Print Standard Segment Offset

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1 Basic information and data

1.1 Objective and purpose

This document is a specific addition to the Print Standard Master project/documentation. It is intended to add to the Master document all the printing segment specific information, so that people get familiar with the particular printing segment only see the relevant information tailored to their machine class.

Nonetheless all detailed information about the Print Standard is described in the Print Standard Master and assumed to be understood/available.

In most cases also a for the relevant machine segment simplified SIMOTION Scout project is available.

This approach provides the following benefits:

- Faster learning curve for first time users of the Print Standard
- The customer/user sees only the technological content relevant for their machine class / industry segment.
- Setpoint channel and required machine technologies can be tailored to the segment needs, but programming concept, interfaces and all programs are identical with the core Print Standard Master code, which means the Segment projects can be easily generated from the master.

2 OFFSET Segment overview

This segment specific Scout project and document has its focus on one specific printing technology. This way the code complexity can be minimized and the content can be better tailored to what is needed for the specific segment.

Nevertheless the Print Standard Master documentation is always the basis document with detailed (segment independent information) about the Print Standard.

The SEGMENT OFFSET is divided in 3 Machine types:

- Newspaper Web Offset
  Typ. Products (daily papers, free papers, advertising)

- Commercial Web Offset
  Typ. products (magazines, journals, advertising)

- Sheet Fed Offset
  Typ. products (magazines, posters, packages, labels)

The following document describes concepts and examples for commercial web offset, but the content/concepts can also be applied to the newspaper and sheet fed machine types.
2 OFFSET Segment overview

2.1 Overview

Offset-printing is a printing technology where printing and none printing areas are situated on the same layer. The printing process is based on the repulsive effect of water and oil. The printing areas of the printing plates reject water and absorb the oil-based ink. The none printing areas are covered with water and reject the oil-based ink.

Figure 2-1 Main parts of the Offset Printing process

In sheet-fed presses above “blanket to impression cylinder” configuration in each print unit is used. Presses with impression cylinder can only print all colors on one side first.

In web presses often a “blanket to blanket cylinder configuration” is used. That means in above picture instead of the impression cylinder another blanket/plate couple can also print on the lower side of the web.

In commercial presses the blanket to blanket configuration is standard, while in newspaper presses both types are common.

Commercial and newspaper presses print on web and have typically fixed format length (= plate cylinder circumference / cutoff).

NOTE As a rare exception some special offset presses for packaging material also adjust the format length.
Newspaper presses sometimes use “footprint” configurations (several print towers/units are still mechanically synchronized) or “multi drive” configurations with individual drives for many cylinders in the machine. Those machines have typically at least one motor per “print couple” (blanket and plate) and many servos in the folder and pull roll sections. Average servo axis count of 20-30 for a commercial web press and > 100 for newspaper web presses are common.

In web offset presses modern folders became highly modular to simplify the complex mechanical construction of e.g. cams, slow down belts, chopper, diverters etc. These “multi drive” folders and especially the required “product tracking” for synchronization can be a complex side effect of the many separate driven mechanical parts.

Some sheet-fed presses print front and backside color one after the other. The sheets are transported in the machine by a continuous train of cylinders with grippers handing them over from one to the next. Therefore sheet-fed presses can print a range of sheet formats in the same machine. In sheet fed offset machines the main gear train is still mechanical and driven by one AC or DC motor. Some machines were recently developed with independent driven plate cylinders to allow independent and faster “plate change” / “make-ready”.

2.2 Web Offset Machine configuration examples

Figure 2-2 Commercial press: 1 production with 1 web, 4 units, 1 folder

Figure 2-3 Commercial press: 1 production with 2 web, 8 units (inline), 1 folder

Figure 2-4 Commercial press: 2 possible productions with 2 web, 8 units (duplex), 2 folders

Figure 2-5 Newspaper press:
2 possible productions with 10 web, 8 towers (w. 8 couples each), 2 folders
2.3 General machine spec of a commercial web offset press

Typical machine specification of the commercial web printing segment:

- **Machine length**: 20m - 60m
- **Machine width**: 2m - 3m
- **Machine height**: 3m - 10m
- **Machine weight**: 100 – 250 metric tons
- **Production speed**: 35,000 – 120,000 products/h
- **Web speed**: 5 – 16 m/s
- **Amount of servo drives**: 10 – 50
  (depending on degree of servo modularity and amount of webs and folders)
- **Installed drive system power**: 50kW – 600kW
- **Cut register accuracy**: +/- 100 µm
- **Color register accuracy**: +/- 10 µm
2.4 Typical machine components of commercial web offset

Above picture shows examples of the basic machine components of a small 1 web commercial offset press.

The unwind can be a standalone automation solution independent of the rest of the machine. About 3 to 6 vector drives implement the winder functionality. Modern unwinds automate the splice and change of the paper rolls.

Typically 2 up to 6 print units operate on one web. For color printing 4 print units (black, cyan, magenta, yellow) are necessary. Each print unit has typically 1 or 2 servo motors to run the print/blanket cylinders of the upper and lower web print couple. Additional just speed controlled drives operate the ink and water (dampening solution) rollers in the print unit.

The dryer is again a standalone unit independent of the servo synchronization. The dryer has many standard V/f and vector drives and an automation solution to dry the web after the print process.

The chill section starts the pull roll section after the dryer. The “pull rolls” pull the web with position controlled “draw” into the folder. The chill is often servo driven by one or two drives. More individual servo driven “pull rolls” guide the web after the chill into the folder. e.g. slitter, roller top former.

The folder cuts and folds the product before it leaves the folder via delivery belts towards the finishing/ post press process. Modern folders have about 10 to 20 servo drives with individual driven “Main Nips”, “Cut Cylinder”, “Diverter”, “Chopper”, “pull rolls” and “delivery belts”.

NOTE Additional auxiliary modules (not included in above basic picture) are often used in the web path which are also synchronized and servo driven. Examples are Gluer, Perforator and Pre-folder stations.
2 OFFSET Segment overview

2.5 Standard technological features in commercial web presses

The following is an exemplary list of shaftless servo functionality that is required for the commercial web offset segment and included in the Print Standard concept.

The modular machine concepts demand and make use of the independent driven machine servo sections. That means that each servo can be operated independent from the others at any time. This provides significant time savings during make-ready of the machine but also during manufacturing and test at the OEM facilities and during commissioning at the end-customer.

Most axes in the machine touching the web or in the folder the product are angular or position synchronized “following axes”. A Global Virtual Machine reference is acting as virtual line shaft.

Virtual Global Master concept:
The virtual master code can generate multiple disturbance free position/speed setpoint(s) which replace mechanical (line) shaft’s. These setpoint’s are broadcasted to all connected drive-nodes.

One or more virtual Global Master (GM) axes for the whole machine are possible. It depends on how many different productions have to be performed at the same time in the machine (for commercial web typically up to 4 to synchronize two 2 web machines side by side).

The global virtual master as set point source could also be replaced by an external encoder as a real master e.g. in case of retrofits or extensions of shafted machines with new machine modules.

Modular Following servo drive concept:
All servo drives are standardized using the same program code and interface to the PLC to offer the following standard servo functionality.

- Following capability to Master references (Global or Group “Gear Mode”): The drives can switch between possible masters depending on production and machine state. e.g. between “global master” of web 1 or web 2 or to a “group master” e.g. to operate just one folder independent:

  a. angular synchronized (e.g. folder cut cylinder and print units) with any adjustable register/register/phase offset e.g. 0 to 360 degree (or necessary modulo for product tracking).

  The phase / register value can be changed at any time absolute, relative or by inch/jogging on top of the current machine speed. The total current phase is accumulated and stored in the drive.

  b. Synchronized to match web speed with position controlled overspeed “draw” to pull the web (e.g. all pull rolls and nip rolls). Typically 0 to 1% draw can be individually applied to each separate driven pull roll.

- Independent drive operation (“Local Modes”):
2 OFFSET Segment overview

Each drive can perform the following modes in local operation independent of the rest of the machine at any time:

a. Local speed operation: Speed setpoint is given as setpoint value or via faster, slower, hold (Motorized Potentiometer MOP) functionality.

b. Local positioning operation: In this mode the drive can position the load cylinder at any given position. Positioning can be operated based on relative or absolute setpoints. This is e.g. used for angular synchronous drives like print units during plate change or in the folder to preset different production modes.

c. Local referencing mode: After motor/encoder change or during first time commissioning an alignment between encoder zero and mechanical load position can be performed using various "referencing" methods. Absolute and incremental encoder types can be referenced/homed via active and passive methods.

- The necessary dynamic dynamics (i.e. speed profile ramp up / ramp down times and rounding/jerk values) can be configured in the drive/motion system. Each technological drive mode has a different possible set of dynamics.

Standardized Interface concept:

The Machine PLC program can control all drives/axes in the machine, the virtual (like virtual global machine masters) or the real (like all drives) in the exact same way using the same interface of control/actual data.

With this concept the highest modularity and consistency is achieved.
3 Example of a machine setpoint structure

Figure 3-1 Example of machine setpoint structure (Basic example: one production into one folder)

Above picture shows an example of a possible machine setpoint structure of a small one web commercial offset press.

NOTE

The unwind does not need to be part of the synchronized setpoint distribution if a standalone solution is preferred.

The setpoint structure / cascade with the Siemens SIMOTION motion control system is generated via Technological Object (TO) connections.

The picture shows the Axis TO’s for GM (Global Master), LM’s (Local Masters) and RA’s (Real Axis). Each Real Axis runs a servo motor using the SINAMICS drive system on the press.

The amount and distribution of SIMOTION D CPU’s/stations is just an example and will vary depending of amount of drives needed and the decision made on modularity of the hardware concept.

Larger machine parts with many drives like the folder are typically processed with several SIMOTION or SINAMICS processors.

The Global Master(s) can be processed in any station, typically in station(s) which are always needed for production are chosen.

The function of the Local Master axes are to receive the distributed synchronized setpoints from it’s Global Master. The Local Master can also be used to shift the registration/phase of all connected real axes independent and simultaneously. e.g. for print to cut register moves of the print units.
4 Example of gearing and normalization concept

The following pictures show example of gearing and normalization concepts for commercial web offset printing presses.

Picture 4.1 is focusing on basic machine types with one product around the print cylinder circumference and a basic folder type (without the added complexity of modern combination folders).

This example is used to demonstrate the electronic gearing and unit normalization based on three common axes types: a print cylinder, the main folder drive and one pull roll.

Picture 4.2 and 4.3 show based on this core principle advanced gearing and normalization concepts needed for 2-around machines or when combination folders create the need for product tracking / synchronization.

These examples cover only one possible way of normalization and are described in more detail on the following pages. Please note that many different ways of normalization/gearing concepts are possible and they all have different pros and cons.
4 Example of gearing and normalization concept

Figure 4-1 Basic example for normalization and gearing

**4 exemplary axes of a commercial web offset printing press:** „print-unit“, „pull roll“, „folder cut cylinder“ and „folder chopper“

Example Machine specification / definitions:

- GM speed normalization: 100% = 8000 deg/sec = 80000 impression / h (= print cylinder rev / h)
- GM position normalization: 360 degree = 1 product = 1 impression = 360 degree of print cylinder
- GM axiscycle length: 1440 degree = 4 products = 4 print cylinder revolutions
- Cutoff / Print cyl. Circumference: 565,150 mm

![Diagram of printing press axes](image)
4 Example of gearing and normalization concept

Figure 4-2 Advanced technological setpoint channel and normalization/gearing “1 around”

Example of gearing and normalization:

GM speed normalization: 100% = 8000 deg/sec = 80000 IPH = 80000 print cyl. rev/h
GM position normalization: 360 degree of GM = 1 product = 360 degree of print cyl.
GM axis cycle length: 1440 degree = 4 products/impressions = 4 print cyl. revs

PLC Interface (definition, units and data type):
Speed: DW: 2°/30 = 100%
Position/Register: DW: 3600000 = 360 degree of load cylinders

Example of machine spec. variations depending on machine type:
16 / 24 page machines:
max. speed = 2400 fpm; 38 in (965mm) / 57 in (1450mm) web width

24 / 32 page machines:
max. speed = 3000 fpm; 57 in (1450mm) / 72 in (1830mm) web width

Fixed cut off lengths between: 21.00 in (533.40mm) – 24.41 in (620mm)
Various folder types: with different spee limits: e.g. 56000 – 100000 fpm

“1 AROUND”
1 cutoff = 1 impression
per print cylinder revolution

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4 Example of gearing and normalization concept

Figure 4-3 Advanced technological setpoint channel and normalization/gearing “2 around”

GM speed normalization: 100% = 8000 deg/sec = 80000 IPH = 40000 printcyl rev/h
GM position normalization: 360 degree of GM = 1 product = 180 degree of print cyl.
GM axisycle length: 1440 degree = 4 products/impressions = 2 print cyl. revs
GM = “impression (product) based concept.”

Example of machine spec variations:
48 / 54 page machines:
max speed = 37500 / 45000 U/h; 1450mm / 2000mm web width
32/48 page (short grain / legend):
max.speed = 56000 U/h; 1320mm / 2000mm web width
Fixed cut off lengths between: 145mm – 620mm
Various folder types: with different speed limits: 37500 – 60000 U/h

“2 AROUND”
2 cutoff = 2 impression per printcylinder revolution

Paging format
6 x 4 / 6 x 4 / 6 x 4 / 6 x 8

Page 16 of 64

Print Standard Segment Offset
Entry-ID: 48946827, V3.0.0, 01/2017
4.1 Machine specification, defined resolutions and definition of GM axis

Given specification:
- max. machine product speed is 80000 products / hour
- 565,150 mm cutoff (circumference of cut cylinder and print cylinder)
- 626,482 mm circumference of exemplary pull roll
- Folder chopper module (3.fold) expects 1 product per mechanical load mechanism revolution
- mechanical total gear ratio of cut cylinder motor to cut cylinder load roll is 7 to 3
- mechanical total gear ratio of print cylinder motor to print cylinder roll is 2 to 1
- mechanical total gear ratio of pull roll motor to pull roll cylinder roll is 80 to 38
- mechanical total gear ratio of chopper motor to chopper mechanical load mechanism is 2 to 1

Defined:
- The position (setpoint) normalization/resolution of the Global Virtual Master axis is defined to 360 degree of GM = 1 product = 360 degree of one print cylinder revolution
- 100% speed of GM is defined as max. machine operating speed of 80000 products / hour

NOTE: The SIMOTION axis process actual/setpoint positions with internal LREAL accuracy, but the SIMOTION axis preset the position resolution to three decimals 1000/unit i.e. 360,000 degree. This should be increased to maximum value 1000000/unit. The real achievable position accuracy (at the motor shaft) is more likely limited by the used encoder types. The optics and A/D conversion of standard sin/cos encoders typically achieve repeatable relative accuracies of about one million per encoder revolution.
4 Example of gearing and normalization concept

4.2 Resulting gearing related drive SIMOTION Axis “TO” calculations/settings

Virtual Global Master: (POS Axis)

**Speed:**
With 100% = max. press speed = 80000 IPH (= print cylinder rev / hour)
max. GM speed = max. print cylinder speed = 80000 rev/hour = 80000 * 360 / 60 / 60 °/s = 8000 °/sec
=> Set TO systemvariable: VA_GM_01.userdefaultdynamics.velocity = 8000

**Position:**
=> Setup axis as standard rotary axis with position in degree
=> Set position resolution to 1000000/unit

**Modulo:**
(=Axis cycle length)
=> Set TO config data: VA_GM_01.modulo length = 1440 degree (= 4 products)

REAL AXIS (print cylinder): (FOLLOWING Axis)

**Speed:**
Top speed = 80000 IPH. Same as master calculation
=> Set TO systemvariable: RA_PC_0x.userdefaultdynamics.velocity = 8000 °/sec

**Position:**
=> Setup axis as standard rotary axis with position in degree
=> Set position resolution to 1000000/unit

**Modulo:**
=> Set TO config data: RA_PC_0x.modulo length = 360 degree (1 product)

“Setpoint” Gear Box:
(electronic gearing in setpoint channel between GM and RA)
=> RA_PC_0x STDcIo.In.i32GearNumSetpoint= 1
=> RA_PC_0x STDcIo.In.i32GearDenSetpoint= 1

“Actual” Gear Box:
(electronic gearing in actual channel between motor and load)
=> Set TO config data:
RA_PC_0x.TypeOfAxis.NumberOfDataSets.DataSet_1.Gear.numFactor = 2
REAL AXIS (folder: cut cylinder): (FOLLOWING Axis)

Top speed = 80000 IPH. Same as master calculation

=> Set TO systemvariable: RA_Folder.userdefaultdynamics.velocity = 8000 °/sec

Position:

=> Setup axis as standard rotary axis with position in degree

=> Set position resolution to 1000000/unit

Modulo:

=> Set TO config data: RA_folder.modulo length = 1440 degree (4products)

NOTE

This ACL length ensures that GM can be set to folder position without loss of product tracking information.

"Setpoint" Gear Box:
(electronic gearing in setpoint channel between GM and RA)

=> RA_Folder STDcIO.In.i32GearNumSetpoint= 1

=> RA_Folder STDcIO.In.i32GearDenSetpoint= 1

"Actual" Gear Box:
(electronic gearing in actual channel between motor and load)

=> Set TO config data:

RA_Folder.TypeOfAxis.NumberOfDataSets.DataSet_1.Gear.numFactor = 7
RA_Folder.TypeOfAxis.NumberOfDataSets.DataSet_1.Gear.denFactor = 3

RA_PC_0x.TypeOfAxis.NumberOfDataSets.DataSet_1.Gear.denFactor = 1
4 Example of gearing and normalization concept

REAL AXIS (folder: chopper):  (FOLLOWING Axis)

Top speed = 80000 IPH. Same as master calculation
=> Set TO systemvariable: RA_chopper.userdefaultdynamics.velocity = 8000 °/sec

Position:
=> Setup axis as standard rotary axis with position in degree
=> Set position resolution to 1000000/unit

Modulo:
=> Set TO config data: RA_chopper.modulo length = 360 degree (1product)

NOTE
This ACL must ensure product tracking for the various folder modes (collect / no-collect and divert / no-divert)

“Setpoint” Gear Box :
(electronic gearing in setpoint channel between GM and RA)
=> RA_chopper STDcIO.In.i32GearNumSetpoint= 1 / 1 / 1
=> RA_chopper STDcIO.In.i32GearDenSetpoint= 1 / 2 / 4

(set from plc code depending on folder mode)

“Actual” Gear Box :
(electronic gearing in actual channel between motor and load)
=> Set TO config data:
RA_chopper.TypeOfAxis.NumberOfDataSets.DataSet_1.Gear.numFactor = 2
RA_chopper.TypeOfAxis.NumberOfDataSets.DataSet_1.Gear.denFactor = 1

REAL AXIS (pull roll 1) (same for pull roll2):  (FOLLOWING Axis)

Speed:
Top speed = 80000 IPH. Same as master calculation
=> Set TO systemvariable: RA_pullroll1.userdefaultdynamics.velocity = 8000 °/sec

Position:
=> Setup axis as standard rotary axis with position in degree
=> Set position resolution to 1000000/unit
Example of gearing and normalization concept

Modulo:
=> Set TO config data: RA_pullroll1.modulo length = 360 degree
(one mechanical rev of pull roll cylinder)

NOTE
The ACL on pull rolls is typically not used, as the pull rolls are not absolute position synchronized axis or axis which need to perform positioning.

"Setpoint" Gear Box:
(electronic gearing in setpoint channel between GM and RA)
=> RA_pullroll1 STDcIO.In.i32GearNumSetpoint= 560150
=> RA_pullroll1 STDcIO.In.i32GearDenSetpoint= 626482

NOTE
The technological position controlled “draw” (speed gain on top of precise web speed) can be controlled via STDcIO.In.Draw_setpoint [unit is percent] e.g. draw input 0.5 % results in factor 1.005 of webspeed on cylinder surface.

"Actual" Gear Box:
(electronic gearing in actual channel between motor and load)
=> Set TO config data:
RA_pullroll.TypeOfAxis.NumberOfDataSets.DataSet_1.Gear.numFactor = 80
RA_pullroll.TypeOfAxis.NumberOfDataSets.DataSet_1.Gear.denFactor = 38
5 Example of dynamic rate calculations

In the Print Standard startup program pMStartup of each SIMOTION station the presets for all the dynamic dynamics (ramp up, ramp down times and rounding/jerk) for all the different axis types can be defined.

Figure 5-1

```
// GM (Example settings for Global Masters)

gsGMAxisConfigData.sLocalDyn.eProfile = eProfile::gProfile::SMOOTH; // [-]
```

**Example calculations for the Global Master axis (GM):**

**GM Local dynamics:**
(The Global Master typically only uses the local speed and E-stop dynamics)

e.g. desired 60 sec from 0 to full press speed (e.g. 8000 °/sec) with 2 sec rounding:

\[
\text{gsGMAxisConfigData.sLocalDyn.r64Accel} = \frac{8000 \, \text{°}/\text{sec}}{60 \, \text{sec}} = 133.33 \, [\text{°}/\text{sec}^2]
\]

\[
\text{gsGMAxisConfigData.sLocalDyn.r64AccelJerk} = \frac{133.33 \, [\text{°}/\text{sec}^2]}{2 \, \text{sec}} = 66.67 \, [\text{°}/\text{sec}^3]
\]

**NOTE**
These values must be adapted to the machine requirements.
5 Example of dynamic rate calculations

e.g. desired 40 sec from full press speed to 0 with 2 sec rounding:
=> gsGMAxisConfigData.sLocalDyn.r64Decel = 8000 °/sec / 40 sec = 200.00 [°/sec²]
=> gsGMAxisConfigData.sLocalDyn.r64DecelJerk = 200 °/sec² / 2 sec = 100.00 [°/sec³]

GM E-stop Dynamics:
e.g. desired 9 sec from full press speed to 0 with 0.1 sec rounding:
=> gsGMAxisConfigData.sEstopDyn.r64Decel = 8000 °/sec / 9 sec = 888.89 [°/sec²]
=> gsGMAxisConfigData.sEstopDyn.r64DecelJerk = 888.89 °/sec² / 0.1 sec = 8888.89 [°/sec³]

Example calculations for the REAL AXES:

Figure 5-2

// EAF (Example settings for Real Following Axis) ------------------------------------------

gsRAPAxisConfigData.sBrakeReaction = eErrorReactionTypeERROR_E_STOP;
gsRAPAxisConfigData.sHomeing.sEStopMode = eStopTypePASSIVE;
gsRAPAxisConfigData.sHomeing.c64HomePosition = 0; // ["] specif
gsRAPAxisConfigData.sAxisFormat.c64MinMaxLength = 600.0; // [mm] for fc
gsRAPAxisConfigData.sAxisFormat.c64MinMaxLength = 1800.0; // [mm] for fc
gsRAPAxisConfigData.sAxisFormat.c64MinMaxLength = 3600.0; // ["] maxima
gsRAPAxisConfigData.sAOP.c64Min = 0; // ["] minima
gsRAPAxisConfigData.sLocalDyn.c64Max = SHOCRH; // [-] veloci
gsRAPAxisConfigData.sLocalDyn.c64AccelJerkStart = 600.00; // [°/sec] smooth
gsRAPAxisConfigData.sLocalDyn.c64AccelJerkStart = 560.00; // [°/sec] smooth
gsRAPAxisConfigData.sLocalDyn.c64AccelJerkEnd = 600.00; // [°/sec] smooth
gsRAPAxisConfigData.sLocalDyn.c64AccelJerkEnd = 560.00; // [°/sec] smooth
gsRAPAxisConfigData.sLocalDyn.c64Accel = 300.00; // [°/sec] accelerate
gsRAPAxisConfigData.sLocalDyn.c64Decel = 300.00; // [°/sec] deaccelerate
gsRAPAxisConfigData.sProfile.sEStop = SHOCRH; // [-] veloci
gsRAPAxisConfigData.sProfile.sEStop = 720.00; // [°/sec] smooth
gsRAPAxisConfigData.sProfile.sEStop = 720.00; // [°/sec] smooth
gsRAPAxisConfigData.sProfile.sEStop = 720.00; // [°/sec] smooth
gsRAPAxisConfigData.sProfile.sEStop = 720.00; // [°/sec] smooth
gsRAPAxisConfigData.sProfile.sEStop = 720.00; // [°/sec] smooth
gsRAPAxisConfigData.sProfile.sEStop = 360.00; // [°/sec] accelerate
gsRAPAxisConfigData.sProfile.sEStop = 360.00; // [°/sec] deaccelerate
gsRAPAxisConfigData.sProfile.sEStop = 360.00; // [°/sec] accelerate
gsRAPAxisConfigData.sProfile.sEStop = 360.00; // [°/sec] deaccelerate
gsRAPAxisConfigData.sProfile.sEStop = SHOCRH; // [-] veloci
gsRAPAxisConfigData.sProfile.sEStop = 900.00; // [°/sec] smooth
gsRAPAxisConfigData.sProfile.sEStop = 900.00; // [°/sec] smooth
gsRAPAxisConfigData.sProfile.sEStop = 900.00; // [°/sec] smooth
gsRAPAxisConfigData.sProfile.sEStop = 900.00; // [°/sec] smooth
gsRAPAxisConfigData.sProfile.sEStop = 900.00; // [°/sec] smooth
gsRAPAxisConfigData.sProfile.sEStop = 30.00; // [°/sec] accelerate
gsRAPAxisConfigData.sProfile.sEStop = 2100.00; // [°/sec] deaccelerate

NOTE
These values must be adapted to the machine requirements.
5 Example of dynamic rate calculations

**RAF Local Dynamics:**
(Real Axis Following type, like plate, folder, pull roll use this e.g. in local speed operation)

- e.g. desired 40 sec from 0 to full press speed (e.g. 8000 °/sec) with 2 sec rounding:
  => gsRAFAxisConfigData.sLocalDyn.r64Accel = 8000 °/sec / 40 sec = 200.00 [°/sec²]
  => gsRAFAxisConfigData.sLocalDyn.r64AccelJerk = 200 °/sec² / 2 sec = 100.00 [°/sec³]

- e.g. desired 20 sec from full press speed to 0 with 1 sec rounding:
  => gsRAFAxisConfigData.sLocalDyn.r64Decel = 8000 °/sec / 20 sec = 400.00 [°/sec²]
  => gsRAFAxisConfigData.sLocalDyn.r64DecelJerk = 400 °/sec² / 1 sec = 400.00 [°/sec³]

**RAF Positioning Dynamics:**
(Real Axis Following type, e.g. plate uses these dynamics e.g. during plate change positioning operation)

- e.g. desired 0.5 sec from 0 to positioning speed (e.g. 40 °/sec) with 0.2 sec rounding:
  => gsRAFAxisConfigData.sPosDyn.r64Accel = 40 °/sec / 0.5 sec = 80.00 [°/sec²]
  => gsRAFAxisConfigData.sPosDyn.r64AccelJerk = 80 °/sec² / 0.2 sec = 400.00 [°/sec³]

- e.g. desired 1 sec from positioning speed (e.g. 40 °/sec) with 0.4 sec rounding:
  => gsRAFAxisConfigData.sPosDyn.r64Decel = 40 °/sec / 1 sec = 40.00 [°/sec²]
  => gsRAFAxisConfigData.sPosDyn.r64DecelJerk = 40 °/sec² / 0.4 sec = 100.00 [°/sec³]

**RAF Clutch Dynamics:**
(Real Axis Following type, e.g. plate is using these dynamics during automatic plate change on the fly to de-clutch from print speed and decel for plate change and then accel back to print speed after plate change)

- e.g. desired 15 sec from 0 to full press speed (e.g. 8000 °/sec) with 2 sec rounding:
  => gsRAFAxisConfigData.clutch_accel = 8000 °/sec / 15 sec = 533.33 [°/sec²]
  => gsRAFAxisConfigData.clutch_accel.jerk = 533.33 °/sec² / 2 sec = 266.67 [°/sec³]
5 Example of dynamic rate calculations

e.g. desired 15 sec from full press speed to 0 with 2 sec rounding:

=> gsRAFAxisConfigData.clutch_decel = 8000 °/sec / 15 sec = 533.33 [°/sec2]
=> gsRAFAxisConfigData.clutch_decel.jerk = 533.33 [°/sec2] / 2 sec = 266.67 [°/sec3]

RAF Register Speeds and Dynamics (Abs/Rel/Inch):
(Real Axis Following type, e.g. plate is using these dynamics to adjust its color register/phase value to the Master. The 3 different modes to change the current register value absolute/relative and inching can have independent speeds and dynamics)

e.g. desired speed of phase adjustment (0.5% of max. press speed = 40 °/sec).

=> gsRAFAxisConfigData.abs.register.speed = 0.5 [%]
=> gsRAFAxisConfigData.rel.register.speed = 0.5 [%]
=> gsRAFAxisConfigData.inch.register.speed = 0.5 [%]

e.g. desired 1 sec from 0 to registration speed of 0.5% (=40°/sec) with 0.1 sec rounding:

=> gsRAFAxisConfigData.abs.register.accel = 40 °/sec / 1 = 40.00 [°/sec2]
=> gsRAFAxisConfigData.rel.register.accel = 40 °/sec / 1 = 40.00 [°/sec2]
=> gsRAFAxisConfigData.inch.register.accel = 40 °/sec / 1 = 40.00 [°/sec2]

=> gsRAFAxisConfigData.abs.register.accel.jerk = 40 °/sec2 / 0.1 sec = 400.00 [°/sec3]
=> gsRAFAxisConfigData.rel.register.accel.jerk = 40 °/sec2 / 0.1 sec = 400.00 [°/sec3]
=> gsRAFAxisConfigData.inch.register.accel.jerk = 40 °/sec2 / 0.1 sec = 400.00 [°/sec3]

e.g. desired 1 sec from registration speed of 0.5% (=40°/sec) to 0 with 0.1 sec rounding:

=> gsRAFAxisConfigData.abs.register.decel = 40 °/sec / 1 = 40.00 [°/sec2]
=> gsRAFAxisConfigData.rel.register.decel = 40 °/sec / 1 = 40.00 [°/sec2]
=> gsRAFAxisConfigData.inch.register.decel = 40 °/sec / 1 = 40.00 [°/sec2]

=> gsRAFAxisConfigData.abs.register.decel.jerk = 40 °/sec2 / 0.1 sec = 400.00 [°/sec3]
=> gsRAFAxisConfigData.rel.register.decel.jerk = 40 °/sec2 / 0.1 sec = 400.00 [°/sec3]
=> gsRAFAxisConfigData.inch.register.decel.jerk = 40 °/sec2 / 0.1 sec = 400.00 [°/sec3]
RAF Synchronization Speed and Dynamics:
(Real Axis Following type, e.g. plate is using these dynamics to synchronize back to the previous phase value to the master after local operations or after machine start)

e.g. desired speed of synchronization (0.5% of max. press speed = 40 °/sec).
=> gsRAFAxisConfigData.synch.speed = 0.5 [%]

e.g. 1sec from 0 to synch speed of 0.5% (=40°/sec) with 0.1 sec rounding:
=> gsRAFAxisConfigData.abs.synch.accel = 40 °/sec / 1 = 40.00 [°/sec2]
=> gsRAFAxisConfigData.abs.register.accel.jerk = 40 °/sec2 / 0.1 sec = 400.00 [°/sec3]

e.g. desired 1sec from synch speed of 0.5% (=40°/sec) to 0 with 0.1 sec rounding:
=> gsRAFAxisConfigData.abs.synch.decel = 40 °/sec / 1 = 40.00 [°/sec2]
=> gsRAFAxisConfigData.abs.register.decel.jerk = 40 °/sec2 / 0.1 sec = 400.00 [°/sec3]

RAF Draw Dynamics:
(Real Axis Following type, like pull rolls use this rate to adjust the current setpoint gear ratio which implements the draw)

e.g. desired 200 sec from 0 to full press speed (e.g. 8000 °/sec) with 0.1 sec rounding:
=> gsRAFAxisConfigData.draw_accel = 8000 °/sec / 200 = 40.00 [°/sec2]
=> gsRAFAxisConfigData.draw_accel.jerk = 40 °/sec2 / 0.1 sec = 400.00 [°/sec3]

e.g. desired 200 sec from full press speed to 0 with 0.1 sec rounding:
=> gsRAFAxisConfigData.draw_decel = 8000 °/sec / 200 = 40.00 [°/sec2]
=> gsRAFAxisConfigData.draw_decel.jerk = 40 °/sec2 / 0.1 sec = 400.00 [°/sec3]

RAF E-stop Dynamics:

e.g. desired 9 sec from full press speed to 0 with 0.1 sec rounding:
=> gsRAFAxisConfigData.local_decel = 8000 °/sec / 9 sec = 888.89 [°/sec2]
=> gsRAFAxisConfigData.local_decel.jerk = 888.89 °/sec2 / 0.1 sec = 8888.89 [°/sec3]
6 Print Standard “Segment OFFSET” Example Project

6.1 Changes from Print Standard Master project

With this document there is also a Segment specific SIMOTION example project available.
The SIMOTION project can be run on a standard SIMOTION demo case and is based on the Print Standard Master project.
Simplifications were made to tailor the project to the needs of the “offset” machine segment.

The changes from the Print Standard master project include:

- Deletion of all program parts for winder, tension control and register control. These parts can be added again quickly if needed.
- Deletion of all adder/formula object TO's
- Creation of 2 Global Masters and 2 Local Masters and 4 following axes simulating standard technological axes of the segment. As example axes the folder cut cylinder and chopper, one print cylinder and two pull rolls were chosen.
  The 2 independent Global Masters are often required for the two possible productions on commercial machines with two folders (2 webs).
  The shown concept can also be used for newspaper with Global virtual "production" Masters and Local virtual "web masters". The script files were preset with the normalizations and dynamic unit calculation results of this document.

Based on this segment example SIMOTION project, the machine project can be created very quickly by duplication of the offered concepts, scripts and programs.
6.2 TO connection overview

The following picture shows the connection of all Technology objects in the Print Standard Segment “Offset” demo project.

Figure 6-1 Demo project Technology Object (TO) connections

With that the following segment specific technology/concepts can be tested and used as basis for development of the customer machine project:

- Global machine master operation of two independent productions, even across multiple controllers/stations via distributed synchronism.

- RA_Folder: Test GM setting to folder position to avoid folder synchronization. The folder can follow production1 or production2 master. The folder cut cylinder can act also as master in folder group mode.

- Axes grouping (e.g. useful to operate one folder synchronized but independent) can be tested with real setpoint coupling between RA_Folder (real setpoint master in local speed mode) and RA_chopper (slave in gear mode following RA_Folder)

- RA_PC_0xBlue and RA_PC_0xRed as exemplary print cylinders following the Local Web Masters (LM) of production1 and production2. By changing the register value of the LM both print cylinders can be shifted synchronized compared to the GM (which can be set at machine start to the cut position). This “full web compensation / print to cut registration” is independent of possible individual “color registration” changes at each print cylinder axis.
6 Print Standard “Segment OFFSET” Example Project

Also “plate change positioning” and “plate change on the fly” can be tested.

- RA_Pullrolls: Test Pull Roll gearing to match web speed and “draw” concept. One Pull Roll can only operate in production1 the other in production2.

- All individual “Local” Axis operation modes can be tested (inching/jogging, referencing, positioning (for folder presets / plate change), speed setpoint / MOP operation)
## 7 Abbreviations

Table 7-1

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Explanation</th>
</tr>
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<tbody>
<tr>
<td>TIA</td>
<td>Totally Integrated Automation concept of Siemens hardware/software products</td>
</tr>
<tr>
<td>TO</td>
<td>Simotion Technology objects: Modular motion control firmware software objects with certain functionality</td>
</tr>
<tr>
<td>RA</td>
<td>Real Axis: Motion control axis which is connected to a physical drive.</td>
</tr>
<tr>
<td>VA</td>
<td>Virtual Axis: Motion control axis without physical drive connection.</td>
</tr>
<tr>
<td>LM</td>
<td>Local Master: Virtual Axis for a group of Real Axis.</td>
</tr>
<tr>
<td>GM</td>
<td>Global Master: Virtual Axis for all Real Axis of the complete machine.</td>
</tr>
<tr>
<td>Profinet IRT</td>
<td>Motion control synchronization implementation of PROFINET communication</td>
</tr>
<tr>
<td>MCC</td>
<td>Motion Control Chart: One of the graphical programming languages of Simotion</td>
</tr>
<tr>
<td>ST</td>
<td>Structured Text: The base programming language of Simotion.</td>
</tr>
<tr>
<td>MOP</td>
<td>Motorized Potentiometer: Program block to modify a (speed) setpoint value with faster/slower/hold bit commands.</td>
</tr>
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</table>
8  **Related literature**

<table>
<thead>
<tr>
<th>Topic</th>
<th></th>
</tr>
</thead>
</table>
| 1 | Siemens Industry Online Support  
https://support.industry.siemens.com |
| 2 | Download page of this entry  
| 3 | |

9  **Contact**

Siemens AG  
Digital Factory  
DF FA PMA APC  
Frauenauracher Straße 80  
D - 91056 Erlangen  
Germany  
mailto: tech.team.motioncontrol@siemens.com

10  **History**

<table>
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<th>Modifications</th>
</tr>
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<td>07/2009</td>
<td>First version</td>
</tr>
<tr>
<td>V3.0.0</td>
<td>01/2017</td>
<td>Adaption to Print Standard library V3.x.x</td>
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