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WARNING: Prior to installing, operating, maintaining or testing this equipment, read and understand the material in this manual. Failure to comply can result in death, severe injury and equipment damage. These instructions are intended to supplement, not replace, local safety practices and procedures.

VARCOM Capacitor Controls set the standard for ease of use by providing sophisticated control and monitoring capabilities in an intuitive easy to use package. VARWARE Control software extends these capabilities.

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OVERVIEW

The VARCOM 1600 and 2600 Capacitor Controls utilize user selectable functions and parameters to control switched capacitor banks. The VARCOM 1600 controls with time, temperature and voltage and the VARCOM 2600 add Amps and KVAR control.

TIME - The Control will close the capacitor bank when the user selected CLOSE TIME occurs. The Control will open the capacitor bank when the user selected OPEN TIME occurs. Both settings are subject to the weekend settings.

VOLTAGE - The Control will close the capacitor bank when the sensed line voltage drops below the user selected CLOSE VOLTS setting. The Control will open the capacitor bank when the sensed line voltage rises above the user selected OPEN VOLTS setting.

TIME WITH VOLTAGE OVERRIDE - The Control will function according to the time mode, except the time mode operating conditions will be overridden by voltage conditions according to the volt mode function.

TEMPERATURE - For Summer Schedule (defined by CLOSE TEMP greater than OPEN TEMP setting) - the Control will close the capacitor bank when the sensed ambient temperature rises above the user selected CLOSE TEMP setting. The Control will open the capacitor bank when the sensed ambient temperature drops below the user selected OPEN TEMP setting.

For Winter Schedule (defined by OPEN TEMP greater than CLOSE TEMP setting) - the Control will close the capacitor bank when the sensed ambient temperature drops below the user selected CLOSE TEMP setting. The Control will open the capacitor bank when the sensed ambient temperature rises above the user selected OPEN TEMP setting.

TIME WITH TEMPERATURE OVERRIDE - The Control will function according to the time mode, except the time mode operating conditions will be overridden by temperature conditions according to the temp mode function.

TEMPERATURE WITH VOLTAGE OVERRIDE - The Control will function according to the temp mode, except the temp mode operating conditions will be overridden by voltage conditions according to the volt mode function.

TIME WITH VOLTAGE AND TEMPERATURE OVERRIDE - The Control will function according to the time mode, except the time mode operating conditions will be overridden by temperature conditions according to the temp mode function and/or by voltage conditions according to the volt mode function. Voltage will override both time and temperature.

AMPS - The control will close the capacitor bank when the line amps drop below the user selected Amps setting. The control will open the capacitor bank when the line amps rise above the user selected Amps setting.

AMPS WITH VOLTAGE OVERRIDE - The Control will function according to the Amps settings, except the Amps setting operating conditions will be overridden by voltage conditions according to the volt mode function.

KVAR - The Control will close the capacitor bank when the line KVAR rises above the user selected KVAR setting. The Control will open the capacitor bank when the line KVAR drops below the user selected KVAR setting.

KVAR WITH VOLTAGE OVERRIDE - The Control will function according to the KVAR settings, except the KVAR setting operating conditions will be overridden by voltage conditions according to the volt mode function.
INSTALLATION

All VARCOM Controls are supplied ready for 4 or 6 jaw meter socket mounting or for mounting directly to a pole with a supplied mounting bracket.

WARNING: Before plugging the Control into a live meter socket, rotate the main switch out of the AUTO position or remove the front panel fuse, and observe all safety procedures for working with exposed live circuits. Failure to comply can result in death, personal injury or equipment damage.

INSTALLING INTO A RINGED BASE

Align the terminals on the back of the Control and press firmly into the meter socket. Use the supplied ring to complete the installation. Attach a ground wire to the external ground lug. Seal or lock the ring only after the entire system has been verified.

INSTALLING POLE MOUNTED CONTROLS

Pole Mounted Controls are mounted with the included pole bracket and user supplied mounting straps or lag screws. After the Control is attached to the pole, attach a ground wire to the external ground lug.

WIRING INSTALLATION:

Use the following wiring diagram for installing a VARCOM control:

Note that the line current sensor connections are polarity sensitive. A control indication of reverse power flow can often be corrected by reversing the black and white leads from the line current sensor from those shown in this diagram.

CURRENT SENSOR

The VARCOM 2600 Control is supplied ready to operate with Lindsey® CVMI or Fisher Pierce® 1301 overhead current sensors, which can be purchased separately. The sensor output must be 600A: 10V. If the current sensor is connected to a phase different than the Control supply voltage, refer to the software section of this manual (beginning on pg 18) to make phase adjustments.

Voltage sensing for the Control is pre-wired to use the supply voltage, typically 120 or 240V. Please consult the factory for other configurations.
FUSING
All VARCOM Controls are supplied with a 15 Amp SLO-BLO® fuse, accessible from the front panel. This fuse protects the capacitor bank switches. If it was removed before installation, the fuse should be reinstalled after installation is complete.

An internal fuse that is not field replaceable protects the Control circuitry. All repairs should be referred to the factory.

MANUAL OPERATION
All VARCOM Controls can be used to operate the connected capacitor bank switches manually. To manually CLOSE or OPEN the capacitor bank using the Control front panel rocker switch:

1) Switch the Control out of the AUTO mode, verify that the red lamp is off, and select TIME DELAY. Using the ADJUST knob, select the desired time delay, in seconds, from 3 to 600. This will delay both manual and automatic operations by the time selected. The OPERATION PENDING light flashes before every open or close operation during the time delay period.

2) Use the MANUAL rocker switch to OPEN or CLOSE the capacitor bank switches. The OPERATION PENDING light will flash for the duration of the selected TIME DELAY. When the output is energized, the CLOSE or OPEN light will flash. Then, the output will de-energize and the light will remain on.

The capacitor bank cannot perform a close operation less than 5 minutes after a trip operation to allow time for the capacitors to discharge. If a CLOSE operation is attempted during this 5 minute time period, the Control will display 5MIN DLY and the Control will not close the bank.
NOTE: Manual operations are counted by the operations counter (close operations only), but manual operations do not count against the preset daily limit set by MAX OPS/DAY.

After completing the required manual operations, return the Control to AUTO for automatic operation. The AUTO light confirms Automatic operation.

NOTE: Pending manual operations can be canceled by turning the Control to AUTO. Similarly, pending automatic operations can be canceled by switching out of AUTO to any other switch position.

PROGRAMMING FOR AUTOMATIC OPERATION

Programming and set-up information for VARCOM Controls.

Settings Common to all Models

AUTO is the normal automatic operating mode for the Control. The display shows the operations counter, which cannot be reset. The operations counter counts all CLOSE operations.

TIME DELAY sets the time delay, in seconds, for both manual and automatic operations. The delay can be set from 3 to 600 seconds in 3 second increments using the ADJUST switch. The OPERATION PENDING light flashes before every open or close operation during the entire time delay period.

MAX OP’S/DAY sets the maximum number of automatic capacitor bank CLOSE operations per rolling 24-hour period. This can be set from 2 to 24 operations using the ADJUST switch. This setting overrides all other time, temperature, current or voltage settings. If the daily operations limit is reached, the display will alternately show the operations counter and OP LIMIT while the Control is in AUTO mode. When MAX OPS is reached, the last operation will be an OPEN. Manual operations do not count against the limit set by MAX OPS/DAY.
SETTING THE CONTROL MODE

The Model 1600 Control can allow voltage and/or temperature to override time settings. The Model 2600 Control can allow voltage to override temperature, time, amp and KVAR settings. Depending on the model, the following Control Modes can be used:

<table>
<thead>
<tr>
<th>Control Mode</th>
<th>Display Shows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time only</td>
<td>TIME</td>
</tr>
<tr>
<td>Time with voltage override</td>
<td>VOLT/TIM</td>
</tr>
<tr>
<td>Voltage only</td>
<td>VOLT</td>
</tr>
<tr>
<td>Time with temperature override</td>
<td>TMP/TIME</td>
</tr>
<tr>
<td>Temperature only</td>
<td>TEMP</td>
</tr>
<tr>
<td>Temperature with voltage override</td>
<td>VOLT/TMP</td>
</tr>
<tr>
<td>Time with voltage and temperature override</td>
<td>V/TMP/TI</td>
</tr>
<tr>
<td>Amps</td>
<td>LINE AMPS</td>
</tr>
<tr>
<td>Amps with voltage override</td>
<td>LINEAMP/V</td>
</tr>
<tr>
<td>KVAR</td>
<td>KVAR</td>
</tr>
<tr>
<td>KVAR with voltage override</td>
<td>KVAR/VOLT</td>
</tr>
</tbody>
</table>

SCHEDULE SETTINGS

Four independent time schedules are available - SCHEDULE 1 through SCHEDULE 4. Each time schedule allows one OPEN and one CLOSE operation per day. The schedules can be used to set multiple OPEN and CLOSE operations for each day or they can be used for seasonal changes to the schedule, e.g. different OPEN and CLOSE times for summer and winter.

For each schedule selected, week days MON-FRI, weekend days SAT and SUN, and HOLIDAYS can be selected to be ACTIVE or OFF. ACTIVE days will follow the TIME ON and TIME OFF settings as well as any temperature or voltage override settings. OFF days will cause the capacitor bank to remain open.

The six standard holidays are New Years Day, Memorial Day, July 4th, Labor Day, Thanksgiving Day and Christmas Day. The VARCOM Controls allow a maximum of ten holidays to be programmed.
EXAMPLE 1 - SEASONAL VARIATION - Two time schedules are used for seasonal variation in the OPEN & CLOSE times and/or override settings (if any). TIME SCHEDULE 1 is a summer schedule with a START DATE of 4/1, a STOP DATE of 9/30, TIME ON at 07:00 and TIME OFF at 18:00 (all time settings are in 24 hour format). TIME SCHEDULE 2 is a winter schedule with a START DATE of 10/1, a STOP DATE of 3/31, TIME ON at 08:00 and TIME OFF at 16:00. For each time schedule, the days of the week, TIME ON, TIME OFF and override settings (if any) can be set independently.

In this example, each schedule is ACTIVE for all days of the week and holidays and schedules 3 and 4 are not used. The CONTROL MODE is set for TIME, so voltage and temperature settings are not used.

To disable a time schedule, set the start date the same as the stop date. To make a schedule run year round, set the start date for 01/01 and the stop date for 12/31. In case of a conflict between time schedules, SCHEDULE 1 takes priority over SCHEDULE 2, SCHEDULE 2 over SCHEDULE 3, etc. In case of a conflict between temperature and voltage settings, voltage takes priority. To make a time schedule active for 24 hours, set TIME ON the same as TIME OFF.

EXAMPLE 2 - Time with Voltage Override - Two time schedules are used for year-round time and voltage control. SCHEDULE 1 is a weekday schedule for time with voltage override. Set the CONTROL MODE for VOLT/TIME (time with voltage override). The TIME ON is 08:00 and the TIME OFF is 18:00. Set MON-FRI to ACTIVE and set SAT, SUN and HOLIDAYS to OFF. The START DATE is 1/1 and the STOP DATE is 12/31.

The Control will anticipate voltage changes caused by opening and closing the capacitor bank. This may cause scheduled open or close operations to be deferred or delayed. See the Voltage Settings section (pg 10) for more information about Adaptive Trip.
IMPORTANT! Time with voltage override means that voltage takes precedence. For these SCHEDULE 1 settings, the Control will close the bank at 08:00 only if the line voltage is below the OPEN VOLTS setting less the Adaptive Trip bias voltage. Conversely, the Control will open the bank at 18:00 only if the line voltage is above the CLOSE VOLTS setting plus the Adaptive Trip bias voltage. If the Control does not close the bank at the TIME ON setting or open the bank at the TIME OFF setting due to voltage conditions, it will open or close the bank later if the line voltage changes. The Control will also close the bank before the scheduled time of 08:00 if the line voltage drops below the CLOSE VOLTS setting.

SCHEDULE 2 is a weekend schedule for voltage control only. Set the CONTROL MODE for VOLT (voltage control). For 24-hour control, set the TIME ON and TIME OFF to the same time. Set MON-FRI to OFF and SAT, SUN and HOLIDAYS to ACTIVE. Set the START DATE to 1/1 and the STOP DATE to 12/31. The Control will change from a weekday to a weekend schedule at midnight.

If 24-hour voltage control is not desired, the TIME ON and TIME OFF settings can be set as needed. The Control will close the bank at TIME ON only if the line voltage is below the OPEN VOLTS setting less the Adaptive Trip bias voltage. The Control will open the bank at TIME OFF independent of voltage.

EXAMPLE 3 - TIME WITH TEMPERATURE AND VOLTAGE OVERRIDE - Two time schedules are used for seasonal variations in temperature and voltage override settings.

SCHEDULE 1 is set for TEMP/TIME (time with temperature override) using the CONTROL MODE setting. This is a daily summer schedule so the START DATE is 4/1 and the STOP DATE is 9/30. The TIME ON is 08:00 and the TIME OFF is 18:00. The OPEN TEMP is 60°F and the CLOSE TEMP is 80°F. MON-FRI SAT, SUN and HOLIDAYS are all set to ACTIVE.

IMPORTANT! Time with temperature override means that temperature takes precedence. For these SCHEDULE 1 settings, the Control will close the bank at 08:00 only if the temperature is above the OPEN TEMP setting of 60°F. Conversely, the Control will open the bank at 18:00 only if the temperature is below the CLOSE TEMP setting of 80°F. If the Control does not close the bank at the TIME ON setting or open the bank at the TIME OFF setting due to temperature conditions, it will open or close the bank when the temperature changes. The Control will also close the bank before the scheduled time of 08:00 if the temperature increases above the CLOSE TEMP setting.

SCHEDULE 2 is set for VOLT/TIME using the CONTROL MODE setting. This is the winter schedule so the START DATE is 10/1 and the STOP DATE is 3/31. The TIME ON is 08:00 and the TIME OFF is 18:00 MON-FRI, SAT, SUN and HOLIDAYS are all set to ACTIVE. Voltage settings are set as needed.
OTHER SETTINGS

Besides the four independent time schedules, there are three other time settings to be entered. **DAYLIGHT SAVINGS** can be set to ACTIVE or OFF. Selecting ACTIVE automatically adjusts the internal clock and all time settings for daylight savings time in the spring and fall. Selecting OFF causes the Control to ignore daylight savings time changes.

**SET TIME** and **SET DATE** are used only for initial set-up of the Control, or after the back up duration has been exceeded. The time is entered in 24 hr. format and manually adjusted in 5-minute increments. The date is entered as mm-dd-yyyy. [The first day in the year 2000 will be displayed as 1/1/00]. Reference the VARWARE software for setting the date and time.

**Voltage Settings**

OPEN VOLTS must be at least 3 volts above CLOSE VOLTS and cannot be set to any voltage difference less than 3 volts. The control voltage is measured and averaged over a 5-minute period to reject momentary spikes or sags. The Control will not respond to short-term voltage changes such as those caused by a sudden line voltage change or adjusting the control voltage with a variable transformer.

Voltage Controls also incorporate Adaptive Trip; the Controls are sensitive to the voltage rise caused by closing the capacitor bank. The voltage rise caused by closing the capacitor bank is averaged over the last 4 close operations and is used to anticipate the voltage change for the next close or open operation. This voltage change is used as a bias, and if the next close operation would cause the Control voltage to be above the open voltage set-point, the close operation is not performed until the voltage falls below the open voltage set point less the bias voltage. Similarly, if the next open operation would cause the Control voltage to be below the close voltage set point, the operation is not performed until the voltage rises above the close voltage set point plus the bias voltage. The initial factory default bias setting is 2 volts.

Line voltages above the Emergency High Volts setting will cause the control to open the capacitor switches without delay and the switches will remain open until the line voltage drops below this setting by at least the amount of the stored delta voltage. This setting is accessible only via the VARWARE software. The default setting is 130.0 and voltages of 130 or above will cause the control to open immediately. With a typical delta voltage of 2 volts, the control will not operate normally again until the voltage drops below 128 volts for at least several seconds. When the line voltage exceeds Emergency High Volts setting, the LCD will display EV OPEN ACTIVE until the line voltage is reduced.

**Temperature Settings**

OPEN TEMP cannot be set closer than 5°F above or below CLOSE TEMP. OPEN TEMP can be either higher or lower than CLOSE TEMP for summer or winter peaking loads. Temperature is measured and averaged over a 30 minute period so the Control will better respond to temperature sensitive VAR loading. The Control will not respond to short-term temperature changes such as those caused by spraying cold water on the temperature sensor.
**KVAR settings**

KVAR OPEN and KVAR CLOSE determine when the capacitor bank will open and close. The Control will display LD for leading KVAR and LG for lagging KVAR. KVAR CLOSE can only be set lagging and must be at least 20KVAR more than KVAR OPEN.

KVAR is measured and averaged over a five minute period to reject momentary transients. The KVAR settings also incorporate Adaptive Trip; the Control is sensitive to the change in KVAR caused by closing and opening the capacitor bank. The change in line KVAR caused by closing the capacitor bank is averaged over the last 4 close operations and is used to anticipate the change in KVAR caused by the next close or open operation. This change is used as a bias. If the next close or open operation will place the Control beyond the next KVAR set point, that operation is not performed until the line KVAR changes beyond the KVAR setting plus the bias. The initial factory default bias setting is 20 KVAR.

**NOTE:** The KVAR settings and the monitored line KVAR are both single phase values. For example, a typical 600kVAR capacitor bank will be 200KVAR/phase.

Reverse Power sets the action of the Control when reverse power flow is detected. Options are: IGNORE – to do nothing and leave the capacitor bank in its present state, VOLT – to revert to voltage control, or OPEN – to open the capacitor bank until normal power flow is restored.

**EXAMPLE** – KVAR with Voltage Override – The CONTROL MODE is set to KVAR/VOLT, for KVAR with Voltage Override. That is, the Control will follow the KVAR settings unless the voltage is outside of the voltage set points. The KVAR settings are set as follows: KVAR OPEN is LD 250 and KVAR CLOSE is LG 300. Voltage Override settings are set to VOLTS OPEN 128 and VOLTS CLOSE 122.0. The Control will open the bank, regardless of KVARs, if the control voltage exceeds 128V. The Control will close the bank, regardless of KVAR, if the control voltage falls below 122V.

**IMPORTANT!** The Control may not operate exactly at the above set points due to the Adaptive Trip feature described earlier. For example, the Control may not close at the KVAR CLOSE set point of LG 300 if doing so would raise the control voltage above the VOLTS OPEN set point of 128.5V. Similarly, the Control may not open the bank at the KVAR OPEN set point of LD 50 if doing so would lower the control voltage below the VOLTS CLOSE set point of 122V. Any operation that is deferred due to Adaptive Trip will take place as KVAR or voltage conditions change.
SYSTEM MONITORING

Depending on the model, the actual line voltage, ambient temperature or current can be monitored using the MONITOR settings. This can be helpful for setting up and checking Control operation. All parameters are measured and displayed real-time without any time delay or averaging.

LINE AMPS is the total current on the line, both real and reactive. AMPS REAC is the reactive component of the total line current. Reactive amps will be displayed along with LD for leading, LG for lagging, RV for reverse, and UN for unity power factor. Both LINE AMPS and AMPS REAC will show LOW AMPS in the display if less than 3 amps are measured. The AMPS REAC setting can be particularly helpful when adjusting the Amps Reactive set points for VAR Control. The effect of the capacitor bank on feeder VARs can also be seen by monitoring this setting while manually opening and closing the capacitor bank. AMPS THD% is the Total Harmonic Distortion in the line current. KVA is Kilo Volt Amperes.

KILOWATTS are the real component of the KVA. POWER FACTOR is displayed as a percentage of unity, e.g. 90% for a 0.9 power factor. To properly display KVA, KVAR and KW; the PT RATIO must be set. This is the ratio of the transformer supplying power to the Control. For example, the ratio for a 7200V line to ground connected transformer supplying 120V to the Control would be 60 (7200 / 120 = 60).

CONTROL VOLTS is the voltage used to power the Control, typically 120 or 240V. KV is the primary voltage in kilovolts and is derived from CONTROL VOLTS x PT RATIO. KV THD% is the Total Harmonic Distortion in the line voltage. POWER FLOW DIRECTION shows in the display as FORWARD or REVERSE. This will indicate a current sensor that is wired backwards.
NEUTRAL CURRENT MONITORING

On units equipped with optional Neutral Current monitoring, the capacitor bank neutral line is monitored. A neutral current sensor is mounted around the capacitor bank neutral lead and is connected to the Control. High neutral current is indicative of unbalanced VAR loading and can be used to trip the capacitor bank off line and keep it off line until the Control is manually reset. The neutral amps are averaged over five minutes when in AUTO mode. This average is used for comparison to the set point.

The NEUTRAL SENSE OPTION works in the following manner:

1. In MANUAL MODE, monitoring of neutral amps is accomplished by selecting VOLTS MONITOR, then toggling the ADJUST switch one position in either direction.

2. In AUTO MODE, monitoring of neutral amps is accomplished by toggling the ADJUST switch slowly until the display reads iA (Instantaneous Neutral Amps), and aA (5-minute Averaged Neutral Amps).

3. The neutral amps trip set point can be set from 3 to 100 amps. The setting below 3 amps will disable the neutral amp trip function. The display will read disabled.

4. In AUTO mode, if the neutral amps rise above the set point, the Control will open the capacitor bank, light the neutral trip LED, and hold the bank locked out until manually reset. Resetting the Control from neutral amp lockout is accomplished by rotating the MODE switch to the NEUTRAL AMPS, TRIP / RESET position.

CLOCK BACK-UP

The VARCOM Capacitor Control uses a capacitor back-up for maintaining the internal clock settings when Control power is interrupted. If power is interrupted to a Control for more than 10 days, the time settings may be lost. When this happens, the Control will alternately display TIME ERR when in the AUTO mode.

Only the internal clock is dependent on the capacitor back up. All other previously logged data, front panel settings and Control programming is stored in non-volatile memory, which retains its contents indefinitely without power.
The following information regarding the front panel displays may prove helpful in diagnosing a Control that appears to be functioning improperly.

**LED INDICATORS**

**AUTO** - Indicates the Control is in automatic mode. The Control will open and close the bank only per the programmed settings and the toggle switch is disabled. The display indicates the total number of CLOSE operations. When the LED is off, the Control is in manual mode and the toggle switch is enabled.

**NEUTRAL AMPS TRIP / RESET** - (Optional) - The capacitor bank neutral current has exceeded the preset threshold and the bank is locked OPEN. To reset this condition, rotate the MODE switch to the AMPS TRIP/RESET position.

**SCADA ACTIVE** - Indicates SCADA override of Control function when the control is in the Remote mode.

**COM ACTIVE** - Indicates communication has been received from the SCADA Master within a 5 minute timeout period.

**OPERATION PENDING** - Flashes during the number of seconds selected by TIME DELAY for every pending OPEN or CLOSE operation. CLOSE shows the bank status as closed. A flashing LED indicates the CLOSE output is energized. OPEN shows the bank status as open. A flashing LED indicates the OPEN output is energized.

**CLOSE** - Shows the bank status as closed. A flashing LED indicates the CLOSE output is energized.

**OPEN** - Shows the bank status as open. A flashing LED indicates the open output is energized.
LCD DISPLAY

COMBUSY - The Control is communicating via the communications port.

LOW LINE - The supply voltage has dropped below its operating threshold (92V for a 120V unit and 180V for a 240V unit). The Control will go into a standby mode until the voltage recovers and will then perform a power up self-check.

OP LIMIT - The Control has reached its daily limit of automatic close operations as set by MAX OPS/DAY. The Control will not CLOSE automatically again during the present 24 hour period. Manual CLOSE and OPEN operations can still be performed.

SYS ERR - The Control has detected a memory defect. The Control will stop operating and must be returned to the factory for repair.

TIME ERR - The Control has detected a timing error, most likely due to a discharged clock backup capacitor. This condition can be reset by resetting the time and date via the front panel or via the VARWARE software.

VOLT ERR - The voltage sensor is not operating properly or the voltage being measured has fallen either below 100V or above 150V. If this display is due to a short-term voltage change, the Control will reset automatically. While this condition persists, the Control will not perform any voltage related operations but will otherwise operate normally.

AMP ERR - The current sensor is not operating properly. If this is a transient condition, the Control will automatically reset the current sensor input and continue to operate properly. A permanent current sensor failure can be verified with the MONITOR - LINE AMPS setting which will show LOW AMPS. If this condition is permanent, the Control will not perform any VAR related operations but will otherwise operate normally.

5MIN DLY - Will be displayed for 5 minutes following any OPEN operation. The Control will not perform a CLOSE operation this period.
SPECIFICATIONS

**Electrical**

**POWER REQUIREMENT:** 100-140 or 200-260 VAC, 10W

**MOUNTING:** 4 or 6 Jaw Meter Socket or Pole Bracket with Amphenol connector.

**OUTPUT CONTACTOR:** 30A, 120/240 VAC. 15 second “on” duration for motor and solenoid operated switches.

**FUSE:** 15A SLO-BLO®

**SURGE / LIGHTNING PROTECTION:** ANSI C37.90.1 1989

**OPERATING FREQUENCY:** 60Hz (optional 50Hz available)

**VOLTAGE ACCURACY:** ±0.5 VAC, 0.1 VAC Resolution

**LINE CURRENT ACCURACY:** ±1% +5 counts, excludes line current sensor accuracy.

**TEMPERATURE ACCURACY:** ±1°F, 1°F Resolution

**TIME ACCURACY:** Temperature compensated oscillator, ±0.001%

**CLOCK BACK-UP:** Capacitor - 10 days

**DISPLAY:** Liquid Crystal

**COMPUTER INTERFACE:** USB

**COMMUNICATIONS INTERFACE:** Com 1: RS-232 serial interface for DNP 3.0

**COMMUNICATION COM 2:** RS-232 serial interface for local or remote PC interface

**COMMUNICATIONS POWER SUPPLY:** 12 VDC, 1 Amp

**COMMUNICATION PROTOCOL:** DNP 3.0

**Mechanical**

**MOUNTING:** 4 or 6 Jaw Meter Socket or Pole Bracket with Amphenol connector.

**ENCLOSURE:** NEMA 4X weather tight fiberglass; 8.75 x 10.75 x 5.5 in. (222mm x 273mm x 140mm) Hinged left, lock hasp on right side. Weight 8.5 lbs. (3.9 kg.)

**Environmental**

**TEMPERATURE:** -22°F to +185°F (-30°C to +85°C)

**HUMIDITY:** 5 - 95%, non-condensing

**Repairs**

If any damage is found please contact us at 800-435-0786 to arrange for service.
**Settings**

**USER INTERFACE:** Front panel user interface with visible access to all local control settings via rotary and rocker switches.

**VOLTAGE:** Close: 105 - 127 / 210 - 257 VAC; Max. setting = Open Volts -3 VAC. 
Open: 108 - 130 / 213 - 260 VAC; Min. setting = Close Volts +3 VAC. 5-minute time averaged voltage response. Setting in 0.1 volt increments.

**AMPS - CLOSE:** 10 - 600

**AMPS - OPEN:** 5 - 300, no less than 5 amps less than Close amps.

**KVAR - CLOSE:** -10 to -2000

**KVAR - OPEN:** -280 to 1000, no less than 20 KVAR more leading than Close KVAR

**TEMPERATURE:** Close: 0 - 120°F; 
Open: 0 - 120°F, no closer than 5°F to Close temperature.

**TIME DELAY:** 3 - 600 seconds, 3 second increments.

**MAX OPERATIONS/DAY:** Configurable from 2 - 24

**MANUAL TRIP:** Momentary Open or Close, Close and Open operations delayed by selected Time Delay, 5-minute delay following Open before re-close.

**NEUTRAL AMPS TRIP:** 3 - 100 Amps, harmonic filtered, 5-minute time average response, manual reset, 5-minute minimum tripped time

**PT RATIO SET:** 1 - 300
VARWARE PROGRAMMING AND DATA ANALYSIS SOFTWARE

Features
VARWARE® software aids in programming a VARCOM Capacitor Control for capacitor bank switching and power system monitoring via a computer. The software includes the following features:

- Design capacitor bank control strategies in the office for future uploading to the Control.
- Create and save different Control strategies for different model Controls all with the same software.
- View and analyze data downloaded from Capacitor Controls. Examine Control switching operations, power outages and system parameters.
- Graph stored voltage, temperature and current data. Zoom in on areas of interest.
- Connect to a Control for real time monitoring of the Control parameters such as voltage, temperature and current.
- Download stored programs to update a Control strategy or download a Control program from a control back to a computer.
- Setup the Control for data logging. Program the Control to store control and system parameters such as switching operations, voltage and temperature.

PRECAUTIONS

Precautions must be taken before connecting a computer to an installed capacitor bank control.

<table>
<thead>
<tr>
<th>CAUTION! Before connecting a computer to an installed capacitor bank take the following steps:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ensure the Capacitor Control is properly grounded.</td>
</tr>
<tr>
<td>2. Set the Control so it is not at AUTO or SET TIME.</td>
</tr>
</tbody>
</table>

Failure to follow these precautions may result in damage to the computer, unexpected capacitor bank operation or personal injury.
SOFTWARE INSTALLATION

VARWARE software runs on Windows 10. The current version can be downloaded from the HD Electric website. This software will communicate with the VARCOM Control via USB or Bluetooth.

Using the Software for the First Time
Start the software via the icon or use the Start button to navigate to the folder. Before connecting the computer to a Control, verify that the computer is set up for communications on the correct COM port. COM1 is the default port in the software. If necessary, change the port using the Communications drop-down menu.

IMPORTANT! If the COM port is changed, the software must be restarted for the change to take effect.

Create a Control Program
To program a Capacitor Control with a computer and software, a Control program must be created.

Select File, then Open. If this is the first time for setting up a program, select one of the default programs for the Control model that is to be programmed. For example, select 1600.ws for a VARCOM 1600 Control. A previously created file may also be selected. All setup files will have a .ws extension.

After the file is opened, the name of the file will be shown on the title bar of the main window.

NOTE that the VARCOM Control front panel ADJUST switch can be disabled in the main window by un-checking Manual setpoint adjustment enabled. This provides a level of security and prevents unwanted changes to the control program in the field.

Select a Schedule. Each time schedule must be programmed individually. To disable a schedule, set the start date the same as the stop date. To make a schedule active 24 hours per day for around the clock voltage control, set the start time the same as the stop time. The schedules in black lettering are active schedules, orange lettering refers to inactive schedules.

After entering all the desired settings, save the new file. Enter a file name and select File, then Save. The software automatically adds the .ws extension. If an existing setup file was modified, Save As must be selected so the original file is not overwritten.
To print the Active setup file, select File, then Print. To print another setup file, select File, then Open, then Print.

**Upload a Setup Program to a VARCOM Control**

To upload a setup program to a VARCOM Control, follow the precautions shown at the beginning of the software section of this manual (page 18) and connect a computer to the Control. Select Communications, then Setup, then Send settings data to control from the main menu.

Note that the name of the active setup file that will be uploaded to the VARCOM Control is shown in the upper left corner of the main title bar.

At this time, the current setup program can be downloaded from a VARCOM Control to a computer by selecting Communications, then Setup, then Read settings data from control.

Any time communications are initiated with a VARCOM Control, a warning will appear asking the user to verify that the Control is not in Auto or Set Time. While the setup data is being transferred, the LCD display on the VARCOM Control will display **COM BUSY**.

**Edit Unit ID** will give each Control a unique identification. The factory default ID is the serial number of the Control. This number is used in the header of all downloaded data and is also the default file name for the data file.

To set the clock on the Control, select Communications, then Set Unit Clock. The clock can be set according to the clock on the computer that is connected to the VARCOM Control. Alternately, the clock can be set manually with the front panel knobs.

**USE PROFILE DATA LOGGING**

Set up and use of the internal data logging features in a VARCOM Capacitor Control and download the stored data.

**Initialize the Profile Data Collection Options**

From the main menu, select Communication then Profile, then Edit profile options:

**Sample Period** sets the sample frequency for voltage and temperature data. All collected data are instantaneous readings and are not averaged or delayed.

**Circular overwrite enabled** will overwrite the oldest data when memory is full.

**Record temperature** enables temperature data recording.

**Record neutral current** enables neutral current data recording. This option is only available if the Control has the neutral sense feature enabled.

Select **Relay operations** to record data after an open or close operation. If selected, select a **Record delay** frequency from the drop-down box. A time delay is recommended to allow switching transients to settle.
When all desired options have been selected, select OK to update the Control. **Updating Profile options erases any previously stored data in the Control.**

To download stored data, select Communications, then Profile, then Download profile data. The default file name is the Control ID# selected earlier (a .pro filename extension will be automatically added.) A different filename can also be entered at this time.

**VIEW AND GRAPH DOWNLOADED PROFILE DATA**

Review VARCOM Capacitor Control switching operations and system power outages, or graph collected system data such as voltage, temperature and current.

**View Profile Data Files**

Select View Data from the main menu, then View Profile Data.

Select from the available profile files.

The stored data will be shown as a file of data points. A new header with a record number is generated every time power is restored, every day just after midnight, following a manual adjustment of the time clock, or whenever the Control performs a switching operation.

Power outage duration can be determined by the time difference between the last recorded data point and the time that power is restored.

The data file also displays the status of the Control, the MODE (AUTO or MANUAL), the STATE of the bank (OPEN or CLOSED), the OPERATION occurring, or the reason for the last Control operation (TIME, VOLTAGE, TEMPERATURE, etc.).

To print a copy of this file, select File, then Print.

**Graph Profile Data Files**

Any stored system parameter such as voltage and temperature can be graphed. Select View Data, then Graph Profile Data and choose the desired data file.

Select the data to be shown on the graph. The proper graphing options will be enabled for the appropriate control model.

To print a graph, select Files, then Print.

**Modify Profile Graphs**

To zoom in on a particular set of data points, click and drag the mouse around the area to be zoomed. Release to complete the selection.

Zooming can also be accomplished by selecting Chart, then Zoom. Select the appropriate zoom function.

Clicking the right mouse button anywhere on the graph will also access the zoom function via a pop-up menu.
Using the **Zoom In** or **Zoom Out** functions will zoom in or out referenced from the center of the graph. **Full View** displays the entire graph.

**GRID LINES:** Toggles the display of grid lines on and off.

**EXPORT:** Allows the graph to be exported to a specified file or copied to the clipboard.

**MOUSE CLICK ACTION, ZOOM IN:** With this option enabled, double clicking on the graph area will zoom in.

**MOUSE CLICK ACTION, ZOOM OUT:** With this option enabled, double clicking on the graph area will zoom out.

**MOUSE CLICK ACTION, NONE:** With this option enabled, double clicking will have no effect.

**SHOW DATA HINT:** Displays a popup window with details of the closest data point.

**TABLE, SHOW TABLE:** Displays a data table at the bottom of the graph window.

**DATA OPTIONS:** Changes the data that is displayed on the graph.

**MARK POINTS:** Places a point at each data point on the graph.

**TITLE:** Changes the title of the current graph.

**REAL TIME MONITORING OF THE VARCOM CAPACITOR CONTROL**
Connect a computer to the Control for real time monitoring of the Control. **Follow the precautions shown at the beginning of the software section of this manual** (page 18) and connect a computer to the Control.

Information will be displayed depending on the Control model currently connected. All displayed values will be updated continuously until the Communications Monitor window is closed.
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2. **TERMS OF PAYMENT:** Terms are stated on HDE's invoice in U.S. currency. HDE shall have the right, among other remedies, to either terminate this agreement or to suspend further performance under this and/or other agreements with the Buyer in the event Buyer fails to make any payment when due, which agreements between Buyer and Seller hereby amend accordingly, or HDE otherwise deems it necessary. Buyer shall be liable for all expenses, including reasonable attorneys' fees, in connection with recovery of delinquent payments or any claims. Should Buyer's credit become unsatisfactory to HDE, HDE may terminate this Agreement or cancel any order or invoices, and any unshipped Goods may be required by HDE for future deliveries and for the goods theretofore delivered. If such cash payment or security is not provided, in addition to HDE's other rights and remedies, HDE may discontinue deliveries. HDE may apply a finance charge of three percent (3%) per month on all overdue accounts.

3. **SHIPMENT AND DELIVERY:** Unless otherwise expressly provided, shipments are made F.O.B. HDE's shipping point. Risk of loss or damage and responsibility shall pass from HDE to Buyer upon delivery to and receipt by common carrier. Any claims for shortages or damages in transit are the responsibility of Buyer and shall be submitted to the Buyer directly by the carrier. Shortages or damages must be acknowledged and signed for by the receiving carrier within twenty-four (24) hours of receipt or time would have passed to maintain the claims. Such claim shall be addressed to the carrier. HDE reserves the right to pro-rate the full amount to partial shipment. HDE's total obligation shall not exceed the purchase price. All invoices are due and payable in full in accordance with the terms of the invoice. No partial payments, exchanges, or credits will be allowed. Buyer shall not be entitled to deduct the cost of any additional charges, transportation, costs or other additional expenses resulting from claims. Invoices must be approved by the person or department described on the invoice. Claims for shipping errors, lost shipments or other discrepancies must be made within ninety (90) days or they will be disallowed and deemed waived.

4. **WARRANTY LIMITS:** HDE covers its products with a manufacturer's warranty against defects in material or workmanship for a period of ten years in the case of Capacitor Controls and in all other circumstances for a period of one year, unless otherwise stated by HDE. The warranty period shall be determined from the date of shipment from any HDE Authorized Service Center. This warranty shall not apply to any Goods including but not limited to products which: (a) have been repaired or altered outside HDE's factory (or Authorized Service Center) or in any manner so as, in HDE's judgment, to affect its serviceability; or (b) have been subject to misuse or abuse by the Buyer or any other person. Buyer, at its expense, agrees to promptly inspect the Goods upon receipt thereof, and in no event later than thirty (30) days from the date of receipt of the Goods. Buyer shall return to HDE, within fifteen (15) days of inspection, and in no event later than forty-five (45) days from the date of receipt of the Goods, written notice of any and all deficiencies, defects, variations from specifications or complaints of any kind with respect to the quantity, quality, condition, shipment, performance, price or appearance of the Goods so received by Buyer. In the event no such written notice is received by HDE, Buyer shall be deemed conclusively and irrevocably to have accepted the Goods in accordance with the terms of this Agreement. The terms of this Agreement shall be binding on Buyer and all claims, including non-authorized warranty repairs, made outside the warranty period shall be barred and Buyer shall otherwise be responsible for the cost of such repairs.

5. **INSPECTION:** HDE shall have the right to conduct an inspection of the Goods to be purchased or to perform a test, upon receipt of the Goods, or upon giving written notice of protest within fifteen (15) days of delivery of the Goods, at the Buyer's expense.

6. **DISPUTE RESOLUTION:** All disputes arising out of or relating to this Agreement shall be resolved by the Federal, state, or local court or agency, or such other forum as the parties may agree in writing, in accordance with the Federal Arbitration Act (9 U.S.C. §1, et seq.) and will be governed by the interpretation and enforcement. The binding arbitration shall be held at a location determined by AAA at or such other location as mutually agreed. In addition to the terms stated above, the following will apply to the binding arbitration: (1) the arbitrator, and not any federal, state or local court, will have exclusive authority to resolve any dispute arising under this Agreement, including an arbitration agreement; (2) the arbitrator shall apply Illinois law consistent with the Federal Arbitration Act; (3) the arbitrator shall not have the power to assess punitive damages; (4) an arbitrator shall not award compensatory, general, or consequential damages in an amount greater than the greater of $25,000 or 25% of the lesser of the amount of any claim or counterclaim, unless the arbitrator finds for the party obtaining such relief; (5) the arbitrator shall not award attorneys' fees unless the prevailing party is a low-income consumer. In any arbitration, the parties agree to be bound by the following rules: (1) the arbitrator shall award the prevailing party, if any, reasonable attorneys' fees and costs unless the arbitrator finds for the prevailing party, if any, and reasonable attorneys' fees and costs unless the arbitrator finds for the prevailing party, if any, and reasonable attorney's fees and costs unless the arbitrator finds for the prevailing party, if any; and (2) the arbitrator shall award reasonable attorney's fees and costs unless the arbitrator finds for the prevailing party, if any.

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