✓	
XIOFunctionPos4	Cnfig.XIO-4.Function	✓	
XIOFunctionPos5	Cnfig.XIO-5.Function	✓	
XIOFunctionPos6	Cnfig.XIO-6.Function	✓	
XIOFunctionPos7	Cnfig.XIO-7.Function	✓	
XIOFunctionPos8	Cnfig.XIO-8.Function	✓	
XIOActiveLevel	Cnfig.XIO-*n*.ActivLvl	✓	
XIODefOut	Cnfig.XIO-*n*.DefOutpt	✓	
XIORBEMask	Cnfig.XIO-*n*.RBE	✓	
Regulator Control	Cnfig.Cntrl...		
ClockTOD	Cnfig.Cntrl.Lcl Time	✓	
BaseTime	Cnfig.Cntrl.SysYrBas		
LocalTimeOffset	Cnfig.Cntrl.LclTOff	✓	✓
TSYearBase	Cnfig.Cntrl.TSYrBase	✓	
TSFormat	Cnfig.Cntrl.TSFormat	✓	✓
CktIDNum	Cnfig.Cntrl.CktIdNum	✓	✓
CktID	Cnfig.Cntrl.CktIdTxt		✓
DevAddress	Cnfig.Cntrl.Dev Addr		
Sc1	Cnfig.Cntrl.Security	✓	

Category, Subcategory, or Data Item Identifier	Menu Legend or Access Mechanism	Remotely Accessible	User Profile
Protocol Port	Cnfig.PrPrt...		
ProtMode	Cnfig.PrPrt.Mode		
ProtBaud	Cnfig.PrPrt.BaudRate		
ProtFrameType	Cnfig.PrPrt.FrameTyp		
ProtTxDly	Cnfig.PrPrt.Tx Delay		
PC Port	Cnfig.PcPrt...		
PCBaud	Cnfig.PcPrt.BaudRate		
User Profiles	Prof...		
UserProfs	Prof..SaveUserProf 1	✓	
	Prof..LoadUserProf 1		
	Prof..SaveUserProf 2		
	Prof..LoadUserProf 2		
	Prof..SaveUserProf 3		
	Prof..LoadUserProf 3		
VRCRs	Prof..LoadFacDefs		
Date Activation	Prof..DAP-*x*...		
ProfDate_*x*	Prof..DAP-*x*.DateTime	✓	
ProfTime_*x*	Prof..DAP-*x*.DateTime	✓	
ProfNum_*x*	Prof..DAP-*x*.ProfNum	✓	
Maintenance	Maint...		
SecurityLevel	Maint.Security Level		
SerialNum	Maint.Serial Number	✓	
VRegSN	Maint.Reg Serial Num		✓
UserID	Maint.User ID		✓
ClearDatLg	Maint.Clear DatLg		
ProgramFlash	Maint.Reprogram		
Security Level Enable Log	Maint.SecEn...		
SecEn_*n*	Maint.SecEn.*n*	✓	
Firmware Version Numbers	Maint.Code...		
RegVersion	Maint.Code..Registry		
BootVersion	Maint.Code..Boot Blk		
AppVersion	Maint.Code..App Code		
ProtVersion	Maint.Code..Protocol		
Board ID Numbers	Maint.BdID...		
MainBoardID	Maint.BdID..Main Brd		
DisplayBoardID	Maint.BdID..Display		
IOBoardID	Maint.BdID..I/O Brd		
SwitchBoardID	Maint.BdID..Switch		
Diagnostics	Maint.Diag...		

Appendix A: Line Drop Compensation Setpoint Calculation

Regulation of the Voltage at the Load using Line Drop Compensation

Note: This segment is adapted from LTC Control and Transformer Paralleling, ©Copyright 1998, 2001 Harlow Engineering Associates, used by permission.

It must be acknowledged that if it were easy to do so, the preferred objective would be to regulate the voltage at the load, rather than at the substation bus. The difficulty is that the voltage at the load is not measured and communicated to the control, therefore it must be calculated in the control using system parameters calculated by the user. Basically, the calculation involves determining the line impedance between the substation and the load, the location of which is itself usually very nebulous.

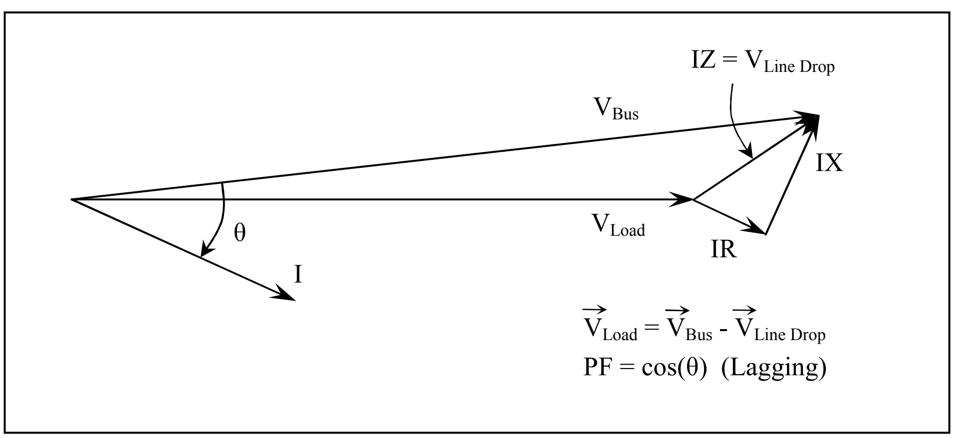
The procedure used is that of Line Drop Compensation (LDC), that is, the adjustment of the voltage at the substation in order to compensate for the voltage drop on the line. The validity of the method is subject to much debate because of the uncertainty of where to consider the load to be when it is in fact distributed, and the inaccuracies encountered in determining the feeder line resistance and reactance.

The principle upon which LDC is based is that there is one concentrated load located sufficient distance from the regulator for the voltage drop in the line to be meaningful. The distance from the substation to the load must be defined in terms of the electrical distance, the resistance (R) and reactance (X) of the feeder. The CT will be of a ratio where the primary is somewhat greater than the maximum current rating of the regulator, and the secondary is 200 mA.

The traditional means of determining the LDC R and X settings is presented following this discussion. Many users have developed simplified techniques which approximate the results, albeit with some measure of error; contact ICMI for discussion of this matter.

The LDC resistance and reactance settings are in volts, expressed on the base voltage. These values are the voltage drop on the line (R = in-phase component, X = quadrature component) when the line current magnitude is the CT primary rated current, which is not usually the same as the rating of the regulator.

The manner in which the control accounts for the line drop is illustrated with a phasor diagram. In the illustration, the voltage desired at the load, V_{Load} is the reference phasor; it is depicted as horizontal and its magnitude does not change. All of the other phasors will change when the load current changes in magnitude or phase angle.



- IR = voltage drop on the line due to line resistance; in-phase with the current.
- IX = voltage drop on the line due to line inductive reactance; leads the current by 90°.
- IZ = total line voltage drop, the phasor sum of IR and IX.

In the illustration, the power factor angle, θ, is about 30°, the angle by which the current lags the voltage; this for an exaggerated illustration of a power factor of about 0.87. It is seen that the voltage at the bus will need to be boosted to the value V_{Bus} in order to overcome the IR and IX voltage drops on the line. The LDC algorithm accurately models the line drop, both in magnitude and phase.

Given that LDC is used to model the resistance and reactance of a distribution feeder, and that these will always be positive ohmic quantities, why does the UVR-1 permit the setting of negative values of R and X? There are two answers to this question:

1) There is a means of paralleling LTC transformers called the Negative Reactance method which requires that a negative value of X be used for LDC. It is to accommodate this paralleling method that the C57.15 standard originally required the negative X capability.

2) When step-voltage regulators are connected in delta, the signals from the VT and CT, both of which are internal to the regulators, are displaced in phase relative to each other by ±30°. In the past, this resulted in a complication in the selection of LDC setpoints. This is not an issue for the UVR-1, since the Phasing parameter automatically corrects for the ±30° discrepancy.

No “typical” values for LDC R and X can be given except zero, as the values are so specific to the application.

Traditional Means for Determination of Parameters for Line Drop Compensation

Line drop compensation will model the distribution feeder; it is therefore necessary to determine the resistance and reactance of the line.

1. Obtain information on conductor type (Cu or Al), kCM size, and conductor configuration.

2. Use the figures on the following pages to obtain the line resistance (R) and inductive reactance (X) in ohms/conductor/mile.

   a) If a three-phase system (wye, open delta, or closed delta), use the values from the figures.
   b) If a single-phase system, multiply the values from the figures by 2, to recognize the return path impedance.

   Note: "Spacing" in the figures is the equivalent spacing between the phase conductors, i.e. the cube root of the product of the three individual phase spacings: Spacing = $\sqrt[3]{S_{a\text{-}b} * S_{b\text{-}c} * S_{c\text{-}a}}$.

3. Determine the ohmic line resistance and reactance values based on line length (miles):
   R_{Ω} = line length * R
   X_{Ω} = line length * X

4. Determine the system impedance base, based on the system voltage (SysV) and the CT primary rating:
   a) wye and delta: $Z_{BASE} = SysV_{L\text{-}L} / (\sqrt{3} * \text{CT Rating})$
   b) single-phase: $Z_{BASE} = SysV_{L\text{-}G} / \text{CT Rating}$

5. Determine the LDC R and X setpoints as per unit of the base impedance:
   $R_{SET(PU)} = R_{\Omega} / Z_{BASE}$
   $X_{SET(PU)} = X_{\Omega} / Z_{BASE}$

6. Scale the LDC R and X setpoints to the base voltage (BaseV), i.e. the values to be set:
   $R_{SET(VOLTS)} = R_{SET(PU)} * \text{BaseV}$
   $X_{SET(VOLTS)} = X_{SET(PU)} * \text{BaseV}$

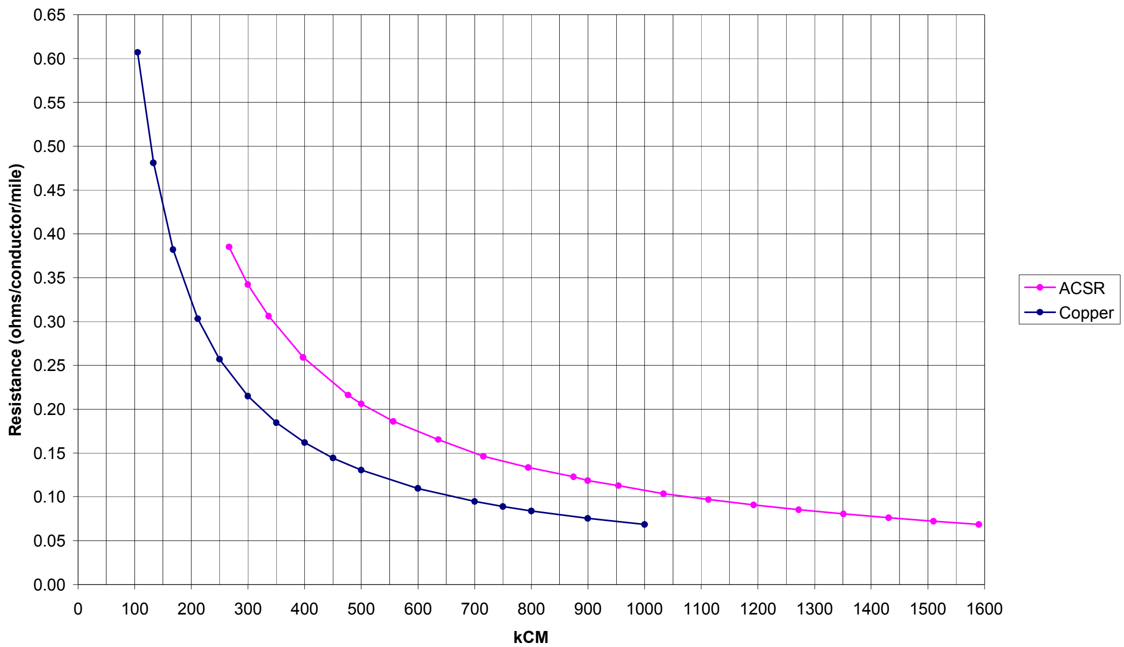
A few observations are made regarding the classical application of the LDC calculation:

1) For most commonly used overhead feeders, the ratio of impedance X to R will be in the range of 2.0 to 4.0. Therefore, the settings will also be in this ratio.

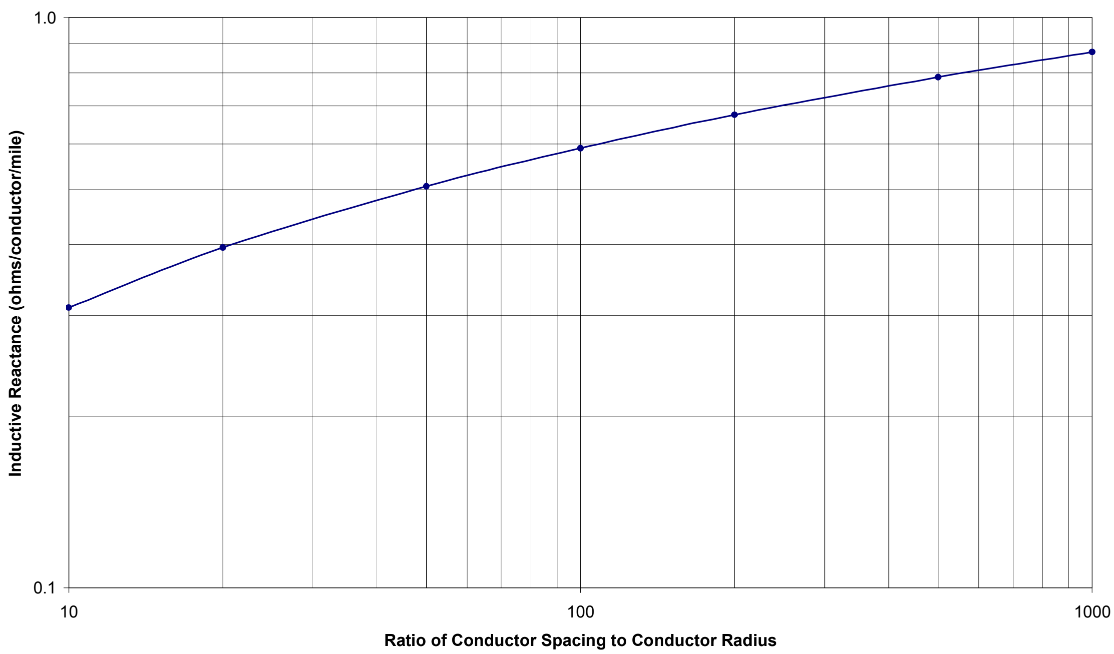
2) The R and X settings, expressed on the base voltage, are the volts increase at the source required to hold the set point voltage at the load *when the source is delivering CT rated primary current.* The R volts add in phase with the line current; the X volts add in quadrature (advanced 90°) with the current. The voltage added will be more or less than the values set as the load current is more or less than the CT primary rating.

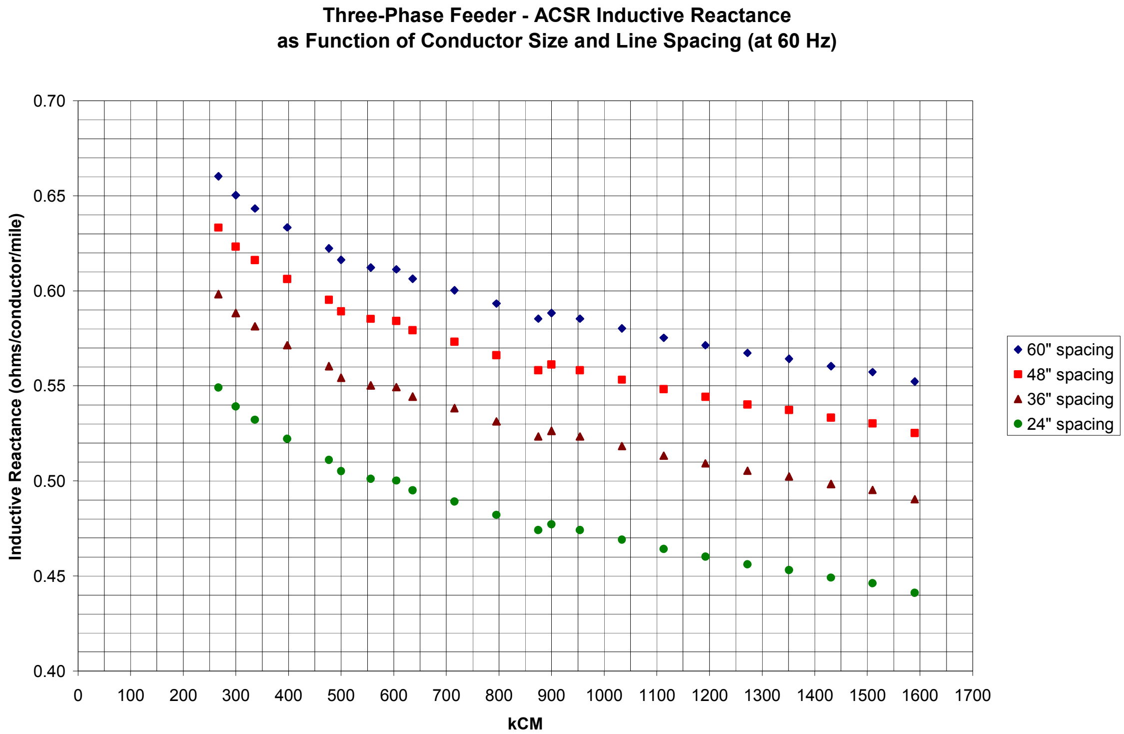
3) The calculations above do not involve the load power factor. The power factor is automatically considered by the control by recognizing that the LDC R and X voltage phasors are in relation to the line current.

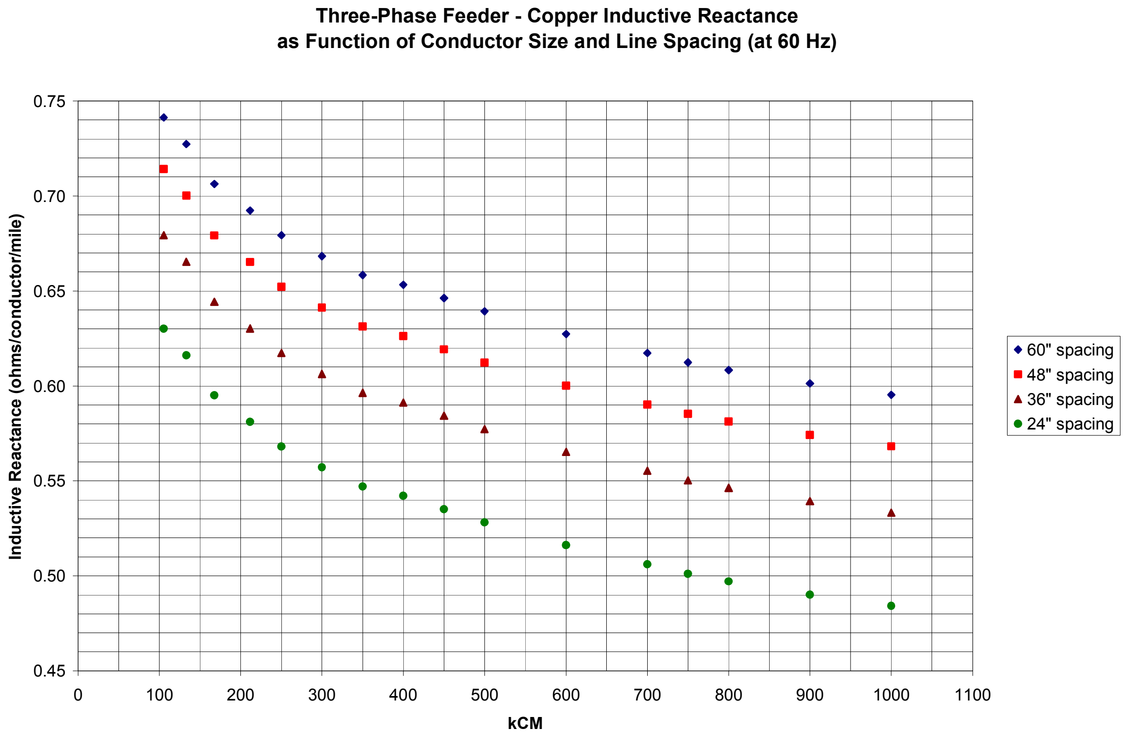
Line Resistance as Function of Conductor Size and Material (at 50 C)



Single-Phase Two-Conductor Feeder Inductive Reactance as Function of Line Spacing Ratio (at 60 Hz)




Three-Phase Feeder - ACSR Inductive Reactance
as Function of Conductor Size and Line Spacing (at 60 Hz)
Inductive Reactance (ohms/conductor/mile)
kCM
60" spacing
48" spacing
36" spacing
24" spacing


Three-Phase Feeder - Copper Inductive Reactance
as Function of Conductor Size and Line Spacing (at 60 Hz)
Inductive Reactance (ohms/conductor/mile)
kCM
60" spacing
48" spacing
36" spacing
24" spacing

Example: LDC Classical Application

The classical application for LDC is based on the premise that there is a well defined "load center" located at some distance (a few miles) from the regulator. The load center comprises *all* of the load on the regulator. This case, while unrealistic for most real-world applications, is useful to describe the LDC operation.

For this example, presume the following: The 3-phase overhead line from the regulator to the load is 1.5 miles in length. The line impedance has been determined to be R = 0.2 ohms/conductor/mile and
X = 0.6 ohms/conductor/mile. The CT primary rating is 800 A, and the system voltage is 12.47 kV.

Calculation of LDC settings:

1. Determine the ohmic line resistance and reactance values based on line length:
   R_{Ω} = line length * R = 1.5 miles * 0.2 Ω/mile = 0.3 Ω
   X_{Ω} = line length * X = 1.5 miles * 0.6 Ω/mile = 0.9 Ω

2. Determine the system impedance base, based on the system voltage and the CT primary rating:
   $Z_{BASE} = SysV_{L\text{-}L} / (\sqrt{3} * \text{CT Rating}) = 12470\ V / (\sqrt{3} * 800\ A) = 9.0\ \Omega$

3. Determine the LDC R and X setpoints as per unit of the base impedance:
   $R_{SET(PU)} = R_{\Omega} / Z_{BASE} = 0.3\ \Omega / 9.0\ \Omega = 0.033$ pu
   $X_{SET(PU)} = X_{\Omega} / Z_{BASE} = 0.9\ \Omega / 9.0\ \Omega = 0.100$ pu

4. Scale the LDC R and X setpoints to the 120 V base voltage, i.e. the values to be set:
   $R_{SET(VOLTS)} = R_{SET(PU)}$ * BaseV = 0.033 pu * 120 V = 4.0 V
   $X_{SET(VOLTS)} = X_{SET(PU)}$ * BaseV = 0.100 pu * 120 V = 12.0 V

Appendix B: Determination of Voltage Regulator Internal Regulation

Test Procedure

1. Setup the regulator to be excited at its rated voltage, with no load.
2. Run the regulator to tap position 16 raise.
3. Measure the S and L terminal voltages with respect to the SL terminal.

Internal Regulation Calculation

Calculation of the internal regulation depends on the ANSI regulator type and the regulation range (in percent). The value of the IntReg configuration parameter (in percent) is:

Type A: IntReg = ((V_L / V_S) - (1 + RegRange / 100)) * 100

Type B: IntReg = ((1 / (1 + RegRange / 100)) - (V_S / V_L)) * 100

Examples

For a Type A regulator, if V_S = 7200 volts, V_L = 7950 volts, and RegRange = 10.0%,

IntReg (percent) = ((7950 / 7200) - (1 + 10.0 / 100)) * 100
= (1.1042 - 1.1000) * 100
= 0.42

For a Type B regulator, if V_S = 7200 volts, V_L = 7955 volts, and RegRange = 10.0%,

IntReg (percent) = ((1 / (1 + 10.0 / 100)) - (7200 / 7955)) * 100
= (0.9091 - 0.9051) * 100
= 0.40

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