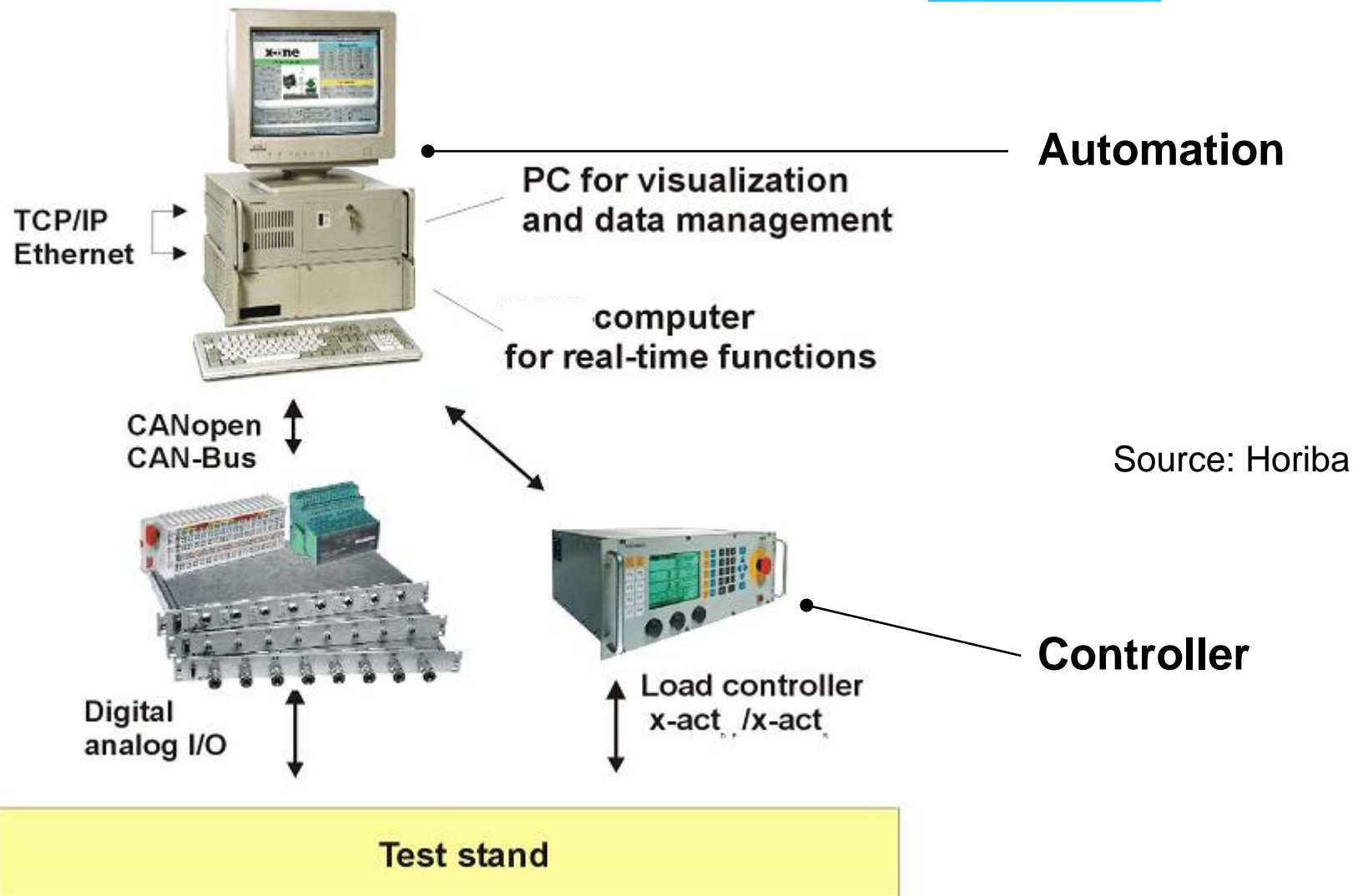


# Contents

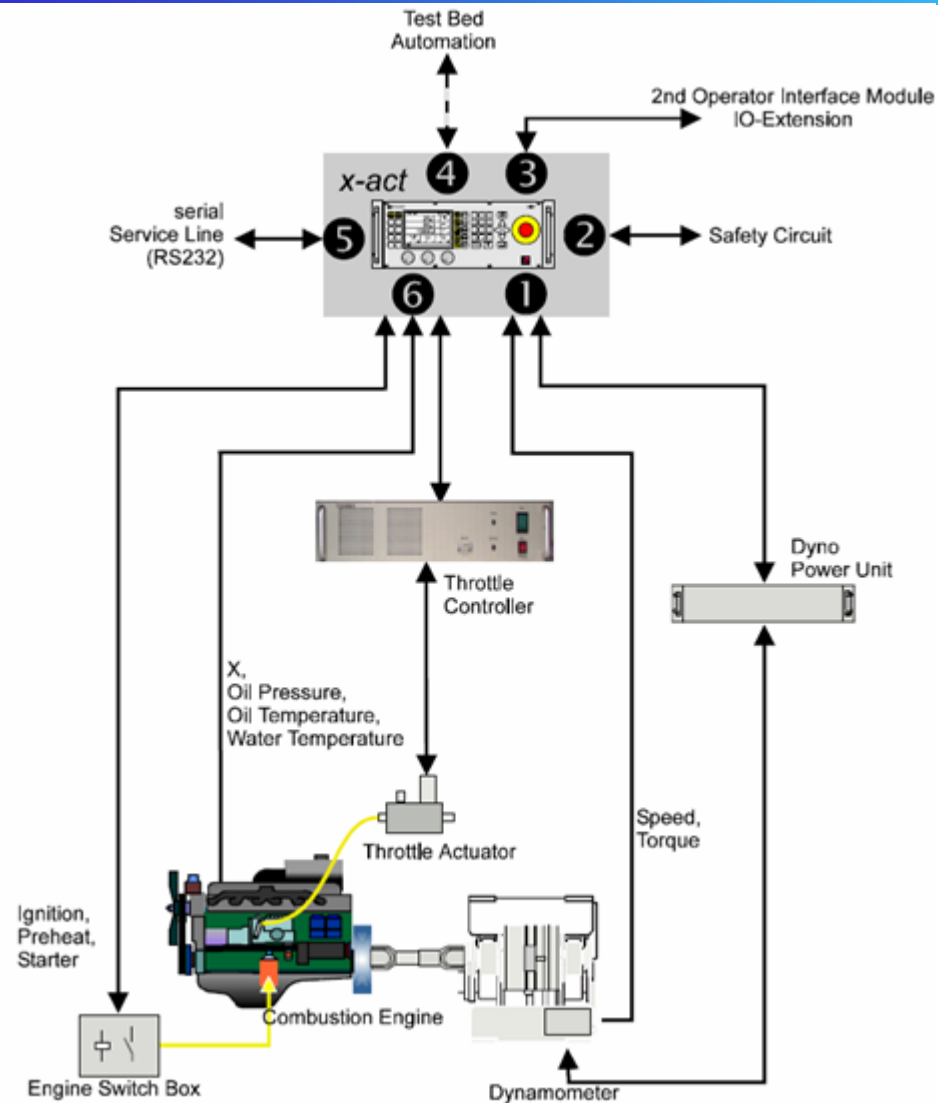
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- 1 Internal Combustion Engines**
- 2 Overview of Engine Test Cells**
- 3 Brakes and Dynos**
- 4 Mechanic Design**
- 5 Measurement Systems**
- 6 Test Bench Control and Automation**
- 7 Test Cell Buildings**
- 8 Safety**

# Structure



# Structure

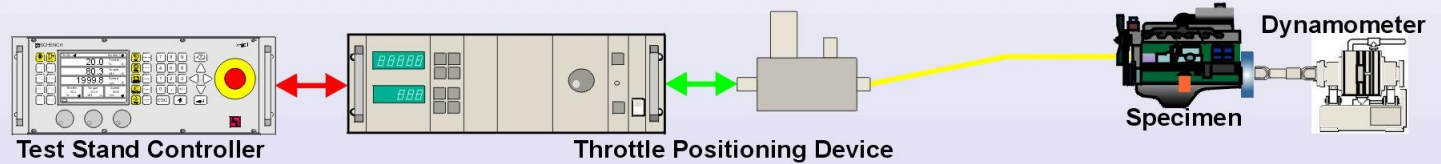


Source: Horiba

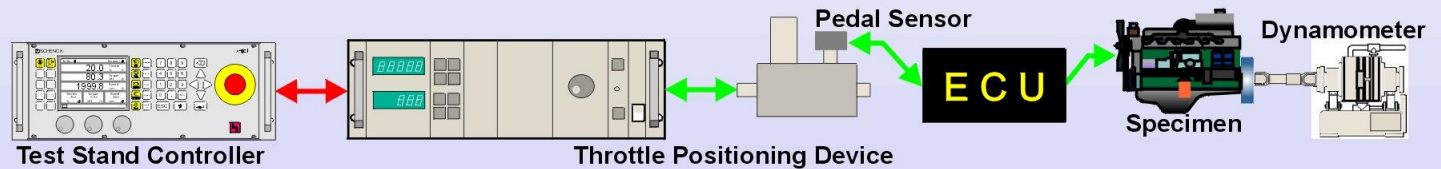
## Different Ways of “Opening the Throttle” at the Test Stand

— Mechanical Connection  
— Analogue Connection  
— Digital Connection

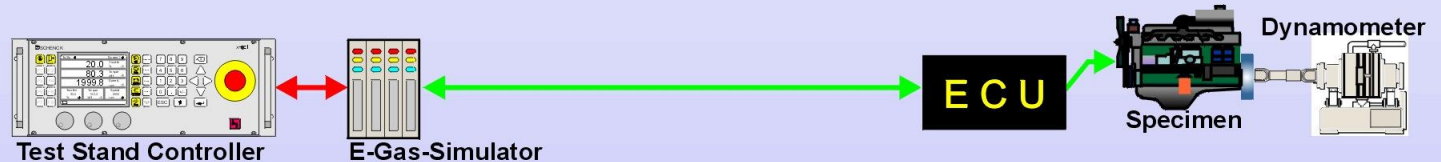
“Classic”



By Pedal  
Sensor



usual  
today  
E-Gas



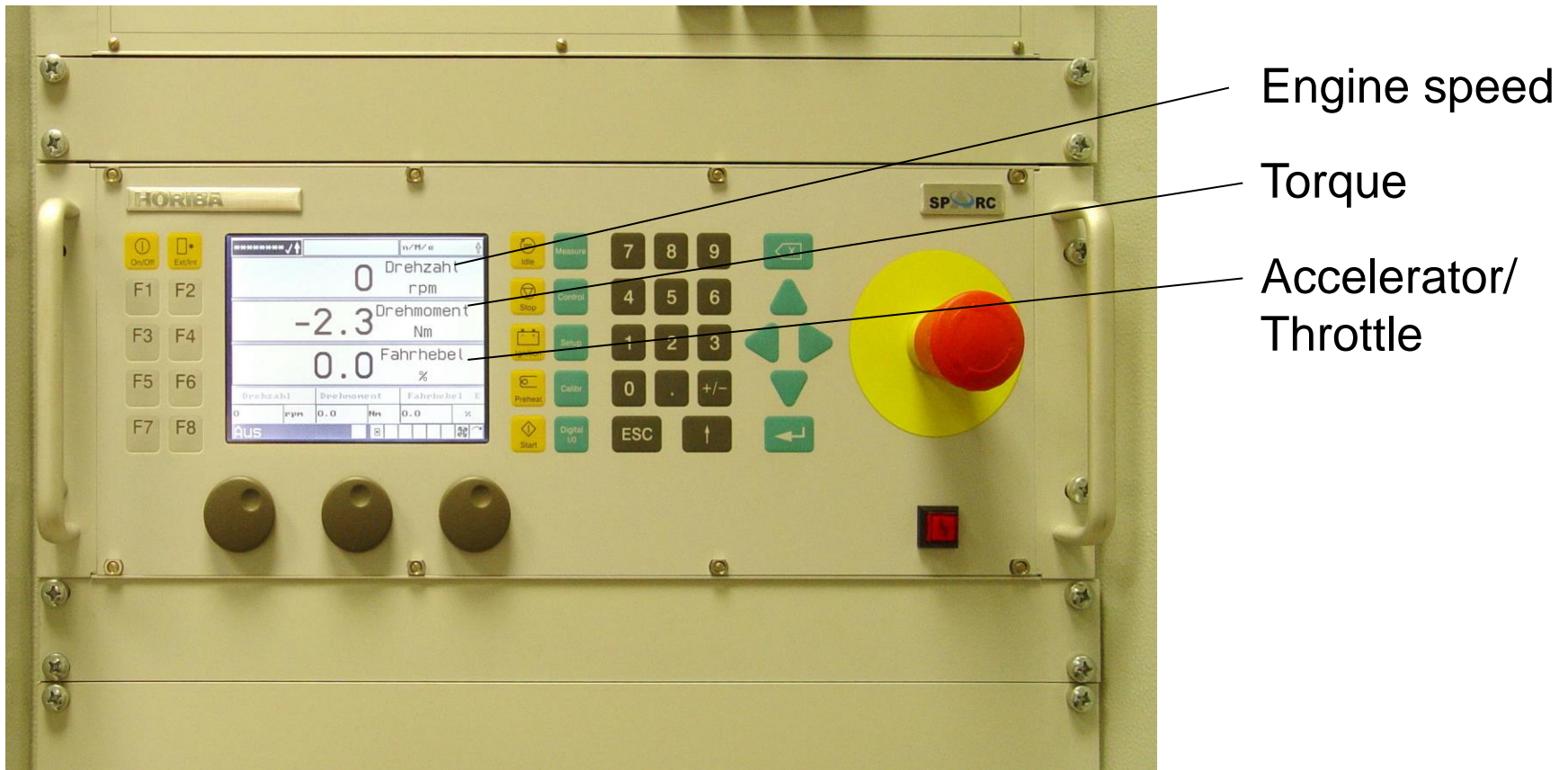
CAN-Gas



# Structure

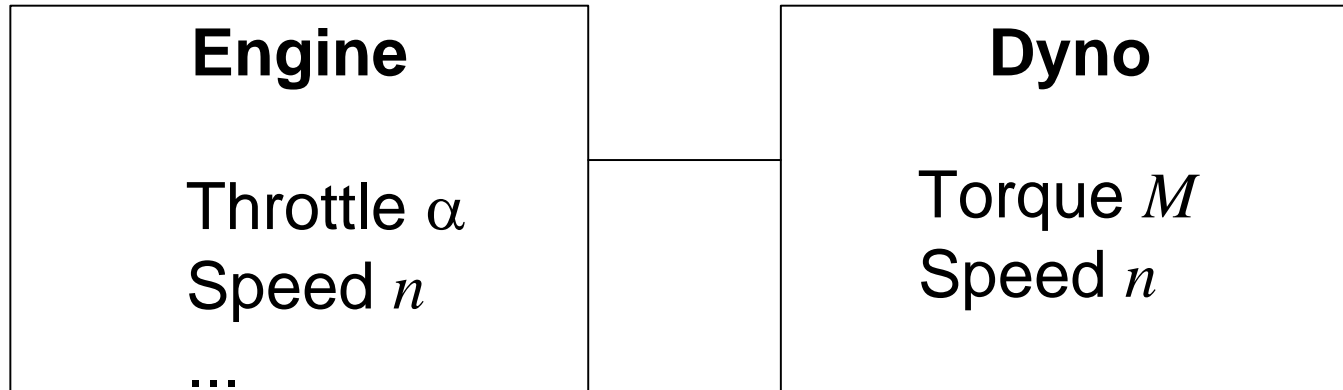
## Example of Controller

(usually real-time industry PC with many interfaces and without clumsy desktop operating system)



# Control Strategies

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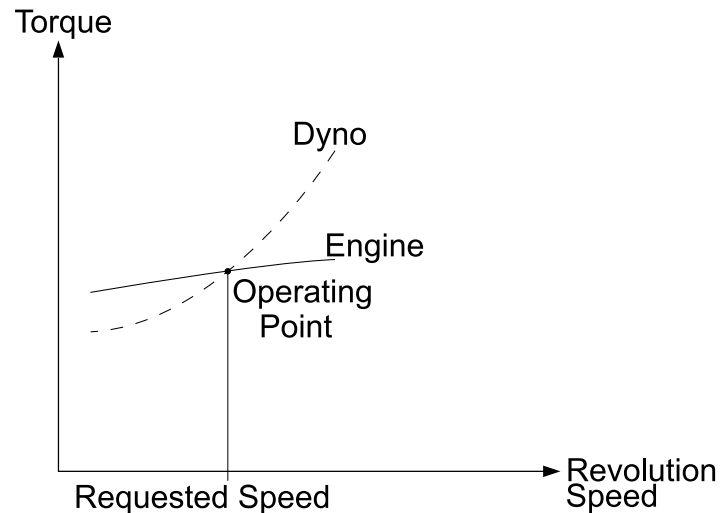
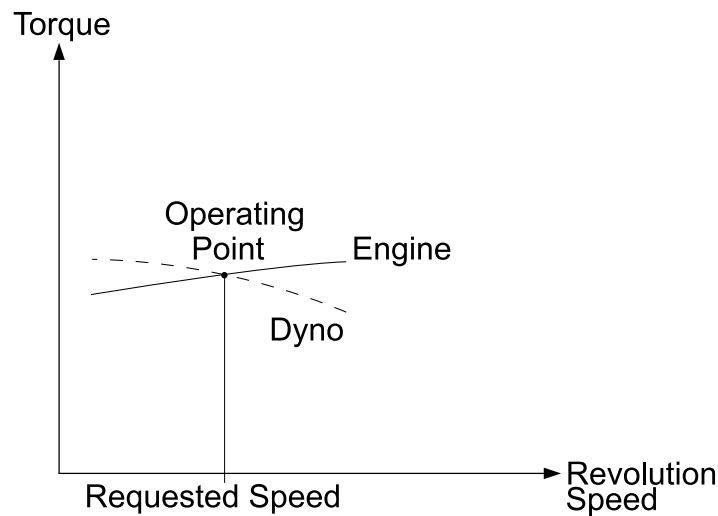


Possible Combinations of  $\alpha, n, M$  ?

# Control Strategies

Stability of Control:

Which of the two operating points is stable and which one is unstable?



# Control Strategies

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## Examples of Control Strategies Offered by Controller

- Start
- Idle
- Stop
- Setup
- $\alpha/n$  (Engine/Dyno)
- $\alpha/M$  (also  $M=0$  or  $M=f(n)$ )
- $X/n$  ( $X$ : Arbitrary Value)
- $n/M$  (also  $M=0$  or  $M=f(n)$ )
- $M/n$



## Road Load Simulation

- simulates resistance profile as e.g. in slide 3-2.
- considers switching program of automatic transmission (or driver model for manual transmission)
- simulates further components of powertrain if necessary

# Automation

## Tasks



Source:  
Siemens

- Test Bench Remote Control (also over Internet)
- Automatic Test Sequences
- Display, Logging and Post Processing of Measurements