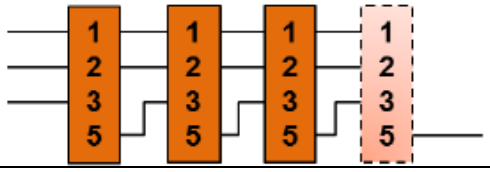
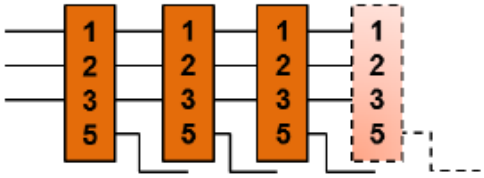
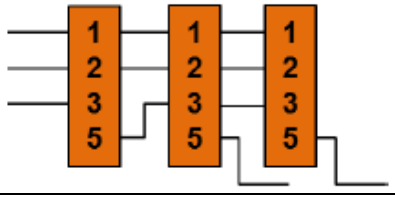
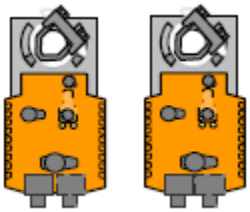
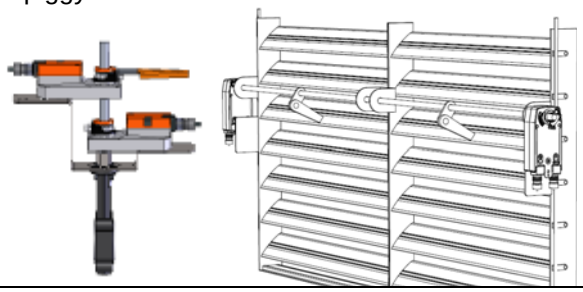
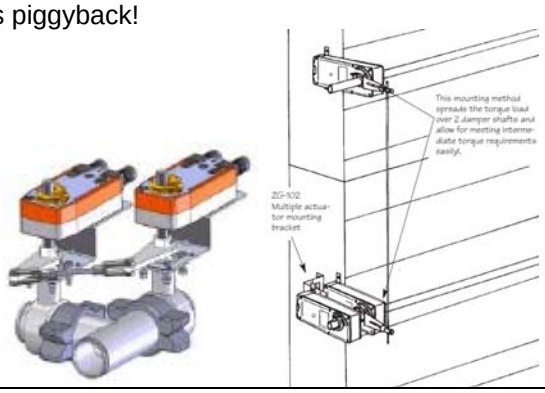
What Piggyback is all About

Terminology	Description
Piggyback	Increase in torque achieved by simultaneously controlling and physically coupling two or more actuators on one shaft or multiple mechanically linked shafts.
PGB I	Original algorithm for piggy-back applications of modulating MFT actuators. This method can be characterized by Master-Slave wiring. After mechanical overload detection the actuator shifts the U5 signal relative to the actual position value by 0.5V in each direction. In case the whole set up starts moving again after a mechanical overload, the actuator is in the piggyback mode and repeats the shift of U5 for every repositioning until power off.
PGB II	New algorithm (SW V01.28) for piggy-back applications of MFT actuators. The new piggyback algorithm PGB II is characterized by the following three steps: 1. An initialization period after each power up defines who the Master is and who the Slave is. Or if the actuator is in a single mode. 2. The U5 output of the Master and Y3 input signal of the Slave will be adjusted to 2...10V, independent of the configuration of the MFT actuators. The signal between the actuators reflects the PWM (velocity) of the actuators motors. 3. As the Master receives a control signal via its Y3 input, its U5 output provides the Slave's Y3 input with a signal to drive in a specific direction and velocity. As a result, each actuator has the same load evenly distributed amongst them.

Overview of the Electrical Wiring Options for Piggyback Mounting

Type	Description
Daisy Chain	The old fashioned way to connect multiple actuators together. The next actuator in a group of two or more always has the feedback signal (5) from the predecessor connected to its own control input (3). Only drawback is when the first actuator of the "chain" fails, the others will not respond to the control signal. 
Parallel	This is ideal for On/Off and –SR actuators, each actuator works independent of each other but responds to the same control signal. Every actuator gets the same control signal from the controller to their input (3), and every actuator provides its feedback signal (5) back to the controller (if applicable). If one fails, the others keep working! 
Master-Slave	This wiring method is preferred for piggyback applications. The Master actuator gets the control signal from the controller. Every actuator connected to it (Slave) gets the control signal from the Master to their control input (3). Every Slave provides its feedback signal (5) back to the controller (if applicable). If the Master fails, the others will not respond to the control signal. 

Clarification of Mechanical coupling and piggyback

		Typical Wiring		
Type	Description	Daisy Chain	Parallel	Master-Slave
None	* Two or more actuators on two or more shafts. * No mechanical elements for connection of the actuators. * This is not piggyback! 	☑ -SR models	☑ On/Off, Floating Point, -SR and even MFT models	
On one shaft	* Two or more actuators on one shaft. * The shaft is the means that physically connects the actuators. * This is piggyback! 		☑ On/Off, Floating Point and specific -SR models*	☑ MFT models
On more than one shaft	* Two or more actuators on two or more mechanically linked shafts. * Additional mechanical components for the connection of the actuators. * This is piggyback! 		☑ On/Off and Floating Point models*	☑ MFT models

* Piggy back GKB24-3's for On/Off or Floating Point control is <u>not</u> possible. See details on next page.

Capabilities and requirements for actuators with PGB II

	Failsafe			Non Failsafe
	GK	EF	AF	GM
Wiring	Master-Slave			
Maximum number of actuators	2	3	2	2
Combined Torque (in-lb)	720	2x = 540 3x = 810	360	720
Allowable Motor Running Time (seconds)	90 to 150	60 to 150	70 to 150	90 to 150
Shaft Diameter Requirements	1"	2x : ≥ ¾" 3x : 1"	¾"	1"

- Actuator wiring must be done in a Master-Slave configuration, for example feedback from Master (wire 5) to the control input (wire 3) of the Slave(s).
- The direction of rotation switch must be at the same setting on both the Master and Slave(s).

IMPORTANT FACTS

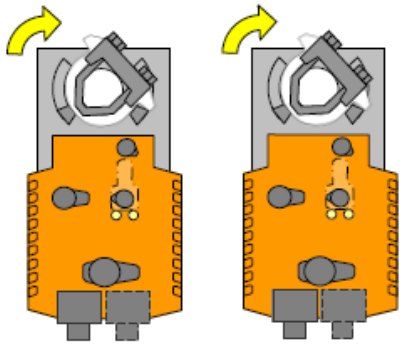
On/Off and Floating Point control actuators will not have PGB II. These models are not MFT based, so the algorithm cannot be uploaded. On/Off and Floating Point actuators do not have a feedback wire, so the Master has no way to communicate to the Slave(s). Today's EFB and AFB On/Off models can be wired in Parallel for On/Off operation with no issues (maximum of two actuators). GMB24-3 and -SR, can be wired in Parallel with no issues (maximum of two actuators). Torque loss for specific models used in piggyback still apply, i.e. two GMB24-3's or GMB24-SR's will provide 640 in-lbs instead of 720 in-lbs.
The GKB24-3 cannot be used in piggyback for On/Off or Floating Point control due to the fact of not having the ability of Master-Slave wiring. The GK -3, Master-Slave wiring is critical to not only ensure proper operation, but to also prevent the actuators from fighting one other if the fail-safe position setting of each actuator is set at a different position.

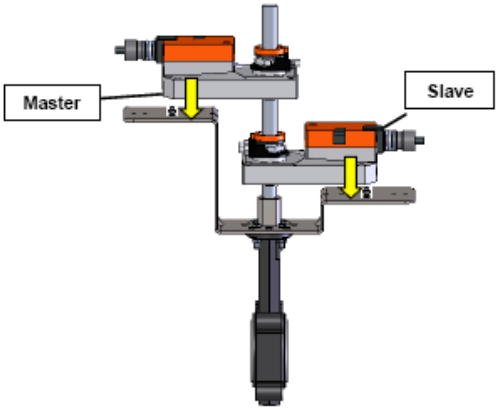
- The new PGB II algorithm will work with PGB I capable actuators of the same series. If an actuator with the new algorithm is paired up with a like actuator with the previous PGB I algorithm the feedback of the Master must be programmed the same as the control input of the Slave(s). All actuators must be programmed to the same motor run time with the fastest speed being 150 seconds. Any loss of torque will still apply.
- MFT95 is piggyback capable. The MFT95 versions of certain product series can be piggybacked with another MFT actuator. The Master must be an MFT95 and the Slave(s) must be a standard MFT.
- Mechanical limit stops must not be used. If mechanically limited at the actuator, this will cause an additional hysteresis between the Master and Slave causing it to stop. Master and Slave(s) must be allowed to run as one to reach its internal or electronic limit stop (95/90 degrees) or any external mechanical stop for proper operation, such as the full opening of a damper or complete rotation of a valve.

- Manual override cannot be used. This still applies just like previous piggyback combinations. This will cause the actuators to lose its place and will have to be reset either by running an adaptation or complete reinstall (i.e. loosening of clamp or linkage and running an adaptation from its start position).

INSTALLATION ON ONE SHAFT

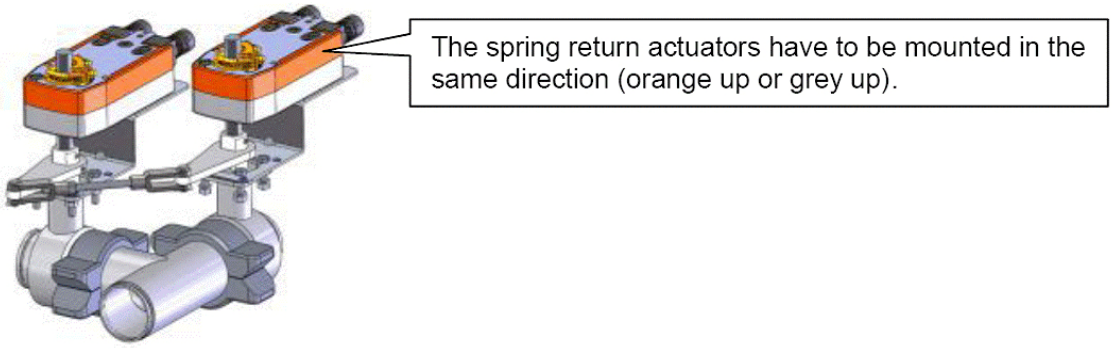
- The best results are achieved when both actuators are mounted on one shaft.
- The Master and Slave must be driven independently into the desired end stop.
- When the actuators are mounted, the wiring can be done.
- Make sure, that all actuators are on the same power source.
- Adaptation can be run when piggybacked with new algorithm (PGB II). Push the adaptation button on the Master and they will both run an adaptation.
- If the actuators run synchronously, the piggyback combination was installed properly.





MORE THAN ONE SHAFT (MECHANICALLY COUPLED)

- Even if the actuators are not mounted on the same shaft but are mechanically connected, it is a piggyback application.
- When the actuators are mounted, the wiring can be done.
- All actuators must be on the same power source.
- If a crank arm system with two actuators on two shafts is necessary, it is important that the actuators are running synchronous over the whole range. This means the two crank arms must run parallel and the crank arm system must form a parallelogram.



New piggyback algorithm, PGB II has been developed by Belimo to allow faster runtimes and no torque loss when piggyback mounting of Multi Function Technology (MFT) versions of GM, GK, EF and AF damper actuators.

The new PGB II algorithm improves the piggyback capability on the following models:
GK..24-MFT, new generation AF..24-MFT(95) for damper and valve applications and the EF..24-MFT for damper applications only.

First quarter 2012 the GM..24-MFT for damper and valve applications will be available.

How PGB II Algorithm Works

The master actuator performs a “search” for a Slave actuator at power up. Once it recognizes that a Slave(s) is connected, it reconfigures the Slave to run at the same speed and provide the same feedback as the Master, regardless what it was previously programmed for.

This algorithm is only possible with MFT based actuators; this is to ensure that the actuators work in tandem correctly and efficiently to deliver 100% of the rated minimum torque by distributing the load equally between the actuators, this is currently not completely achieved with prior piggyback capable actuators.

One more important fact, once that the Master-Slave recognition is complete between the actuators, the Master will always drive the Slave with the assumption it is under load and on a single shaft. For example, imagine two people riding on a tandem bicycle. Both people are peddling in unison to achieve the sufficient amount of force to make the bike move and maintain its speed.

Benefits and Features of the New PGB II Algorithm

- **One programming code for all actuators.**

It is no longer necessary that the control input of the Slave(s) be the same as the feedback of the Master. The new algorithm automatically recognizes that it is in a Master-Slave configuration and reconfigures the feedback of the Master and control input of the Slave(s) to 2-10 VDC.

- **Running times are automatically configured.**

The same is true with the motor running times; the Slave(s) runtime is automatically adjusted to match that of the Master by means of the new algorithm.

- **Adaptation can be run when piggybacked with new algorithm.**

This feature was not possible with PGB I. Simply push the adaptation button on the Master and they will both run an adaptation.

- **Fail-safe position and power fail delay settings for electronic failsafe actuators.**

These settings on the Slave actuator are overridden by the Master when wired for Master-Slave operation.