Peak Demand Control

LOW INVESTMENT:
Pay back is 2-4 months with a threefold return on investment the first year. Savings then continue.

TRANSPARENT TO CONSUMER: Does not require consumer to turn off equipment to lower Demand.

CONTINUOUS MONITORING: Catches every peak which assures optimum savings.

LOW COST INSTALLATION: Operates in conjunction with existing regulator control circuits. No additional CT's or PT's required.

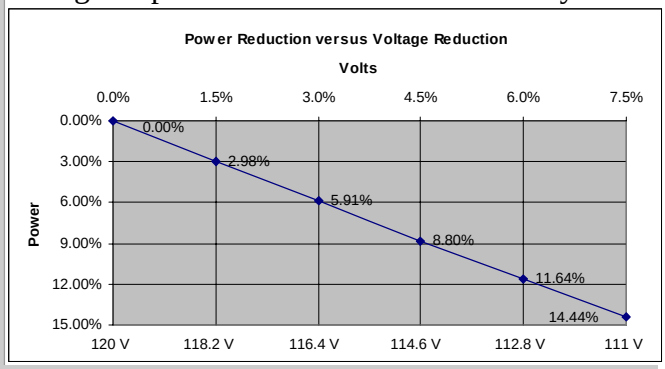
SELF CONTAINED: Can be installed at any Regulator or Load Tap Changing Transformer. Does not require SCADA or other equipment, but can be actuated by a SCADA system if desired.

Introduction

Peak electricity use has continued to rise in the United States and abroad. Excess Power generation facilities built decades ago are now being used to capacity, and demand is still growing. Peak electricity needs have surpassed peak generating capacity. Power distribution companies must find ways to reduce their peak power demand. "Demand side" approaches like radio switches on residential loads, and partial plant shutdowns, are expensive and can create customer discontent. One "Supply side" tool many utilities use is voltage control. The chart below shows that even a slight reduction in voltage can create a significant reduction in power. The chart shows reduction based on a resistive load. Results may vary with different loads, but most circuits are primarily resistive. This method of peak demand control will usually be transparent to customers. Existing generation and distribution capacity can be stretched to give quality power to all of your customers, all of the time.

Some modern distribution regulators use different methods for peak power demand reduction including SCADA control. Many existing regulators do not have any features to facilitate Voltage reduction. The Demico **Peak Demand Control** enables **existing** regulators, that do not have the Voltage reducing features, to reduce line voltage automatically when peak conditions are sensed by the Peak Demand Control, or as desired using a SCADA output contact, radio switch, or timer contact. Voltage reduction can be used only during peak conditions, when it is needed, if the control is used in automatic mode. At other times, the regulator operates normally.

Why not just lower the voltage setting on the regulator during the peak season? That will certainly lower



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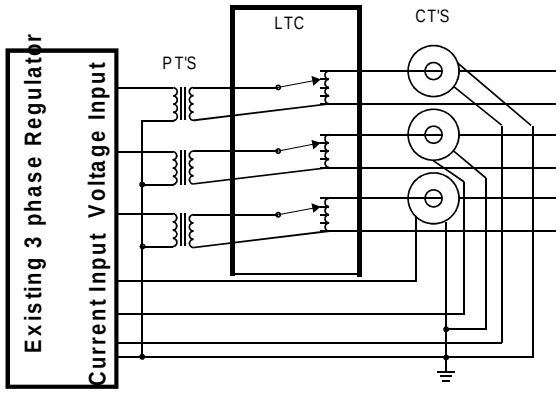
the peak power usage during peak conditions, but power delivered during non peak conditions will also be less, affecting revenue.

How does it work?

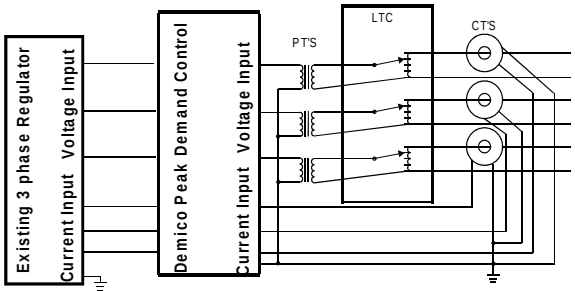
Most distribution regulators work by sensing the output voltage of the distribution transformer through a Potential Transformer (PT). Three phase systems use three PT's. Likewise, Current Transformers (CT's) are used to monitor the load current on the secondary of the transformer. The diagram below illustrates the concept.

The Peak Demand Control is installed between the regulator and its sensors (PT'S and CT's) as shown in the following diagram.



Typical Distribution Transformer Voltage Regulator

During non-peak conditions, the Peak Demand control connects the Voltage from the PT directly to the Regulator control. During Peak conditions the current sensed



Typical Distribution Transformer Voltage Regulator with Peak Demand Control

will increase. The Peak Demand control senses this and switches a higher voltage to the regulator. The regulator thinks the line voltage is too high, and lowers the line voltage.

This simple, low cost regulator accessory can be used on any regulator, and will lower your Peak Demand. "Supply side" demand control treats all of your customers the same, and lets your customer's personal equipment operate continuously without interruption.

Technical Operation Information

The Peak Demand Control is a solid-state electronic device, which monitors the ***C***urrent ***T***ransformer (CT) secondary (single or three phase) of a Regulator or ***L***oad ***T***ap ***C***hanging Transformer (LTC). Individually adjustable current set points automatically raise the feedback voltage to the regulator control circuit when the ***high current set point*** is exceeded. This causes the regulator to reduce the line voltage a preset percentage, which will lower the Peak Demand. When line current decreases to a level where the Regulator control current is below the ***low current set point,*** the Regulator control is allowed to operate normally.

Managing Peak Demand:

Providing capacity to serve a total system demand is a major cost factor to any utility. In some instances these costs are routinely paid in the form of demand charges. In others they are paid as additional investment for generation, transmission and/or distribution facilities. In either case, minimizing costly short-term demand **Peaks** is a constant goal. Voltage reduction during peak demand periods is recognized as an effective way to attain this goal without customer's service being affected. The Peak Demand Control automatically reduces voltage every time a peak condition develops. In other than peak demand periods, the control allows the system to return to normal operation to maintain revenue from energy sales. Power demand reduction is proportional to the square of the voltage; therefore, a **1.5% voltage reduction** during a peak period will result in approximately **3% power reduction**, depending on the **power factor**. An example of savings calculations based on a $10 per KWH demand surcharge, and a 1000 KWH base load.

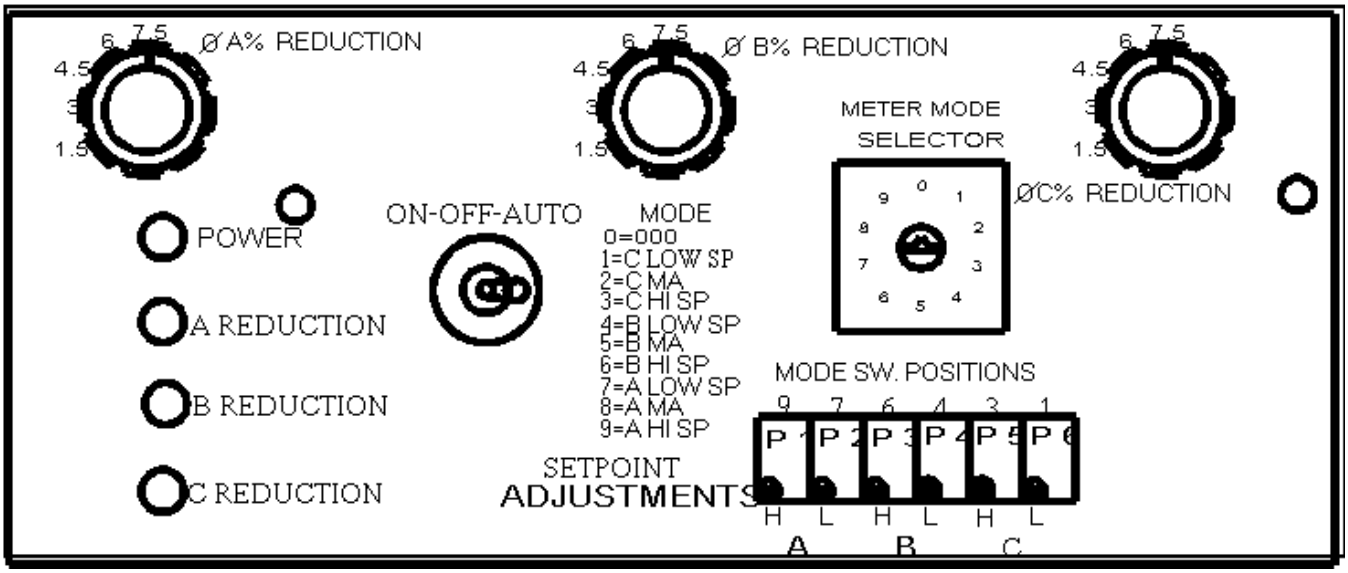
Reducing the voltage 1½% to 3% can reduce the power by 3 to 6%. Assume a 3% power reduction and a monthly demand surcharge of $10 per KWH.

Power Reduction = .03 X 1000 KWH = 30 KWH
Cost Reduction = 30 KWH X $10 = $300
Yearly Cost reduction = $300 X 12 = $3600

That is a yearly savings of $3600 per megawatt-hour just using the lowest reduction setting.

How is the consumer affected?

Most consumers will not be aware of voltage reductions. How many people can tell whether an



incandescent bulb has 110V or 120V powering it just by looking at it? For a 4 ½% voltage reduction (about 5.4V on a 120V line) , the water heater will run about 9% longer, incandescent lights will be imperceptibly dimmer, drying clothes may take about 9 percent longer to dry, Electric heaters and stoves will produce about 9% less heat requiring a little longer heating and cooking time. Electric motors may run with slightly less torque. The net effect is that power-consuming appliances will run a little longer at reduced voltage. The net power used will be about the same, but that net power will be spread over a longer time. For many situations, even lowering the voltage 7.5% will not be noticeable to the consumer. The key point for the consumer is that the power delivered is within the voltage range all electrical equipment is designed to work within. All household appliances continue to heat, cool, dry, cook, and compute normally. The lowered voltage is a small price to pay to reduce the possibilities of system wide brownouts, rolling blackouts, and skyrocketing peak demand charges.

Input

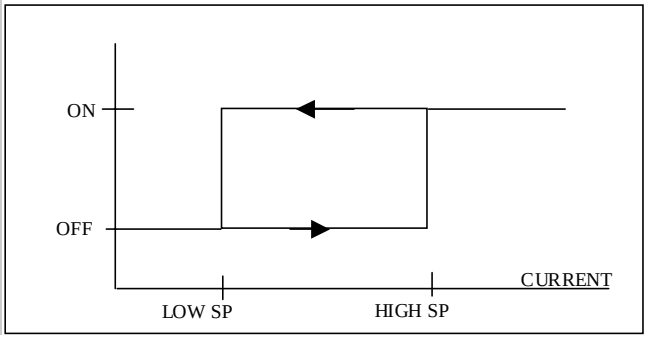
The Peak Demand Control is connected in series with the Regulator or LTC CT secondary (0 to 200 mA) to monitor instantaneous line current.

Output

The output section is connected in series with the Regulator or LTC control ***P***otential ***T***ransformer (PT) secondary. When the high current set point is exceeded, the voltage in the Regulator control circuit is raised by the Peak Demand Control causing the Regulator to reduce the line voltage a user selected amount. The percentage of line voltage reduction can be user selected to be: 1.5%, 3%, 4.5%, 6% or 7.5%. These values may be selected independently when the control is used with three single-phase regulators having separate controls. If you are maintaining 120 volts at the end of your distribution line, a 7 1/2 % reduction will still give the end user **111 volts** but **will reduce power approximately 14.5 %**.

Current Set Points

Each phase can be set independently for monitoring feeders with three single-phase regulators. There are three adjustable high and low set points with a digital current readout in milliamperes located on the control. For LTC's with single phase sensing, only one set point is required. See drawing above for selector switch and set point adjustment potentiometers. The Peak Demand Control automatic mode of operation senses the present power demand by monitoring the load current through the CT's. The Control compares the present phase current to two set-points for each phase. The two set-points form the limits for a hysteresis loop. If a single set-point was used instead of two, then the output voltage could toggle on and off repeatedly



while the current was near the set-point. When the current reached the single set-point, the voltage would reduce, and the current also would be reduced, perhaps to a level below the set-point, which would cause the voltage to increase again. With the two set-point hysteresis, the set-points can be spaced far enough apart to prevent the output from switching back and forth when the current reaches a set-point.

Voltage Reduction Settings

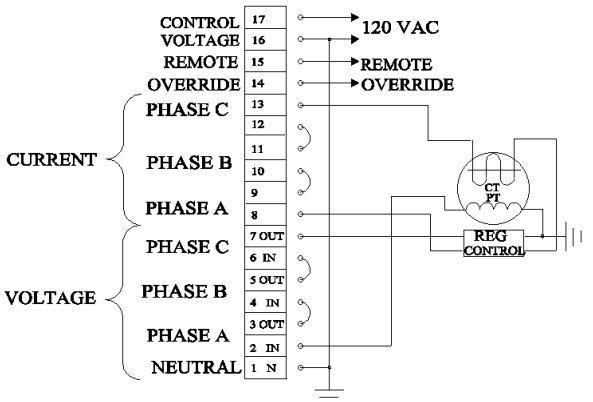
A choice from five voltage reduction steps is added to the Regulator voltage sensing circuit when current exceeds the high set point, causing the Regulator to reduce line voltage 1.5%, 3%, 4.5%, 6% or 7.5%. A separate selector switch for each phase is provided (See Selector Panel Picture). When the Peak Demand Control is used in conjunction with an LTC Transformer having single phase sensing, only one current sensing circuit with its corresponding output is utilized.

Digital Display

Located on the front panel to adjust high and low set points or read instantaneous current. Current display is from the secondary of the Regulator CT and reads in milliamperes proportional to line current (0 to 200 mA). A meter selection switch is used to determine which current is displayed.

Control Switch

The Control can be locally operated by a three-position toggle switch mounted through the cover plate.
ON = Control reduces line voltage by preset percentage.
OFF = Control output circuit is deactivated.
AUTO = Current sensors monitor CT secondary current and when an individual high set point is exceeded, Control will automatically cause Regulator to step line voltage down the selected percentage.



FOR USE WITH A LTC THREE PHASE TRANSFORMER USING A SINGLE PHASE REGULATOR

Indicators

Four red LED's are located on the front panel. When the Peak Demand Control calls for a voltage reduction in any phase the corresponding LED for that phase is illuminated. The fourth LED shows that the Peak Demand Control is energized.

Remote Override

Two terminals are available to wire for a remote contact closure to cause the Peak Demand Control to override both current sensing and control switch settings to lower line voltage by the percentage selected. On removal of this signal, control will return to original operation, as determined by control switch setting.

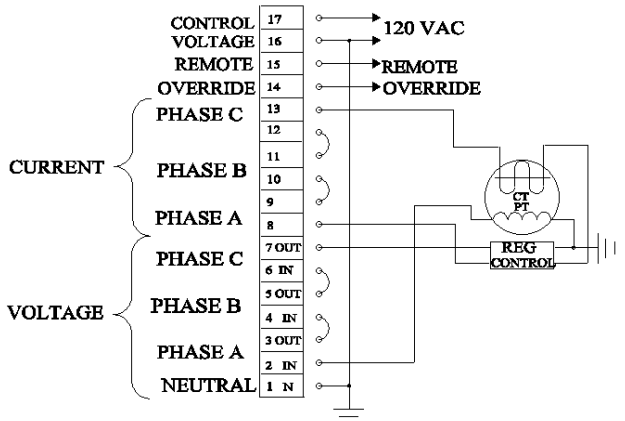
Recording Activations

There are two terminals for each phase on the top side of the Control where an hour meter and/or counter can be connected to keep up with total activation time and number of times activated.

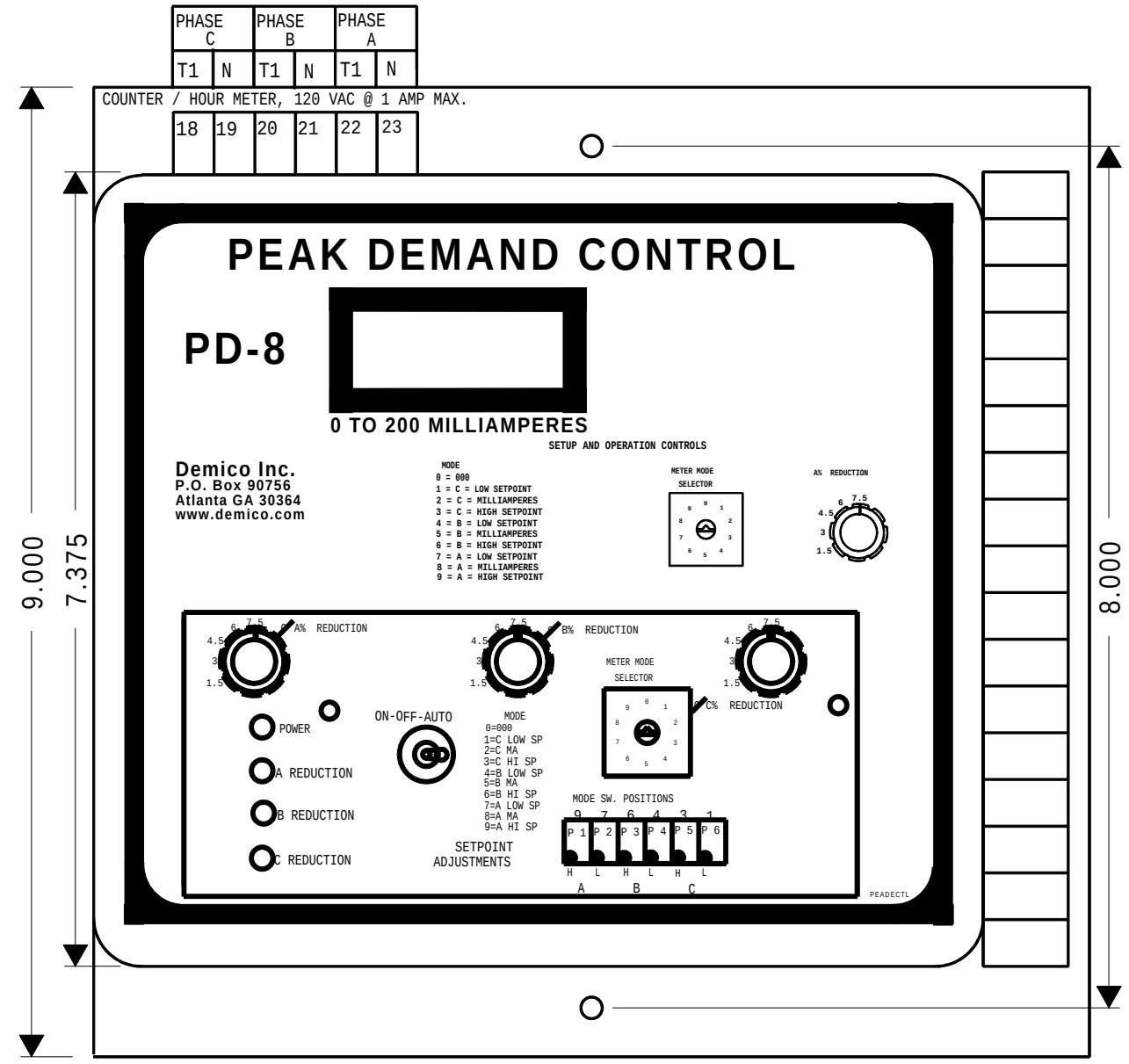
Three Stage Reduction Operation

The Control can be wired to automatically provide three steps of voltage reduction as demand increases. This mode of operation can be utilized in conjunction with a 3 phase LTC transformer having single phase sensing as follows: Connect

		1st Stage	2nd Stage	3rd Stage
% reduction	0.00%	1.50%	1.50%	1.50%
% Voltage	100.00%	98.50%	97.02%	95.57%
Voltage	120	118.20	116.43	114.68
Power reduction	0.00%	2.98%	5.86%	8.67%
% reduction	0.00%	3.00%	3.00%	3.00%
% Voltage	100.00%	97.00%	94.09%	91.27%
Voltage	120	116.40	112.91	109.52
Power reduction	0.00%	5.91%	11.47%	16.70%



FOR USE WITH A LTC THREE PHASE TRANSFORMER USING A SINGLE PHASE REGULATOR


PHASE C
PHASE B
PHASE A
T1
N
T1
N
T1
N
COUNTER / HOUR METER, 120 VAC @ 1 AMP MAX.
18
19
20
21
22
23
PEAK DEMAND CONTROL
PD-8
0 TO 200 MILLIAMPERES
SETUP AND OPERATION CONTROLS
Demico Inc.
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MODE
0 = 000
1 = C = LOW SETPOINT
2 = C = MILLIAMPERES
3 = C = HIGH SETPOINT
4 = B = LOW SETPOINT
5 = B = MILLIAMPERES
6 = B = HIGH SETPOINT
7 = A = LOW SETPOINT
8 = A = MILLIAMPERES
9 = A = HIGH SETPOINT
METER MODE SELECTOR
A% REDUCTION
B% REDUCTION
C% REDUCTION
POWER
A REDUCTION
B REDUCTION
C REDUCTION
ON-OFF-AUTO
SETPOINT ADJUSTMENTS
MODE SW. POSITIONS
9 7 6 4 3 1
P 1
P 2
P 3
P 4
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all three current sensing input circuits in series and adjust set points of the Peak Demand Control in ascending order, such as: 80% (160mA), 90% (180mA), and 95% (190mA) of full load Current. Connect all three Voltage outputs in series with each individual reduction value set as desired in the sequence, such as: 1½% reduction at 80% of full load current, 1½% reduction at 90%, and 1½% reduction at 95%. The chart shows that the 120V decreases to a minimum of about 115V, and the power is reduced by about 8½%. Using 3% for each reduction still gives a minimum voltage of about 110V, and the power is reduced over 16%.

Practical reduction settings will vary with utility policies and the individual circuits load characteristics. End of distribution line min-max Voltage monitoring is suggested to verify that minimum acceptable Voltage is being provided during Peak periods.

Specifications

SENSE CURRENT: 0 to 200 mA
SENSE VOLTAGE.:100 to 135 V.
OUTPUT: 120 VAC @ 1 AMP.
POWER SUPPLY: 120 Vac Nominal (+/-20%) @ 6 VA.
CT. BURDEN: Less than 0.15 VA.
SET POINT PRECISION: 1 Milliampere
LIQUID CRYSTAL DISPLAY (LCD): 3 digits
SURGE WITHSTAND: ANSI Standard 37.801978.
CIRCUIT BOARD PROTECTION: Polyurethane Coated.
DIELECTRIC TEST: 1500 VAC Production tested.
clamps.

MECHANICAL REQUIREMENTS

1. Install the Peak Demand Control module in a weather tight enclosure using the mounting holes in the base of the control. See Figure 1.

2. Mount the enclosure near the voltage regulators and install conduit between the enclosure and the regulator control cabinets.

WIRING REQUIREMENTS

1. Each Peak Demand Control has three individual control circuits for three phase operation. Each control circuit requires four wires from the Peak Demand Control to the transformer voltage regulator. Use 4 color coded conductors for each Peak Demand Control circuit to the regulator control or a total of 12 conductors to the three single phase transformer regulators or four wires to the LTC single phase transformer regulator. If the Peak Demand Control is mounted ten feet or more from the Regulator use minimum #14 size conductor.

CAUTION: Follow the Regulators "Manufacturer's Instructions" and remove the regulators from service before making any connections to the regulator control.

2. Make connections per Wiring Diagrams, and the voltage regulator schematic furnished by the regulator manufacturer for the precise locations to connect the current and voltage circuits to the Peak Demand Control. Wiring Diagrams show how to wire a system for a LTC transformer, and how to wire a system for three single phase regulators.

3. Each current circuit is to be placed in series with the load side winding of each regulator ***C***urrent ***T***ransformer as shown in Wiring Diagrams.

4. Each voltage circuit is also placed in series with each regulator's ***P***otential ***T***ransformer secondary winding as shown. Do not include the motor circuit in this control circuit.

5. A 120 Vac Power Supply is required. Connect the phase wire to terminal 17 and the neutral to terminals 16, 1, and ground.

SETUP AND OPERATING PROCEDURES

The Peak Demand Control has three individual control circuits that can be used with a three phase regulator and have a single reduction percent selector and high and low set points for each phase. The control can also be used with LTC regulators having single phase voltage control, but all three of the control circuits can be utilized in a stepping configuration when wired per Figure 2. Phase 1 can be set with a low reduction with its high and low set points. Phase 2 can be set for a higher reduction and set point and when the current reaches that set point the phase 2 reduction cuts in. Phase 3 can be set at a higher set point with a larger reduction which will allow the Peak Demand Control to keep your system "Peaks" under better control while continuing to sell as much power as possible without affecting your customers.

1. Switch the Peak Demand Control switch to OFF. This deactivates the control but leaves Power ON.

2. Remove the clear cover plate

3. Refer to Figure 4 for identification and location of the Mode Selector, Set point adjustments and the voltage reduction switches. While the mode selector switch is positioned for each mode,

make the adjustments and read the settings on the LCD display. There is a High and Low Current set point for each phase. Calculate high and low current set points in milliamperes. The Current input range is 0 to 200 mA.

4. Use a small screwdriver to adjust the HIGH and LOW set points for each phase by turning the set point adjustment potentiometers and observing the set points on the display.

5. Adjust the selector switches marked A%, B%, and C%, to the desired voltage reduction level. The cover plate must be removed to set these switches. If the Peak Demand Control is being used with a three phase Voltage regulator, each phase can be set for the individual reduction percent. If the Peak Demand Control is being used with a LTC single current sensing and Voltage output Regulator, the three control circuits can be used in series.

6. Following the "Manufacturer's Instructions" put the regulator back into service.

7. Test the operation by switching the toggle switch to ON. The regulator should step the voltage down the percent selected. When the test is complete, replace the cover and set the toggle switch to AUTO.

8. For future changes of the HIGH and LOW set points, the set point adjustments can be reached through the holes in the clear cover plate with a small screwdriver.

ACCESSORIES

1. There are two terminals per phase on the topside of the Peak Demand Control to connect a counter and / or a hour meter to record the number of activation's and the total time the control is activated. These terminals output 120 VAC while the control is activated.

NOTE:

The following considerations should be made to gain the greatest advantage in the use of the Peak Demand Control.

A. When using the Peak Demand Control care should be taken to assure that acceptable voltage levels are maintained both at the substation and at the last customer on each Distribution Line.

B. Select set points to cause operation of the Peak Demand Control to operate at every Peak, and be inactive at all other times.

Demico Inc. also manufactures a very sophisticated Socket mounted Electronic Recording Averaging Voltmeter (AV121R) that can be mounted on the last pole on each distribution line to record the high and low Voltages. This Voltmeter has a RS232 port where a telephone modem, radio, or other data transmission device can be attached to feed real time data to your SCADA system. This Voltmeter can reset itself the first second of each month, store the high and low voltages for each month, and time stamp each event, for a period of 13 months. Free Demicomm Interface Software allows the data to be downloaded into a notebook computer at any time.

Please visit our web site at www.demico.com for information about our Specialty Transducers, Ampere Demand meters, and other Meters and controls specifically designed for the Power Utilities.

Other Demico Devices to help you to better utilize your Electric Utilitity System

The Demico Inc. Recording Averaging Voltmeter is usually mounted on the last telephone pole in each Distribution line to keep a record of low or high voltages and insure the quality of power being delivered to customers. It records the high and low voltage and records and time stamps the high's and low's for each month . It also can be set to automatic reset during the first second of each month and retain thirteen months of history that can be downloaded into a notebook computer for further analysis. You can download the datasheet from our web site for more information.

The four phase AD418R is designed to emulate the "Lincoln" thermal Ammeter that has been used since about 1919. The digital logarithmic averaging produces the same thermal response as the original meter, but with vast improvements in accuracy, stability, and features. It can be set up and operated from the front panel or with a computer. The AD418R can automatically collect and store monthly Demand data for all three phases plus the neutral in a transmission or distribution line to help a Utility to operate its system in an efficient manner.

The Battery Transducer runs on the Battery power that it monitors. It has an isolated analog output. Models are available for all commonly used voltages.

The DC Voltage transducer is used for many different purposes, but one of the primary purposes is to monitor Capacitor Trip DC Voltage.