Metal forming solution packages

Solutions for servo press

siemens.de/Metalforming

Metal Forming Solution Package

Complete range of standard solutions for the complete world of metal forming technology

Mechanical Presses

Flywheel Press
Servo Press

Handling Systems

Roll Feed
Electronic Transfer
Feeder systems

Blanking Lines / Cut-to-length Lines

Blanking Line
Flying Shear
Rotary Shear

Hydraulic Presses

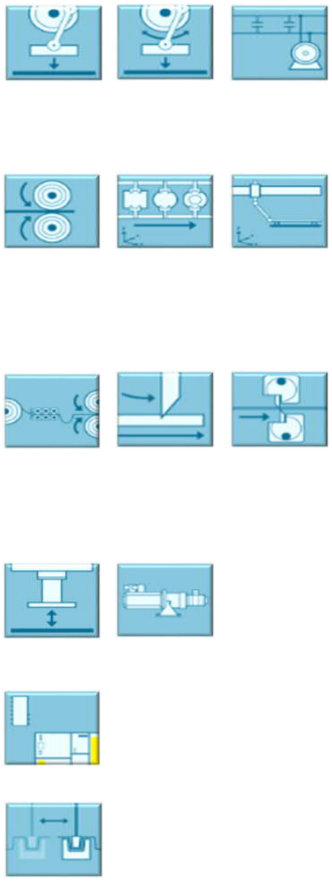
Hydraulic Presses
Servo Pump

Press Safety

Press Safety Library

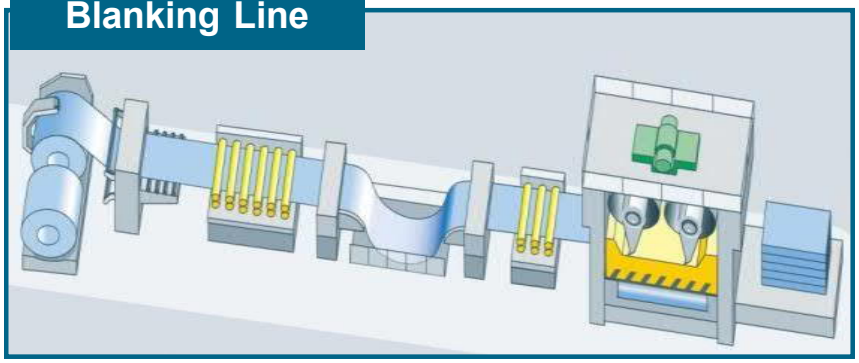
Press Simulation

Press Line Simulation (PLS)

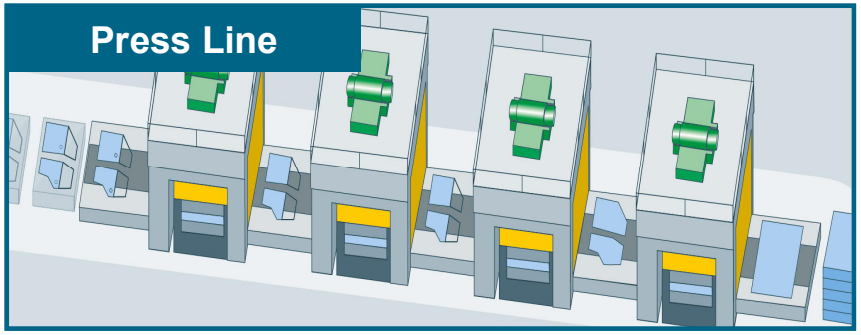


Metal Forming Solution Package Solutions for automation of Press Shops

Blanking Line



Press Line



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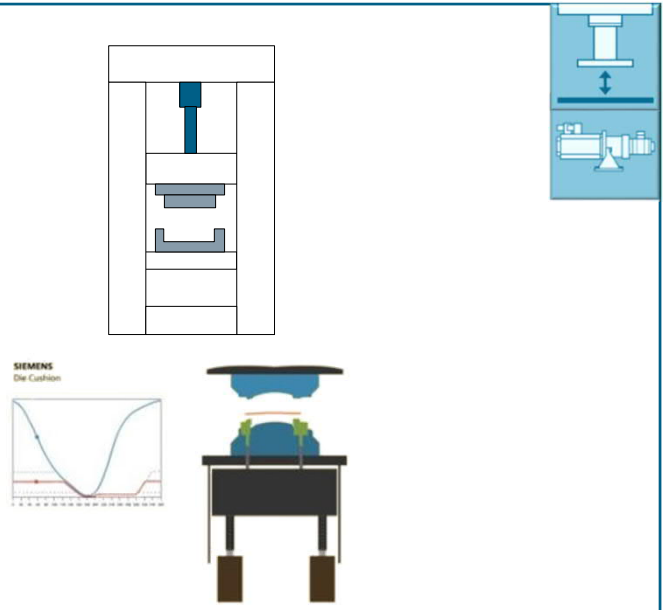
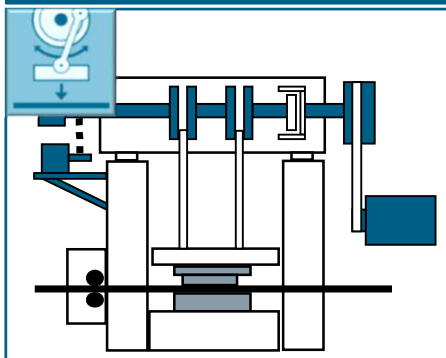
Solutions for mechanical Presses

Hydraulic Press

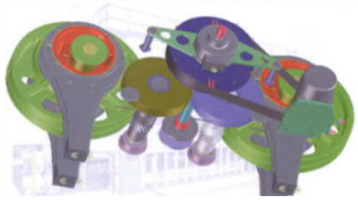


Low Productivity, high Flexibility in the forming process

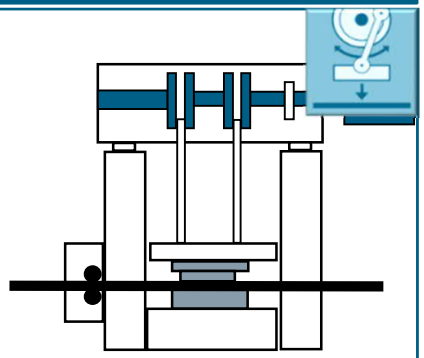
Mechanical Press



Press with Flywheel



Medium to high Productivity, low Flexibility in the forming process



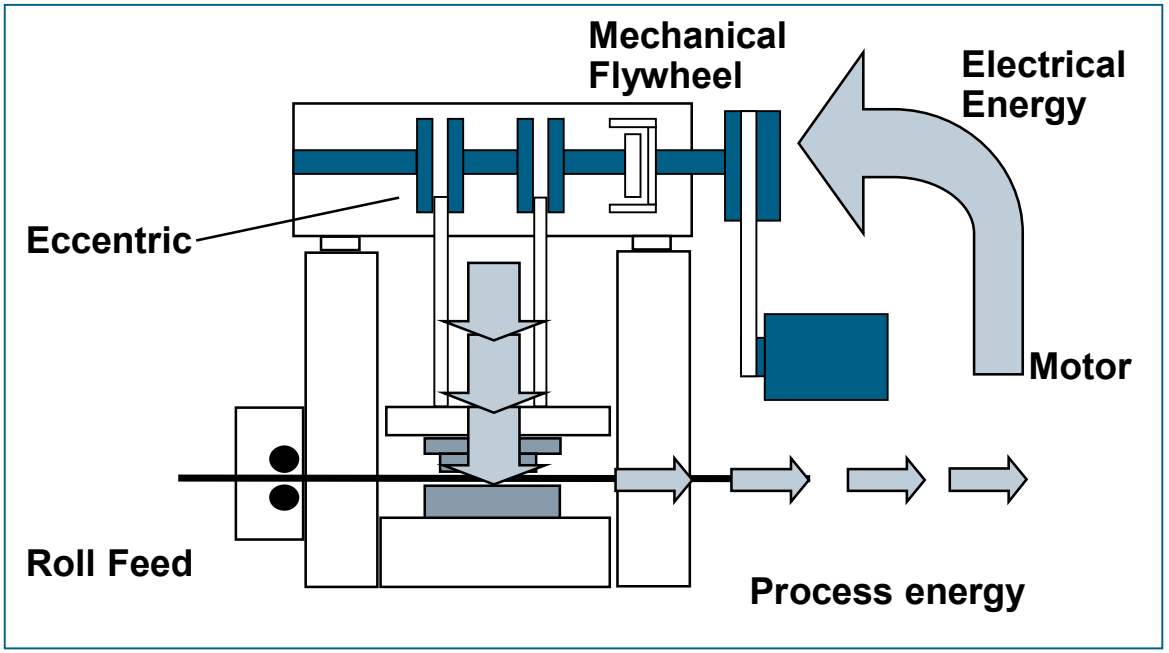
Servo press

Medium to high Productivity, high Flexibility in the forming process

Metal Forming Solution Package

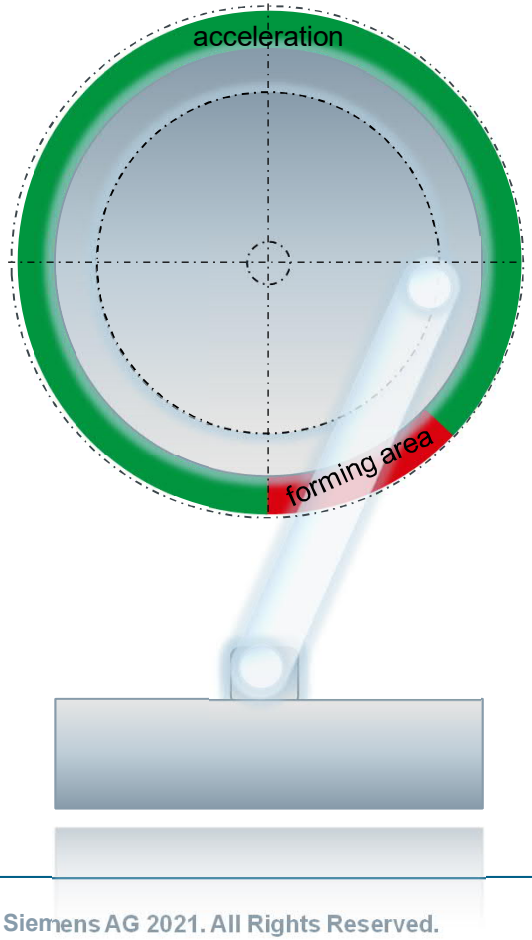
Functional Principle of mechanical Presses with Flywheel

- Mechanics:
  Eccentric, Knee lever, others
- Brake-/ Clutch combination
- Mechanical Flywheel
- AC Main Drive



Metal Forming Solution Package

Functional Principle of mechanical Presses with Flywheel



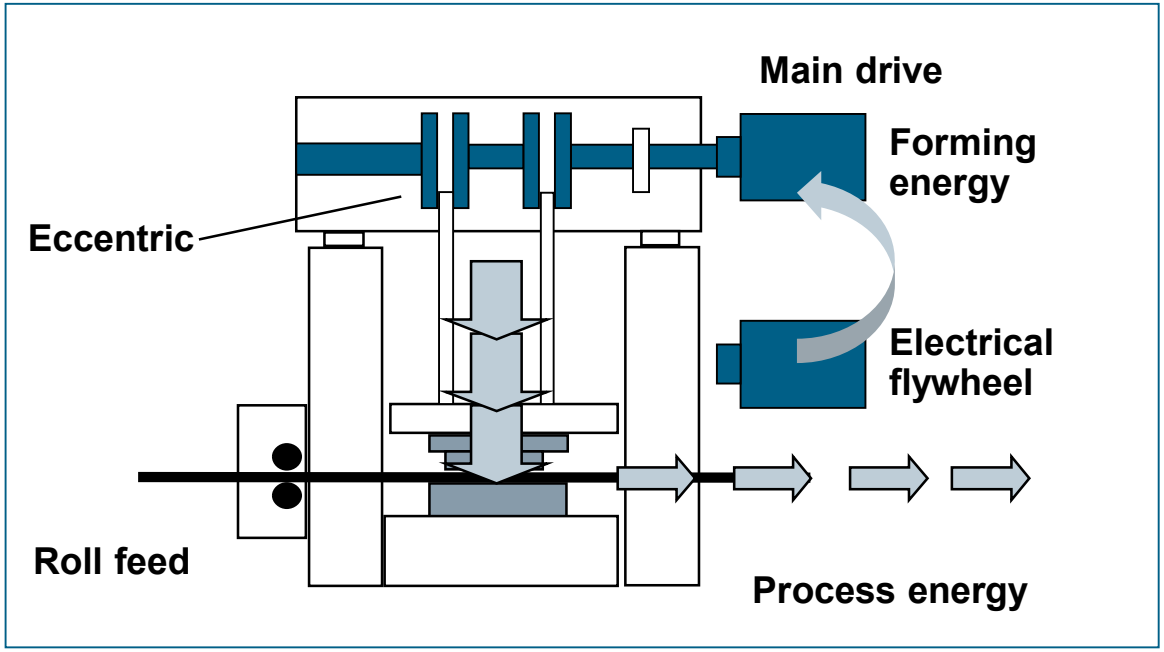
Mechanical Flywheel:

- The flywheel is almost exclusively used for the forming process
- Press speed is almost constant -> there are no phases were the press is accelerated or decelerated
- The forming energy is taken from the mechanical flywheel by reduction of the speed, the drive accelerates it and restores the energy
- The infeed provides the forming energy and the losses
- The press is operated in “constant” speed as result of the speed of the flywheel
- Clutch- / Brake combination and machine encoder required.

Metal Forming Solution Package

Functional Principle of Servo Presses

- Mechanics:
  Eccentric, Knee lever, others
- One or more main AC-drives
- Electric Flywheel or capacitors
- Energy optimized movement profile



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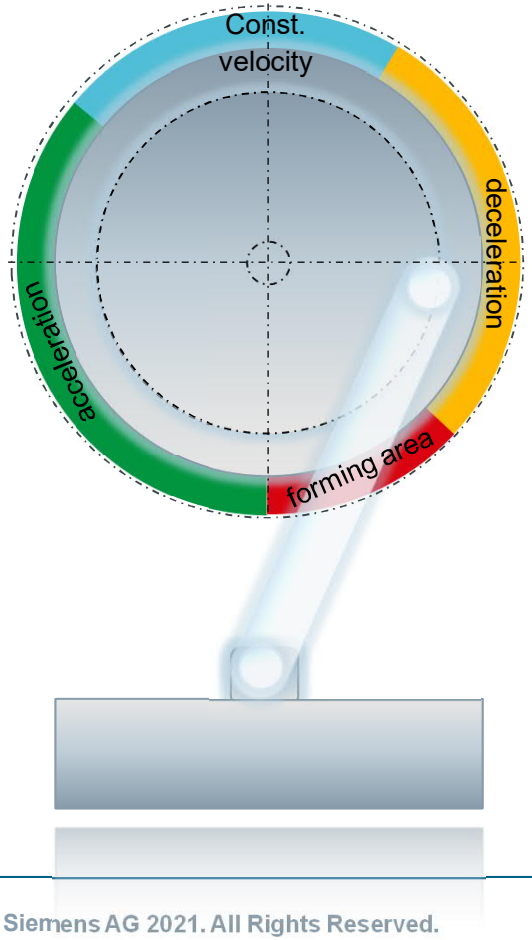
Functional Principle of Servo Presses



Servo press / Energy storage:

- No flywheel energy storage, press speed is not constant
- The energy storage is used for reduction of peak power at forming, acceleration and deceleration
- The braking energy is stored in the buffer and reused for acceleration or forming
- The infeed provides the forming energy and the losses
- There is no connection between work capacity and speed of the press like in a press with mechanical flywheel
- No brake / clutch unit required
- No machine encoder required

Metal Forming Solution Package

Functional Principle of Servo Presses

Advantages of a Servo press

Motor speed is variable:	Ram can be accelerated / decelerated within physical limits, higher productivity, Pendulum operation is possible
Accurate positioning:	No braking angle calculation due to the missing clutch, positioning of the eccentric based on a defined setpoint
Low machine speeds:	No minimum operation speed because all energy comes from main drive , hand wheel operation possible (motion of the ram by increments)
Machine Stop:	Fastest way to stop the press is via motor deceleration
Safety:	No DIN / EN standards for servo presses defined yet, extended Drive Safety necessary
Energy Management:	High energy requirement due to acceleration / deceleration, oscillating energy has to be buffered
Transfer Systems:	Press speed is variable and depends on calculated profile, coupling of handling system via virtual press master

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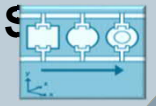
Solutions for Servo Presses

Industry Products and Systems

SIMOTION SimoPress S



SIMOTION OACamGen

SIMOTION Multipoint

SIMATIC Press safety

SIMOTION Easy Project

Solution Fit

Standard Applications Ready-to-Apply

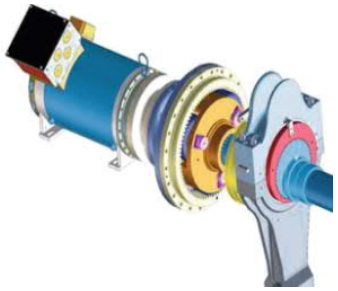
Customization

We increase the productivity of our customers with innovative products, systems and branch specific solutions

Metal Forming Solution Package

Solutions for Servo Presses

Sizing of the drive system	Motion Profile	Energy management	Robust drive technology
• How do we size the drive system in a way that ensures the desired performance data of the press?	• How do we tell the press to run a motion profile that matches the tool in the machine? • How can we adapt the machine to a new tool?	• Can we avoid to see the effects of the oscillating process power of a servo press on our power grid? • If I have a large drive system-do I also need a large infeed system?	• Can we operate any type of motors and drives in the servo press application? • What are the critical characteristics we must observe?



Servo press

High productivity **and** high flexibility in the forming process

Metal Forming Solution Package

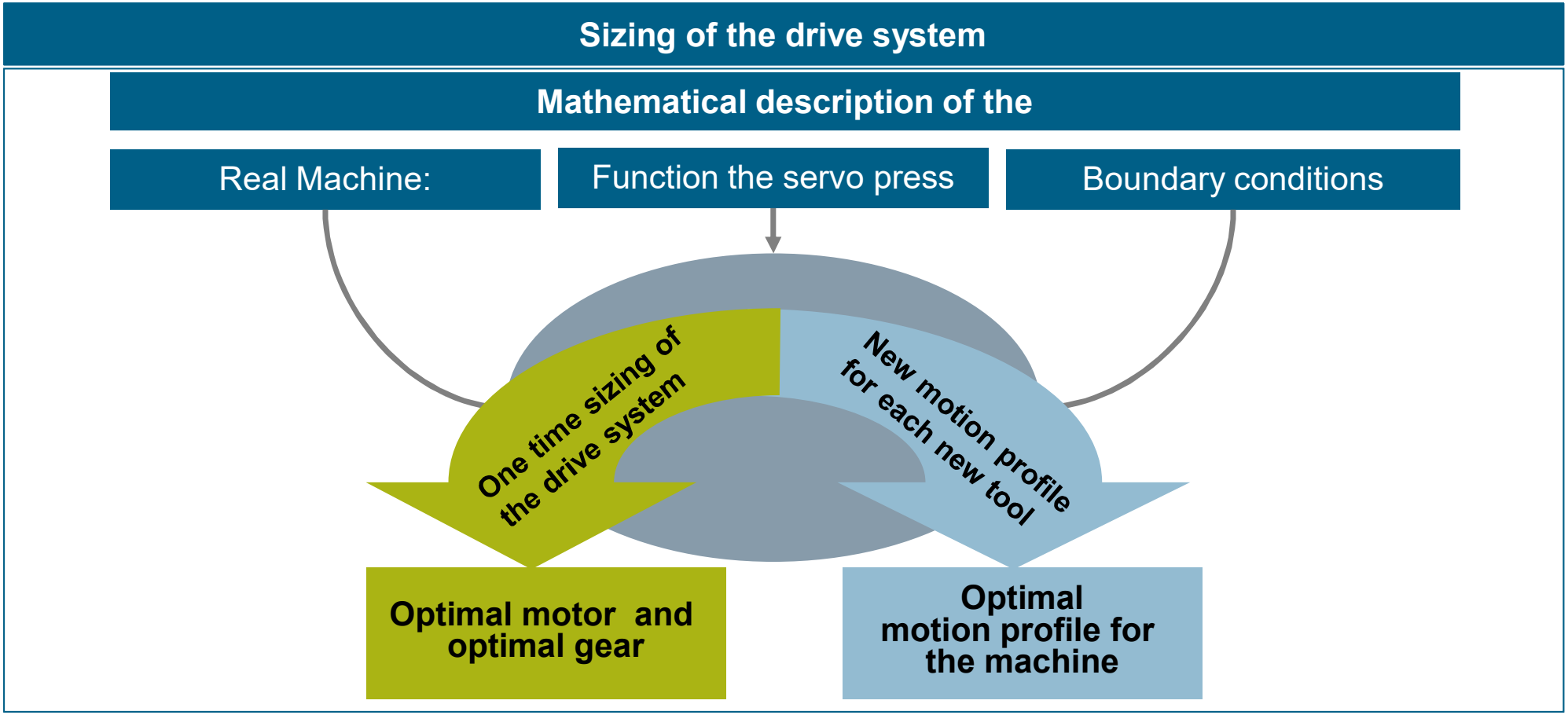
Benefits of the Solution

OEM	End customer
• Time saving in engineering • Application Support by Motion Control specialists • Open customizable solution • Continuous enhancement • Simple to learn & get to know using application examples • The Application is free of charge • Universal and scalable range of hardware for all machine requirements	• Higher Productivity • Higher Quality • Higher Availability • Higher Flexibility • Avoiding “Black Box” or special solutions leads to unified automation structures and results in simplified service & maintenance

The solution for the automation of Servo Presses
SIMOTION SimoPressServo

Metal Forming Solution Package

Solutions for Servo Presses



Metal Forming Solution Package

Solutions for Servo Presses

Sizing of the drive system

Machine data

- Machine specification – **Excel Questionnaire**

Sizing Tool

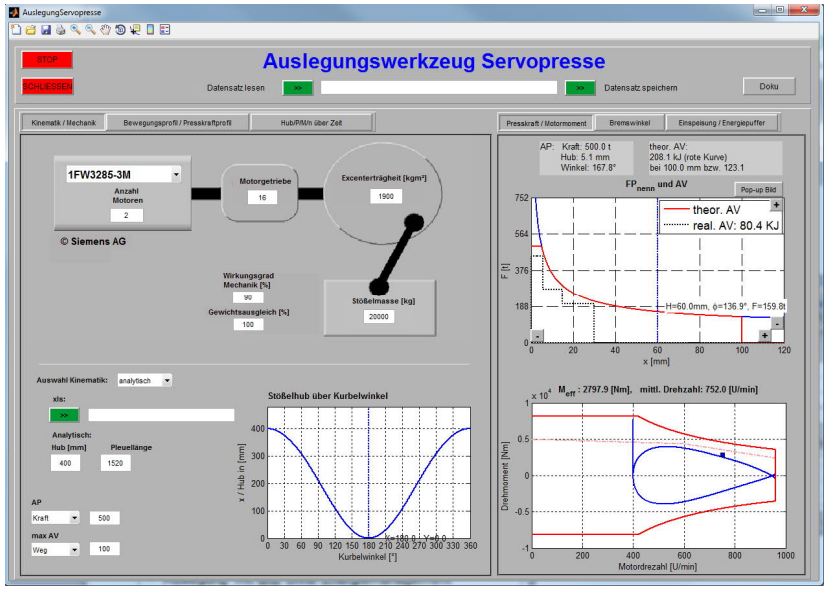
- Siemens developed a sizing tool for servo presses
- All functions and results of the tool have been verified via measurements on existing machines

Mechatronic concept

- Understand the machine as mechatronic system
- Deep knowledge of the functional principle of Servo presses and funded knowledge of motor and drives results in an overall system capable of fulfilling the requirements of equipment of servo presses

System sizing with energy management

- Sizing with and without energy managment



Metal Forming Solution Package

Solutions for Servo Presses

Generation of Motion Profiles

Flexibility in Motion

- How do we use the abilities of a servo drive? How do I tell my machine to do the perfect motion for the tool I want to operate next?

Optimized Motion

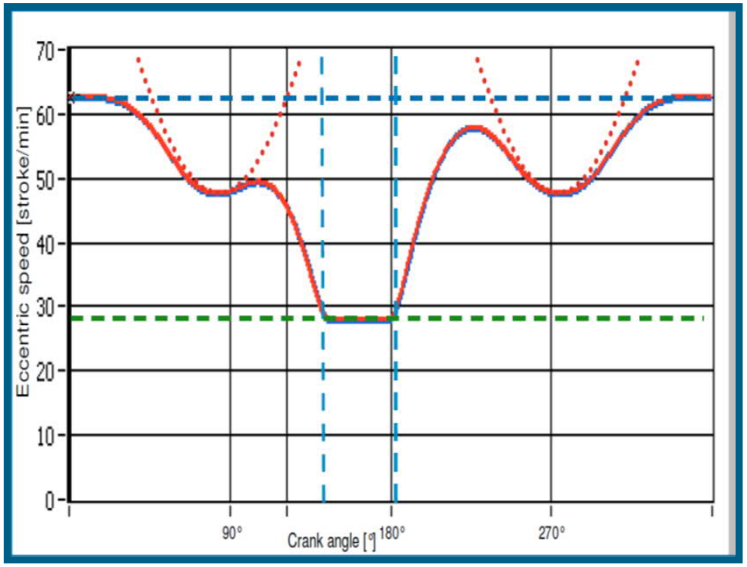
- How do we generate the optimized motion profile? Defining some points on a graph manually or go for an optimization algorithm that performs this task automatically?

Technological Challenges

- Reduce stress for the tool
- Transfer time
- Drawing process
- Optimized pendulum mode

Observing all Boundary Conditions

- We must ensure that ALL boundary conditions of the system are observed permanently? (Acceleration, Jerk, max. Speed, max. Torque, max. Forming Speed)

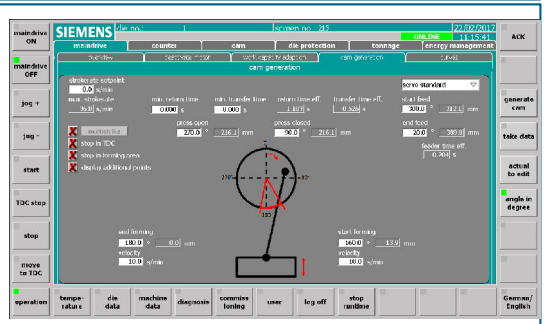


Metal Forming Solution Package

Solutions for Servo Presses

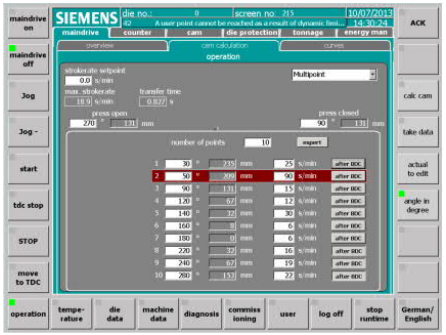
Generation of Motion Profiles

SIMOTION OACamGen



- Order-No: 6AU1820-3EA20-0AB0 (L-Price: ~3.446€ FY16/17)
- RT-License
- Integrated in SIMTDCION SimoPress Servo
- Calculation of energy optimized motion profiles for pendulum and servo operation taking machine specific parameters into account
- Controller: From V2.0: Simotion D455-2 recommended, no release for Simotion D410

SIMOTION Multipoint



- Integrated in SIMOTION SimoPress Servo
- No license required, no additional costs
- Breakpoint based (10) calculation of motion profiles for pendulum and servo operation taking machine specific parameters into account
- No restrictions concerning the hardware platform

Customer specific functions or fixed curves can be integrated

Metal Forming Solution Package

Solutions for Servo Presses

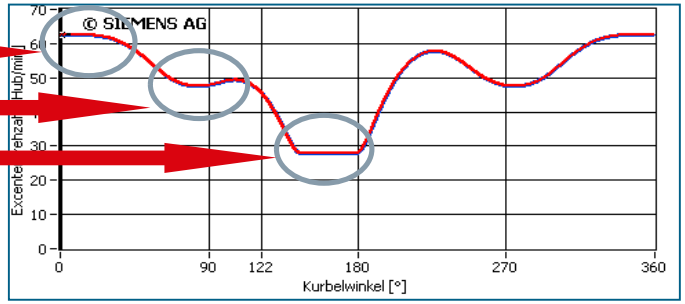
Generation of Motion Profiles using OACamGen

Limitations:
Max. Motor speed
Max. Ram speed
Max. Forming speed

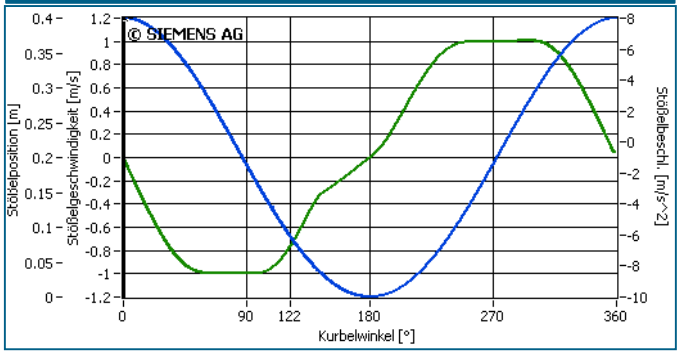
The generation of the motion profile of the eccentric is taking all limitations precisely into account.

Result is a higher productivity of the press.

Motion Profile Eccentric



Motion Profile Ram



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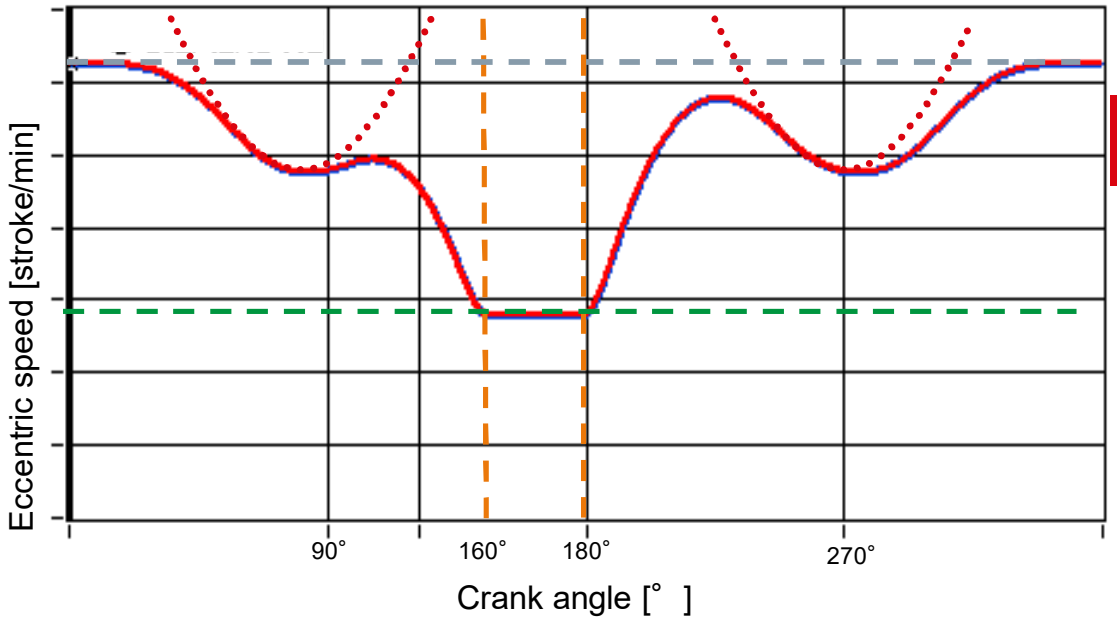
Solutions for Servo Presses

Generation of Motion Profiles using OACamGen



Maximum motor speed

Energy optimized motion profile

Forming Area

Maximum ram speed

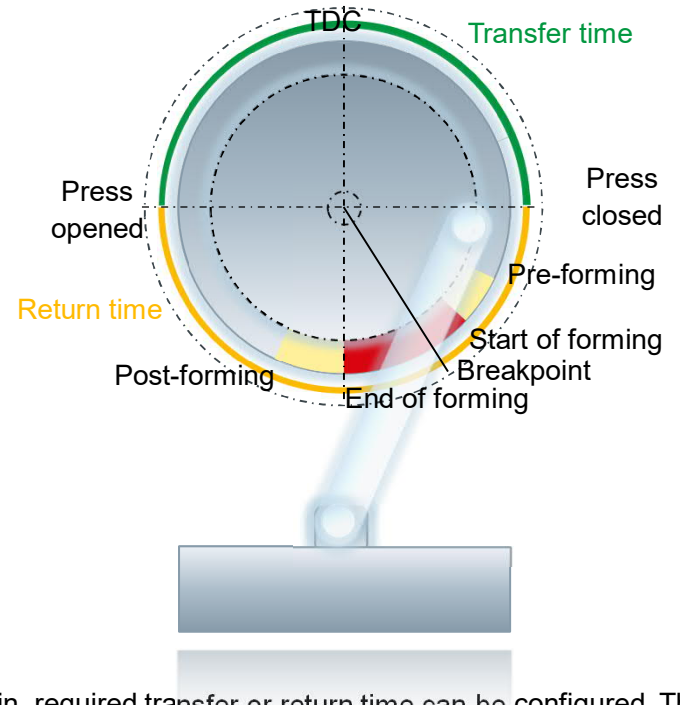
Optimal forming speed

SIMOTION calculates automatically an Energy optimized Motion Profile for the Eccentric

Metal Forming Solution Package

Solutions for Servo Presses

Generation of Motion Profiles using OACamGen



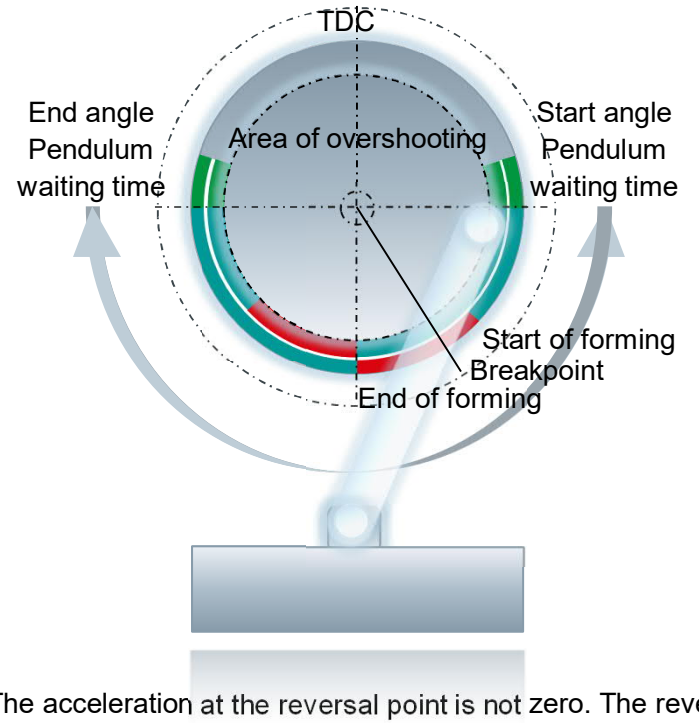
Min. required transfer or return time can be configured. The press profile will be optimized according this requirement to still reach a max. possible stroke rate.

Servo operation with transfer time, return time

Coordinate	Description	Units
Pre-forming	Angle / Speed before forming	° / spm
Start of forming	Start angle forming / forming speed	° / spm
End of forming	End angle forming / forming speed	° / spm
Post-forming	Angle / Speed after forming	° / spm
Press open	Angle / height, at which the press is open	°
Press closed	Angle / height, at which the press is closed	°
Breakpoint in forming area	Angle + waiting time of breakpoint in forming area	° / s
Time press open	Time for roll feed / transfer	s
Time press closed	Return time	s

OACamGen V4 / 2017

Generation of Motion Profiles using OACamGen



Pendulum mode with waiting time and „overshooting“

Coordinate	Description	Units
Start Pendulum	Start angle Pendulum motion	°
End Pendulum	End angle Pendulum motion	°
Waiting time	Waiting time at reversal point at start and end angle pendulum motion	s
Start of forming	Start angle forming / forming speed	° / spm
End of forming	End angle forming / forming speed	° / spm
Angle of overshooting	Area of overshooting	°
Breakpoint in forming area	Angle + waiting time of breakpoint in forming area	° / s

The acceleration at the reversal point is not zero. The reversal point is passed with max. possible acceleration until the max. overshoot area. A higher machine performance is reached.

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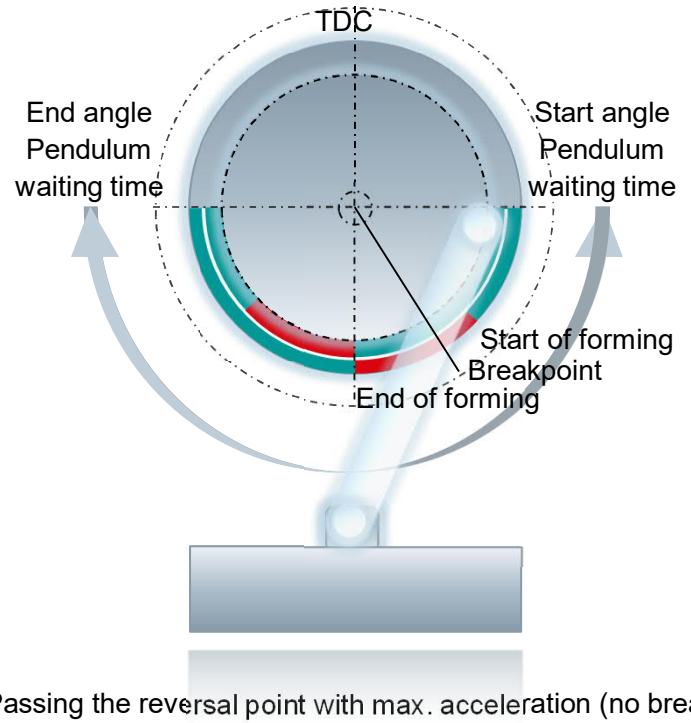
Solutions for Servo Presses

Generation of Motion Profiles using OACamGen



Pendulum mode with max. acceleration at reversal point

Coordinate	Description	Units
Start Pendulum	Start angle Pendulum motion	°
End Pendulum	End angle Pendulum motion	°
Start of forming	Start angle forming / forming speed	° / spm
End of forming	End angle forming / forming speed	° / spm
Breakpoint in forming area	Angle + waiting time of breakpoint in forming area	° / s
Operating mode	Mode max. acceleration at reversal point	

Passing the reversal point with max. acceleration (no breaking to acceleration = zero), thus a higher velocity of the machine can be achieved.

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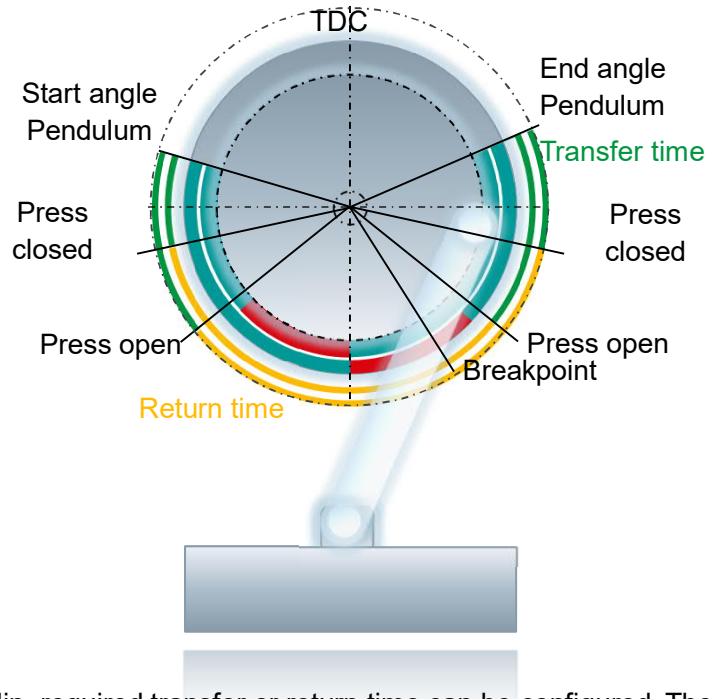
Solutions for Servo Presses

Generation of Motion Profiles using OACamGen



Min. required transfer or return time can be configured. The press profile will be optimized according this requirement to still reach a max. possible stroke rate.

Pendulum mode with transfer time, return time

Coordinate	Description	Units
Start Pendulum	Start angle Pendulum motion	°
End Pendulum	End angle Pendulum motion	°
Start of forming	Start angle forming / forming speed	° / spm
End of forming	End angle forming / forming speed	° / spm
Press open	Angle / height, at which the press is open	°
Press closed	Angle / height, at which the press is closed	°
Time press open	Time for roll feed / transfer	s
Time press closed	Return time	s
Breakpoint in forming area	Angle + waiting time of breakpoint in forming area	° / s

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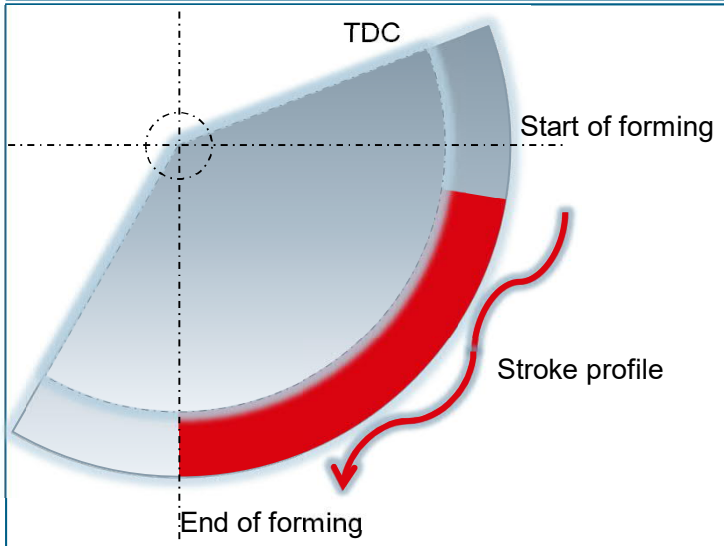
Metal Forming Solution Package

Solutions for Servo Presses

Generation of Motion Profiles using OACamGen



Servo or pendulum operation with multi strike

	Angle [°]	Speed [Hub/min]	Acceleration factor	Waiting time [s]	Max. Speed [Hub/min]
1	100	25	1	0	-1
2	165	0	0,9	0,5	10
3	159	0	0,25	0	10
4	173	0	0,9	0,5	12
5	167	0	0,25	0	12
6	180	0	0,5	0,1	-1
7	185	25	1	0	-1

Servo operation and pendulum mode with multi strike operation;
forward and backward motions in the forming area are configurable

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Solutions for Servo Presses

Generation of Motion Profiles using OACamGen

- Energy optimized motion profiles
- Calculation of two cycle times specified by start and stop angle for e.g. transfer or roll feed applications
- New optimization algorithm (higher precision, in general better utilization resulting in higher reachable machine performance)
- Memory for 1024 profiles
- Calculation of the energy loss for comparison of pendulum and servo operation
- Expert parameters (torque for forming process, resolution of the optimization algorithm) changeable via function block
- Extension of pendulum operating modes („Overshooting“, max. acceleration at reversal point)
- Extension of parametrization of the time of transfer (time of transfer and return in servo operation and pendulum mode)
- Multi strike operating mode (Chart of points in forming area in servo operation and pendulum mode)

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Metal Forming Solution Package

Solutions for Servo Presses

Energy Management

Special Characteristic of Servo Presses

- Cyclic load change caused by permanent acceleration and deceleration.
- What does this mean to the drive system of the machine?

Advantages / Disadvantages of an energy management

+ Smaller infeed
- Higher invest
+ Avoid power peaks
+ Reduction of harmonics

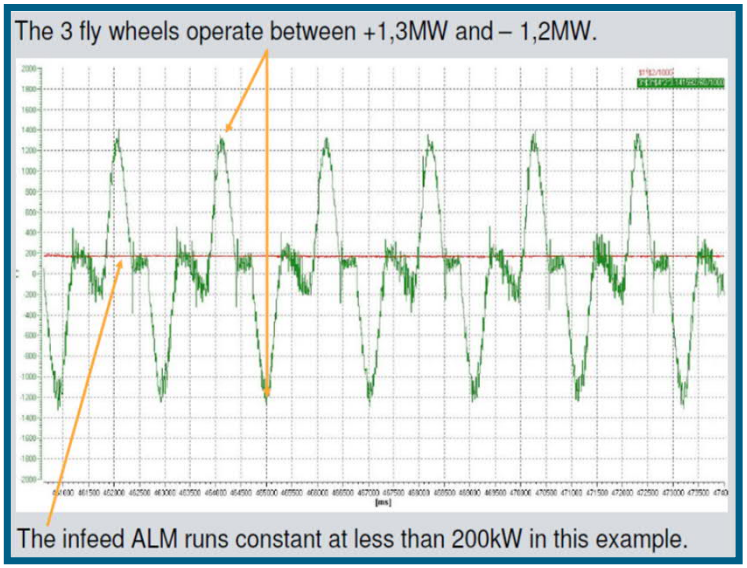
Technological Challenges

What types of affordable energy buffers are available?

- **Capacitors**
- **Kinetic buffer**

Energy Saving / Cost Reduction?

- Forming Work remains the same!
- Fed back Energy will not be refunded by the power company
- For large presses Energy management is a MUST



Energy Management

Why Energy Management?

- Reduced infeed power:
  With intelligent energy management it is possible to limit the infeed power to the actual work that needs to be done by the machine plus the mechanical and electrical losses of the system.
- Reuse of braking energy:
  The braking energy remains in the system and will not be regenerated and therefore will not cause any cyclic load changes on the supplies.
- Energy buffer during power loss:
  The energy remains in the system after a power loss and can be used for emergency movements and automation controllers for an optimized stand-still

Metal Forming Solution Package

Solutions for Servo Presses

Energy Management

Kinetic energy storage: Flywheel motor

☺ High energy density and low peak high power

☺ Safety: Encapsulated mechanical system

😐 Maintenance: Rotating mechanical system

☹ Higher expenses for infrastructure in case of water cooling

☹ Energy efficiency

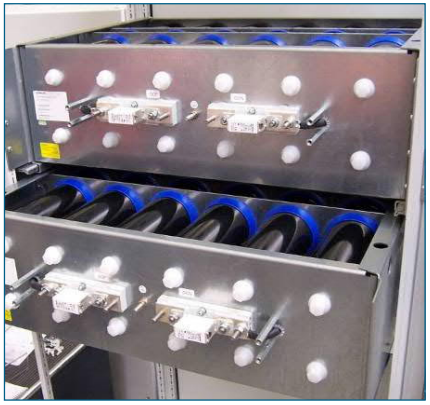
Electric energy storage: Capacity

☺ Low energy density and high peak power

☺ High energy efficiency

☺ Easy to install

☹ Lifetime is limited by load cycles and high ambient temperature



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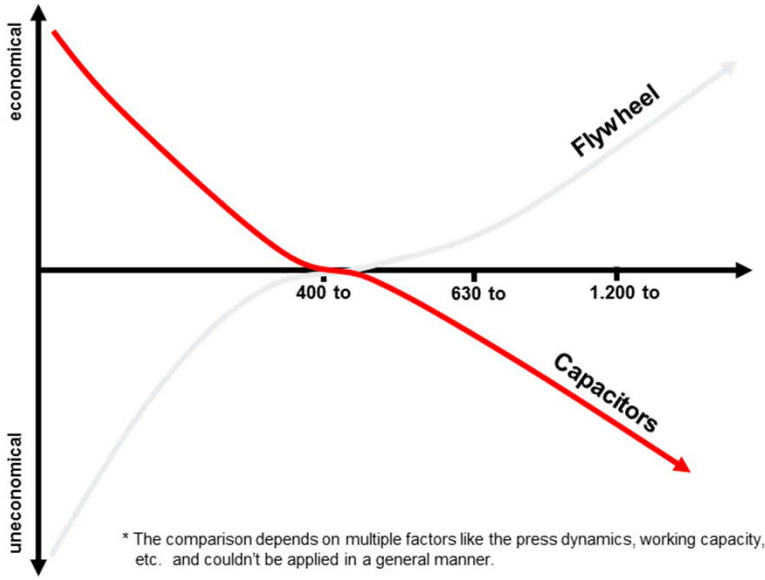
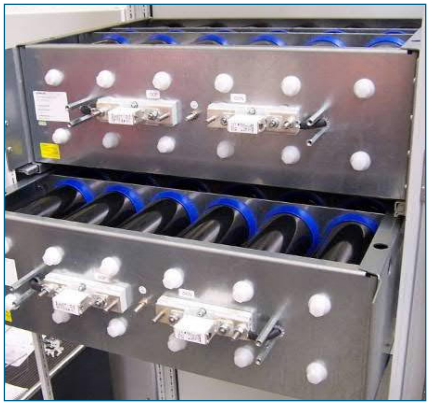
Solutions for Servo Presses

Energy Management

Schematic illustration of the system costs*



* The comparison depends on multiple factors like the press dynamics, working capacity, etc. and couldn't be applied in a general manner.



The capacitor solution is in relation to the control requirements the simplest one. However, in larger press systems the required capacitor quantity is too high to compensate the total peak motor power in the most cost-efficient way.

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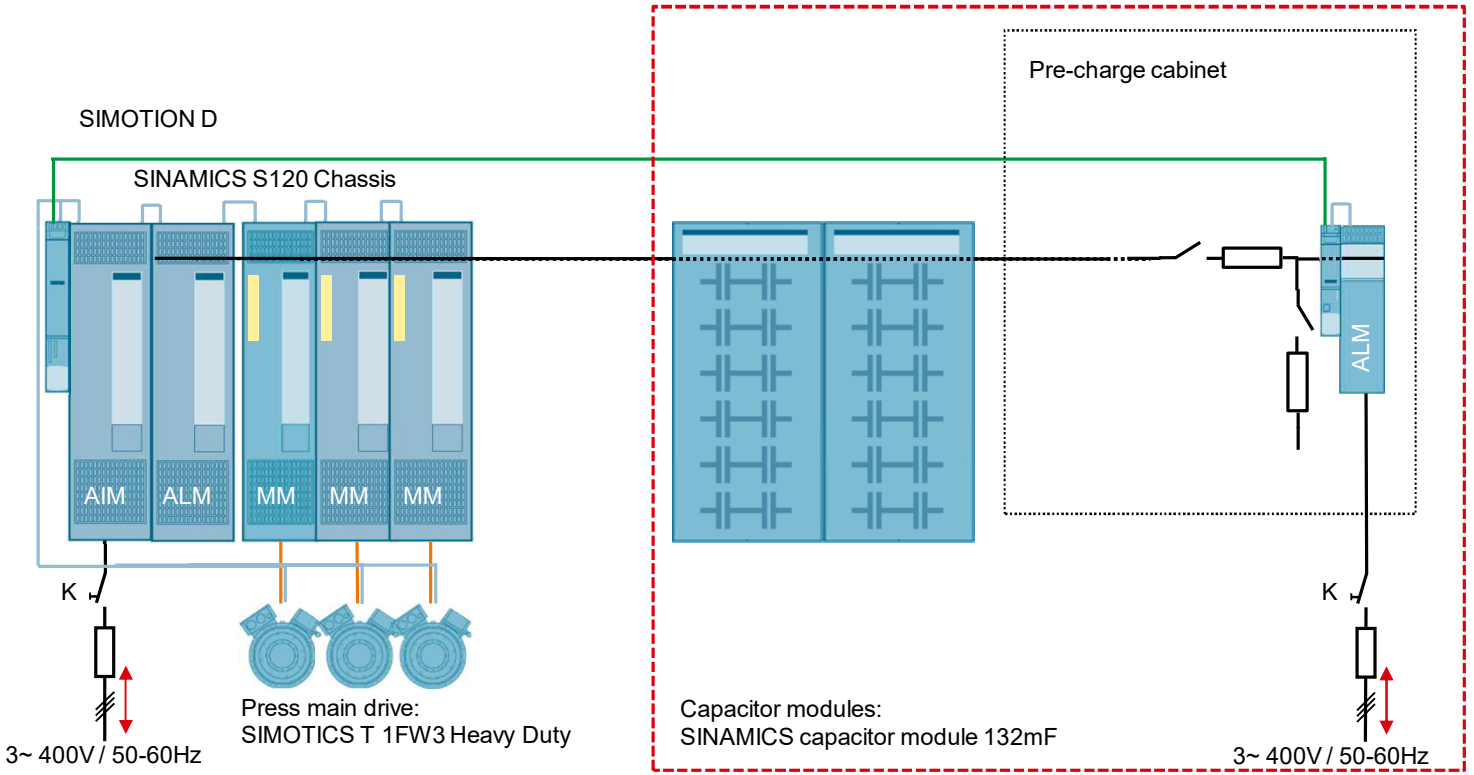
Solutions for Servo Presses

Energy Management with electric buffer



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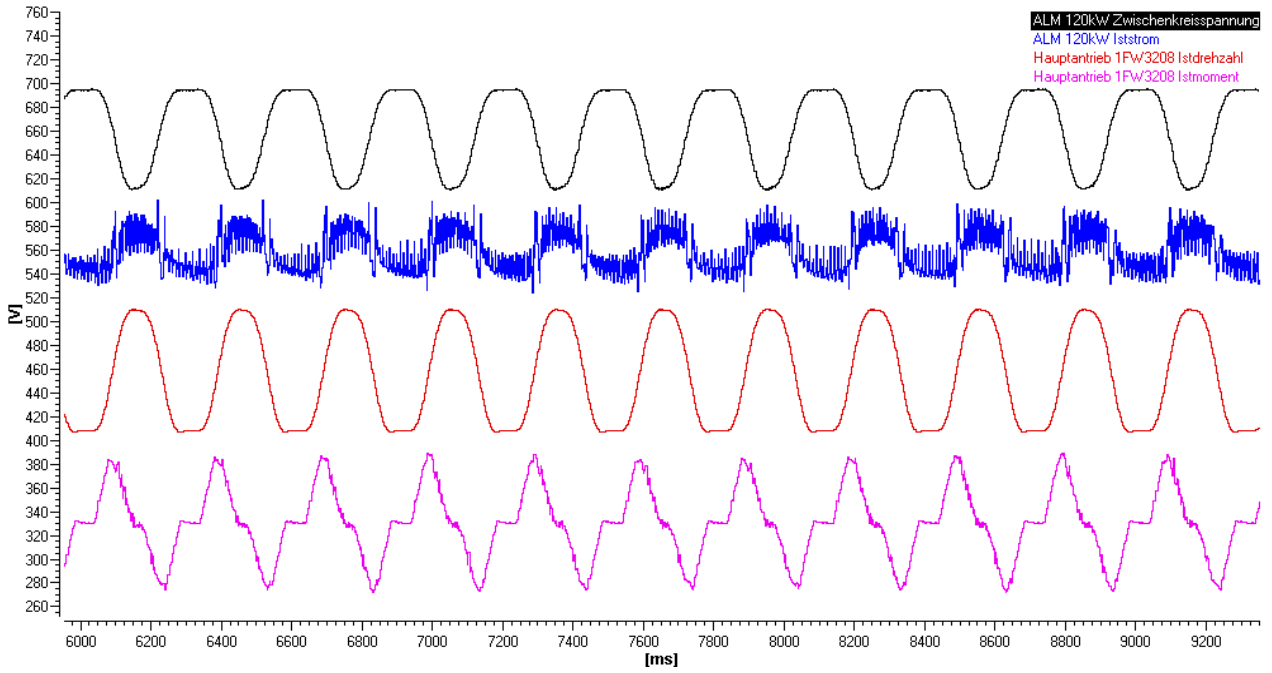
Solutions for Servo Presses

Energy Management with electric buffer



With maximum load the DC-link voltage level varies from 600V to 700V. There is no regenerating operation.

Metal Forming Solution Package

Solutions for Servo Presses

Energy Management with electric buffer

Product:

6SY7000-0AE64: SINAMICS Capacitor Module 132mF

Limitations:

- System limitation of the DC-link capacity is 2,3F (18 capacitor modules with 132mF each)
- Min. DC-link voltage: 600V
- Max. DC-link voltage: 720V
- Pre-charging required

Engineering:

- No additional control of the system required, manipulation of the voltage control in the ALM required

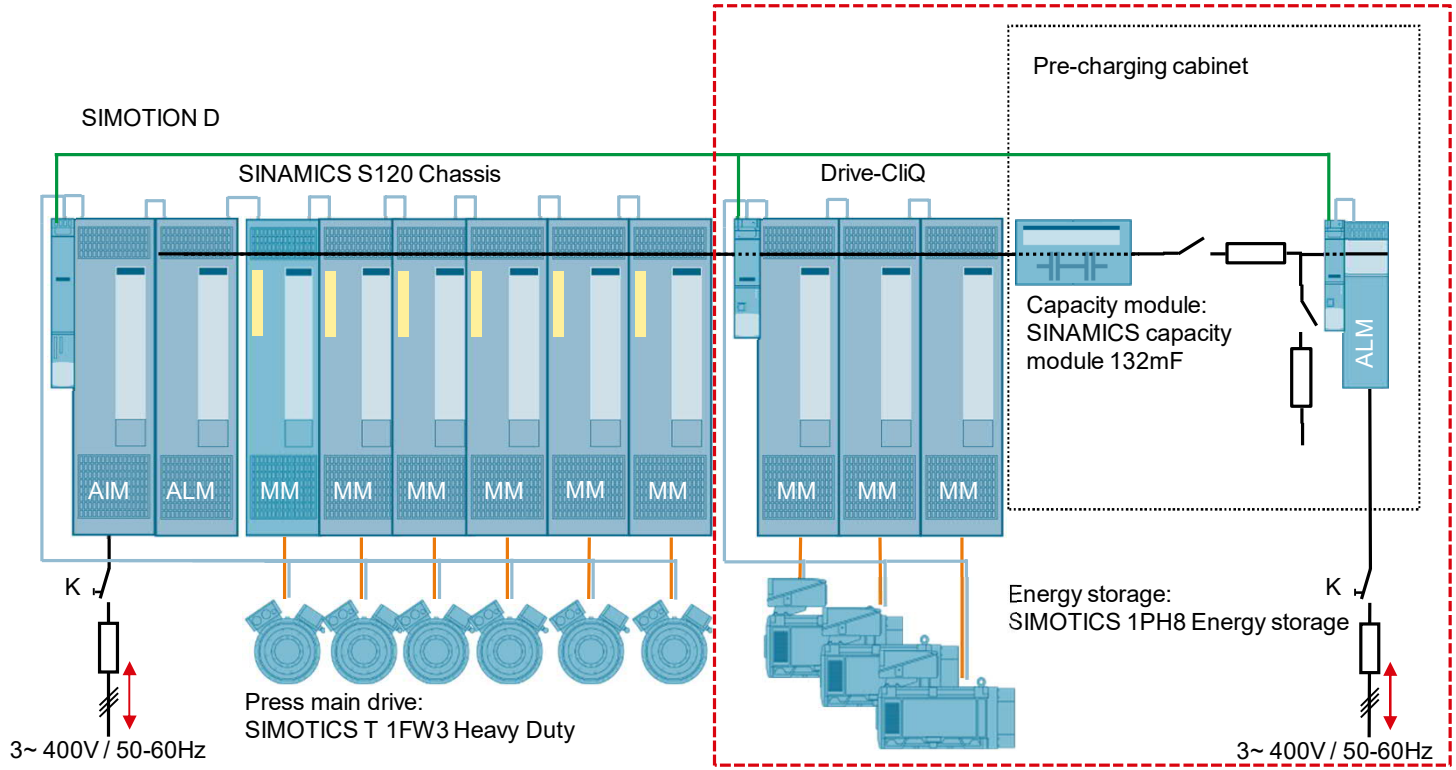
Fields of Application:

- Electric buffers are not applied to “larger” presses (>400t) because of the system limitation of 2,3F, cabinet space and price

Metal Forming Solution Package

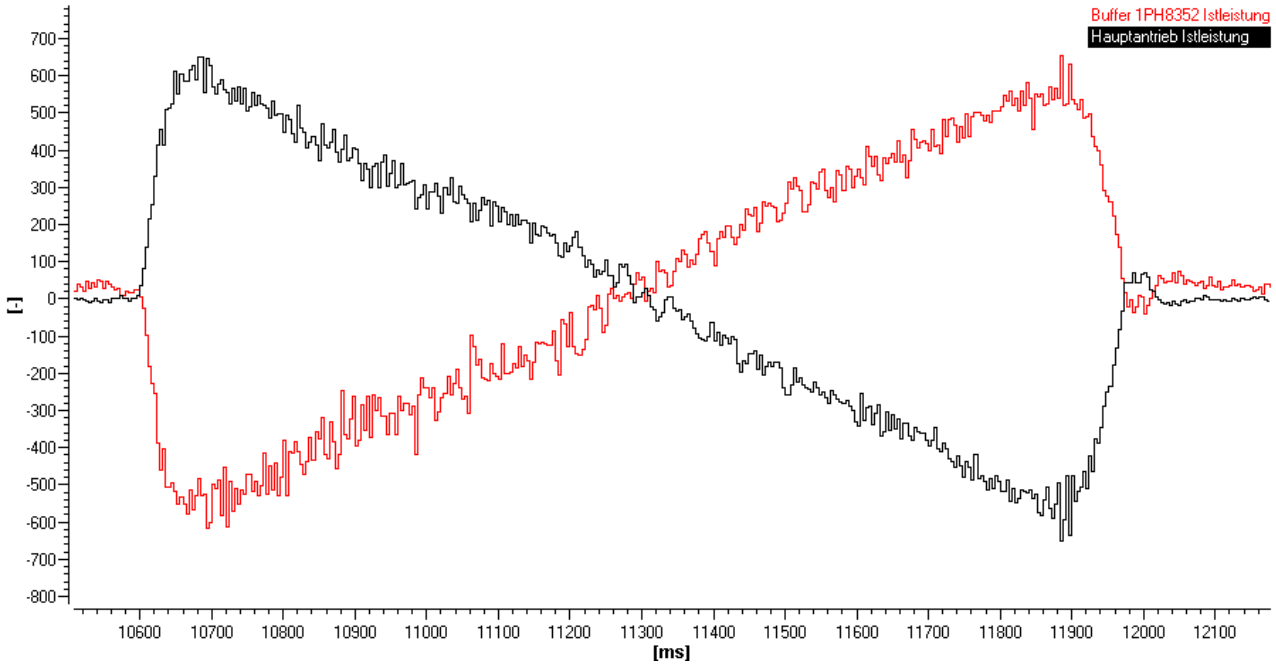
Solutions for Servo Presses

Energy Management with kinetic buffer



Solutions for Servo Presses

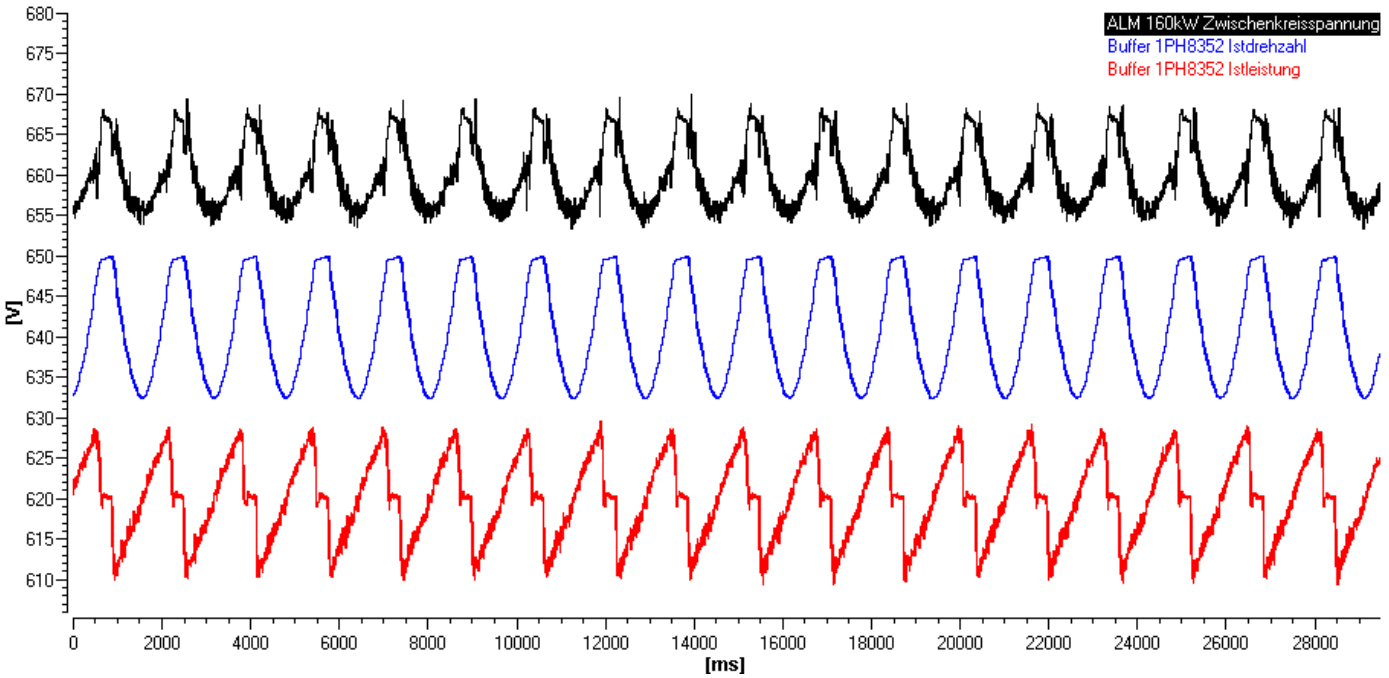
Energy Management with kinetic buffer



The main drive’s power is max. 600kW, required within 60ms. The power generated by the kinetic buffer is contrary.

Solutions for Servo Presses

Energy Management with kinetic buffer

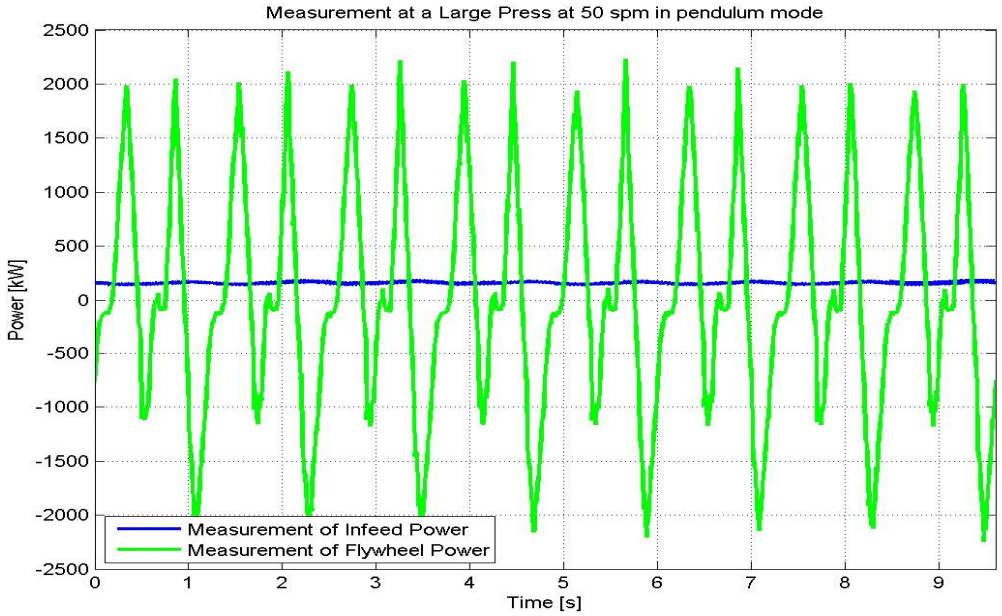


The DC-Link voltage differs ± 10V at max. load. The speed of the kinetic buffer is 1950rpm (±300rpm).

Metal Forming Solution Package

Solutions for Servo Presses

Energy Management with kinetic buffer



Press with 3 Flywheels:

Peak Load: ±2,2MW

Result :

The required power of the press is less than **200kW**..

Reduction of the power input through consequent Energy Management

Metal Forming Solution Package

Solutions for Servo Presses

Energy Management with kinetic buffer

Product:

SIMOTICS 1PH8 in shaft height 355 Energy storage

Features:

- No system limitation like the solution with capacities
- Nearly constant infeed power without regeneration
- Smallest infeed power

Limitations:

- Short cycle times because of the high dynamic of the system required (≤ 1ms)
- One capacity module required to improve the system robustness
- Pre-charge circuit required

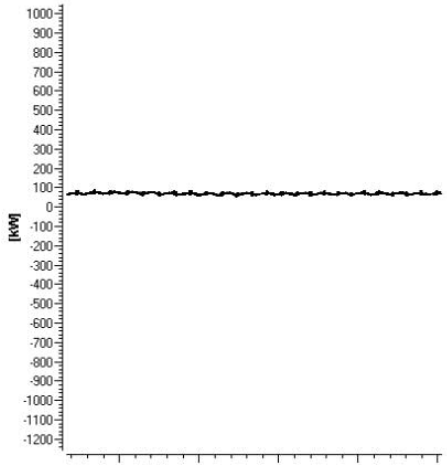
Engineering:

- Additional control required
- Implementation of the control within SIMOTION in a know-how protected function block

Metal Forming Solution Package

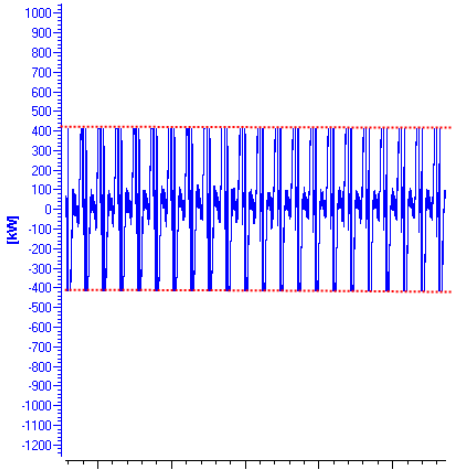
Solutions for Servo Presses

Types of Energy Management



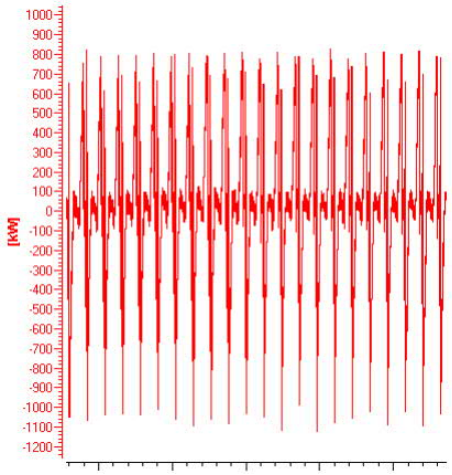
Full Size EM

Almost constant infeed power, no regeneration. Smallest supply power required.



Semi EM

Reduction of power peaks, in general lower infeed power required (scalable system), oscillating power.



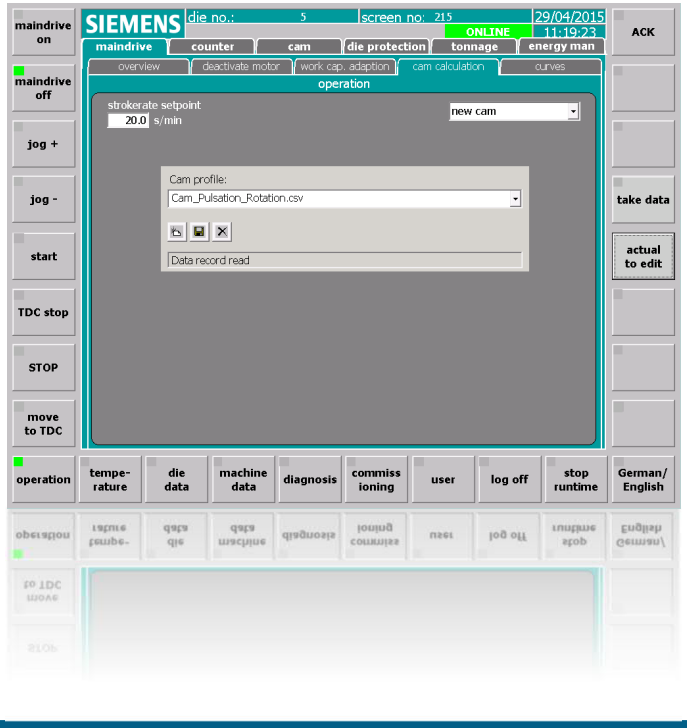
No EM

Power has to be taken directly from the infeed, highest power requirement, high requirements on the infrastructure (high oscillating power)

Metal Forming Solution Package

Solutions for Servo Presses

SIMOTION SimoPess Servo: Free Cam Profiles



- **User-defined** cam profiles for press motion
- Cam profile as **interpolation point table** (eccentric position [°] at virtual master position [°])
- Up to **720 interpolation points** possible
- File must either be **CSV** or **TXT**
- File must have **specific structure** (distinction between rotation and pendulum profiles)
- File must be stored on **CF card** of SIMOTION (USER > SIMOTION > HMI > USERFILES)
- Referenced by **file name**

Caution: No verification regarding any mechanical or electrical limits!

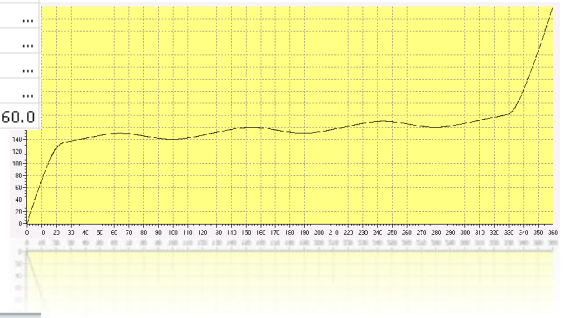
Solutions for Servo Presses

SIMOTION SimoPess Servo: Free Cam Profiles

Rotation profiles:

- First interpolation point must be **(0.0, 0.0)**
- Last interpolation point must be **(360.0, 360.0)**
- Remaining interpolation points can be chosen arbitrarily (in ascending order)

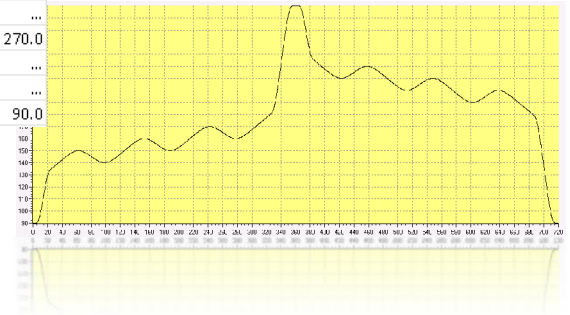
	A	B
1	0.0	0.0
2	...	...
3	...	...
4	...	...
5	...	...
6	...	...
7	360.0	360.0



Pendulum profiles:

- First interpolation point must be **(0.0, start point pendulum)**
- One interpolation point must be **(360.0, end point pendulum)**
- Last interpolation point must be **(720.0, start point pendulum)**
- Remaining interpolation points can be chosen arbitrarily (in ascending order)

	A	B
1	0.0	90.0
2	...	...
3	...	...
4	360.0	270.0
5	...	...
6	...	...
7	720.0	90.0



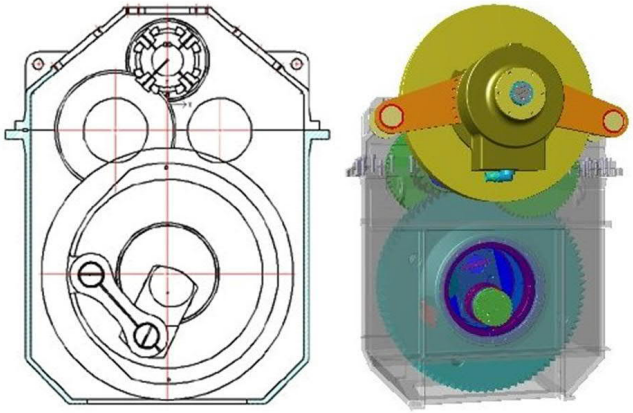
Solutions for Servo Presses

SIMOTION SimoPress Servo: Customized Kinematics

Customized Kinematics:

- Drag link system
- Link drive
- Knee lever
- etc.

Customized kinematics can be included via array of data or cam.
Die data has to be available in form of breakpoints angle of the eccentric / stroke heights with sufficient resolution (minimum 1°).



Advantages:

- Reduced motor power
- Cheaper systems

SIMOTION SimoPress Servo: hand wheel operation

Mini-Handheld for handwheel operation:

- Handwheel with magnetic latching and incremental encoder
- 2 channel enabling button
- 2 channel emergency stop
- Connection to Sinamics S120 via SMC 30
- Resolution / Speed configurable via Simopress Servo

E.g.
6FX2007-1AD03: With 3,5m coiled cable
6FX2007-1AD13: With 5m straight cable
6FX2006-1BG03: Connection kit (>= 25m)
6SL3055-0AA00-5CA2: SMC 30

Attention:
Take the output current derating for frequencies < 10 Hz into account!

Metal Forming Solution Package

Solutions for Servo Presses

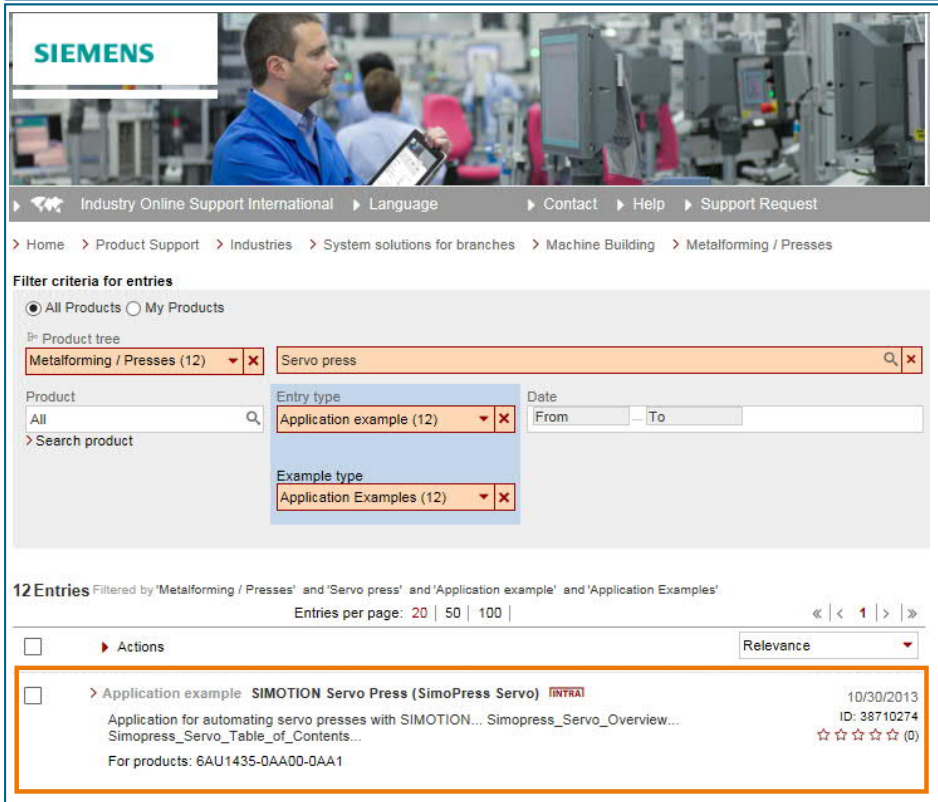
SIMOTION SimoPress Servo V3.8: Scope of Functionality

- Automatic calculation of energy optimized motion profiles for servo presses
- Integration of individual kinematic systems (eccentric, link-drive, drag-link…)
- Easy generation of motion profiles via OACamGen, Multipoint, integration of external curves
- Generation of the motion curves directly in the machine
- Generation of motion profiles via parameter (start angle, end angle of the forming area, speed, time for press handling, waiting time, pendulum, target machine speed)
- Continuous or pendulum operation possible
- Electronic hand wheel for tryout operation
- Reduction of the connecting power via scalable energy management
- Supports electronic energy buffer (capacities) or kinetic buffers (flywheel)
- Calculation of the press performance via web-server possible
- Operating mode manager (Setup, Single Stroke, Automatic, Positioning, OT-Stop, Hand wheel)
- Three different stop reactions (TDC stop, immediate stop, safety related stop)
- Direct synchronization between press handling and press possible (roll feed, transfer)
- Inclusion of restriction caused by the press handling system
- Tool data management

Metal Forming Solution Package

Solutions for Servo Presses

Applications & Tools



Contents :

- PowerPoint Presentation (German / English)
- Manuals (German / English)
- Application for SIMOTION D demo system including HMI
- Information material (German / English)

What offers the application:

- Simplified engineering
- Optimal Project structure
- Simplified Support
- Documented and tested Software

Price:

- The application is free of charge

How to get the application:

- Request at DF FA PMA BR3-2 or APC
- Via Applications & Tools portal

Metal Forming Solution Package

Solutions for Servo Presses

From a servo press to a coordinated servo press line

What are the challenges in servo press coordination?

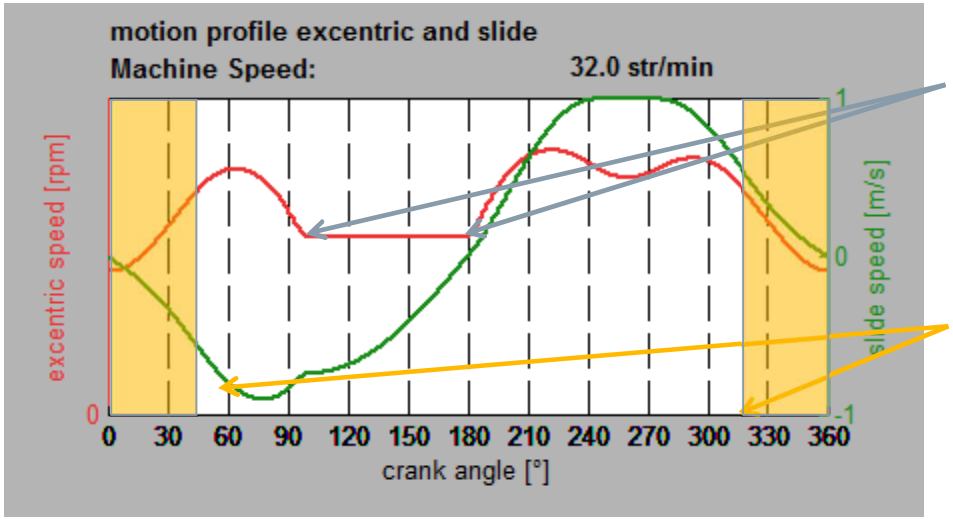
If one wants to operate servo presses in a coordinated manner he will find out quickly that the presses usually must follow the transfer device.
The handling application creates very specific requirements for the movement of the single presses.
Distance between tools, acceleration and jerk at the point where the product is held force the handling device to move in a way that defines the range for the offset angle of the presses right and left of the handling device.
This results in defined offset angles between the individual presses that must be controlled by the press line automation system in order to reach the ideal parts flow through the press line.
In order to give the handling device space and time for a collision free movement it is essential that the motion control system of each single press allows the manipulation of its motion profile in a way that opens the press fast and delays the closing of the press while observing all other settings for an optimized production rate and highest energy efficiency.

Here the flexible OACAMGEN can show its superior functionality!

Solutions for Servo Presses

From a servo press to a coordinated servo press line

Flexibility in the definition of the motion profile:



Forming area is defined and must not be changed.

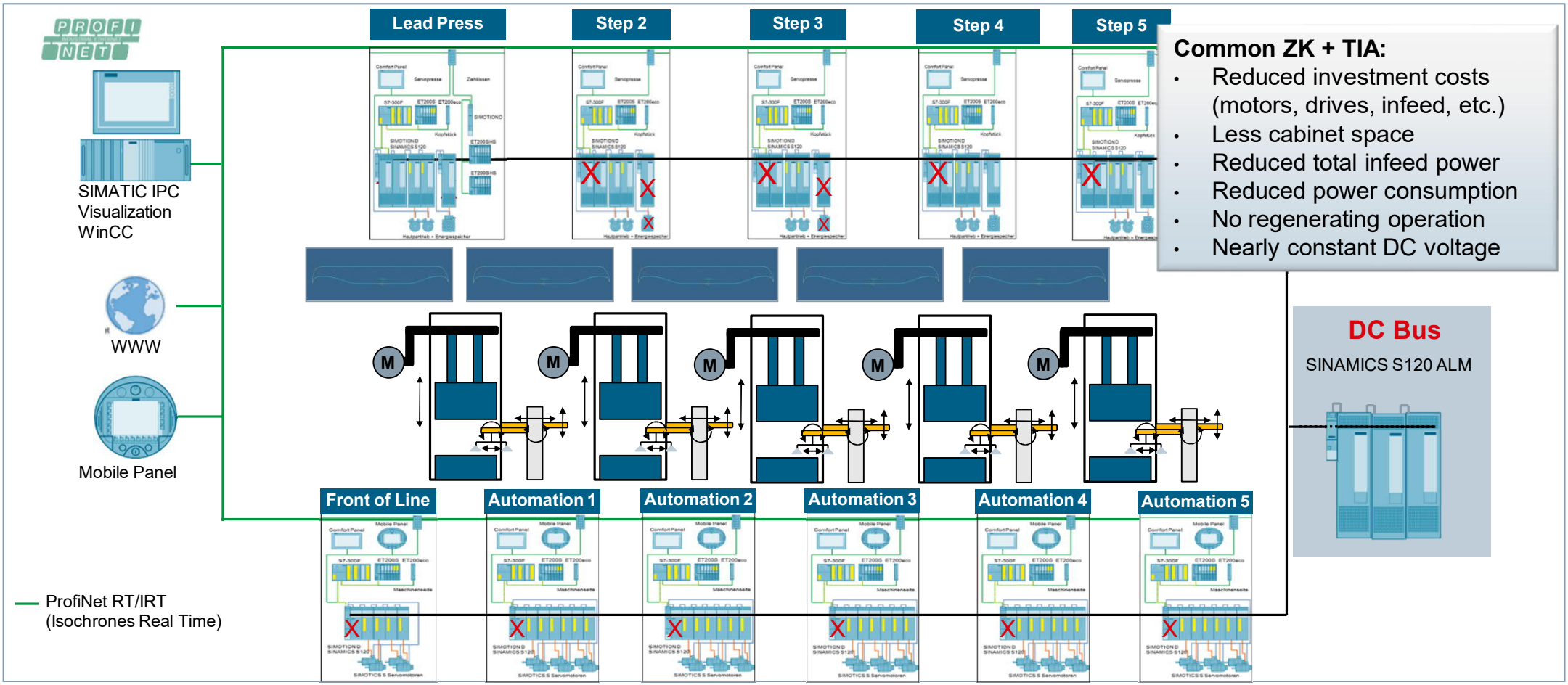
OACAMGEN allows to keep the press in „open condition“ longer and thus gives more time for the handling system to run a smooth profile.

If your machine operator had the choice - would he leave the definition of those complicated curves to smart software or would he rather go for the try-and-error method to define these motion profiles?

Simotion OACAMGEN is the perfect tool for this job.

Metal Forming Solution Package

Solutions for Servo Presses



Common ZK + TIA:

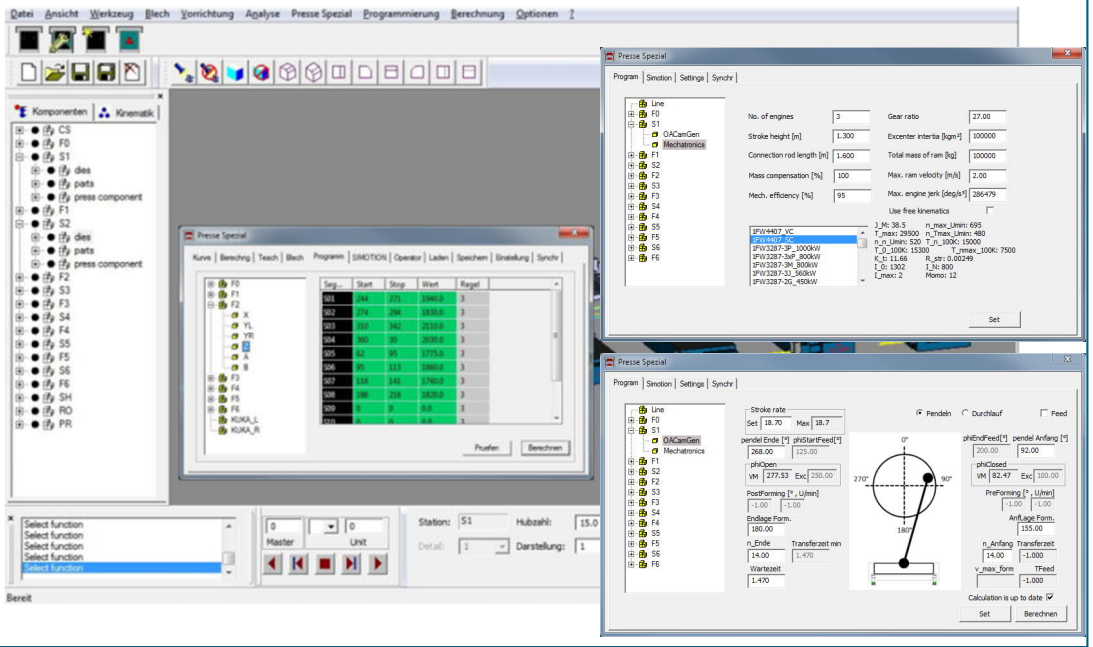
- Reduced investment costs (motors, drives, infeed, etc.)
- Less cabinet space
- Reduced total infeed power
- Reduced power consumption
- No regenerating operation
- Nearly constant DC voltage

Metal Forming Solution Package

Press Line Simulation (PLS)

Press Line Simulation (PLS)

- Simulation by a precise model of the press
- Simulation of complete press lines
- Collision detection (Automation, Die)
- PLS consists of three functional packages (Generation of press models, Press Line Simulation, Die Validation)
- Transfer programming **identical to SIMOTION SimoTrans**
- Optimized handling motion profiles can be **directly transferred to the handling controller (Simotion)**
- Generation of Motion profiles for Servo presses identical to **SIMOTION SimoPress Servo**
- Press profiles can be **directly transferred to the press controller (Simotion)**



- **Virtual optimization and verification of all function components**
- **Minimizing of errors through simulation**
- **Increase of productivity by optimized process parameters**

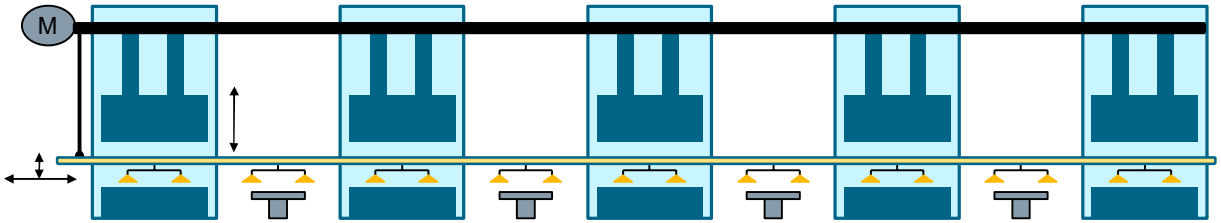
Metal Forming Solution Package

Press Line Simulation (PLS)

Press concepts in the past and today

Past / Today: Transfer presses

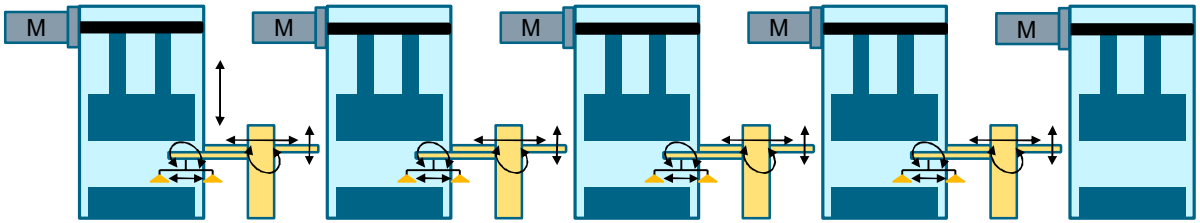
- Common drive / mechanical connection
- Mechanical Flywheel
- Mechanically synchronized transport system
- Low dynamic
- Limited flexibility (rotation)



- **Low potential for optimization**
- **Low danger of collisions**

Today / Future: Servo presses

- One drive per slide / direct drives
- Flexible and programmable material transport
- High dynamic
- Electrical synchronization



- **High potential for optimization**
- **High danger of collisions**

Optimization only possible via Simulation due to complexity

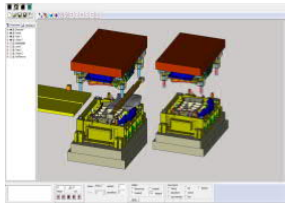
Metal Forming Solution Package

Press Line Simulation (PLS)

Interface example for PLS / SIMOTION available

PLS (Simulation)

- Servo press
- Handling system



Simulation result

OPC XML DA

PROFINET

Servo press

- Movement profile
- Energy management

Data area in Simotion (Data and control signals):

```
sPressType : STRUCT
        r32startFormingAngle  : REAL;   // Start angle forming
        r32endFormingAngle    : REAL;   // End angle forming
        r32Formingspeed       : REAL;   // Target speed
        u8ProfileType         : USINT;  // Profile type
END_STRUCT;
```

Handling

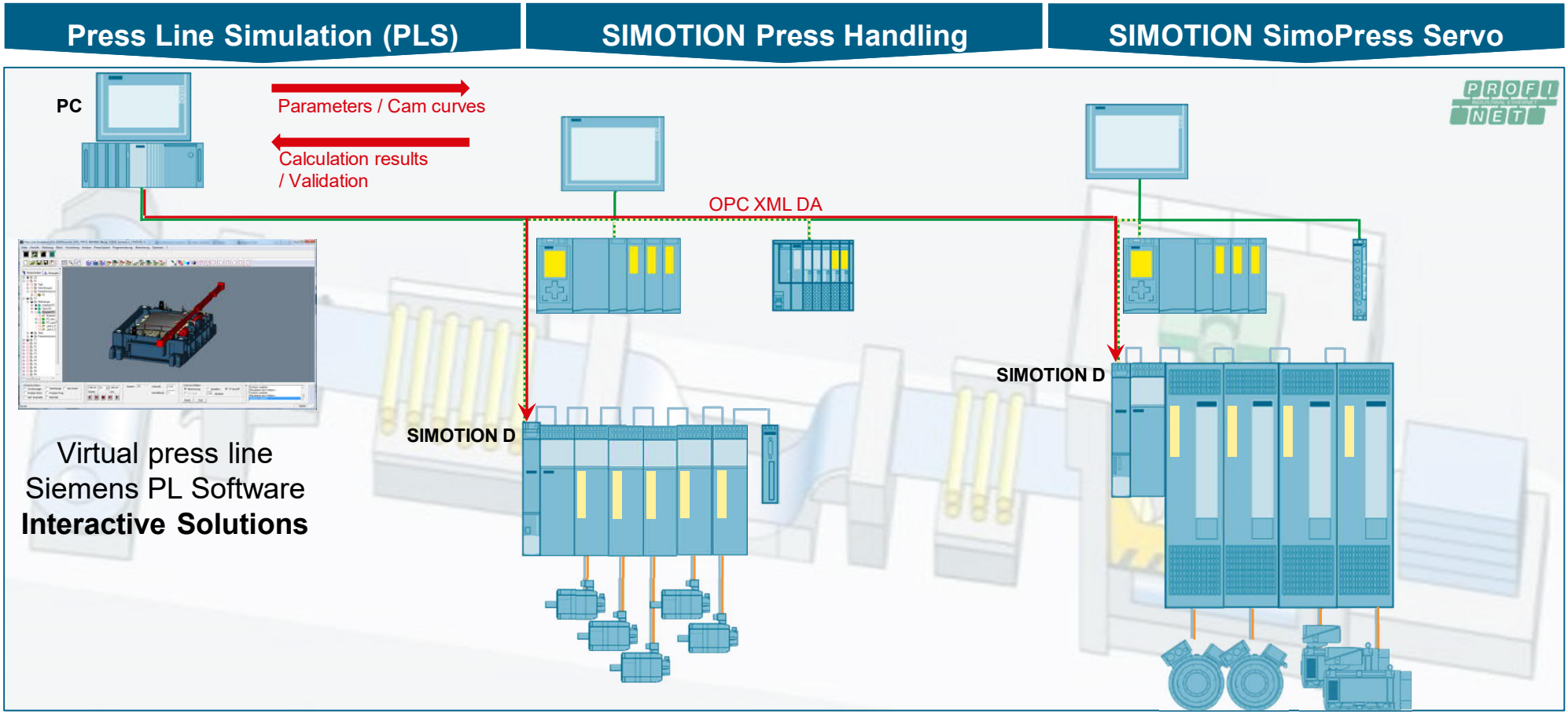
- Synchronization with press Movement profile

Data area in Simotion (Data and control signals):

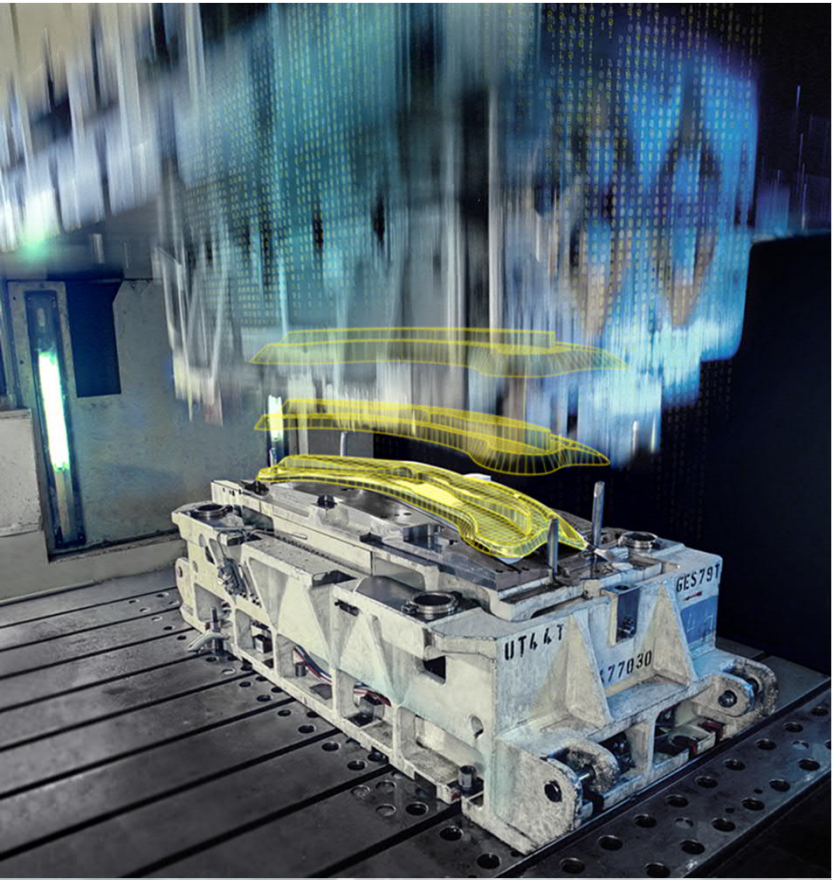
```
sMoveSetType : STRUCT
        r32StartLeadingValue  : REAL;   // Start angle virtual master
        r32EndLeadingValue    : REAL;   // End angle virtual master
        r32FinalPosition      : REAL;   // Target position
        u8ProfileType         : USINT;  // Profile type
END_STRUCT;
```

Metal Forming Solution Package

Press Line Simulation (PLS)



Thank you for your attention!



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