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BECK® ELECTRIC ACTUATORS

FOR INDUSTRIAL PROCESS CONTROL

INDUSTRIAL STEAM BOILERS

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Increasing Business Pressures Necessitate Boiler Control Improvements

Today's industrial climate is characterized by ever increasing fuel costs, emission regulations, and global competition—optimizing boiler efficiency is critical to meeting these challenges. Whether producing process steam, plant power—or both—boilers need to maintain optimum combustion and feedwater control under a variety of changing conditions. In response, industrial plants are continually investing in control systems and instrumentation to meet regulations, reduce costs, and avoid costly trips and outages. There is no end to this trend in sight.

Valve and Damper Actuation is Key to Improved Boiler Control and Efficiency

In spite of the critical role of boiler control valves and dampers with respect to efficiency, safety and reliability, their performance is often ignored. In many cases, actuator problems tend to be addressed only after a serious or complete failure occurs. The rest of the time, poor performance goes undetected, or is simply tolerated, while more visible problems receive attention.

Boiler valve and damper actuators are a leading source of boiler control problems. Pneumatic actuators are highly susceptible to stick/slip response, excessive dead time, inconsistent performance with changing conditions, and performance degradation over time. As a result, pneumatic actuation simply cannot provide the level of control performance provided by Beck actuators. Similarly, typical electric actuators are poorly suited for active boiler control since most are limited by motor duty cycles, provide less accurate positioning capabilities, and are less reliable—especially in the harsh operating conditions for which Beck actuators are designed.

Hundreds of Boilers are Benefiting from Beck Actuators ...and the Number is Growing

Investments in advanced control instrumentation and logic are very necessary, but are only as effective as the precision, repeatability and responsiveness of the valves and dampers. Industrial boiler owners and operators who understand the importance of the valve and damper control hardware, replace pneumatic actuators with Beck Electric Actuators. In fact, Beck actuators are installed on modulating applications on over 600 industrial boilers of all sizes and styles. In addition to industrial applications, Beck actuators are modulating the valves and dampers on over 1,000 electric utility boilers—and the number of boiler installations is continually growing.

Why do Beck actuators improve control and eliminate the inherent problems of pneumatic actuators and typical electric actuators?

- Beck actuators respond to a modulating controller demand signal instantaneously, regardless of changing loads and conditions. Therefore, Beck actuators will not stick or slip like pneumatic actuators, thus eliminating dead time and position overshoot.
- Beck actuators track the controller demand signal closely under closed-loop conditions, with resolution unmatched by pneumatic and typical electric actuators. This eliminates limit cycling and ensures tight, stable process control.
- Beck actuators provide consistent control over time with virtually no maintenance requirements.
- Beck actuators eliminate the dependence of costly and unreliable air systems, thus eliminating problems like freezing and contamination.
- Weather, dust, dirt, and temperature (-40 to 185° F.) conditions do not affect performance.
- The extreme ruggedness and quality of Beck actuators simply ensures that they outlast and outperform other actuators.

Contact a Beck Sales Engineer at 215-968-4600 to find out more about the best actuators for your installations.
Visit our website at www.haroldbeck.com.
E-mail: sales@haroldbeck.com

All Types of Boilers Benefit

Whether a boiler is large or small, subject to severe load swings or base-loaded, Beck actuators provide the best possible valve and damper control. Some of the biggest benefits are realized on boilers subject to extreme load swings. In these cases, Beck actuators have shown that the instantaneous response capability, without overshoot, provides exceptionally stable and fast load changes. Likewise, boilers with active loads or other external disturbances benefit from the actuator's ability to track a demand signal closely, without modulation restrictions and performance inconsistencies. Improving positioning, while eliminating dead time and overshoot, always results in better process control. Loops not only perform better, but also are easier to tune, stay tuned longer, and are more tolerant of varying conditions.

Field Proven Results

Continually, boiler owners make the investment in Beck actuators and realize the long term benefit. Following are a series of data charts that were generated by just one such Beck actuator user.

Figure 1A

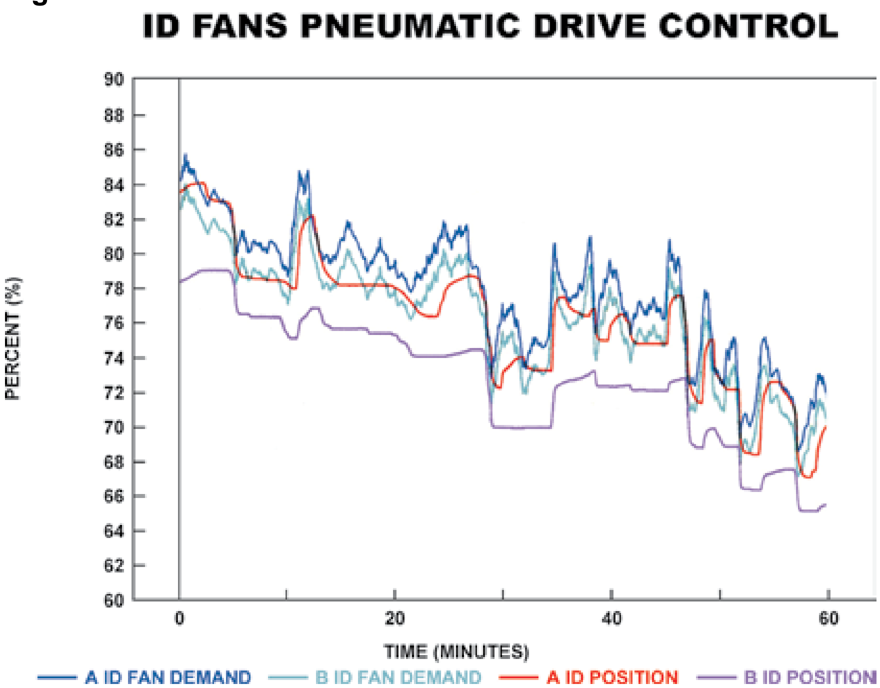


Figure 1A shows data for a boiler with dual ID dampers modulated with pneumatic actuators. Both dampers' actuators receive the same demand signal which is shown biased for clarity. The corresponding damper responses are shown as well. Neither damper actuator could follow the signal closely enough to provide good furnace pressure control. Additionally, although dampers, damper actuators and the controller demand signal are identical, the actuators performed differently from one another. This highlights not only poor response, but the typical inconsistent response of pneumatic actuators as well.

Figure 1B

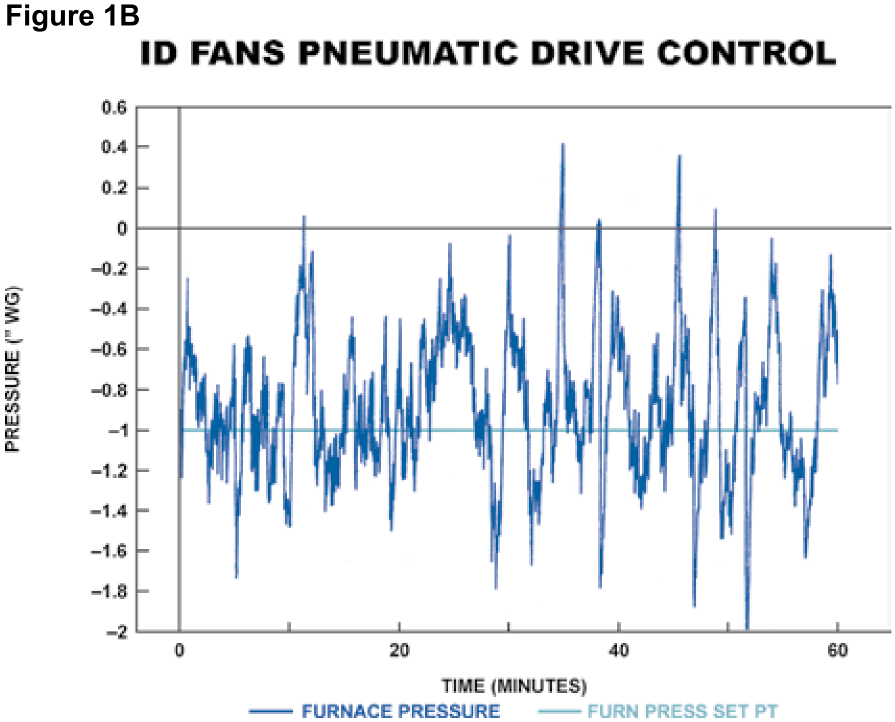


Figure 1B shows the resulting furnace pressure control with the pneumatic actuators in place. Note the following: 1) The pressure control is poor with a wide band of variability; 2) the furnace pressure occasionally goes positive; 3) the control setpoint is set at –1 inch of water column. Compare these results to Figure 2B after Beck actuators were installed.

Figure 2A

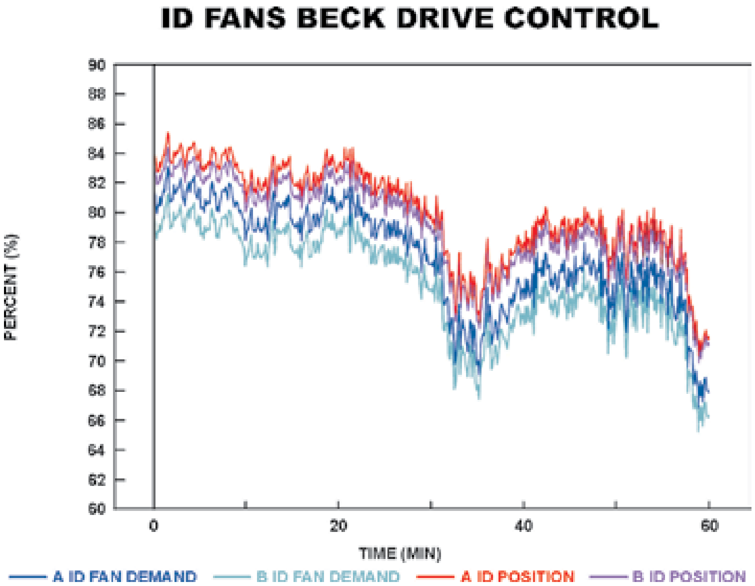


Figure 2A shows the response of the two ID dampers after Beck Electric Actuators were installed. As in Figure 1A, biases were added to all the signals for the sake of display clarity, but the two demand signals are identical and the position signals actually overlay the demand. Note how closely the damper position tracks the demand, allowing for optimal furnace pressure control.

Figure 2B

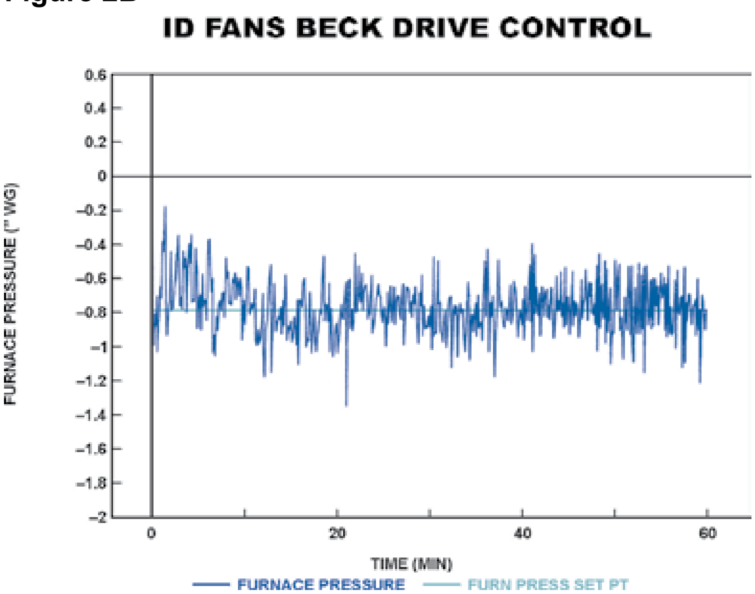


Figure 2B shows the furnace pressure control after the Beck actuators were installed. It is easy to see at a glance how much tighter the control results are compared to Figure 1B; however, it is also important to note the following: 1) Furnace pressure no longer makes positive excursions; 2) the loop setpoint has actually been moved from –1 in WC to a more efficient –0.8 inches WC; 3) this data was collected after the Beck actuators were installed, but before any tuning or other changes were made.

Figure 2C

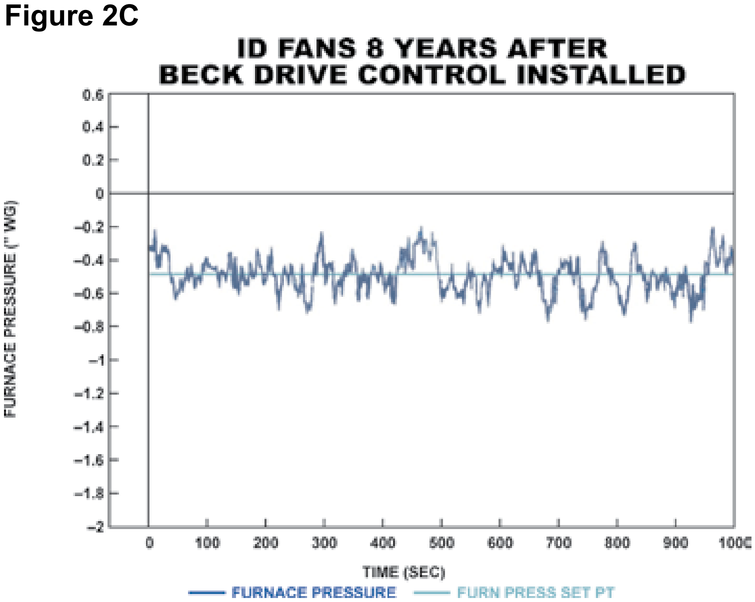


Figure 2C shows data collected on the ID dampers eight years after the Beck actuators were installed. Clearly, performance is still excellent. Further control improvements over the years allowed the furnace pressure setpoint to be moved from –0.8 inches WC to –0.5 inches WC; further accentuating the need for excellent damper control.

In addition to damper control, good boiler control also requires stable feedwater and fuel control. The example below shows the results of installing a Beck actuator on a feedwater flow control valve. This particular boiler is subject to extremely large and sudden steam load swings, often in excess of 30% of the boiler rating in less than one minute. With the original pneumatic actuator installed on the feedwater valve, drum level control limited the boiler's ability to meet the steam load requirements. The installation of a Beck actuator provided the feedwater valve performance necessary for responsive, stable drum level control—even during the most severe load changes.

Figure 3A

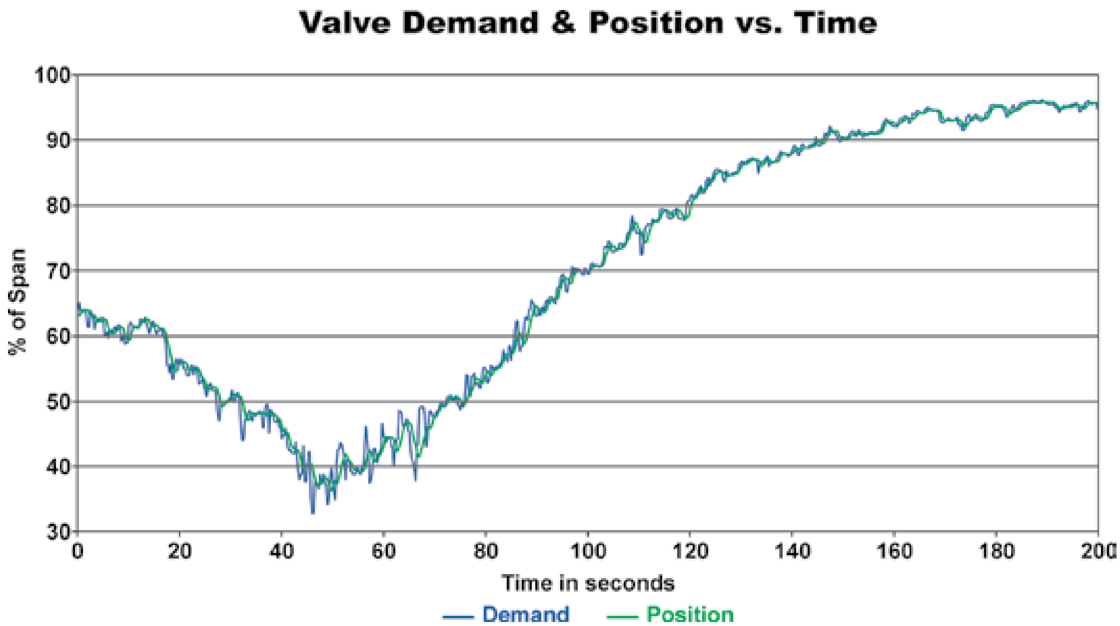


Figure 3A shows both the controller demand signal to the feedwater valve, as well as the position feedback signal from the Beck actuator. This data indicates the controller's response to a rapid 30% load increase on the boiler. Some inverse response due to level swell initially occurs, after which the controller rapidly increases demand to the feedwater valve. The Beck actuator follows the demand perfectly.

Figure 3B

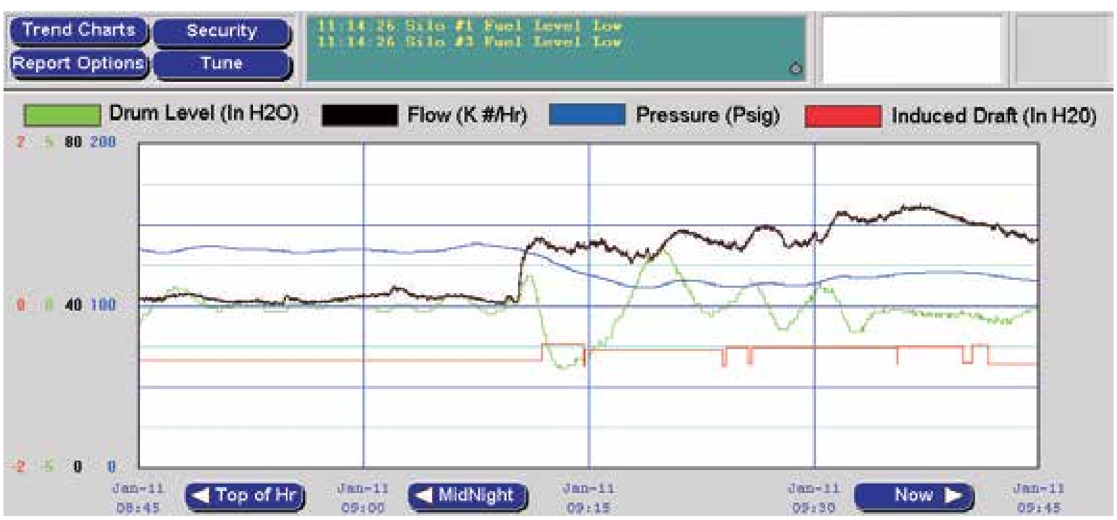
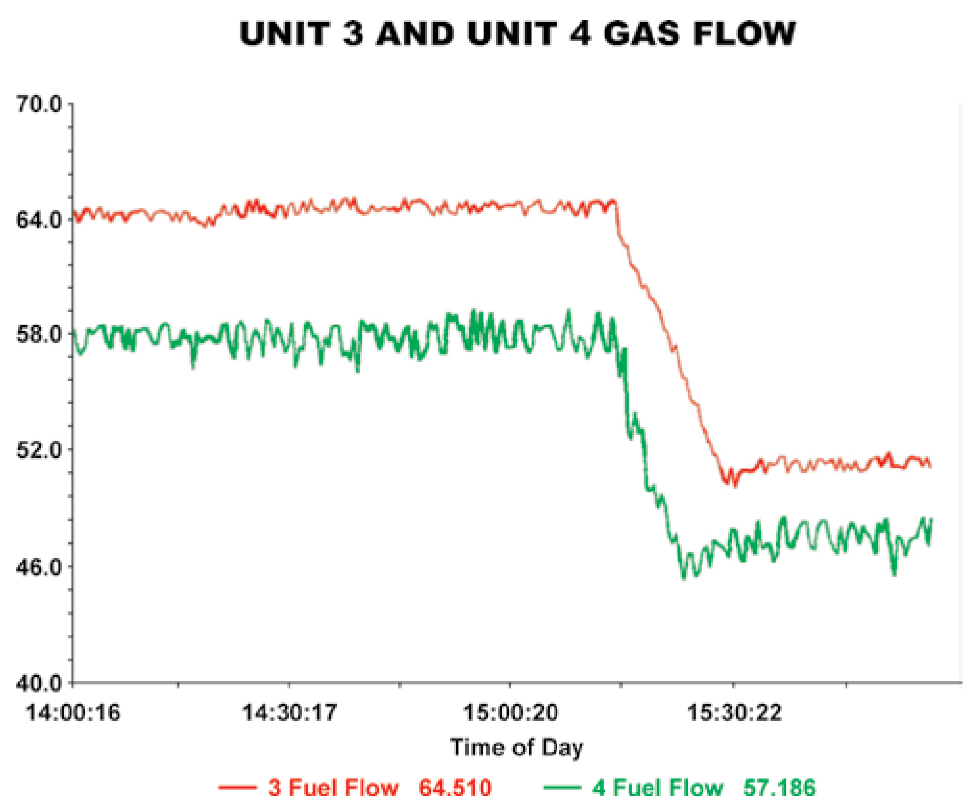


Figure 3B shows a process trend during the entire recovery period of the load upset depicted above. In spite of boiler swell caused by the excessively large and rapid load swing, the drum level was controlled effectively, never exceeding safe limits and settling out within 20 minutes. The excellent feedwater response provided by the Beck actuator enabled the plant to aggressively tune the drum level loop; thereby avoiding high and low drum level conditions.

Figure 4, below, contrasts the performance between natural gas fuel valves on two large, identical, gas-fired boilers. One boiler's gas valve was fitted with a Beck actuator, while the second's was fitted with a pneumatic actuator. The graph below plots the gas flow for each simultaneously, with both boilers under the same loading conditions. Note that the gas flow from the Beck-equipped valve (red line) is more stable than that through the pneumatically actuated valve (green line). Improving the ability to control the fuel flow more closely and with greater stability is an important advantage offered by the Beck actuator. Not only is boiler efficiency improved by the direct benefit of better gas flow control, but better overall boiler performance can be achieved by reducing the interactions with other control loops. For example, better fuel flow control results in the following:

- Reduced air flow instability induced through cross-limiting in the control strategy.
- Reduced furnace pressure instability caused by fuel variations and induced air flow variations.
- Reduced excess air fluctuations caused by fuel and air flow variations.

Figure 4



Although much of the data shown in the above chart is under steady-state load conditions, more active boiler loads increase the importance of fuel flow control.

GENERAL SPECIFICATIONS

Power	
Model 11	120 V ac, single-phase, 60 Hz (50 Hz Optional) (208, 240, 380, 415, 480 & 575 V ac, 60 or 50 Hz Optional)
Model 14, 29 & 42	120 V ac, single-phase, 60 Hz (50 Hz Optional) (240 V ac, single-phase, 60 or 50 Hz Optional)
Model 22-309	120 V ac, single-phase, 60 or 50 Hz (240 V ac Optional) (208, 240, 380, 416, 480, 575 V ac, three-phase, 60 or 50 Hz Optional)
Model 22-409	208 V ac, three-phase, 60 or 50 Hz (240, 380, 416, 480, 575 V ac Optional)
Model 22-809	480 V ac, three-phase, 60 or 50 Hz (208, 240, 380, 416, 575 V ac Optional)
Output Torque/Thrust	
Model 11	Up to 1,800 lb-ft (2 440 N•m)
Model 14	Up to 4,000 lbs of thrust (17 800 N)
Model 22	Up to 8,000 lb-ft (10 846 N•m)
Model 29	Up to 6,100 lbs of thrust (27 134 N)
Model 42	Up to 1,000 lbs of thrust (4 450 N)
Operating Conditions	
Model 11, 14 & 29	–40° to 185° F (–40° to 85° C) 0 to 100% relative humidity, non-condensing
Optional for Models 11-200, -300, -400	–58° to 185° F (–50° to 85° C) 0 to 100% relative humidity, non-condensing
Communication Interface Options	
All Models (Option 9 only)	HART, Modbus RTU, Modbus TCP (Ethernet), Foundation Fieldbus, Profibus PA, local pushbutton/LEDs and DB9 Serial Commands
Position Feedback Signal	4–20 mA or 1–5 V dc (V dc not available with Option 9)
Action on Loss of Input Signal	Stays in place (all models) or moves to a preset position (configurable with some models)
Action on Loss of Power	Stays in place
Enclosure	Type 4 or 4X (depending on specific model). Models approved for use in Hazardous classified locations are also available—contact a Beck Sales or Application Engineer for details.

HART COMMUNICATION PROTOCOL

Modbus MEMBER

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5/21
Rev. 4.5