The Flexx Family: Achieving more through unrivaled modularity

This article is the second instalment in The Flexx Family, our five-part series of white papers on our Metroflexx and Regioflexx brake control solutions.

- Pushing boundaries with integrated solutions
- Achieving more through unrivaled modularity
- A maintenance breakthrough
- New functionalities thanks to SIL4 architecture
- Converging on the future of brake architecture

Wabtec

Laying the foundations of a unique versatility

For the second part of this series, we will focus on a standout feature of the Flexx Family: its versatility. We will explain how Metroflexx and Regioflexx can cover all current brake control architectures, and explore the cutting-edge innovation that enables the Flexx Family to meet demanding Guaranteed Emergency Brake Rate (GEBR) requirements at a highly effective Total Cost of Ownership (TCO).

In the previous instalment of this series, we explained that our Flexx Family products feature commonalities in their electronic and pneumatic architecture.

Electronics

Metroflexx and Regioflexx both feature two independent electronic units. One SIL2 unit performs the main functions, while one SIL4 unit performs high safety-related functions and monitors the SIL2 unit.

Pneumatics

Both products incorporate two relay valves, which build up brake cylinder pressure (including wheel slide protection control). These valves offer unmatched performance in terms of air flow and reaction time, with extremely low hysteresis. A third pneumatic module ensures safe load control over brake cylinder pressure, even in the event of electric or electronic failure.

Each relay valve ensures adequate air delivery to maintain the brake cylinder pressure for a complete bogie (up to six brake cylinders), meeting the required response times for filling and venting.

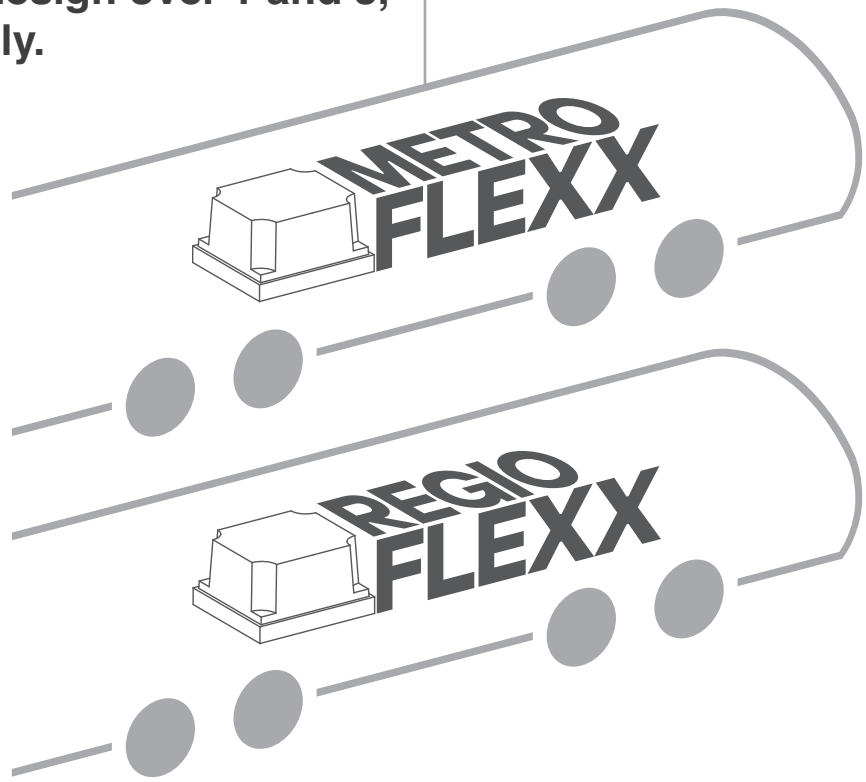
During the development of the Flexx Family products, we identified a significant opportunity: providing the options to have a common supply for the two relay valves or have a dedicated independent supply for each relay valve. Recognizing the benefits this would offer our customers, we integrated this patented feature into our design, establishing the unique versatility that characterizes the Flexx Family today.

In practice: how the Flexx Family design offers customers unrivaled modularity

The figure below shows the different brake control architectures supported by the Flexx Family.

Configurations 1 and 3 correspond to the traditional and widely used “control per car” and “control per bogie” architectures, respectively.

Meanwhile, configurations 2 and 4 showcase the improvements made possible by our Flexx Family’s unique patented design over 1 and 3, respectively.



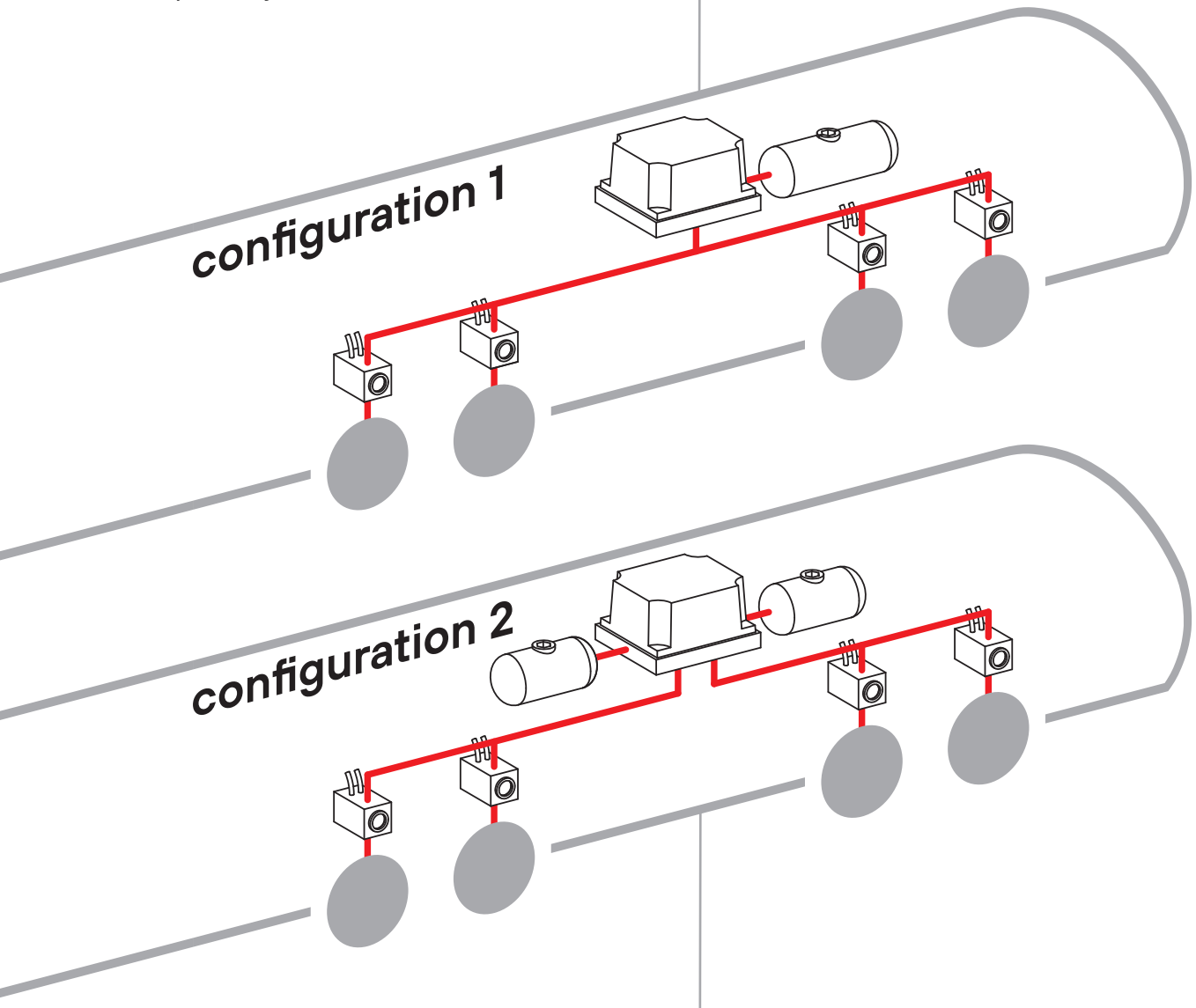
Configuration 1

Configuration 1 features one Flexx unit per car, equipped with one brake reservoir. This set-up requires external dump valves installed close to the bogie to ensure optimal wheel slide protection (WSP) performances.

Emergency braking operates on a per-car basis while service braking and WSP are distributed at the level of each bogie and axle, respectively.

This configuration offers the optimal TCO for long trains comprising five or more cars depending on GEBR requirements. Its key enablers are the Flexx high-performance relay valves, which can each provide brake cylinder pressure for one complete bogie.

Under this architecture, a single worst-case failure may result in the loss of brake capacity for the entire car.



Configuration 2

Configuration 2 features one Flexx unit per car, and combines the relay valves' high performance with the added modularity of supplying each valve from a separate brake reservoir.

As a result, emergency braking operates on a per-bogie basis, while service braking and WSP remain distributed at the level of each bogie and axle, respectively.

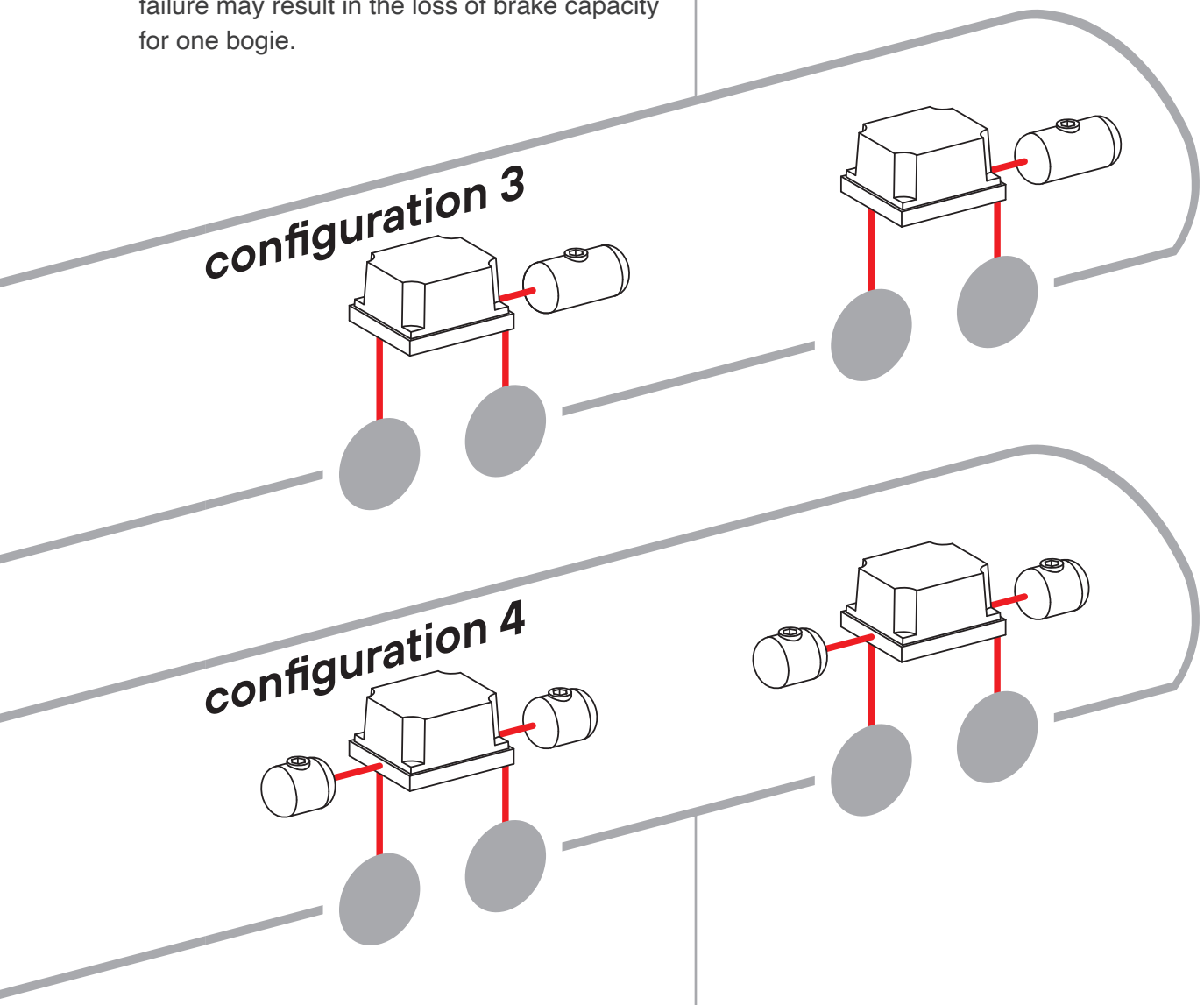
This improvement is delivered at near-identical cost as configuration 1, reducing manufacturers' operating expense and train operators' lifecycle costs.

Under this architecture, a single worst-case failure may result in the loss of brake capacity for one bogie.

Configuration 3

Configuration 3 features one Flexx unit per bogie.

Having one brake reservoir per bogie enables emergency braking to operate at the level of each bogie, while service braking and WSP are both distributed at the level of each axle. Under this architecture, a single worst-case failure may result in the loss of brake capacity for one bogie.



Configuration 4

Configuration 4 features one Flexx per bogie, with each relay valve fed by a separate brake reservoir.

The result is that emergency braking, service braking and WSP are all distributed at the level of each axle.

This configuration is the perfect solution for very short trains, such as two-bogie single-car trains or three-bogie two-car trains. As this market segment grows in Europe, these Flexx Family features are proving very popular. Under this architecture, a single worst-case single failure may lead to the loss of brake capacity for one axle.

Offering customers the right configuration for each market segment

Mass transit

Configurations 1 and 2 are the most popular for mass transit applications, the former being generally the most cost-effective option for trains numbering more than five cars. In addition to providing per-bogie emergency braking for nearly the same cost, Configuration 2 also offers simpler installation, albeit at an increased TCO.

The difference in brake control costs between the four available configurations can be expressed by using Configuration 3 as the reference:

- Configuration 1: 84
- Configuration 2: 86
- Configuration 3: 100 (reference)
- Configuration 4: 102

The discrepancy between Configurations 1-2 and Configurations 3-4 amounts to the cost difference between a single larger brake reservoir and two smaller reservoirs. However, these variations only account for brake control equipment and don't reflect savings on installation and life cycle costs.

To best meet the needs of our customers, the Metroflexx system comes in two versions:

- Metroflexx-B ("Bogie control") for Configurations 3 & 4
- Metroflexx-C ("Car control") for Configurations 1 & 2, which includes the control board for the external WSP valves

Multiple units

A wide range of applications in the XMU segment, especially in Europe, currently involve Jacobs bogies. Configuration 3, with one Flexx unit per bogie, provides a natural fit for these cases. However, in this diverse and often highly competitive segment, car-level control involving one Flexx unit remains a possible solution. For double-pipe applications involving Configurations 1 and 2, Regioflexx features an external WSP control board.

High-speed and very high-speed rail

For very high-speed applications, Regioflexx integrates all the specific functions required for wheel slide protection, including EN 15595-compliant wheel rotation monitoring and electronic redundancy.
The natural configuration for these cases is Configuration 3, which offers major benefits in minimizing complexity and installation cost. That being said, high-speed trains are usually long and may not need to rely on per-bogie control to meet their GEBR requirements. Therefore, Flexx Family also include solutions based on configurations 1 or 2 when competitiveness is a high priority.

Takeaway: how the Flexx Family prepares a high-performance future without the higher cost

We believe increasingly demanding GEBR requirements will be a key component of future rail systems. This will be a natural outgrowth of several market and technical trends, such as advances in managing rail adhesion to make braking distance more predictable. Others include the need for increased efficiency in transport systems, improvements in signaling systems' performance and the rise in automated train operations.
The versatility of the Flexx Family brake control systems, and the possibility of dramatically improving GEBR performance at virtually no additional cost, are powerful tools for building trains that meet tomorrow's requirements today

Pablo Castro
Director of Technical Sales, WABTEC

At a glance: versatility that only the Flexx Family can offer

- Brake control architecture offering optimize TCO in any situation
- Unrivaled flexibility matching any train configuration and GEBR requirements
- A unique capacity for axle-control emergency braking on very short trains, at minimal extra cost
- Future-readiness for evolving GEBR requirements