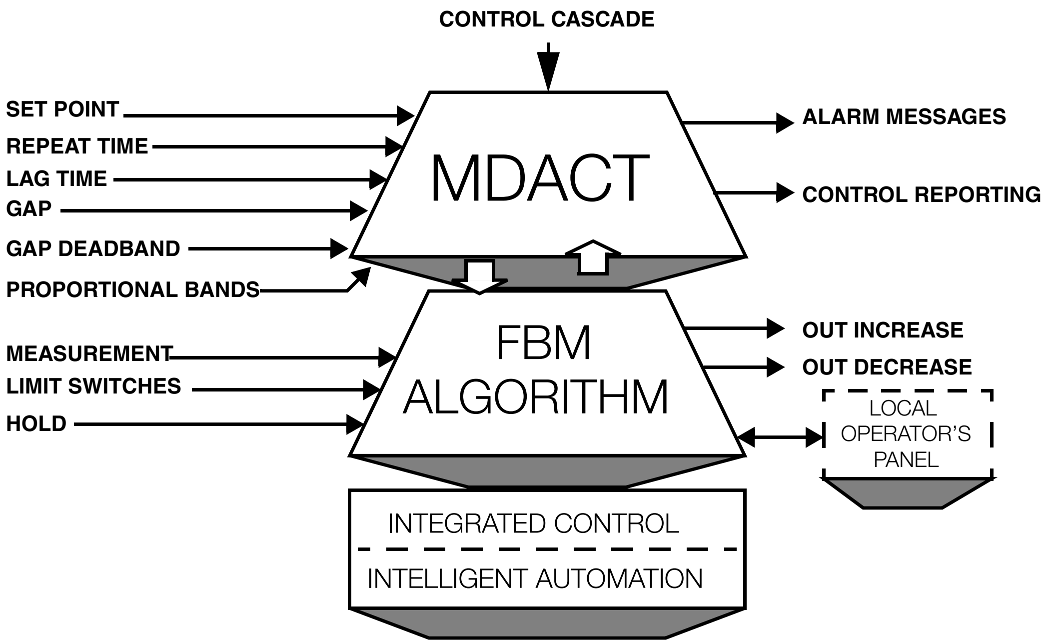
Foxboro Evo™ Process Automation System

Product Specifications

PSS 31S-3MDACT

Motor Driven Actuator (MDACT) Block



Motor Driven Actuator (MDACT) block is used for closed-loop control of bi-directional motor driven valves and similar devices.

OVERVIEW

The Motor Driven Actuator Controller (MDACT) block residing in the Control Processor (CP) together with associated Equipment Control Blocks (ECBs) provides the user interface to the motor driven actuator controller software residing in Fieldbus Module 17 (FBM17). Locating the soft-ware in the FBM results in faster response time for high frequency calculations to provide faster, more precise actuator positioning. The MDACT block provides the parameters to:

- Define the setpoint
- Tune the selected algorithm
- Report the values of all variables exchanged between the FBM and the process.

The two selectable control algorithms located in FBM17 are:

- Tri-state pulse width modulation of separate increase and decrease digital outputs typically used for high speed positioning of a motor driven actuator to a position feedback/sensor reference
- Tri-state feedback lag algorithm typically used for proportional control of a loop with a motor driven actuator without a position feedback/ sensor reference.

Each FBM17 with the selected algorithm executing at a 25 msec interval controls one device. Any analog and digital input points not used by the algorithm are usable by AIN and CIN blocks in the CP. The analog output points of the FBM may be written by AOUT blocks. If the optional Operator's Control Panel is installed, all FBM 17 input and output points are used by the algorithm. See Figure 1.

Alarm detection and reporting are performed by the MDACT block in the CP. MDACT supports:

- Absolute alarming
- High-high/low-low alarming
- Deviation alarming
- Bad alarming, which occurs as a result of hardware faults or a bad measurement input.

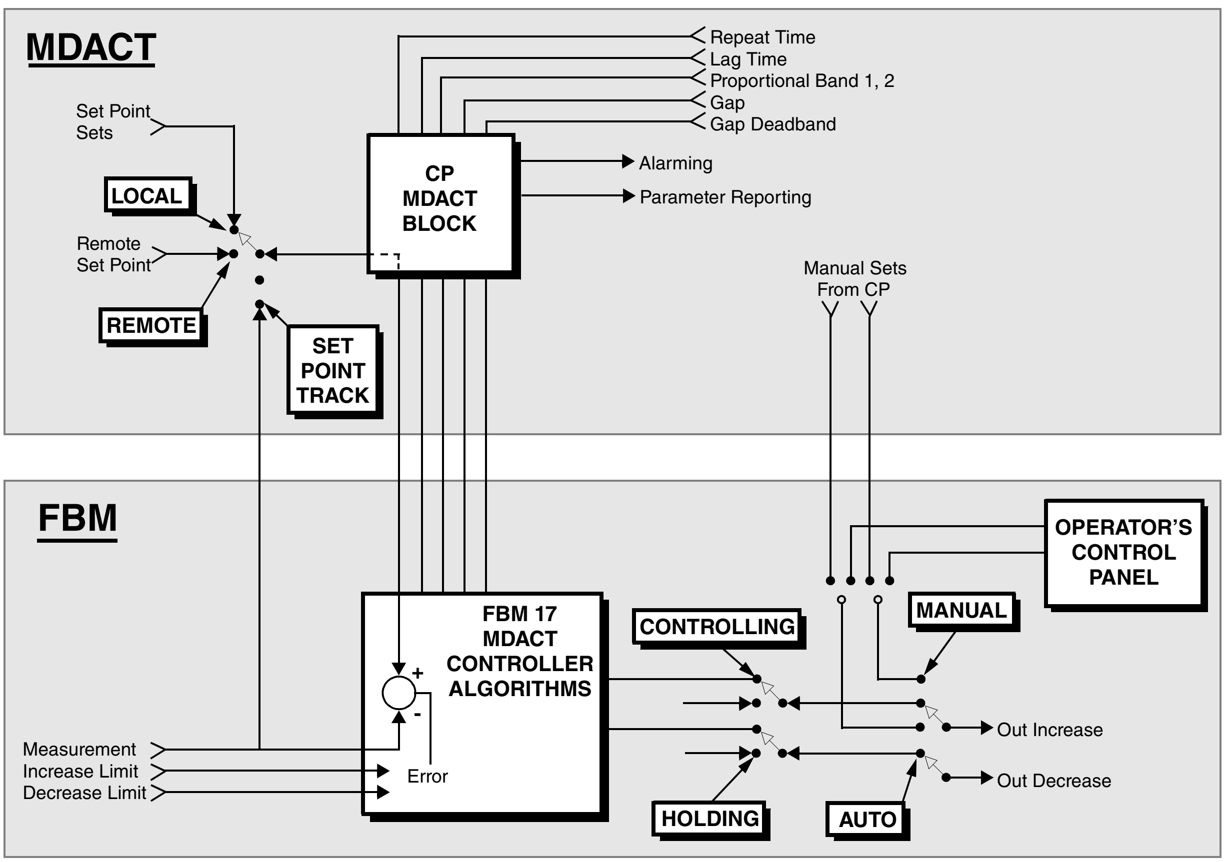


Figure 1. MDACT Simplified Signal Flow Diagram

PULSE WIDTH MODULATION ALGORITHM

The pulse width modulation (proportional time) algorithm provides two Boolean outputs with a control period and the logic to turn an output "on" for a portion of that control period, as follows:

- The controlling period is the time interval between successive output pulses and is established by an adjustable repeat timer parameter.
- The algorithm controls the device by varying the percentage of "on" time (duty cycle) within each control period.
- The "on" time is inversely proportional to the proportional band value and directly proportional to the deviation existing at the time the control period (repeat time) begins.
- Within each control period, the algorithms operate as linear proportional only controllers whose gain is adjusted by the proportional band setting. See Figure 2 for an example of a pulse width modulation timing diagram.
- Each of the two output signals operates independently as a function of the deviation.
- Increase is operational when the deviation is negative (measurement less than setpoint).
- Decrease is operational if the deviation is positive (measurement greater than setpoint).
- Limit switches are used to limit increase and decrease operations.
- The algorithm uses two proportional bands to compensate for any actuator inertia difference between the increase and decrease directions.
- When the measurement is less than the setpoint, one proportional band is used to drive the actuator in the increase direction.
- When the measurement exceeds the setpoint, a second proportional band is used to drive the actuator in the decrease direction.
- Both Boolean outputs are used to control tri-state final operator devices. An adjustable band centered about zero deviation creates a dead-zone region that renders both outputs inoperative when the deviation is in this region.
- The algorithm provides Integral-only (I) response to position a motor-driven valve. An optional local Operator's Control Panel is available for manual driving of the outputs when the pulse width modulation algorithm is in use.

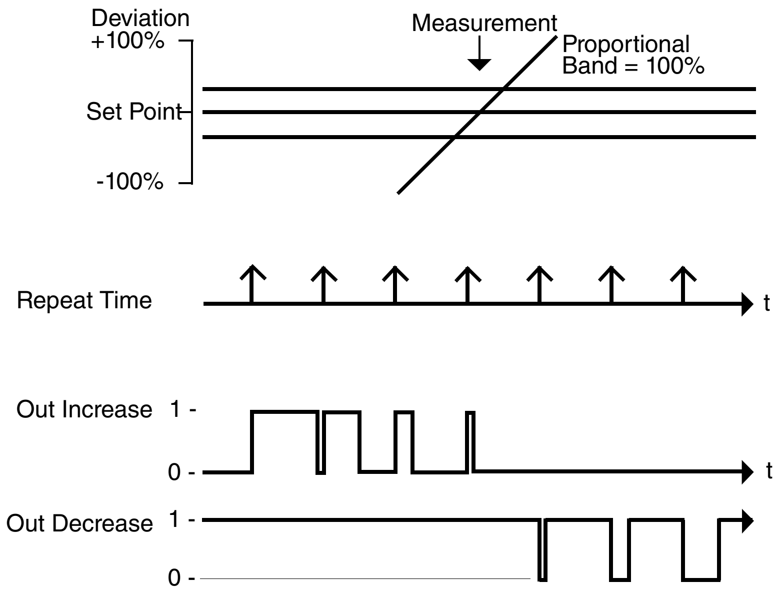


Figure 2. Pulse Width Modulation Algorithm Timing Diagram

FEEDBACK LAG ALGORITHM

The Feedback Lag Algorithm provides two boolean output signals as well as the logic to switch them "on" or "off" as a function of the deviation between measurement and setpoint, the feedback lag, and the proportional band, as follows:

- The algorithm compares the measurement input with the selected setpoint (local or remote).
- When the combination of deviation, feedback, and proportional band exceeds the dead zone and deadband, the algorithm drives the actuator in the decrease or increase direction by switching on one of the two FBM digital outputs.
- When the deviation is within the deadband, the gain of the controller is zero and the Boolean outputs are deactivated.
- Limit switch inputs allow the algorithm to hold the increase or decrease outputs to "off" when a limit input has been reached.
- As a controller for final-operator devices such as bi-directional, motor driven actuators, the algorithm acts as a Proportional + Integral (PI) controller with the feedback lag as the Integral time constant.
- As a secondary controller, such as a steam-flow controller in a cascade control loop for a heat exchanger, the MDACT feedback lag algorithm uses the measurement input from a flow transmitter. The primary Proportional + Integral + Derivative (PID) temperature controller sets the demand for steam flow via the remote setpoint input to the MDACT block.
- To support a 4-20 mA signal, the measurement may be routed via the CP to the FBM (CP Control Mode) rather than directly to the FBM (Direct Control Mode).

See Figure 3 for a timing diagram of the feedback lag algorithm.

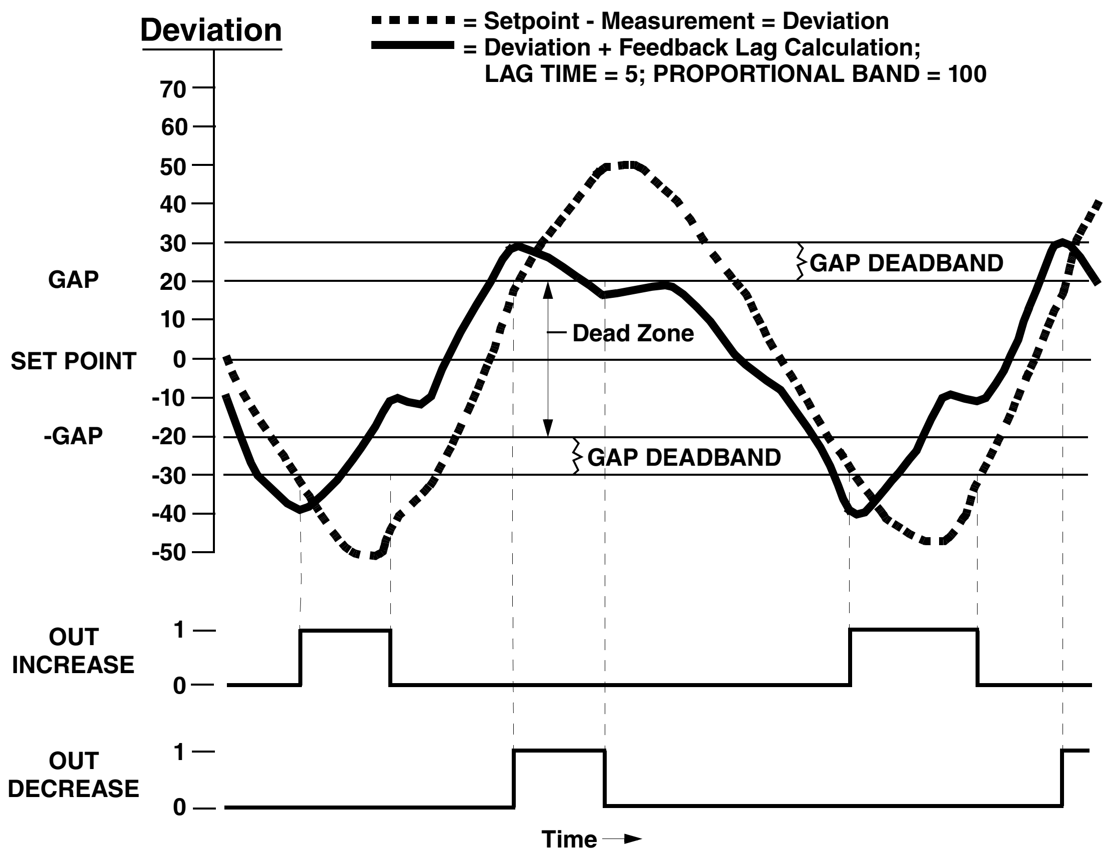


Figure 3. Feedback Lag Algorithm Timing Diagram

OPERATOR'S CONTROL PANEL

When the Operator's Control Panel is installed, the panel uses the two unused analog input points of the FBM17 to drive the boolean output signals on a manual basis, as follows:

- The algorithm is set into the Manual mode either by a command from the MDACT block in the control processor, or by the Control Panel, using one of the unused digital input points as an alternate-action Auto/Manual toggle switch.
- Once the algorithm is in the Manual mode, the boolean output signals will follow the drive commands from the panel if they are active, or the drive commands from the MDACT block otherwise.
- The panel contains a 0-to-100% meter which displays the algorithm's active measurement value at all times, and an LED which signals FBM failure. Two additional LEDs indicate the Auto or Manual state of the algorithm.

STANDARD FEATURES

- Pulse-width-modulation algorithm (FBM Software Type 36).
- Feedback-lag algorithm (FBM Software Type 34).
- Manual/Auto (MA) control of the outputs, which can be initiated by a host process or another block.
- Auto and Manual latch switch inputs (AUTSW and MANSW) that force the block to Auto or Manual.
- Local/Remote (LR) setpoint source selection.
- Local and Remote latch switch inputs (LOCSW and REMSW) that force the block to Remote or Local.
- Bad inputs detection, handling, and alarming.
- Failsafe output, indicating an FBM has asserted Failsafe.
- Automatic cascade handling that includes:
  - Initialization output connection parameter that provides proper coordination and initialization of cascade schemes.
  - Back calculation of the setpoint input for the upstream block, to provide bumpless cascade operation when the cascade returns from an open loop condition.
- Capability of all input points to be read by AIN or CIN blocks.
- Capability of analog and allowable digital output points to be written by AOUT or COUT blocks.

OPTIONS

- Operation with any of the following digital I/O port configurations for the FBM:
  - 125 V dc/0.5 A
  - 125 V dc/10 mA
  - Contact/0.5 A
  - Contact/10 mA.
- Setpoint Tracking forces the setpoint to track the Measurement signal when in the local mode and the output is in manual allowing bumpless return to automatic control when the MDACT block returns to closed-loop operation.
- Hold Option enables the user to specify that one of the unused contact input points is to be used to provide a disable signal, forcing the increase and decrease outputs off. This option is not available when the Panel Option is activated.
- Manual Failsafe which switches the block to manual mode when failsafe is detected.
- Bad/Range allows the user to specify whether an overrange or underrange measurement will cause the measurement to be marked BAD.
- Bad Alarming provides alarming of a BAD measurement
- Measurement Alarming provides absolute and high-high/low-low alarming of the measurement during auto operation. This option also provides standard alarm notification and reporting features.
- Deviation Alarm enables (when true) deviation alarming of the measurement - setpoint error signal.
- Manual Alarming allows the user to invoke all configured alarm options while the block is in manual. Otherwise, alarming is normally performed only in Auto.
- Local Setpoint Secure enables the user to secure against any write access to the LR parameter.

ADDITIONAL FEATURES

- Delayed alarming. A configurable timer delays alarm detection or return-to-normal messages for a specific alarm to reduce the number of alarm messages generated when a block parameter crosses back and forth over an alarm limit.
- Quality Status output parameter provides a single source for the block's value record status, block status, and alarm status.

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