



SERVING  
SAFETY

# Mors Smitt Railway Technology

## Door control units

Gate to safety





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New solutions are co-designed with railway operators and contractors, creating ever safer railway trains

## Gate to safety



Mors Smitt, well known for its railway components, has expanded its wide range of railway products with door control units for all types of rolling stock. The door control units (DCU) are developed in close cooperation with the Dutch company Wilee Techniek.

### Safety

Through the last decades door systems have developed tremendously. Safety and reliability are the key points in this development. Accurate controlling and checking of this safety related component are vital for reliable operation, making the door control unit the 'brain' of the door system.

Door control units control door opening / closing so passengers can safely get in and out of trains. Doors come in all sizes and shapes, different power systems, controls and door types. Examples of the different types that our door control units can handle:

#### Power system

Electric – motor driven  
Pneumatic – air cylinder

#### Door control

Spindle driven  
Belt driven  
Arm

#### Door type:

Sliding  
Plug sliding  
Single leaf  
Double leaf

### Features

- Control movement of doors
- Sensing fault operation or malfunction of any train door
- Prevent opening doors when train is moving and not at the platform
- Prevent closing doors when a person is in the door opening
- Logging faults & events of doors for further investigation purposes
- Prevent door malfunctioning due to compensating for environmental influences and mechanical wear and tear

### Benefits

- Flexible solutions new built trains
- Retrofit specialist
- Turn key project management
- Short delivery time
- Competitive price

**Safety. Reliability. Mors Smitt.**

Powered by:



- 20 years experience
- 50.000 DCU's installed worldwide



www.morssmitt.com





## Door Control Unit



- Control signals**
- Side selection left / right platform
  - Central door open command
  - Central door close command
  - Forced close command
  - Speed signal

- Feedback**
- Interlock / Green loop signal
  - Drag detection loop
  - Status DCU over communication bus
  - Emergency lever used

- Door signals**
- Local control signals
    - Pushbutton
    - Handicap pushbutton
  - Local feedback signals
    - Audio warning
    - Light warning

- Obstruction detection through**
- Photo cell, feedback on obstruction of door
  - Motor obstruction (based on motor current)
  - Sensitive edge, detection of;
    - Obstacle detection
    - Drag detection
  - Speed information (encoder)

- Service and maintenance**
- Wear and tear of the components are compensated, continuous measurement and adjustment of the motor control ensures smooth movements avoiding periodic maintenance.
  - 'WinTrain' monitoring and diagnostic software registers fault & events and helps with setting up and adjusting door systems.

- Environmental conditions**
- Power consumption by the motor and train speed are continuously measured. Software monitors and if necessary adjusts the control levels when for example low temperature or snow increases door sliding resistance

**Ability to control sliding steps / gap bridges**

## Principle

A door control unit is the nerve centre of a door system, the door is controlled and monitored to ensure correct functioning whilst ensuring maximum safety.

To ensure the function and safety the door control unit is continuously checking its own system and components. At each door cycle critical components are checked:

- Open and close switches
- Encoder signals
- Current measuring system
- Safety relay in motor driver
- H-bridge transistors
- Calibration of open position

The design build-up and control allows:

- No single point failures
- Easy function modifications by uploading software via PTU

The system combines the in- and output signal to a safe and reliable door status.

### Detected and controlled signals

Door signals

- Local control signals such as push- and handicap buttons for passengers
- Local feedback signals for passengers like audible and or visual warnings

Obstruction detection through multiple sources

- Photo cell, feedback on obstruction of door
- Motor obstruction (measured on current consumption of the motor)
- Sensitive edge, crush detection / drag detection
- Speed info through motor encoder

Ability to control sliding steps / gap bridges

Control signals from train management system or driver

- Side selection left or right platform
- Central door open command
- Central door close command
- Forced close command

Feedback to train control system or driver

- Interlock / green loop signal
- Status door control unit via communication bus / train network (TMS)
- Emergency lever used



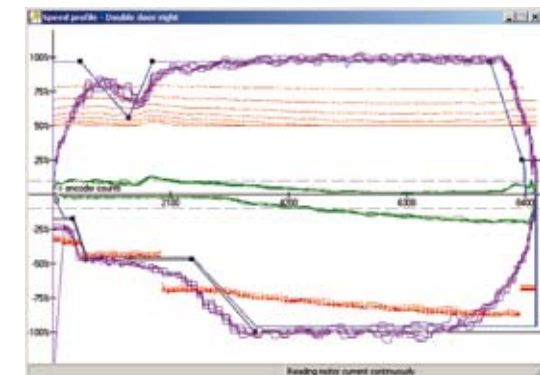
## WinTrain

Software in the door control unit continuously monitors all parameters. Slightly changed values, due to certain seasons or wear and tear of the door like power consumption and speed are compensated and levels are adjusted avoiding unnecessary error reports or maintenance intervals.

The door control unit can be equipped with an external system test at power-on optionally. Components like encoder, moving direction, switches, etc. are checked on presence. With a second option the door control unit determines the motor temperature by simulation algorithm.

The door control unit will be supplied with WinTrain Software. WinTrain is an easy accessible tool which supports easy configuration and maintenance:

- 'WinTrain' provides extended monitoring, diagnosis, up / download features and parameter adjusting for maintenance
- Allowing access to just one, or all door control units simultaneously in the local car network (if RS485 multi-drop is used)
- Access to WinTrain functions units allowed on five different levels (password protected)
- Monitoring of inputs, outputs, parameters, motor current, temperatures, door positions, software states, errors, events
- Depending on the application, parameters can be modified. Access levels are selectable by passwords
- Functions can also be accessed via a train network (option)



## Maintenance free

Automatic measurements and adjustments during each door cycle prevent seasonal adjustments to door systems, e.g. winter / summer season.

Calibration is done automatically by the software during every cycle. The system continuously checks:

- Time-outs and illegal signal combinations
- Redundancy of inputs (zero speed and sensitive edge)
- Short circuited / interrupted inputs (contradicting commands, stuck switches, no over centre signal, etc)
- Short circuited / overloaded outputs or motor
- Motor drivers (short circuit, overload, open circuit and over temperature)
- Door obstruction, cycle counter
- Communication errors





## Principle

The door control system is designed to the latest technology and the system has proven itself in various projects and provided the highest possible level of safety.

- Design approach
- No single point failures
- Presence of hard wired signals to enable motor drive
- Forced door close when doors open on route
- Obstruction detection
- Drag detection
- Guarding maximum force on passengers
- Door closed proving loop (Interlock / Green loop)
- Door system diagnostics

The door control unit ensures a high system safety level for the passengers.

Redundant obstruction detection through:

- Deviation in expected door speed.
- Deviation in motor current
  - Motor current is continuously guarded, resulting in max. impact power regardless of door position
  - Different obstruction levels depending on mechanism (torque/position)
  - Obstruction levels are dynamically updated by averaging door cycles. Elimination of mechanical wear out and environmental temperature
  - Incline detection: obstruction levels are compensated automatically
- Sensitive edges detect obstruction and drag detection (if sensitive edges are fitted)
  - Motor power limitation provides a hardware limitation to the maximum motor current
  - Extensive and flexible hardware interlocking possibilities of safety critical inputs into the motor drive minimize the risk of unwanted door opening
  - Redundant safety critical inputs by double inputs and high and low opposite signals with fault detection

## Standards

The door control units are designed to all applicable hardware and software standards.

- Hardware complies with EN 50121-3-2 & EN 50155 (which covers the former IEC 571)
- Software and documentation comply with the IEEE 730, the EN 50128 and the RIA 23 standard

Each door control unit is fully checked at 3 different stages and registered through a state-of-the-art test program by an automated test computer. Also each unit has gone through a 48 hour burn in test.

	SDC-3	SDC-3P	SDC-4	SDC-4P	TDC-4	SDC-5
Electric door system	✓		✓		✓	✓
Pneumatic door system	✓	✓	✓	✓		✓
System power supply	24 VDC & 110 VDC <sup>1</sup>	110 VDC <sup>1</sup>	24 VDC & 110 VDC <sup>1</sup>	24 VDC	110 VDC	24 VDC & 110 VDC <sup>1</sup>
No. of motors to be controlled	2	-	1	-	3	1
Encoder inputs	2	-	1	1	3	1
Encoder supply	5 VDC or 15 VDC	-	5 VDC or 15 VDC	15 VDC	5 VDC	5 VDC or 15 VDC
Sensitive edge inputs	2	-	2	-	-	2
No. of digital inputs	24	16	24	16	33	16
No. of floating inputs <sup>2</sup>	8	-	8	-	-	-
No. of digital MosFet outputs	5	8	8	16	6	7
No. of relay outputs <sup>4</sup>	6	-	10	1	-	1
Motor brake output	-	-	-	-	1	-
RS232 for local diagnostics	✓	✓	✓		✓	
USB for local diagnostics			✓	✓		
RS485 for network communication	✓			✓	✓	
Other network communication	Hi speed synchronous RS485	-	CANopen	Hit bus - Hi speed synchronous RS485	Mitrac	Ethernet, CANopen
Dimensions mm. (l x w x h)	400 x 200 x 45	185 x 165 x 45	460 x 250 x 50	344 x 233 x 56	500 x 250 x 100	250 x 200 x 60
LED indicators	2	3	2	3	2	2
Fault & event logging	✓		✓	✓	✓	✓
EN 50155 compliant	✓	✓	✓	✓	✓	✓
Drag detection circuit & interlock loop			✓		✓	✓
Extension slots						✓ <sup>3</sup>
Remarks	The digital outputs can also be implemented as relay outputs		The digital outputs can also be implemented as relay outputs	If the relay output is used only 15 digital outputs remain		Under development

<sup>1</sup> 36 VDC & 72 VDC are optional

<sup>2</sup> Of the 24 standard outputs, 8 can be configured 'floating'.

<sup>3</sup> 1x Other / alternative communication, 1x I/O purposes, e.g. floating inputs or relay outputs.

<sup>4</sup> When digital outputs are configured as relay output.

# SF Muni - San Fransisco



# Virm-4 project



## SDC-2 Door control unit

The SDC-2 type door controller is a single door controller design, which is also capable of driving a step besides the door system. The SDC-2 is the foundation of the SDC-3 platform. For this North American project the system supply voltage of the controller was adapted for 36 VDC.



■ **Operator**  
  
 SF muni  
 ■ **Contractor**  
 Ansaldo Breda

### Scope of SF Muni project:

Project duration	1999 - 2000
No. of trams	102
No. of passenger doors	620
No. of door control units	620

## SDC-4P Door control unit

The SDC-4P controller platform is a pneumatic door controller specifically designed for the requirements of the Dutch railroads VIRM train fleet. The SDC-4P is a form, fit & function replacement for the old controller frame, specifically designed for the VIRM-4 series.

To be compatible with the system in the vehicle, the SDC-4P had to communicate to the existing HIT-bus, a protocol was implemented in a piece of configurable logic (CPLD)

On customer request the application is designed to SIL1. The software was developed in time and was certified by an independent assessor, in this case Lloyds Register.



■ **Operator**  
  
 NS / Dutch railways  
 ■ **Contractor**  
**BOMBARDIER**

### Scope of Virm-4 project:

Project duration	2007 - 2008
No. of traincars	210
No. of passenger doors	840
No. of door control units	840



# Victoria Line upgrade



# Eurotram refurbishment



## TDC-4 Door control unit

The TDC-4 is a triple door controller of the 4th generation. The TDC-4 can control three doors simultaneously. For the VLU project in London each TDC-4 controls one set of double doors and one single door.

The reasons for controlling three doors with one controller were because of limited space and reliability reasons. The TDC-4 contains less components compared to three single door controllers, giving a better overall reliability.

The TDC-4 door controller is equipped with a MITRAC compatible communication port, to be used for the Train Control & Management System (TCMS).



■ Operator  
 TFL  
 ■ Contractor  
**BOMBARDIER**

### Scope of VLU project:

Project duration	2006 - 2012
No. of traincars	372
No. of passenger doors	4512
No. of door control units	1504

## SDC-3 Door control unit

For the Eurotram I refurbishment project in France, the original door control panels were replaced by state-of-the-art fully electronic SDC-3 units with extensive diagnostic capabilities.

Upgrade to the SDC-3 platform was chosen to be able to meet the latest standards; the possibility to guard the maximum obstruction forces very precisely without compromising door speed to much. Also extensive diagnostic information is available.



■ Operator  
 CTS  
 ■ Contractor  
**Adtranz**

### Scope of Eurotram project:

Project duration	2010 - 2011
No. of traincars	26
No. of passenger doors	312
No. of door control units	312





All equipment is designed, tested and manufactured  
in compliance with the strictest international standards  
and always with reliability and safety in the front of our mind





Mors Smitt Railway Technology

## Door control units





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