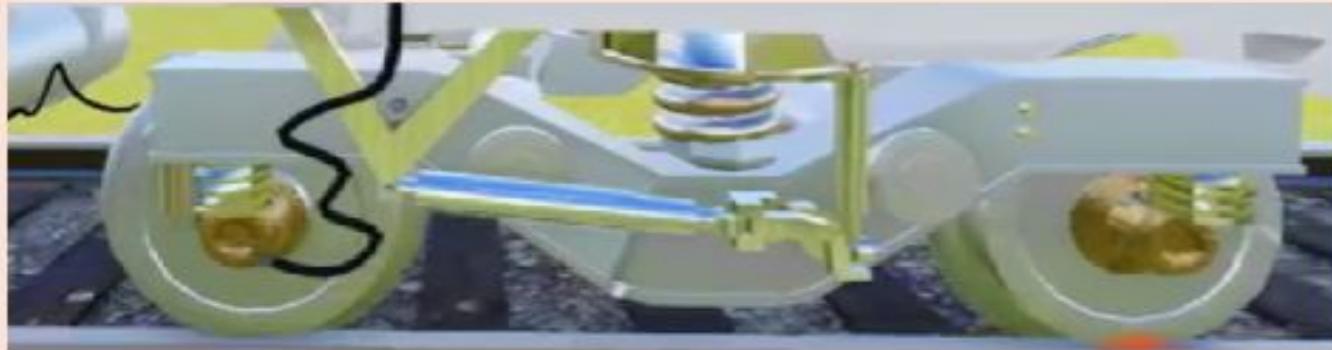




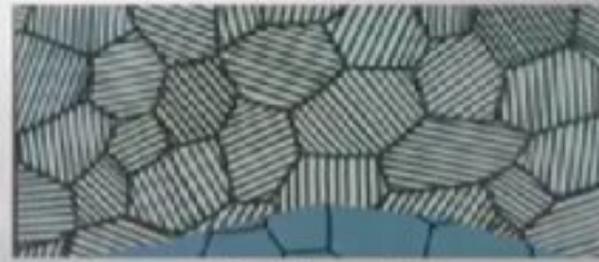
# **Wheel Slide Protection System**



## WHEEL SLIDING EFFECT



When Wheel Slides



Changes in Micro-Structure



Cracking of  
Surface of  
Rolling Stock



# Main components

- Microprocessor
- Speed sensor
- Dump valve
- Phonic wheel
- Pressure switch



## Characteristics of WSP system

- Reduces/checks sliding of wheels on rails.
- It is activated by temporary reduction in Brake force.
- Reduces stopping distance.
- WSP system does not affect Brake power.

## Difference between Slide and Skid

“**Slide**” as the term describes blocking of wheels during braking. It happens when the circumferential speed of the wheels is significantly lower than the speed of the vehicle over ground.

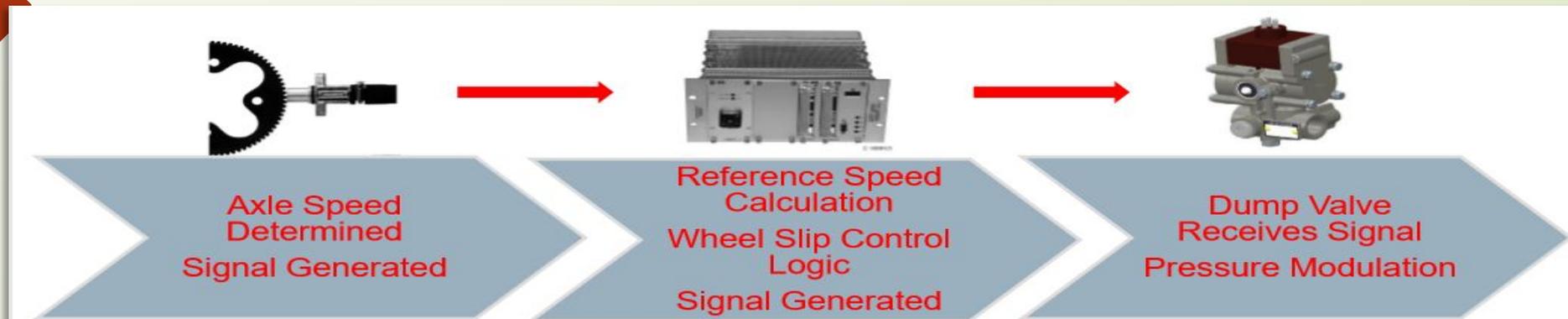
The term “**Skid**” describes the situation when the wheels rotate faster than the speed over ground which can happen during acceleration.

## Working principle

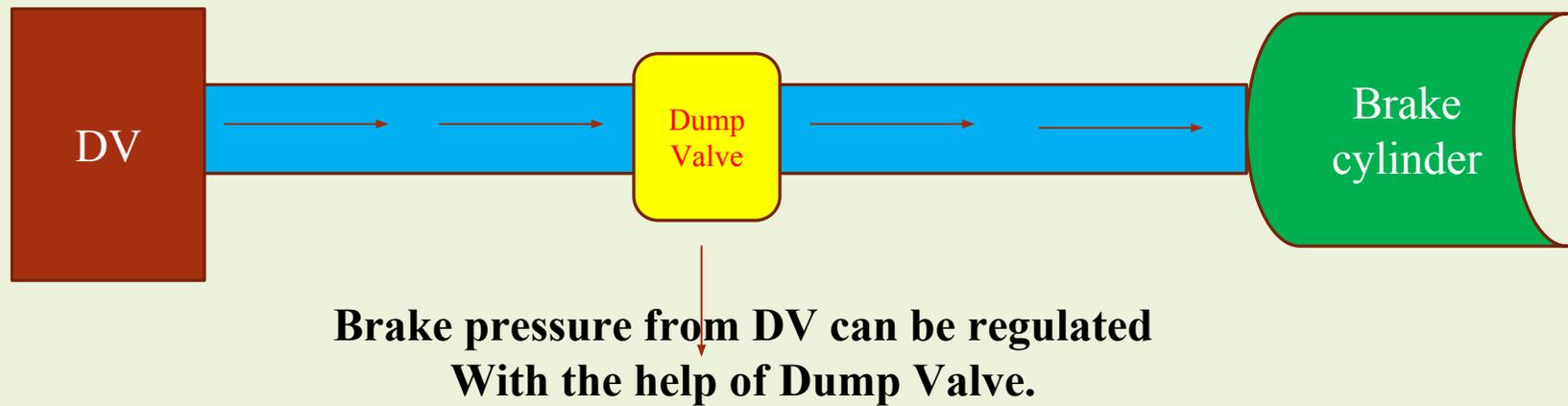
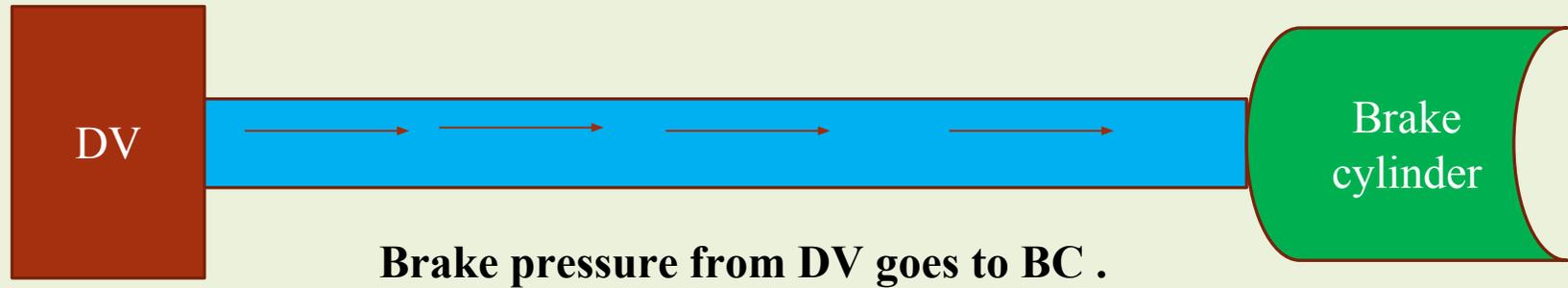
Speed sensor and phonic wheel are mounted on each axle of a coach, which send signal to microprocessor.

Microprocessor evaluates speed of different axles and generate signal to Dump valve.

As per the signal received from microprocessor, Charging port or Exhaust port or both operates to regulate the brake cylinder pressure.



## Difference between brake system with WSP and without WSP



## Software and logics

System first of all identify the axle with highest speed at any instant.  
This speed is the reference speed, **Vref**

Based on reference speed, **Vref**, two other virtual speeds are calculated-  
Threshold Speed1= **Vth1**  
Threshold Speed2= **Vth2**

To calculate **Vth1** and **Vth2** some formula is used in the software, the formulae used may vary between equipment manufacturers

Suppose the formulae to calculate **Vth1** is,  
**Vth1= Vref – (1.5 + 0.06 Vref)**

and to calculate **Vth2** is,  
**Vth2= Vref – (2.5 + 0.25 Vref)**

**(Note- the formula used is only tentative and may vary from actual)**

## Software and logics

Logical statements are provided in the microprocessor software based on which microprocessor generates signal to dump valve to regulate brake cylinder pressure.

Logical statements are of these forms-

If, Speed of any axle=  $V_i$

Threshold Speed1=  $V_{th1}$  (*upper threshold speed*)

Threshold Speed2=  $V_{th2}$  (*Lower threshold speed*)

Then, if  $V_i$ ,

$V_i \geq V_{th1}$  ,                      **Increase brake cylinder pressure**

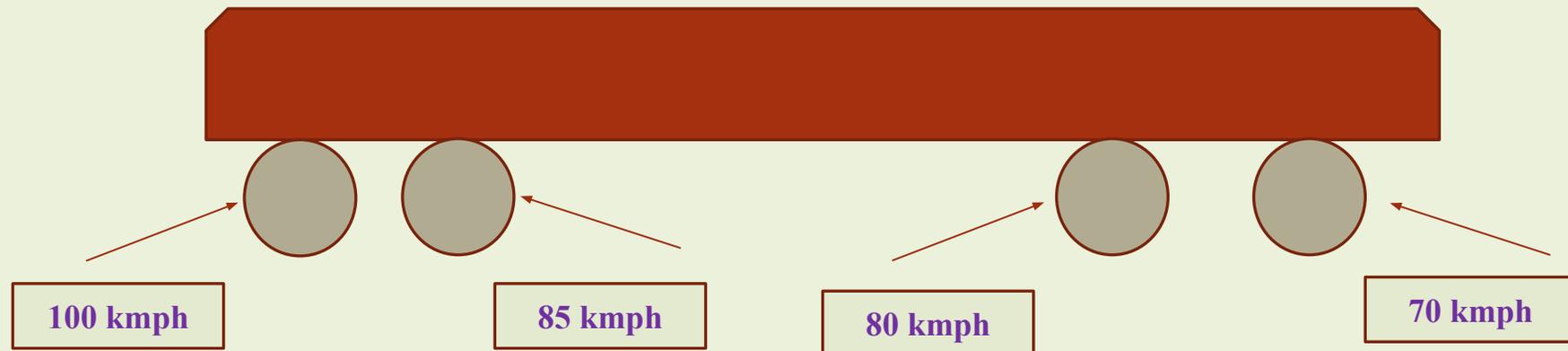
$V_{th2} \leq V_i \leq V_{th1}$  ,            **Hold brake cylinder pressure**

$V_i \leq V_{th2}$  ,                        **Decrease brake cylinder pressure**

**(Note- the logics used is only tentative and may vary from actual)**

## Let us understand with example how system works

Suppose at the time of Braking the axle speeds of different axles are as shown in the figure.



Reference speed  $V_{ref} = ?$

## System calculates Vref, Vth1, Vth2

Reference speed  $V_{ref} = ?$

$V_{ref}$  is the axle with max speed

Therefore,

$V_{ref} = 100$  kmph

$V_{th1} = V_{ref} - (1.5 + 0.06 V_{ref})$  &

$V_{th2} = V_{ref} - (2.5 + 0.25 V_{ref})$

Calculate  $V_{th1}$

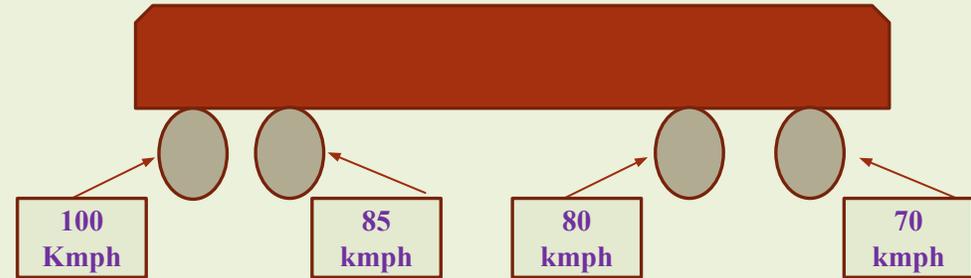
Putting the value of  $V_{ref}$  in formula for  $V_{th1}$

$$V_{th1} = 100 - (1.5 + 0.06 \times 100) = 92.5 \text{ kmph}$$

Calculate  $V_{th2}$

Putting the value of  $V_{ref}$  in formula for  $V_{th2}$

$$V_{th2} = 100 - (2.5 + 0.25 \times 100) = 72.5 \text{ kmph}$$



$V_{ref} = 100$  kmph

$V_{th1} = 92.5$  kmph

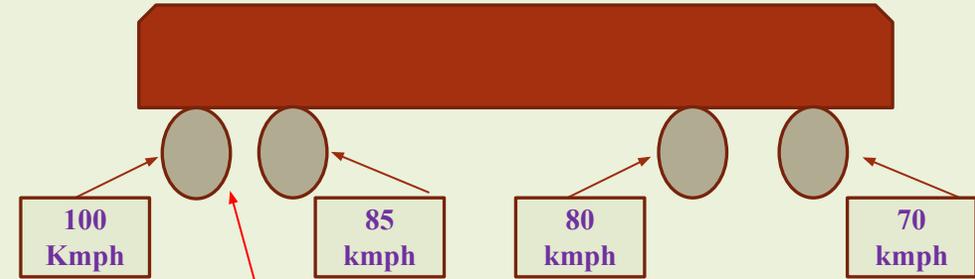
$V_{th2} = 72.5$  kmph

Logical statements  
if  $V_i$ ,

$V_i \geq V_{th1}$ , Increase brake cylinder pressure

$V_i = 100, 85, 80 \text{ \& } 70$

$V_{th1} = 92.5$



System increase brake cylinder pressure on this axle

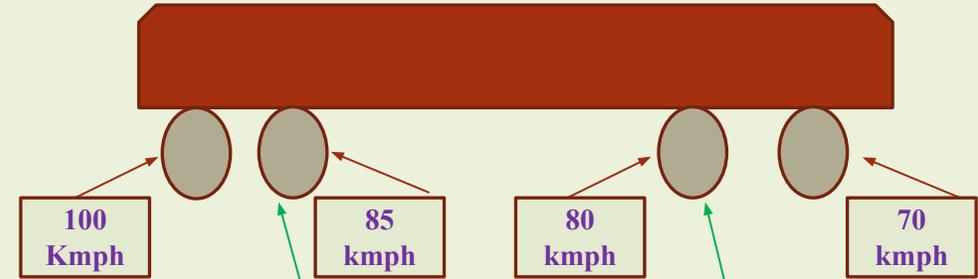
Logical statements  
if  $V_i$ ,

$V_{th2} \leq V_i \leq V_{th1}$ , Hold brake cylinder pressure

$V_i = 100, 85, 80$  & 70

$V_{th1} = 92.5$

$V_{th2} = 72.5$



System holds brake cylinder pressure on these axles

Logical statements  
if  $V_i$ ,

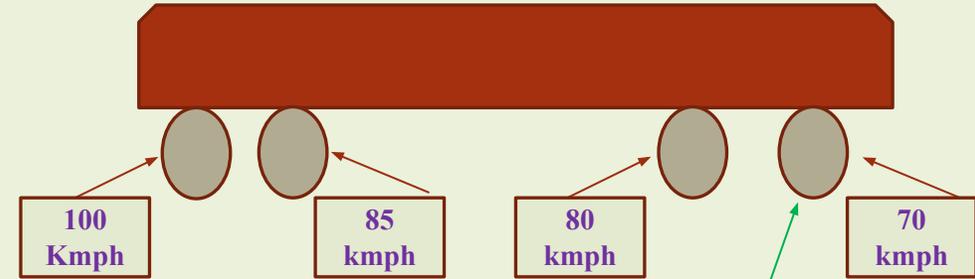
$V_i \leq V_{th2}$ ,

$V_i = 100, 85, 80$  &  $70$

$V_{th1} = 92.5$

$V_{th2} = 72.5$

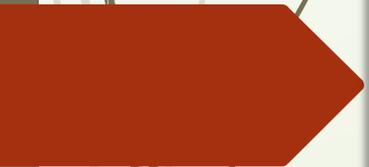
Decrease brake cylinder pressure



System decreases brake cylinder pressure on this axle

**How system regulates brake cylinder  
pressure??????**

Through Dump Valve



# Dump valve

Dump valve is a part of WSP system, which governs brake cylinder pressure based on the signal generated from microprocessor.

Dump valve has two ports-

1. Charging port
2. Exhaust port

Both ports are independent.

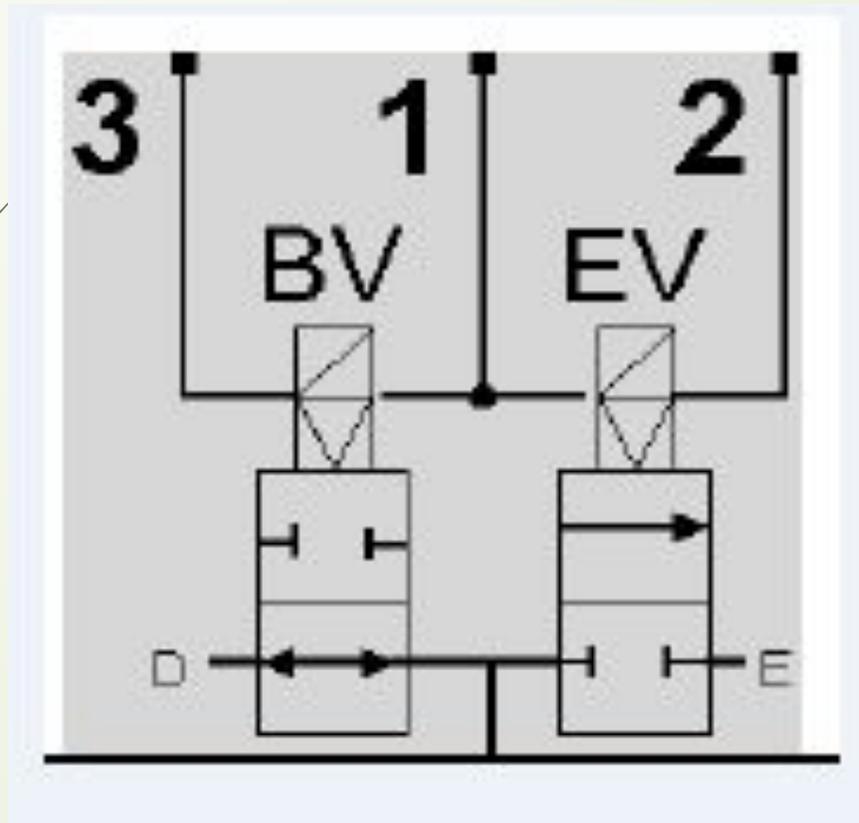
In default position the exhaust port remains closed and charging port in open.

The ports reverse their position, the moment microprocessor generates signal.

Microprocessor generates signal in form of 24V supply to the ports.



# Dump valve



## 24Volt supply from microprocessor

To decrease brake cylinder pressure microprocessor sends 24V signal through cables on both  
“Charging and exhaust” ports



## 24Volt supply from microprocessor

To hold brake cylinder pressure  
microprocessor sends 24V signal  
through cables on both  
“Charging” port



## No supply from microprocessor

To increase brake cylinder pressure, microprocessor don't sends any signal to the ports, as to increase brake cylinder pressure charging port needs to be open and exhaust to be closed, and this is the default position.



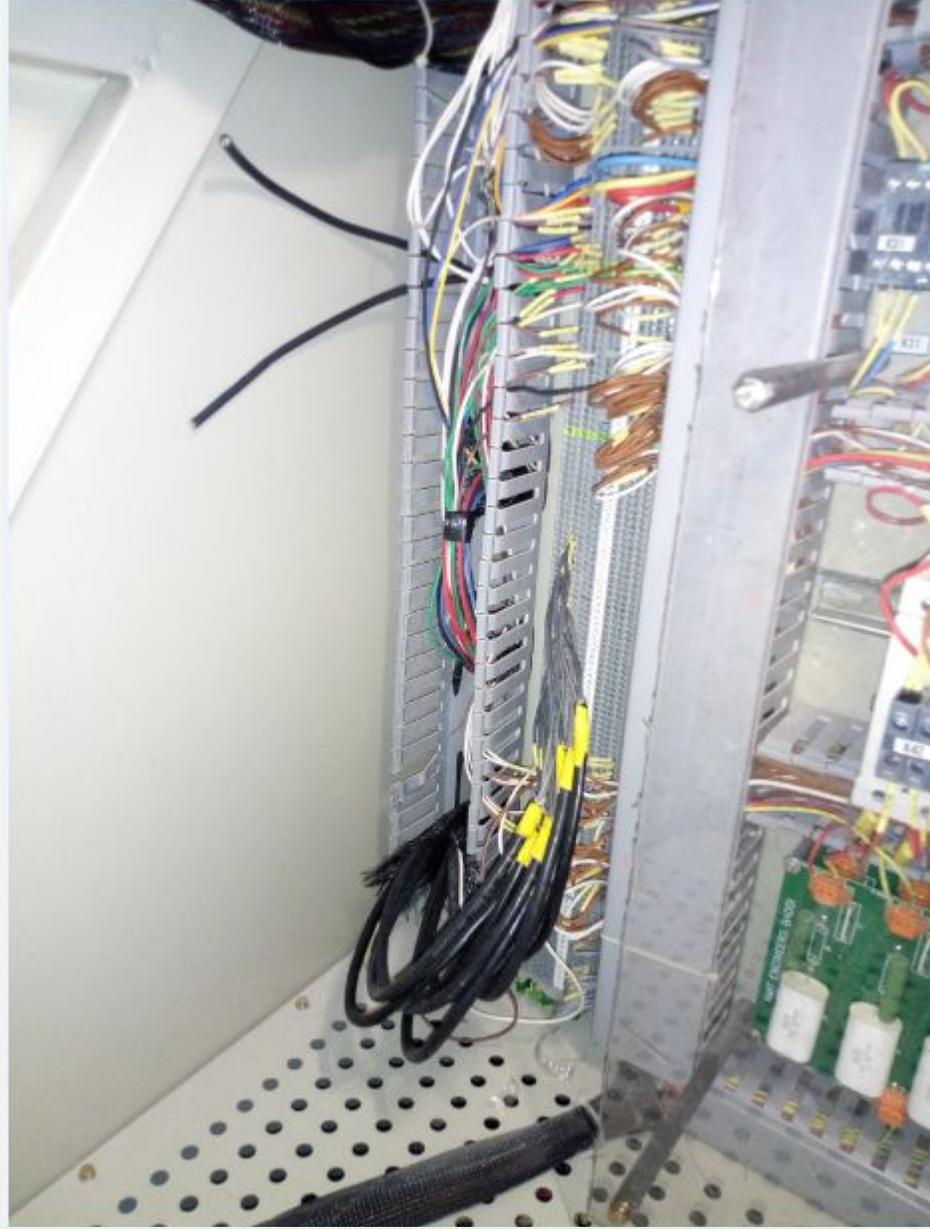
## Speed sensor

The speed sensor scans a ferromagnetic rotating gear (Phonic wheel). It works without physical contact. The frequency of the digital current signal is directly proportional to the circumferential speed of the rotating gear.

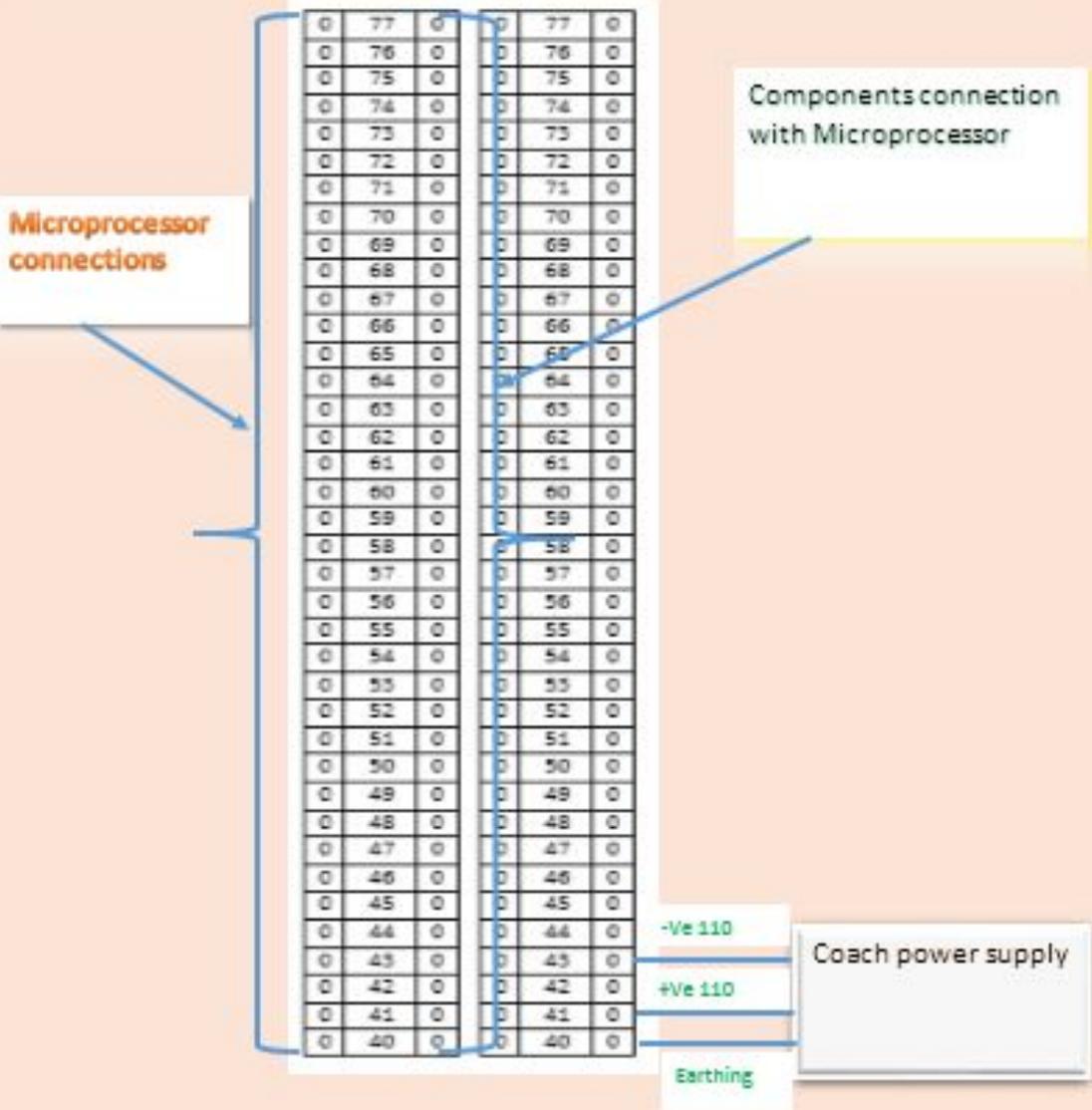




Pics. Showing change in internal inductance of the adjacent sensor



# WAGO NUMBERING SYSTEM AND CONNECTION WITH COACH POWER SUPPLY



## WAGO NUMBERING SYSTEM AND CONNECTION OF MICROPROCESSOR WITH WSP COMPONENTS

