MTS

System Description

WABCO

MTS

System Description

Edition 2

This publication is not subject to any update service.
New versions are available in INFORM at
www.wabco-auto.com

WABCO

Version 1/10.2007(en)
815 010 104 3

1 Symbols used

DANGER 

Imminent hazard situation which can cause serious personal injury or death if the safety instruction is not observed.

WARNING 

Potential hazard situation which can cause serious personal injury or death if the safety instruction is not observed.

CAUTION 

Potential hazard situations that can cause minor or moderate personal injury if the safety instruction is not observed.

Important instructions, information or tips that you should always observe.

- List Action step

– Step

➔ Result of an action

2 Modular Door Control through the years

WABCO has produced bus door drive and control components for many decades. Prior to that, pneumatic safety circuits were already being developed.

Over the decades, ever more complex systems emerged which ultimately only specialists could fully understand. Subsequently, WABCO developed the first electronic control system for pneumatic bus doors as early as 1979.

Continuous further development resulted in the introduction of ETS - the Electronic Door Control System - in 1986/87. ETS was the first system to implement all control and safety functions in only one valve making the system easy to understand and cost-efficient. The need for time-consuming adjustment procedures was also reduced, for these reasons ETS became the standard system for many bus manufacturers.

MTS - Modular Door Control

On the basis of our experience, MTS was developed and deployed for the first time in 1997. The special feature of this system is that it can be used with any door model. Inward swivelling doors, outward swinging doors and swivel sliding doors with pneumatic or electrical drive can be combined with one another without problems.

Another innovation is represented by the connection to the electronic system of the vehicle. Here, it is possible to use a CAN data bus, therefore, only two or three lines are required to control up to 5 bus doors.

For vehicles without a central data bus, conventional cabling can be used as an alternative. However, contrary to other systems, the lines must only be connected to the electronic control unit of the first door.

Regardless of whether CAN or conventional cabling is used, the individual doors must be connected via the system CAN bus and signal processing is centralised in the control unit on the first door. For this reason, the complex relay interconnections in conventional control systems are no longer necessary.

The parameters available in the software make it easy to adapt and control the system to requirements specific to certain vehicle manufacturers. The data for all vehicle doors is stored on the control unit of the first door. This way, the electronic control units on all doors except the first door can be changed without taking the parameters into account.

The MTS system also has a diagnostic capability: diagnosis takes place via the so called CAN diagnosis or via a separate K line diagnosis, regardless of the type of connection used.

If Pneumatic doors are used, they are monitored via newly developed potentiometers and pressure switches which are fitted directly on the rotating column. Due to mechanical coding, these sensors do not require any settings. Electrically driven doors can equally be monitored with the help of these potentiometers; alternatively, pulse generators installed in the engine can be used together with an limit switch.

A simple teaching process is used to balance all the tolerances during initial start-up or when the ECU is replaced for every door. For this you only need to move the doors once to the two stop positions by pressing the workshop push button continuously.

The well-proven ETS principle was further developed for pneumatically driven doors. The end position damping, which was previously part of the door cylinders, was integrated into the revised door valve and is controlled by the electronic control system. Apart from the cost-related advantages, this also results in much more flexibility to the movement of the different doors. This also prevents maladjustments, thereby increasing operational safety.

MTS-PX/EX

WABCO was able to further increase the already proven flexibility of the MTS system in the most recent generation **MTS-PX/EX** by integrating a multiplex system:

If the MTS is connected to the vehicle via a CAN bus, it is possible to freely assign eight inputs and eight outputs at the doors 2-5 respectively. On the first door, 6 inputs and 3 outputs can be freely assigned. The respective data is exchanged with the vehicle computer by means of the newly defined CAN messages and can be combined as required within this computer.

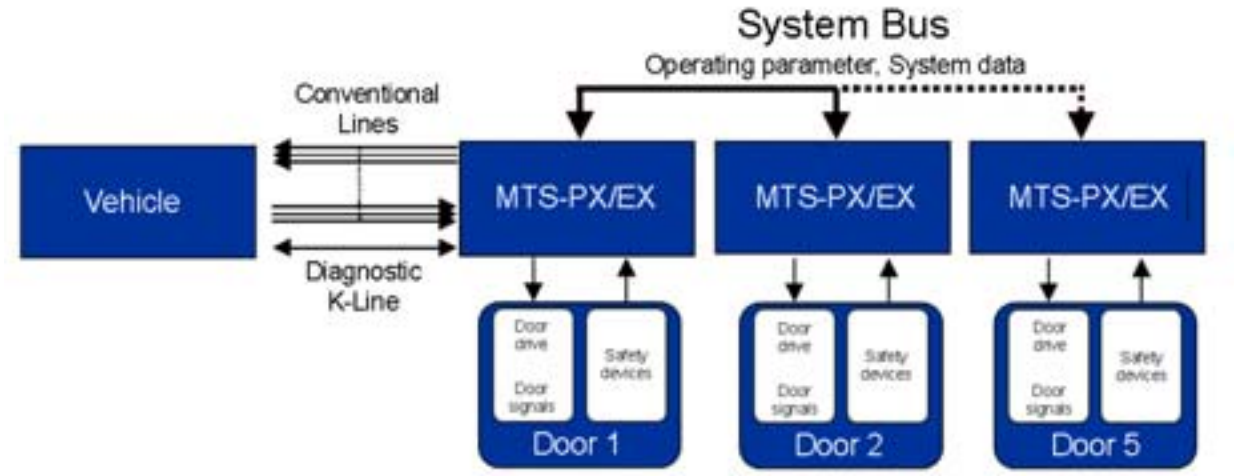
Programming and purpose of the functionality are the responsibility of the manufacturer.

It is possible to connect electrical terminal strips directly to the MTS-PX/EX and to monitor them without any additional devices.

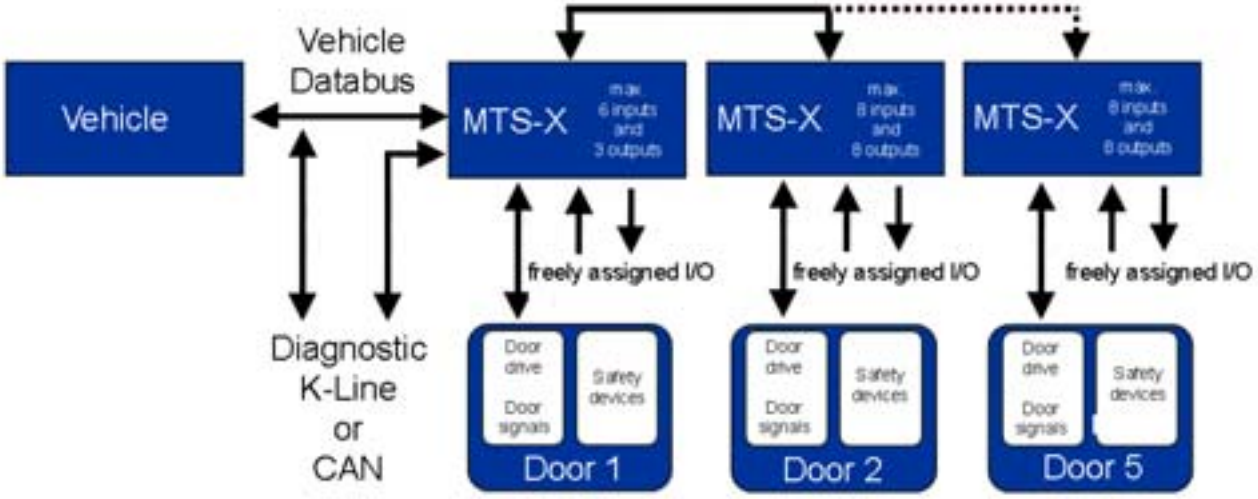
Furthermore, the MTS-PX can control both outward-swinging doors of a touring coach using only a single electronic control unit.

3 System principle of the MTS system

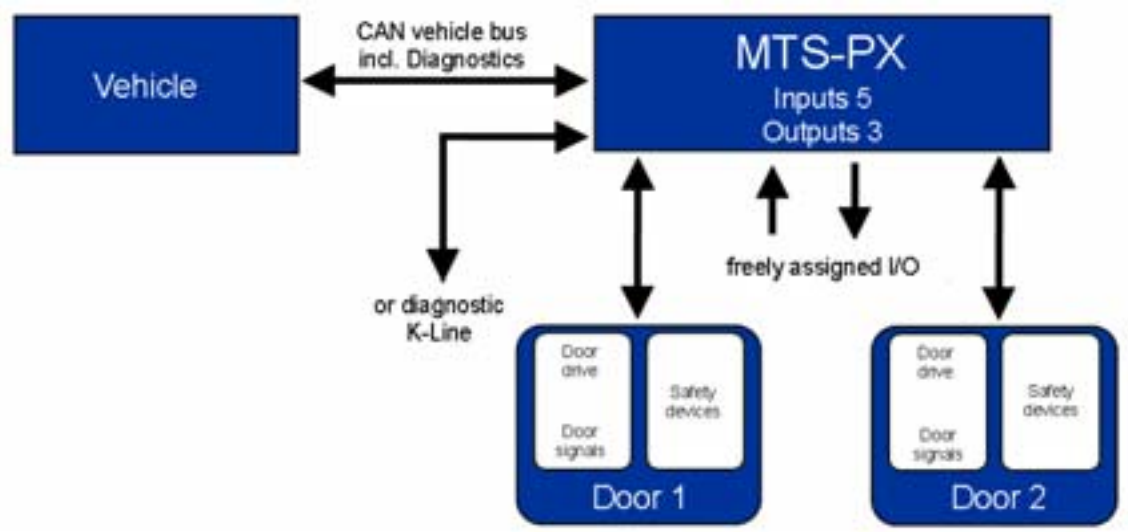
3.1 Connection to a vehicle with conventional cabling



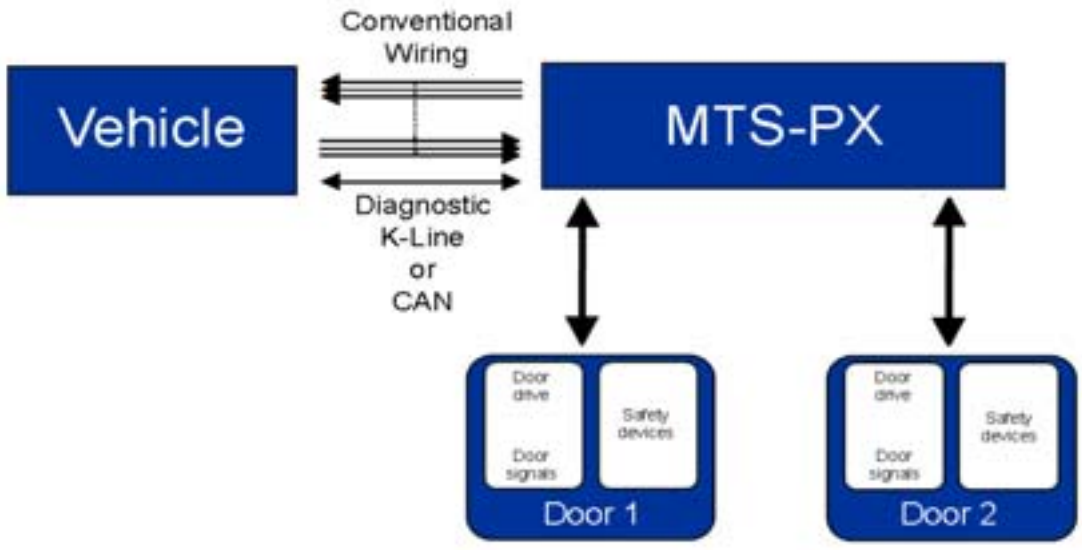
3.2 MTS-PX/EX in the vehicle-CAN-BUS combination



3.3 MTS-PX as touring coach door control – with CAN



3.4 MTS-PX as touring coach door control – conventional

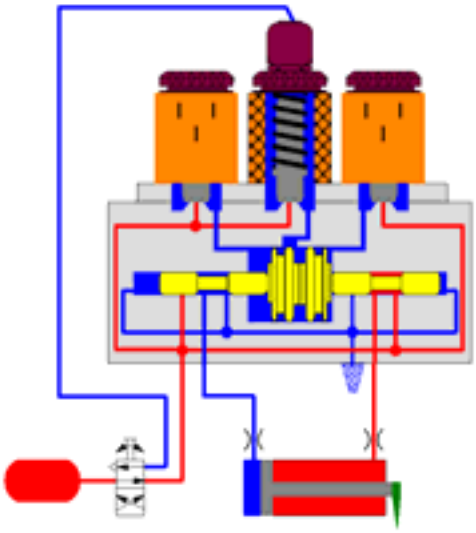


4 ETS – Electronic Door Control System

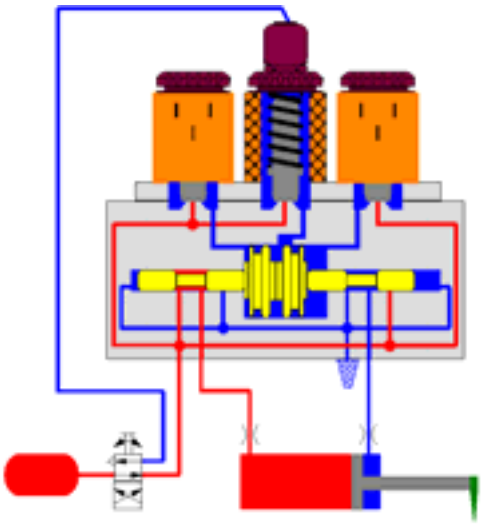
4.1 Basic functions

The following illustrations show the different pneumatic switching positions of the ETS door valve. The same principle is also applied for MTS (additionally enhanced by the "air cushioning" function).

ETS - Door closed under pressure



ETS - Door opened under pressure



Simply put, the ETS valve consists of 2 pistons (right and left) and 3 pilot solenoid valves (top) apart from the housing components.

A short current pulse on one of the outer solenoids causes both both pistons to move into one of the possible end positions simultaneously.

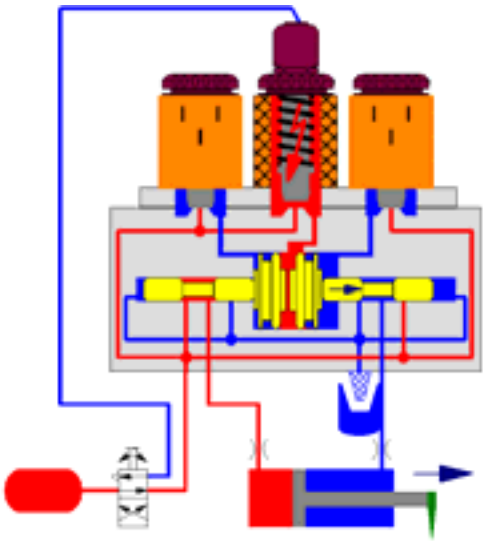
During this process, the valve exhibits the function of a common directional 4/2 valve, i.e., depending on which solenoid was energised last, one cylinder chamber

is charged while the other chamber is vented. In this way the door is opened or closed.

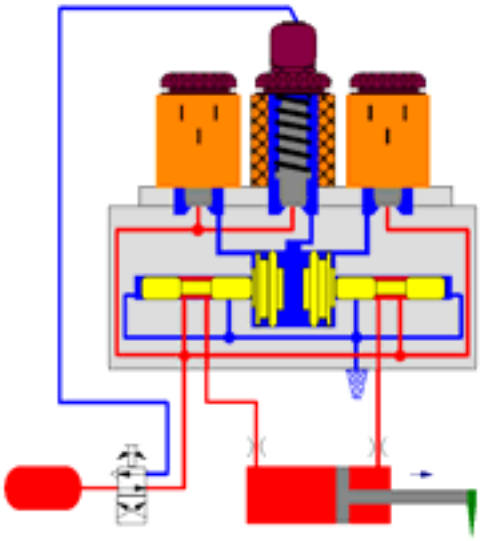
The fixed nozzles in the cylinder lines are decisive in determining the door speed. Air cushioning in the ETS system is implemented via damping integrated in the door cylinders (not shown in the illustrations).

4.2 Jam protection in opening direction (switching to powerless)

ETS - Door switches "powerless" in the direction of opening



ETS - Door is "powerless“



The "powerless function" is used as jam protection in the opening direction. If the electronic control system detects via the sensors that somebody is caught between the doors while they open, a current is briefly applied to the central solenoid. The two pistons in the valve are thereby moved the their respective outer position. This causes both cylinder sides to be charged with full supply pressure simultaneously.

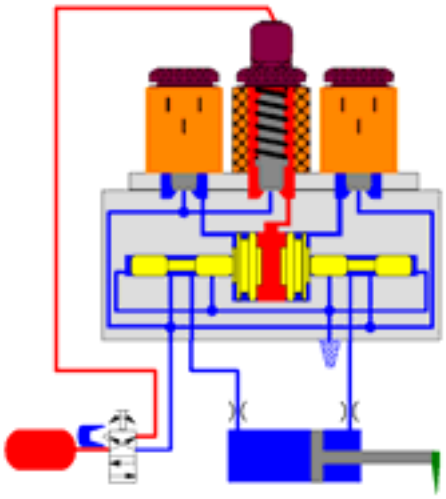
The still remaining (insignificant) force is determined entirely by the piston differential surface area and does not represent any danger.

If this safety function was activated, it is subsequently possible to close the door again without delay.

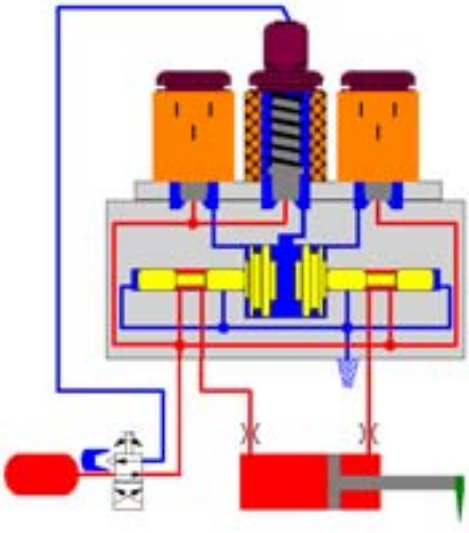
Regarding the construction of the door's mechanical system, it should be observed that a powerless door should tend towards opening.

4.3 Emergency operation: Protection against rapid movement after emergency valve reset

ETS - Emergency valve actuation



ETS - Emergency valve reset

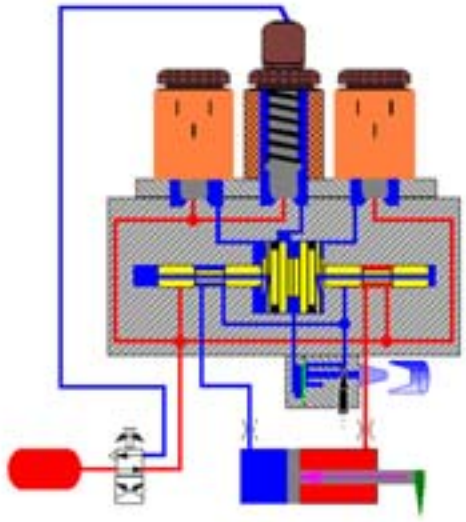


In combination with the directional emergency valve 4/2 the "switching to powerless" function is used to prevent sudden movements of the door wings after the emergency valve is reset. Dangerous sudden door movement is prevented because both cylinder sides are charged simultaneously.

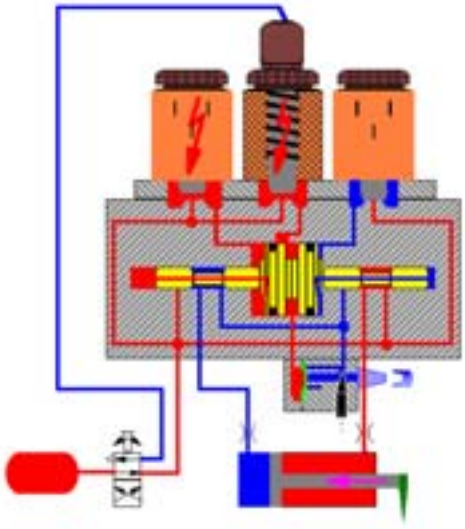
5 MTS solenoid valve

Sectional view of the MTS solenoid valve

MTS solenoid valve with undamped closing movement



MTS solenoid valve with dampened closing movement



A switchable exhaust air throttle was integrated into the MTS solenoid valve in addition to the functions described above. Since the cylinders are controlled by the electronic control unit, they are braked before reaching the respective end positions.

When the solenoid valves are not energised, the cylinders are vented without throttle action.

To brake the cylinders, one of the outer solenoids **and** the central solenoid are activated, depending on the direction of movement. The exhaust air from the cylinders can now only escape into the atmosphere via the adjustable throttle.

6 Teaching for the MTS

Aim:

Adaptation to the most important framework conditions, thereby allowing fast and simple commissioning of the overall MTS system as well as individual door modules.

What is learnt?

For the overall system:

- Number of electronic control systems for doors installed
- System operating mode (conventional or CAN operation)

For each door:

- Door-Open and Door-Closed positions of the door sensors
- Number of door valves

All the programmed values can be read out by means of diagnosis.

How is information learnt?

- By pressing the workshop button for a period of approx. 5 seconds on each door.
- Number of extension modules and door operating modes are programmed by pressing the workshop button on door 1.
- Teach-in process is acknowledged by the entrance lighting flashing.
- Number of flash pulses corresponds to the door position in the vehicle.

7 Components of the MTS system

Component	Comment	Part number
ECU for pneumatic doors* 	MTS-EX replaces 446 190 000 0 446 190 002 0	446 190 001 0
ECU for electrical doors*: 	MTS-EX replaces the MTS-E (446 190 010 0)	446 190 011 0
MTS solenoid valve 	1x for each door 2x in the case of separate door wing actuation	472 600 022 0
MTS door cylinder 	(diameter 50 x 140 mm for doors swinging to the inside) New: Diameter: 50 x 160 mm 1x for each door wing	422 812 000 0 422 812 002 0
Sensor for inward-swinging door 	125° angle of rotation 1x for each door wing with pressure-wave duct	446 190 150 0
Sensor for outward-swinging door	180° angle of rotation 1x for each door wing	446 190 151 0
Sensor for inward-swinging door	125° angle of rotation 1x for each door wing without pressure-wave duct	446 190 152 0
Pressure switch 	4 bar, NO 2x for each door valve	e.g. 441 014 017 0
Emergency valve with electronic switch 	1x for each door	952 003 032 0

* Generally, adjustment work carried out by WABCO is required to ensure that the door's electronic and the door's mechanical systems interact flawlessly for the safety of passengers and operational safety.
To use the system in series it is imperative to discuss this with the door or vehicle manufacturer and to obtain his approval if the joint assessment was positive.

8 Diagnosis of the MTS system

To diagnose the current MTS system, a commercially available laptop (Pentium, WIN 9x/NT...) and a connecting cable between the interface and the door system are required in addition to the diagnostic program and the diagnostic interface including the cable. The type of connecting cable required depends on the diagnostic socket installed by the vehicle manufacturer.

The diagnosis interface serves to connect the PC/Laptop with the vehicle control system. It is included in the delivery of the connecting cable to the 9-pin COM interface of a PC. Depending on the version, it is supplied with a connecting cable to the 9-pin COM interface or the USB port of a PC. It was not developed especially for MTS and is also used for the diagnosis of other WABCO systems.

Component	Description	Part number
PC diagnostic program		446 301 580 0 (D) 446 301 581 0 (GB)
Diagnostic Interface 	including cable between interface and PC COM, USB	446 301 02x 0

9 Annex

9.1 Pin assignment

9-pin connector: Data busses, diagnosis, addressing

Pin No.	Character	MTS code	Pin name
1/9	Bus	CANHF	CAN H vehicle bus
2/9	HF bus ground	CANGF	CAN GND vehicle bus
3/9	Bus	CANLF	CAN L vehicle bus
4/9	Bus	CANHS	CAN H system bus
5/9	Bus	CANRS	CAN termination
6/9	Bus	CANLS	CAN L system bus
7/9	Diagnosis/Address	DIAK/ADR3	Diagnosis K - Line / Address 3
8/9	Address	ADR2	Address 2
9/9	Address	ADR1	Address 1

The vehicle bus is only connected to door 1. If the vehicle does not contain this bus, connection is alternatively possible via the 12 or the 6 pin TS connector as applicable.

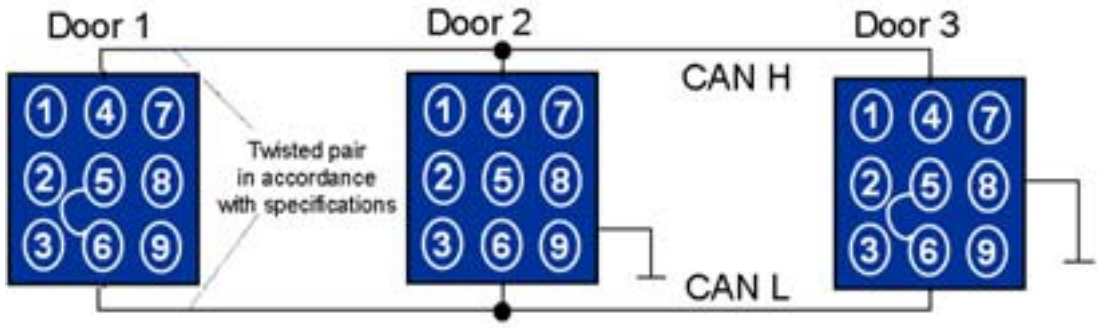
The address pins in the vehicle cable harness must be wired in accordance with the table below in order for the MTS electronic systems to "know" on which door they are deployed.

Address "door"	ADR3 (Pin 7/9)	ADR2 (Pin 8/9)	ADR1 (Pin 9/9)
Door 1	(Diagnosis)	Open connection	Open connection
Door 2	Open connection	Open connection	Ground
Door 3	Open connection	Ground	Open connection
Door 4	Open connection	Ground	Ground
Door 5	Ground	Open connection	Ground

Terminating resistors for the CAN system bus are required on the first and the last door of a vehicle respectively. These are integrated in the electronic system and are respectively active via a bridge between pins 5/9 and 6/9.

When the ignition is switched on, the voltage on all MTS electronic control units must be applied simultaneously to ensure that the overall system is initialised correctly.

System CAN data bus in the case of 3 doors

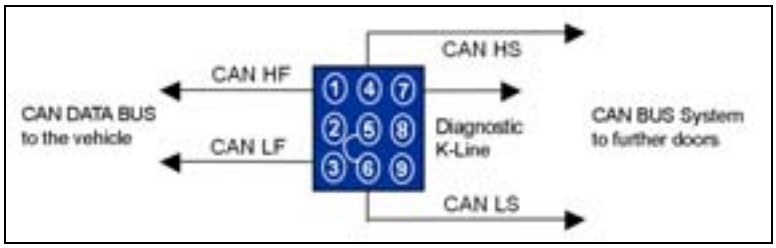


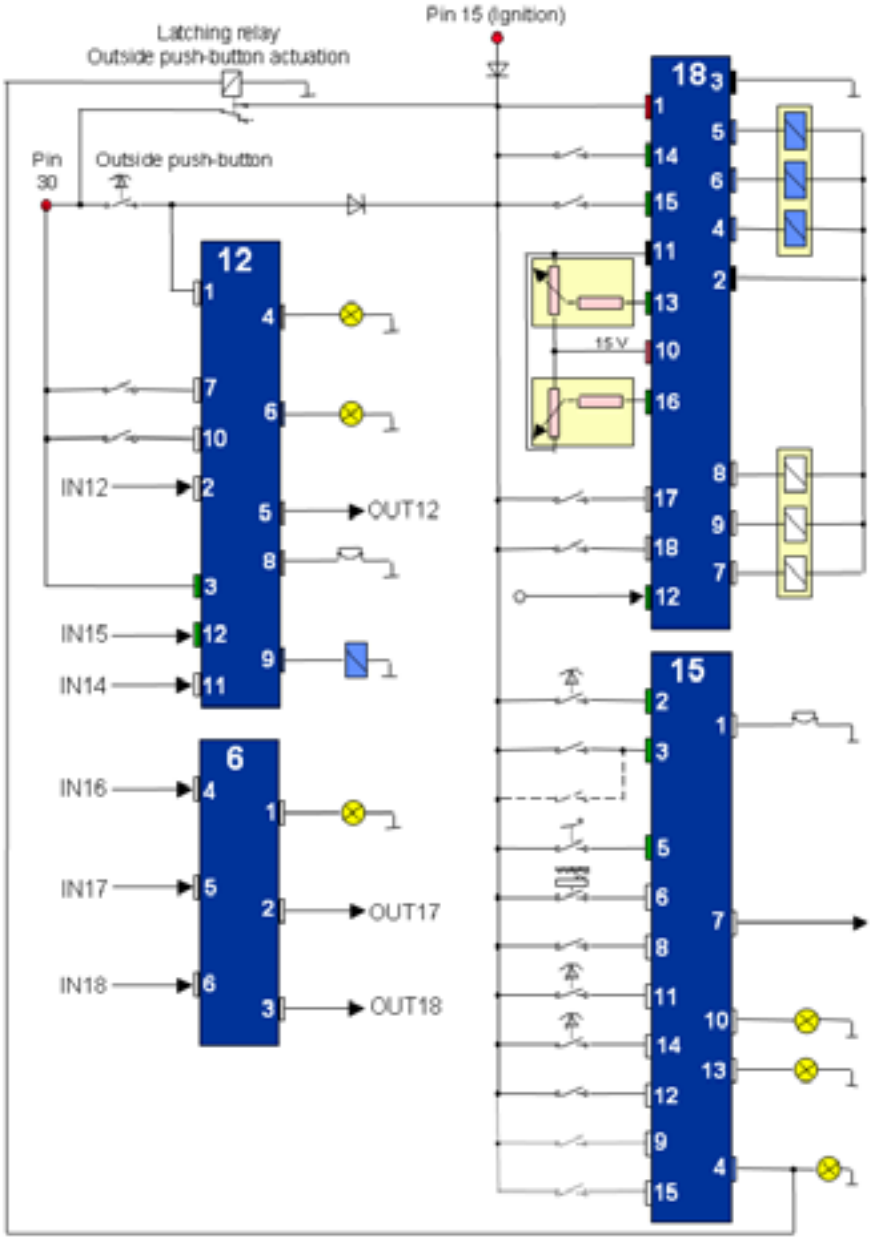
Pin	MTS code	Pin name
6-pin connector:		
1/6	HWA2	Signalling stop request
2/6	KWA	Pushchair request
3/6	ST3	Fault lamp, door 3
4/6	FG	Door release
5/6	KWFA	Pushchair function, driver
6/6	FAT3	Driver button, door 3
9-pin connector:		
1/9	CANHF	CAN H vehicle bus
2/9	CANGF	CAN GND vehicle bus
3/9	CANLF	CAN L vehicle bus
4/9	CANHS	CAN H system bus
5/9	CANRS	CAN system bus
6/9	CANLS	CAN L system bus
7/9	DIAK/ADR3	Diagnosis K - Line (door 1) / Address 3
8/9	ADR2	Address 2
9/9	ADR1	Address 1
12-pin connector:		
1/12	FAT1 (V)	Driver button, door 1 /FAT1 front
2/12	FAT2	Driver button, door 2
3/12	ZUN	Ignition detection
4/12	ST1	Fault lamp, door 1
5/12	ST2	Fault lamp, door 2
6/12	RTGN	Red-Green display
7/12	SPH/FAT1H	Disable door wing, rear / FAT1 rear
8/12	SUM	No-pressure buzzer
9/12	HB	Bus stop brake
10/12	SPV	Disable door wing, front
11/12	LICHT	Enable entrance lighting
12/12	HBAB	Switch off bus stop brake
15-pin connector:		
1/15	TSW	Closing door warning
2/15	WFAT	Workshop button
3/15	DW	Pressure surge (Sensing wing edge)
4/15	ESB	Entrance lighting
5/15	NHB	Emergency valve actuation

Pin	MTS code	Pin name
6/15	LS	Light barrier
7/15	RMPST	Ramp control
8/15	TBL	Door blocking
9/15	EIN1	Input 1 for door-specific functions
10/15	HWA1	Stop request indication
11/15	HW	Stop request
12/15	AUTO	Automatic operation
13/15	FGA	Door enabled indication
14/15	KW	Pushchair
15/15	EIN2	Input 2 for specific functions
18-pin connector:		
1/18	UB	Terminal 15
2/18	VBGND	Valve block, ground
3/18	GND	Terminal 31 / Ground
4/18	AUFV	Valve Open front
5/18	ZUV	Valve Closed front
6/18	ILF	Valve Powerless front
7/18	AUFH	Valve Open rear
8/18	ZUH	Valve Closed rear
9/18	ILR	Valve Powerless rear
10/18	UREF	Reference voltage, sensors
11/18	ANGND	Analogue ground, sensors
12/18	C3	C3 Speed signal
13/18	POSV	Position sensor, front
14/18	DSAV	Pressure switch Open, front
15/18	DSZV	Pressure switch Closed, front
16/18	POSH	Position sensor, rear
17/18	DASH	Pressure switch Open rear
18/18	DSZH	Pressure switch Closed rear

9.2 Wiring examples

MTS-PX, door 1, CAN-BUS cabling, 2 independent door wings

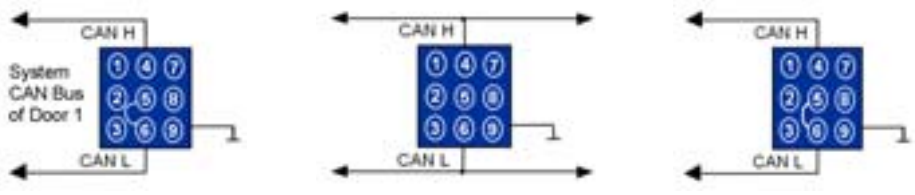


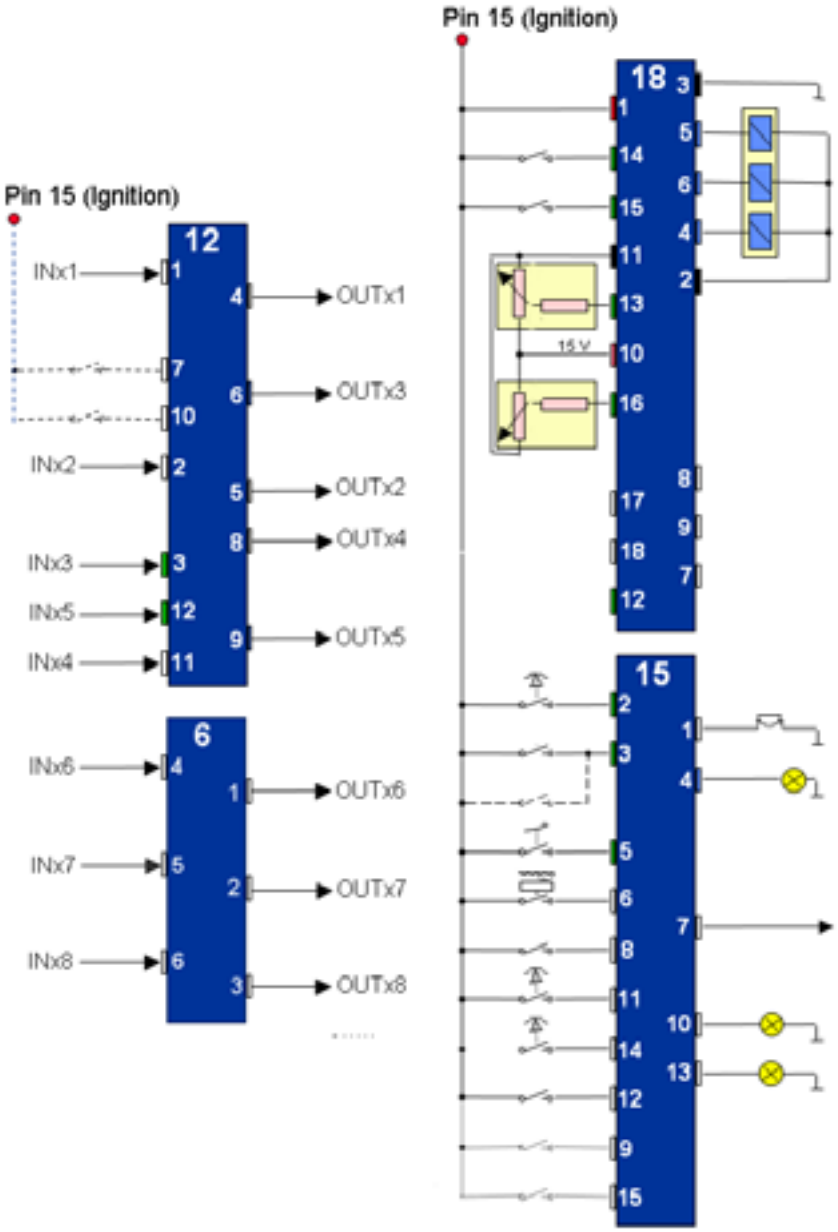


MTS-PX, doors 2...5, CAN-BUS cabling, 2 door wings

9-pin connector

Example: Door 2/2	Example: Door 2/3 or more	Example: Door 3/3

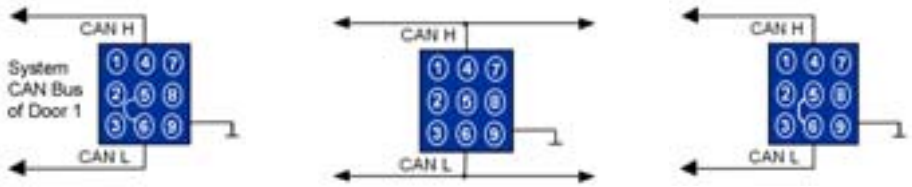


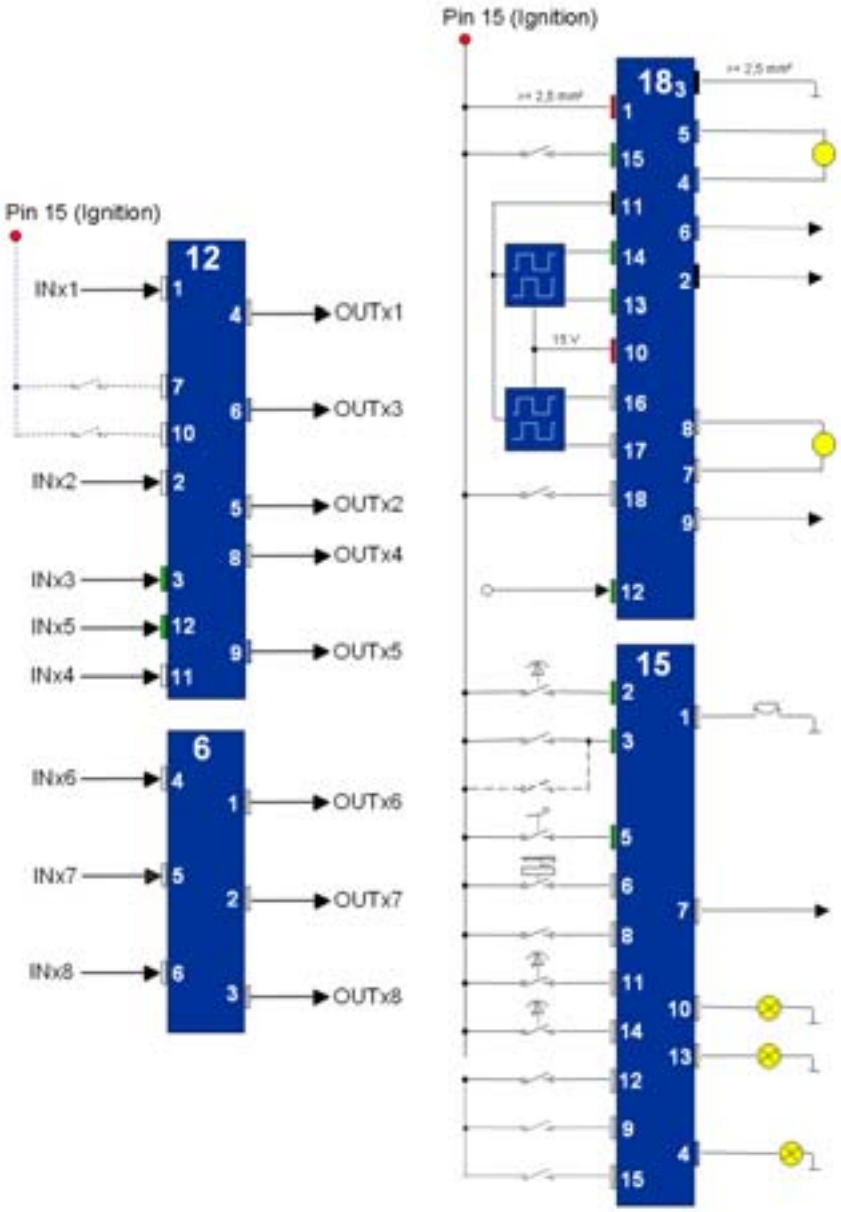


MTS-EX, door 2...5, CAN-BUS cabling, 2 el. motors

9-pin connector

Example: Door 2/2	Example: Door 2/3 or more	Example: Door 3/3





WABCO Vehicle Control Systems, is one of the world's leading providers of electronic braking, stability, suspension and transmission control systems for heavy duty commercial vehicles. WABCO products are also increasingly used in luxury cars and sport utility vehicles (SUVs). Customers include the world's leading commercial truck, trailer, bus and passenger car manufacturers. Founded in the U.S. in 1869 as Westinghouse Air Brake Company, WABCO was acquired by American Standard in 1968 and spun off in 2007. Headquartered in Brussels, Belgium, the business today employs more than 7,000 people in 34 offices and production facilities worldwide. In 2006, total sales were $2 billion. WABCO is a publicly traded company and is listed on the New York Stock Exchange with the stock symbol WBC.

www.wabco-auto.com

WABCO