ICMI UVR-1
Universal Regulator Control Specification

Inductive Components Manufacturing, Inc. is an innovative energy and utility controls company. For over 40 years ICMI has set the standard for technology and reliability in control technology for the utility industry.

- Simple, intuitive, controls for voltage regulators, LTC transformers and reclosers
- Flexible communication options integrate the controls to SCADA/DMS systems for remote control monitoring, volt/VAR optimization and distributed generation
- Low cost of ownership delivered with industry leading warranties, a software based design approach and outstanding customer service and technical support

10 Year Product Warranty

UVR-1

- DNP3 Subset Definition Level 2 Slave Device with Report By Exception
- Integrates seamlessly to SCADA/DMS Systems
- Multiple power flow modes and voltage reduction methods
  - Locked Forward, Locked Reverse, Idle Reverse, Neutral Reverse, Bi-directional, Bi-directional with Tap to Neutral and Co-generation
- Ideal fit for centralized and distributed volt/VAR optimization
- Protocol Port – serial EIA-232, EIA-485 and daughter board selectable
  - Hardened EIA-485 daughter board
  - Fiber-optic daughter board
  - Wi-Fi/Ethernet fiber-optic daughter board
  - 5 or 8 port XIO interface boards
- Supports multi-drop and loop configurations
- Comprehensive data logging & metering
- Tapchanger contact wear log with alerts
- Tap timeout feature to prevent voltage runaway
- Quick programming via front panel or the included UVR-1 Configuration Utility
- Battery backup available
- Compatible with any single and multi-phase step voltage regulators including Type "A" regulators without load side PT's
  - Rail and Harness Kits: GE (SM3,NN Strip), Siemens (IJ,SJ,MJ-XL,MJ-4), Cooper (CL1-5, CL6) and Howard Industries

UVR-1 Universal Regulator Control Specification

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 usually required, but supported* for closed delta reverse regulation or more accurate metering.

- **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.
    - Neutral Reverse - Regulation and metering based on power flow direction, but regulator returns to neutral position during reverse operation.
    - Bi-directional - Regulation and metering based on power flow direction.
    - Bi-directional with Tap to Neutral - Regulation and metering based on power flow direction, but regulator taps toward neutral position when real load current magnitude is below RevCur.
    - 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).
- **Motor/Source-side Voltage Input**[*] - the tapchanger motor voltage can be directly sensed to provide a more accurate motor/source-side voltage, primarily for closed delta reverse regulation or metering.
- **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.
- **Regulator Temperature Monitor*** - present and max oil or hot spot temperature monitoring via current loop input. High temperature threshold can be set to cause an alert and/or control a discrete output†.
- **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.
- Supports ANSI type A regulators without a load-side PT (using the source-side utility winding).
- Source-side sensing transformer not required in most cases.
- 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**
- **Motor/Source Voltage** (direct sensing supported*)
- **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.
- ANSI C12.1-2008, High Voltage Line Surge 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** <u>On</u> indicates load center voltage above high band edge.
  <u>Flashing</u> indicates same, but corrective tap changes inhibited due to operating mode.

- **In Band** <u>On</u> indicates load center voltage within band edges.
- **Low Band** <u>On</u> indicates load center voltage below low band edge.
  <u>Flashing</u> indicates same, but corrective tap changes inhibited due to operating mode.

- **High Limit** <u>On</u> indicates regulator load voltage above high limit setpoint (auto-runback pending).
  <u>Flashing</u> indicates raise operations inhibited near high limit setpoint.

- **Low Limit** <u>On</u> indicates regulator load voltage below low limit setpoint (auto-runback pending).
  <u>Flashing</u> 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/source voltage input 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 capabilities, control and metering functions and communications protocols in the future. 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:
- 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
- Current loop interface board
- XIO port interface board
- XIO port input-only interface board
- Battery backup
- Heater assembly

*Requires appropriate factory configuration. Motor/Source-side Voltage Input and Regulator Temperature Monitor functions are mutually exclusive.
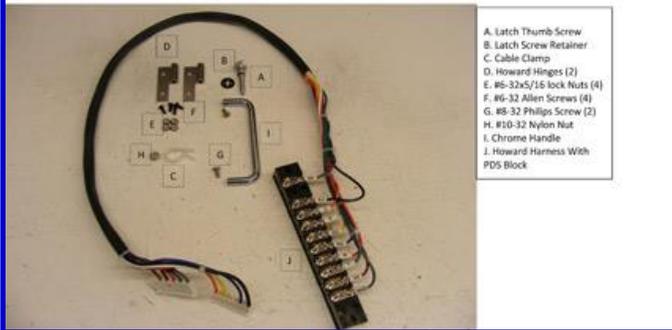
†Requires optional XIO Port Interface Board (or XIO Port Input-only Interface Board if only input functions are needed), available exclusively from ICMI.
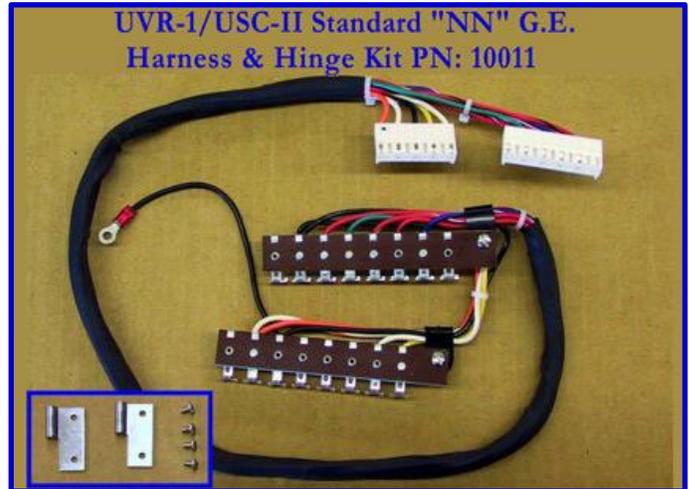
ICMI UVR-1 Regulator Control
Rail and Harness Kit Details
Full Installation Instructions Online

ICMI UVR-1/USC-II HOWARD HINGE KIT (PN: 11004)

A. Latch Thumb Screw
B. Latch Screw Retainer
C. Cable Clamp
D. Howard Hinges (2)
E. #6-32x5/16 lock Nuts (4)
F. #6-32 Allen Screws (4)
G. #8-32 Phillips Screw (2)
H. #10-32 Nylon Nut
I. Chrome Handle
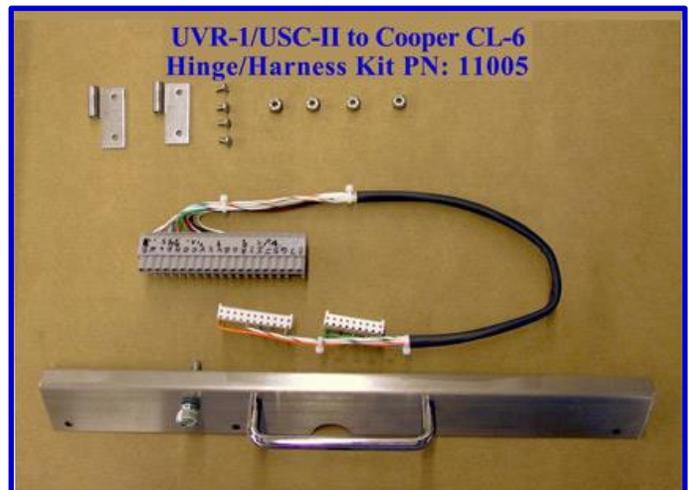J. Howard Harness With PDS Block

UVR-1/USC-II Standard "NN" G.E. Harness & Hinge Kit PN: 10011

UVR-1/USC-II Cooper Harness and Rail Kit PN: 11003

UVR-1/USC-II to Cooper CL-6 Hinge/Harness Kit PN: 11005

UVR-1/USC-II Siemens Rail and Harness kit PN: 11002

UVR-1/USC-II Siemens Rail and Harness kit PN: 11002

Optional Siemens PDS Block PN: 11301