SIEMENS

SIMOREG DC Master

Application

Center winder

6RA70 Series

Microprocessor-Based Converters from 6kW to 1900kW
for Variable-Speed DC Drives

Edition 03

NOTE

These application do not purport to handle or take into account all of the equipment details or versions or to cover every conceivable operating situation or application. If you require more detailed information, or if special problems occur, which are not handled in enough detail in this document, please contact your local Siemens office.

The contents of these application are not part of an earlier or existing agreement or legal contract and neither do they change it. The actual purchase contract represents the complete liability of the A&D Variable-Speed Drives Group of Siemens AG. The warrant conditions, specified in the contract between the two parties, is the only warranty which will be accepted by the A&D Variable-Speed Drives Group. The warranty conditions specified in the contract are neither expanded nor changed by the information provided in the installation instructions.

WARNING

These converters contain hazardous voltages, hazardous rotating machinery (fans) and control rotating mechanical components (drives). Death, serious bodily injury or substantial property damage may occur if the instructions in the relevant operating manuals are not observed.

Only qualified personnel who are thoroughly familiar with all safety notices contained in the operating instructions as well as erection, installation, operating and maintenance instructions should be allowed to work on these devices.

The successful and safe operation of this equipment is dependent on careful transportation, proper storage and installation as well as correct operation and maintenance.

We have checked that the contents of this publication agree with the hardware and software described herein. Nonetheless, differences might exist and therefore we cannot guarantee that they are completely identical. The information given in this publication is reviewed at regular intervals and any corrections that might be necessary are made in the subsequent printings. Suggestions for improvement are welcome at all times.

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1 General

This application note shows how to implement a center winder using the freely assignable function blocks available through the option S00. The number and type of elements used, requires a software version of 1.83 or greater.
The SIMOREG has to have 4Q functionality.
To use all functions, the control of the SIMOREG has to be done using a top level control system (for example SIMATIC S7), using an optional communication board (CB).
If you want to implement a hardware control, the extension board EB1 or EB2 has to be used, depending on your requirements. In this case, it is also required to alter the implementation of the freely assignable function blocks.

Mounting instructions for the optional boards can be found in the Users manual chapter 5.3 „mounting options“

2 Functions

The following functions have been implemented

- direct tension control with tension measuring device
- indirect tension control without tension measuring device using torque control
- dancer roll / compensating roll position control
- stop tension
- slip core control
- setting of a variable web width
- setting a variable material density
- calculator for diameter with monotone or not monotone change of diameter
- 2 gear box stages
- web break recognition

The selection of global settings such as
- control method
- direction of winding
- winder or unwinder
- gear box stage
- winding characteristic

is performed via the top level control system. Depending on the selection, the required changes are automatically performed by the SIMOREG. No changes to connector or binector connections have to be made.
In conjunction to the application, the characteristic curve , control settings and optimizations have to be applied.
In case a hardware control is implemented, the required changes can be done using OR function blocks (for details contact schematic 19).

3 Description of functions

3.1 Direct tension control with tension measuring device

This method works as current limitter.
The pilot control value, derived from the tension set point, influences the limitter for the speed control output, taking the diameter, friction, moment of inertia and acceleration into account. A controller calculates a correction signal using the difference between tension set point and instantaneous value. The signal is added to the pilot control value. This process enables a more detailed guidance of the instantaneous tension value.
To ensure the constance of the speed control output once it reaches the limit, a saturation factor has to be added.

3.2 Indirect tension control without tension measuring device

The function is similar to the function above (3.1) . Since there is no instantaneous tension value, the limitter of the speed control is only influenced by pilot control.

3.3 Compensating (dancer) roll position control

The output of the position control equals a supplementary set point value for the speed control. The influence of the position control should be limited to 10 –20 %. Sometimes it is necessary to implement the position control as proportional control with derivative portion in the actual value channel.
If you want to use an external tension control to influence the compensating roll weight, the
analog output 1 (X175, connector 14 & 15) delivers a tension control setpoint value with influence of the winding characteristic.

3.4 Stop tension control

The addition of the stop tension depends on the external control and the SIMOREG internal speed = 0 message.
The stop tension is parameterized in percent in conjunction to the set operation state. If a constant stop tension is required, Parameter U151.01 has to be connected to K0001.

3.5 Slip core control

The coil hardness influences, in conjunction to the diameter, the tension set point according to an adjustable characteristic. The set points can be taken either from an internal characteristic block or externally from the bus. Depending on the application, 5 additional characteristics are available. It is reasonable to work without the slip core control if an unwinder is used. Switching between different characteristics is done via external control.

3.6 Variable web width

The selection of different web width's is automatically taken into account for the calculation of the moment or inertia and therefore also for the resulting pre – control moment.

3.7 Variable material density

The selection of different material densities, is automatically taken into account for the calculation of the moment or inertia and therefore also for the resulting pre – control moment.

3.8 Calculator for the diameter

Using the web speed set point and winder speed, the calculator reckons the diameter. This calculation is only performed if there is a frictional connection to the continuos material, the tension controller is turned on and the system is in the run state. Since unwinder only reduce and winder increase the diameter, the calculation of the opposite direction is disabled. The calculator can be parameterized to enable processing of both directions.

3.9 Gearbox stage

The gear selection is taken into account for the calculation of the moment of inertia and therefore also the resulting
pre – control moment.

3.10 Web break recognition

If the tension control is turned on, the web break recognition is enabled.

Direct tension control: Triggering results if current tension drops below minimum tension.
Indirect tension control: Triggering results if selectable moment variance is exceeded and moment drops below selectable minimum.
Compensating roll: Triggering results if instantaneous value exceeds selectable position value.

If web tear recognition is triggered, speed set point is set 0 and the calculation for the diameter is disabled. The unwinder turns backwards, the winder forward, both using their bias. If a compensating (dancer) roll control is used, the position controller reaches it's limit, due to the missing instantaneous value. The bias results from the set intervention. After a selectable time , „Off 3" is triggered.

3.11 Interfaces

3.11.1 Received data from top level control

Data exchange is done via the communication board (CB) 1. To ensure flawless operation, the settings in the following table have to be strictly followed.

Word	Connector	Bisector	Label	Note
1	K3001		Control word 1	Control Word 1 according to user manual
2	K3002		Control word 2	Control Word 2 according to user manual
3	K3003		Control word 3	Control word 3 for coilers / winders
		B3300	Maneuver	1.....On
		B3301	Set diameter	1.....Set
		B3302	Stop diameter	1.....Stop
		B3303	Wind/Coil from top/bottom	0.....top / 1.....bottom
		B3304	Winder/Unwinder	0.....Winder / 1.....Unwinder
		B3305	Dancer roll control	If 1, the state of B3306 is not relevant
		B3306	Dir./Indir. Tension Control	0.....direct / 1.....indirect
		B3307	Gear box stage 1/2	0.....Stage1 / 1.....Stage 2
		B3308	Switch characteristic for coil hardness	The selected characteristic
		B3309	Switch characteristic for coil hardness	is the result of the combination
		B3310	Switch characteristic for coil hardness	of these three binectors (B3308,3309,3310)
		B3311	Stop tension control	1.....On
		B3312	Tension control ON ext.	1.....On
		B3313	web break ext.	1.....On
		B3314	Reserved	
		B3315	Reserved	
4	K3004		system speed setpoint	
5	K3005		Tension setpoint	
6	K3006		Diameter set value	
7	K3007		Ext. characteristic coil hardness	
8	K3008		Web width	If different materials are produced
9	K3009		Density	If different materials are produced
10	K3010		Reserved	
⇓	⇓	⇓	⇓	⇓
16	K3016		Reserved	

3.11.2 Transmit data to top level control

Data exchange is done via the communication board 1 (CB1).

Word	Parameter	Bit	Label	Note
1	U734.01		status word 1	Status word 1 according to user manual.
2	U734.02		status word 2	Status word 2 according to user manual.
3	U734.03		status word 3	Status word for winder/coiler status K9113
		0	Tension control is ON	1.....ON
		1	Tension control limit reached	1.....limit reached
		2	Web break	1.....Web break
		3	speed limit succeeded	1.....n>>
		4	Reserved	
		5	Reserved	
		6	Reserved	
		7	Reserved	
		8	Reserved	
		9	Reserved	
		10	Reserved	
		11	Reserved	
		12	Reserved	
		13	Reserved	
		14	Reserved	
		15	Reserved	
4	U734.04		Instantaneous speed value	K0179
5	U734.05		Instantaneous current value	K0109
6	U734.06		Instantaneous value of moment	K0142
7	U734.07		Current diameter	K9304
8	U734.08		Instantaneous tension value	K9240
9	U734.09		Output of tension control	K9249
10	U734.10		Reserved	
⇓	⇓	⇓	⇓	⇓
16	U734.16		Reserved	

3.11.3 Analog input

Maneuver set point: analog input main set point X174: 4-5
value range: -10V.....+10V

tension / position feedback value1 analog input 1 X174: 6-7
value range: tension feedback value: 0.....+10V
position feedback value: -10V.....+10V

3.11.4 Analog output

Tension set point for compensating weight if compensating roll control is enabled : analog output 1 X175: 14-15

3.11.5 Pulse generator input

Input for digital pulse - generator corresponding to „User Manual“.

4 Calculation of acceleration compensation

In order to ensure a constant tension moment during acceleration and deceleration, the armature current should be pre controlled using the required moment. The moment of inertia is, due to the steady change of the diameter of the winder, never a constant value.

- Fixed inertia J_F (adjustable using P407)
- variable moment of inertia J_V (is calculated using building block 116, and is influenced by web width (K3008) and material density K3009)

Chapter 4 contains instructions on how to calculate the two moments using available system data.

4.1 Determination of fixed value inertia

The fixed moment of inertia is the sum of the following moment of inertia

- moment of inertia of motors
- moment of inertia of gear corresponding to the shaft of the motor
- moment of inertia of winder core corresponding to the motor shaft
- additional moment of inertia's such as couplers

Formula:

$$J_F = J_{Motor} + J_{Gear} + \frac{J_{Core}}{i^2}$$

For motor or gear values please contact the datasheet or type plate. The inertia of the winder core has to be calculated. (Contact formula for the calculation of moment of inertia for solid cylinder or hollow cylinder.) If the winders core mass is relatively small, or the gear ratio rather large, the moment of inertia can be considered irrelevant.

moment of inertia solid cylinder

$$J = \frac{\Pi * \rho * b * D^4}{32} \text{ [kgm²]}$$ moment of inertia hollow cylinder

$$J = \frac{\Pi * \rho * b * \left(D^4 - D^4_{Core}\right)}{32} \text{ [kgm²]}$$

Calculation of percental moment of acceleration M_{bF} using the fixed moment of inertia J_F and the acceleration time t_b. The equation outputs a moment of inertia corresponding to the rated current in %.
Precondition: $D = D_{core}$, $t_b = t_h$ and J_{core} is ignored

Determining the value for parameter P407

$$M_{bF} = \frac{J_F * n_N * i}{2{,}865 * D_{Core} * P_N} * \frac{\Delta v}{t_b} \text{ [\%]}$$

Determining the value for parameter P407

$$P407 = \frac{M_{bF} * t_h}{P542} * 100\%$$

4.2 Determination of the variable moment of inertia

The following equation outputs a value for the maximum variable moment of inertia using the maximum diameter, density and maximum width.

$$J_{v\,max} = \frac{\Pi * \rho_{max} * b_{max} * \left(D_{max}^4 - D_{Core}^4\right)}{32 * i^2} \quad [kgm^2]$$

Calculation of percental moment of acceleration corresponding to the related current in %
Requirements: $D = D_{max}$, $t_b = t_h$ and $J_F = 0$

$$M_{bV} = \frac{b_{max} * \rho_{max} * \left(D_{max}^4 - D_{Core}^4\right) * n_N}{29{,}18 * i * D_{max} * P_N} * \frac{\Delta v}{t_b} \quad [\%]$$

Determining the value for Parameter U529:

$$U529 = \frac{M_{bV} * t_h}{P542} * 100\%$$

4.3 Formulas and dimensions

b	web width [m]
D	diameter [m]
D_{max}	maximum diameter [m]
D_{Core}	diameter of winder - core [m]
i	gear ratio
J_F	constant moment of inertia (motor, Gear, winder - core) corresponding to shaft of motor [kgm²]
J_V	variable moment of inertia result of windup material corresponding to shaft of motor [kgm²]
M_{bF}	maximum moment of acceleration corresponding to J_F [% of M_N]
M_{bV}	maximum moment of acceleration corresponding to J_{vmax} [% of M_N]
M_N	rated moment of motor [Nm]
n_N	rated motor speed [rpm]
P_N	rated motor power [kW]
t_b	time of acceleration [s]
t_h	ramp up time of web velocity; range 0 – V_{max} [s]
Δv	speed difference [m/min]
ρ	specific weight (density) [kg/dm³]

5 Commissioning notes

5.1 Speed feedback adjustment

The following parameter have to be set:

U518 minimum diameter of winder shaft in mm

U519 gear ratio

If two gear box stages are used, the gear box with the smaller gear ratio has to be used

for example: i1=4, i2=5.....➔ U519=4

$$i = \frac{n_{Motor}}{n_{winder}}$$

U520 rated speed
The speed in rpm at maximum system speed and minimum winder diameter in min -1

U522 standardization of system speed in m/s at maximum set point

U523 standardization of diameter in mm. 100% = maximum diameter

5.2 Compensation of friction moment

In general, the friction depends on the speed of the winder. Gear warming can result in negative influence. After a few hours of operation there is the possibility a post optimization has to be performed.

Procedure:
- Operate winder only with speed control, binector B3312 (tension control ON ext.) has to be 0
- Disable acceleration compensation f.e. by preventing the dv/dt Signal (set P542 to 0,01).
- Take measurements at minimum diameter of winder; set minimal diameter; there may be no connection to material web.
- Start drive via internal ramp function generator, and increase the speed in steps (f.e 10% steps)
- After each speed increase, obtain the actual value of the current (monitoring parameter r019) and use it to set parameter U 283.01 - .10 (characteristic Nr. 106)
- Stop drive
- Select operation state „indirect tension control“ and set the bias P 405 = 0%, and binector B3302 (hold diameter value) to 1
- Start drive for winder and increase speed in 10 % steps. After each increase check connector K0160 (output of speed controller). The value should be in the range of +/-3%.

5.3 Compensating moment of acceleration

General procedure:
- No connection to material web, gear box stage 1 selected (changeover to gear box stage 2 is automatically taken in to account.
- Set ramp up time and ramp down time according to the application
- P542 is preset to 3s. If the ramp-up time or the ramp down-time is 30 s, the value of dv/dt equals 10 %. If ramp – up time and or ramp down time differ a lot from 30 s, P542 should be set so dv/dt reaches reasonable values.
- Select operating state „indirect tension control“ and set the bias P405 to 0 % and binector B3302 (hold diameter value) to 1.

5.3.1 Constant moment of inertia

- Take measurements at minimum coil diameter; set minimal diameter
- Prohibit influence of variable moment of inertia. fe. by setting the web width to 0% using K3008.
- Vary the speed of the winder between 10% - 90% and observe K0160 (output of speed controller) during acceleration and deceleration.
- Adjust P407 (effects dv/dt), so that K0160 has a maximum value of +/- 3%

5.3.2 Variable moment of inertia

- If possible insert a rather fully loaded coil with a large material width and density.
- Set values of actual diameter, density of material and web width
- Vary the speed of the winder between10% - 90% and observe K0160 (output of speed controller) during acceleration and deceleration.
- Adjust U529 (effects dv/dt), so that K0160 has a maximum value of +/- 3%.

NOTE

If the web width and / or the density is always constant, Parameter U150.03 and / or U525.04 (density) have to be set to K0001 (100%)

5.4 Optimization of speed controller

Lift moment limits, for example by setting the signal “Compensating roll position control ON” . (P605 is set to 100%)
Set the adaptation of kp 2 using P559 and Tn 2 using P560. The value can be calculated using the following formula

$$P559 = P560 = \frac{D_{max}{}^4 - D_{Core}{}^4}{D_{max}{}^4} * U529 * 100\ [\%]$$

Requirement: Density and width of material have to be 100%, U529 calculated according to 5.3.2

5.4.1 Optimization at maximum diameter.

- Run system with fully loaded winder
- Perform optimization for speed controller according to the user manual (P051=26).
- Use value of P225 (kp) and P226 (Tn) to set P550 / P551 (equals upper values of kp-and Tn adaptation)

5.4.2 Optimization at minimal diameter

- Run system with empty winder
- Perform optimization for speed controller according to the user manual (P051=26).
- The set values in P225 and P226 equal the lower values of kp and Tn – adaptation

5.5 Hints for setting Parameters

P406: Gear stage 2.
The value is calculated as follows: i1/i2.
f.e. i1=4, i2=5 ➔ P406 = 4/5 = 80%

U198: Tension control: Value for required tension or moment for web break observation 10%.
Positoncontrol: Set Observation value for Compensating roll, f.e. 90%90%.

U282.01-.10: Characteristic of friction.
U283.01-.10: Only positive values allowed.

U285.01-.10: Characteristic for slip coil control
U286.01-.10: Only positive values allowed.

U288.01-.10: Characteristic (Building block 108).
U289.01-.10: Using this block, you can delinearize the influence of the potentiometer for maneuvering

U450: Delay web break recognition.
Is used to disable false triggering on short, sudden tension or moment drops.

U453: Time, during which the minimum tension (set using U198) has to be surpassed to activate the tension control.

U456: Time for reverse winding if web break occurs.

U539.01: Integration time - calculator for diameter
The following formula is used for calculation:

$$U539.01 = \frac{188{,}5 * U537.01 * D_{max} * L}{v_{max}} \quad [s]$$

D_{max} Maximum roller diameter [m]
L Number of layers on roller with maximum diameter
v_{max} Maximum system speed [m/min]

6 Appendix

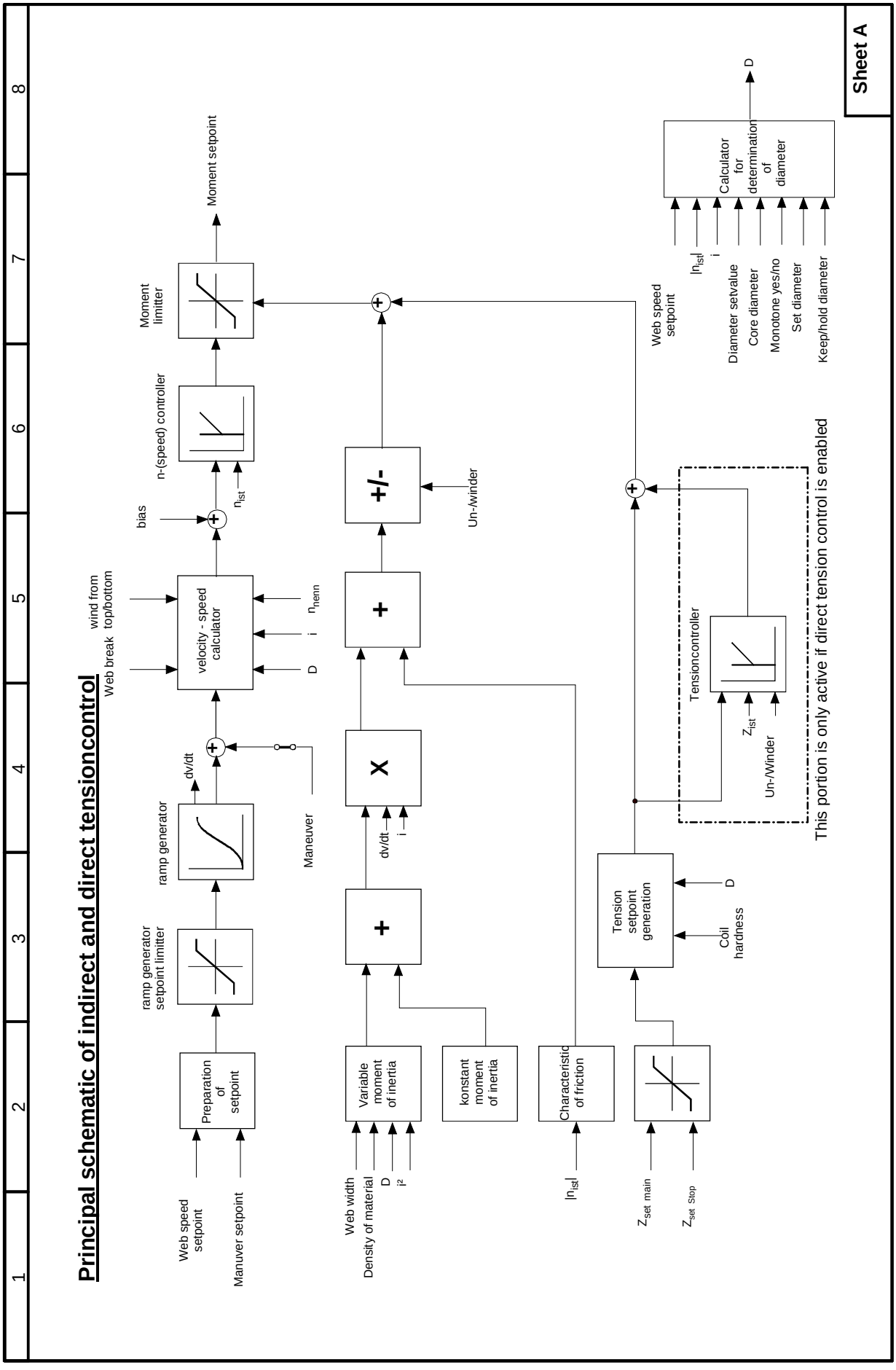
6.1 List of freely assignable function Blocks used

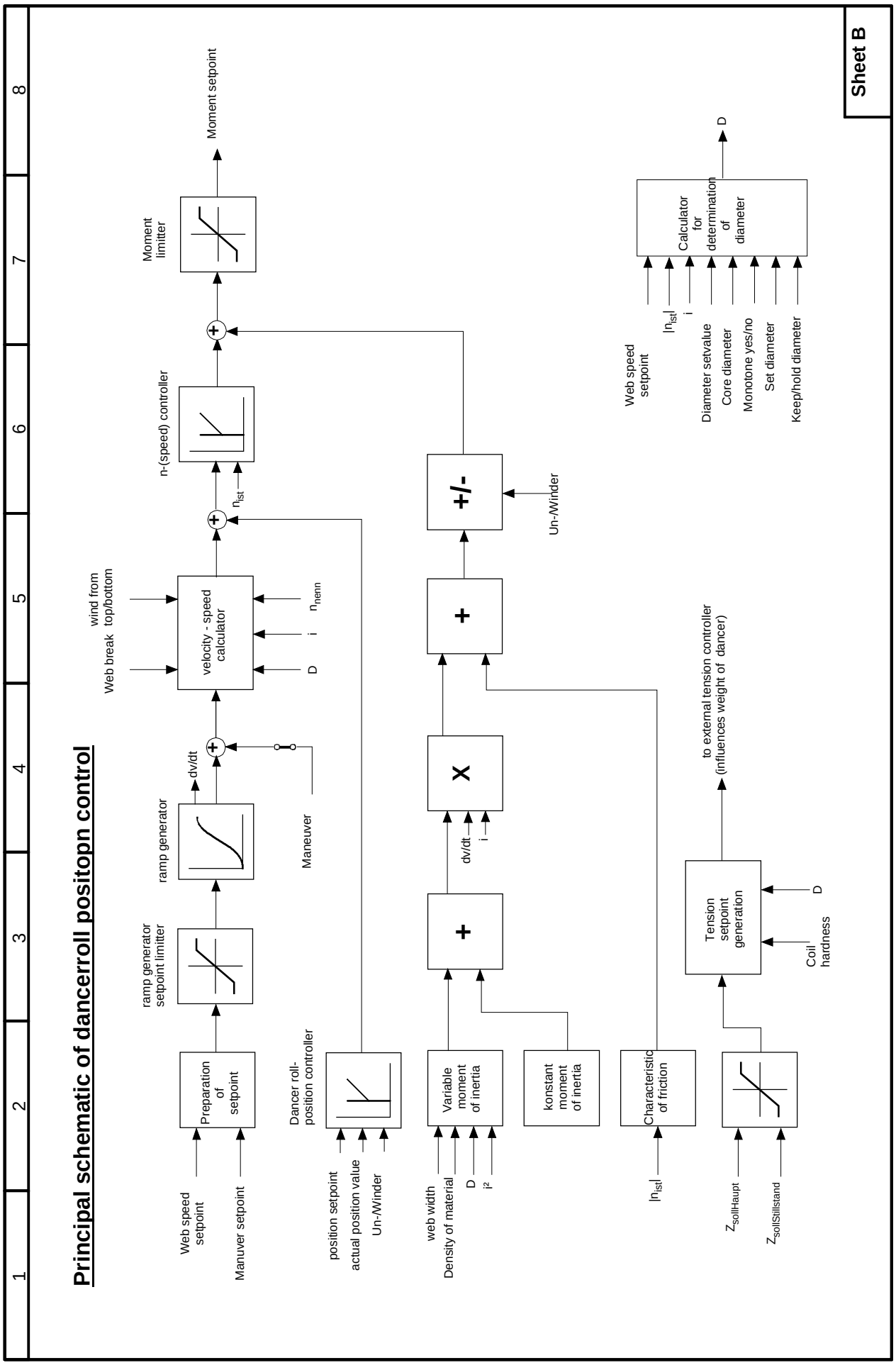
Block type	**Blocknumber**
Binector/connector converter	13
Average value during n cycles	16
Adders/Subtractors	20,21,22,23,24,25
Sign inverters	35,36
Switchable sign inverters	40,41
Dividers	45,46,47
Multipliers	50,51,52,53,290.....297
High resolution Multipliers/Dividers	55
Absolute value generators with filter	60,61
limiters	65
Limit-value monitors without filters	73,74
Tracking-/storrage element	82
Analog signal selector switches	90, 93.....99
Integrators	101
Characteristic Blocks	106,107,108
Simple ramp-function generator	113
Technology controller	114
Velocity-/speed controller	115
Variable moment of inertia	116
multiplexer	86,87
AND – elements	121.....131
OR – elements	150.....154, 156.....167
Inverters	180.....191
RS-flipflop	215
Timers	240.....245
Binary signal selector switch	250,251
PI-controller	260

6.2 List of settable fixed values used

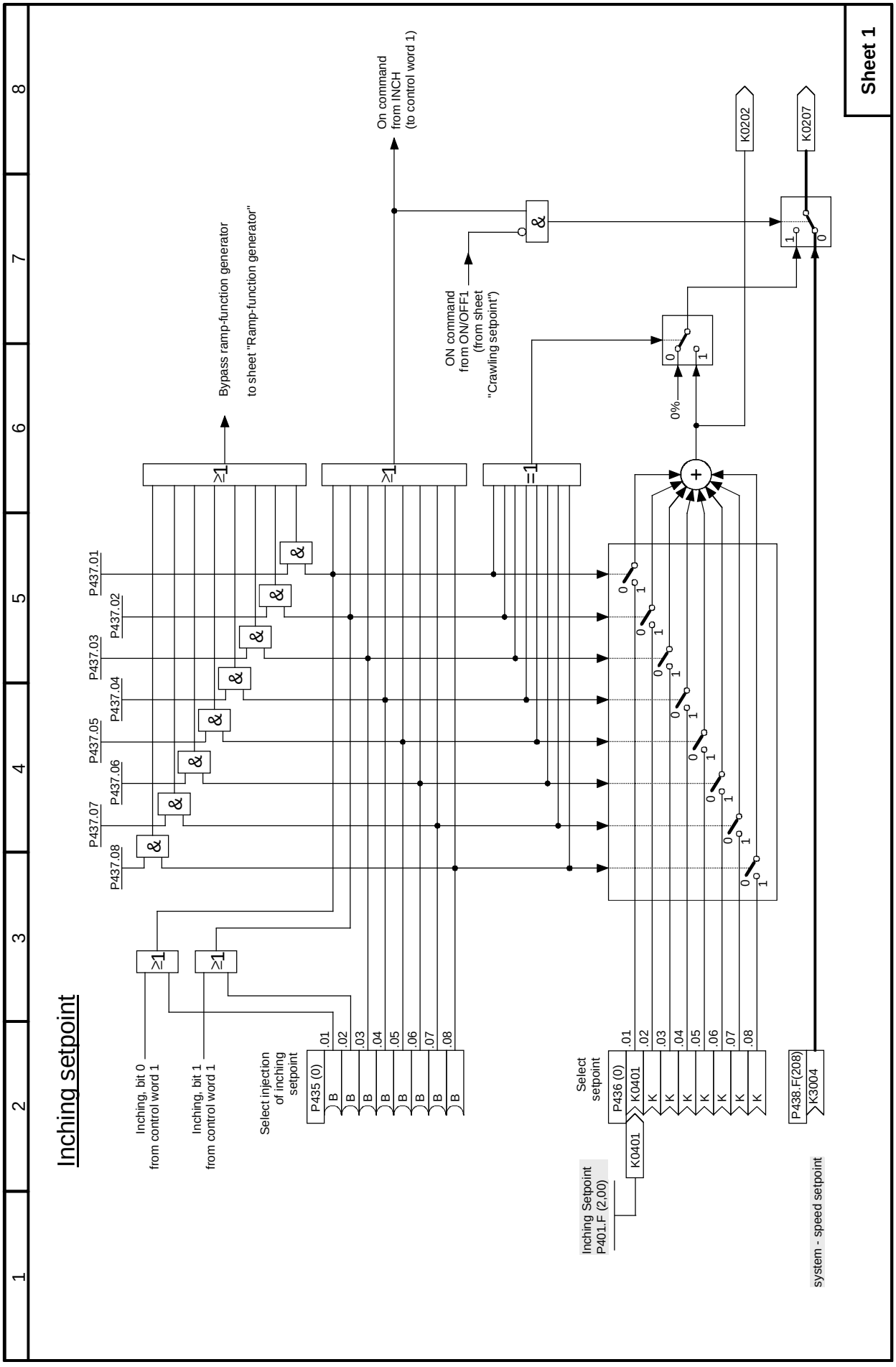
Parameter	Function
P401	Inching set point
P402	Adjustment of set point – actual value difference of moment for web break recognition
P403	Fine tuning of web (system) speed
P404	Diameter of core in % of D_{max}
P405	Bias for Speed controller in conjunction with direct and ind. tension cont.
P406	i gear stage 2
P407	constant moment of inertia
P408	Scaling of tension setpoint
P409	Influence tension-/position controller
P410	Stop tension
P411	Position set point
P421	Change of diameter monotone 0.....no 1.....yes

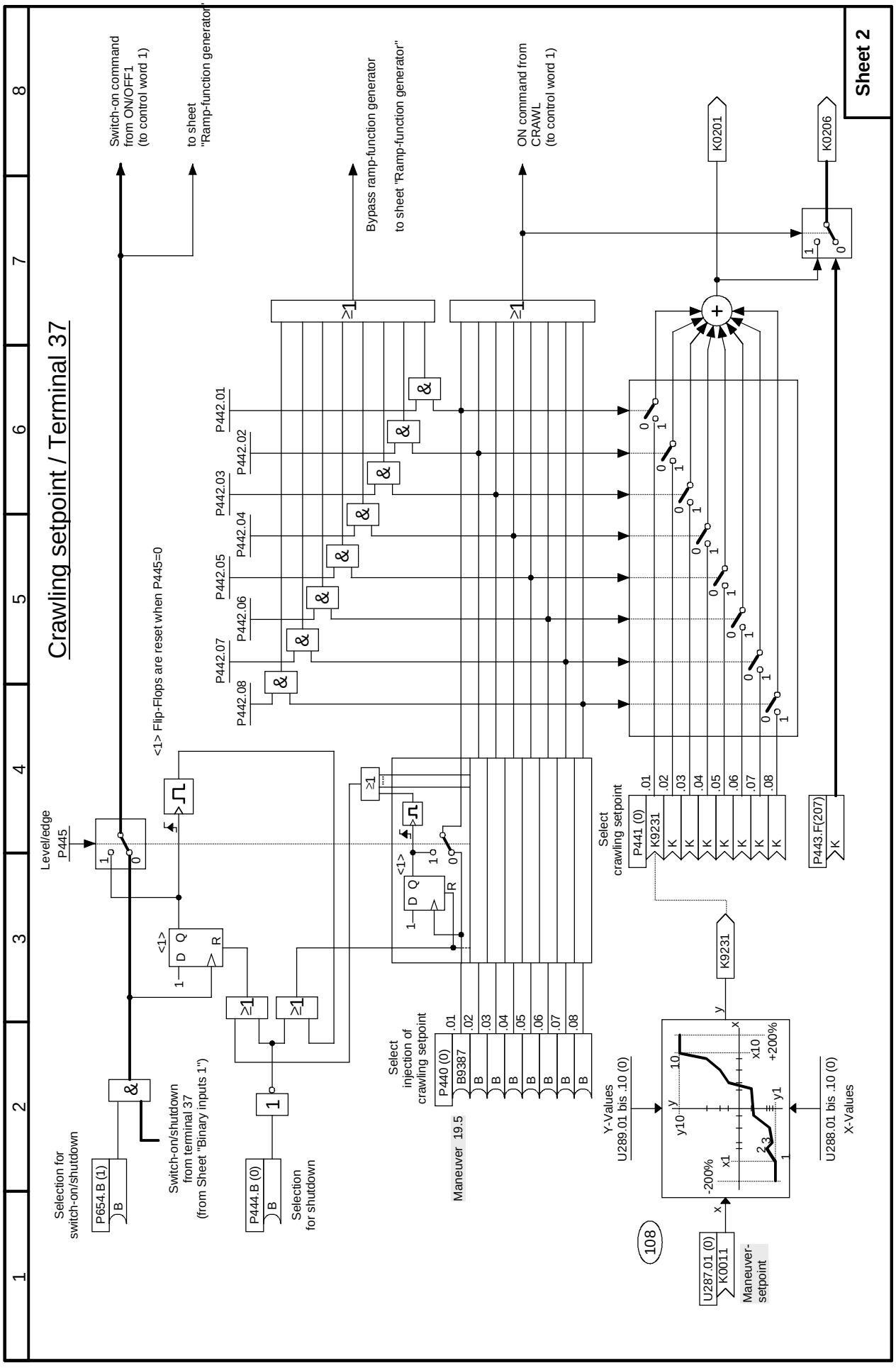
6.3 Schematic diagram of control types

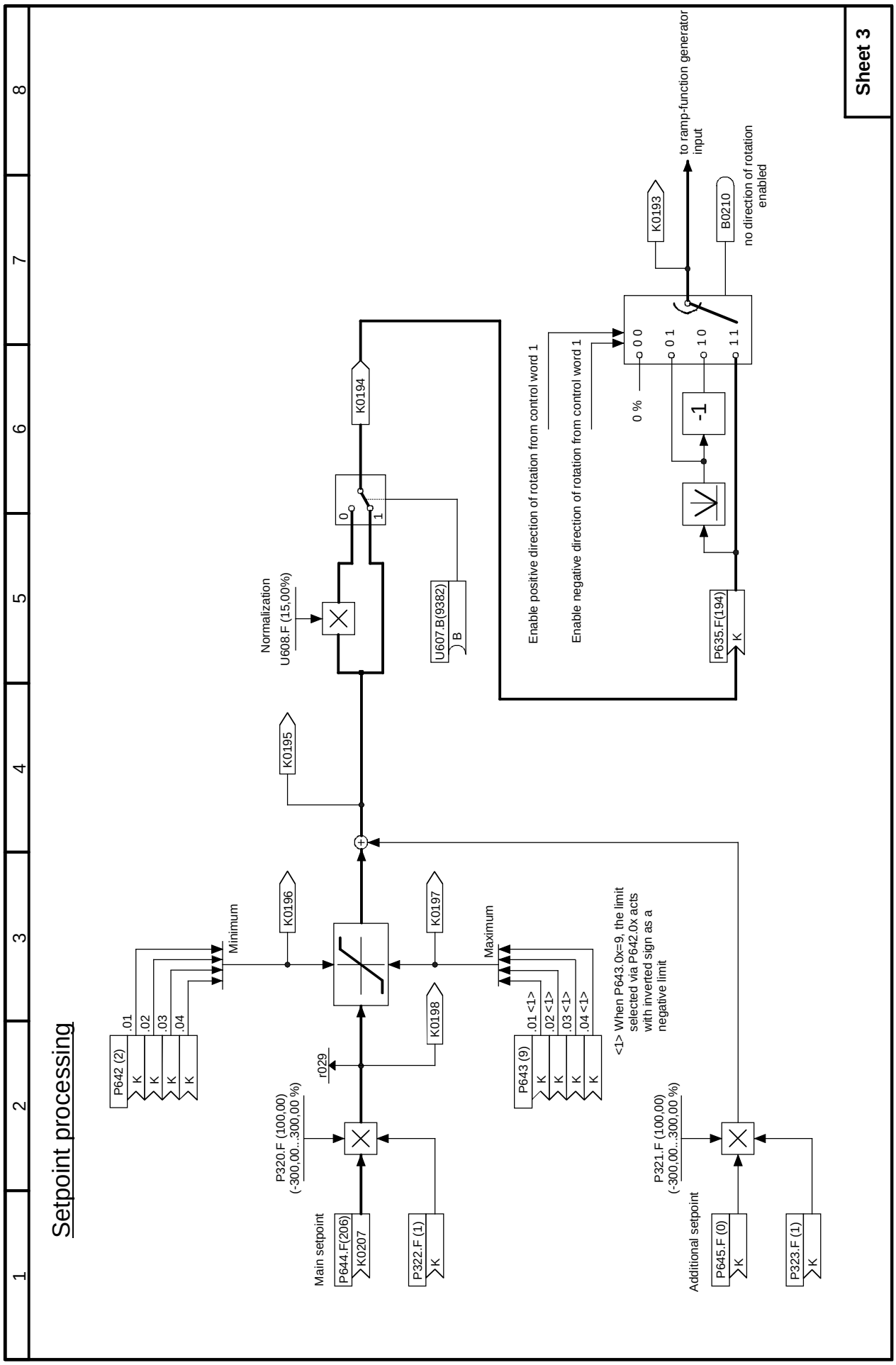


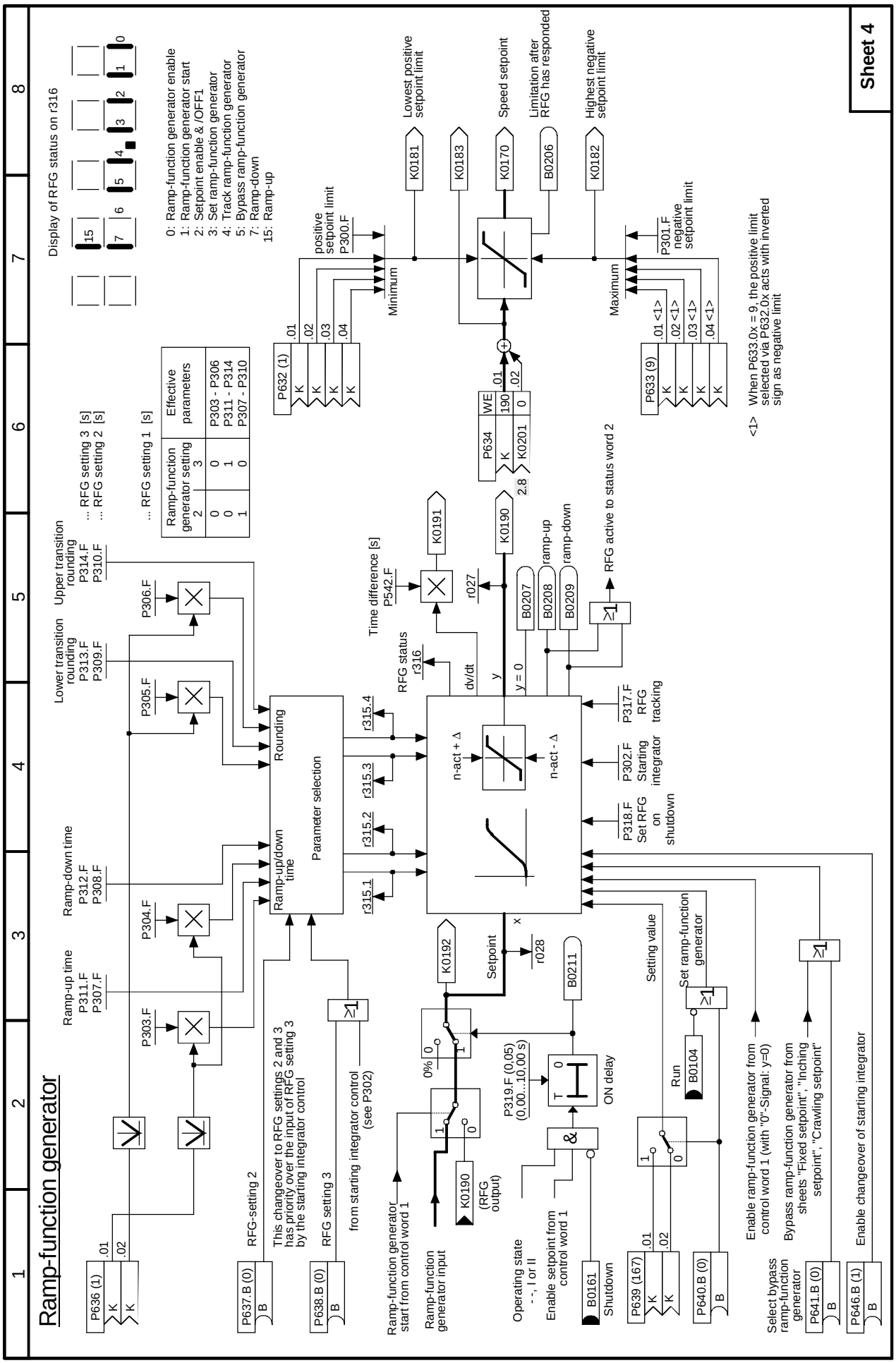

Sheet B
Principal schematic of dancerroll positopn control
Web speed setpoint
Manuver setpoint
Preparation of setpoint
ramp generator setpoint limitter
ramp generator
dv/dt
Maneuver
wind from Web break top/bottom
velocity - speed calculator
D i n_henn
n_ist
n-(speed) controller
Moment limitter
Moment setpoint
position setpoint
actual position value
Un-/Winder
Dancer roll-position controller
web width
Density of material
D
i²
Variable moment of inertia
dv/dt
i
X
+
konstant moment of inertia
+
+/-
Un-/Winder
|n_ist|
Characteristic of friction
to external tension controller (influences weight of dancer)
Tension setpoint generation
D
Coil hardness
Z_sollHaupt
Z_sollStillstand
Web speed setpoint
|n_ist|
i
Calculator for determination of diameter
D
Diameter setvalue
Core diameter
Monotone yes/no
Set diameter
Keep/hold diameter

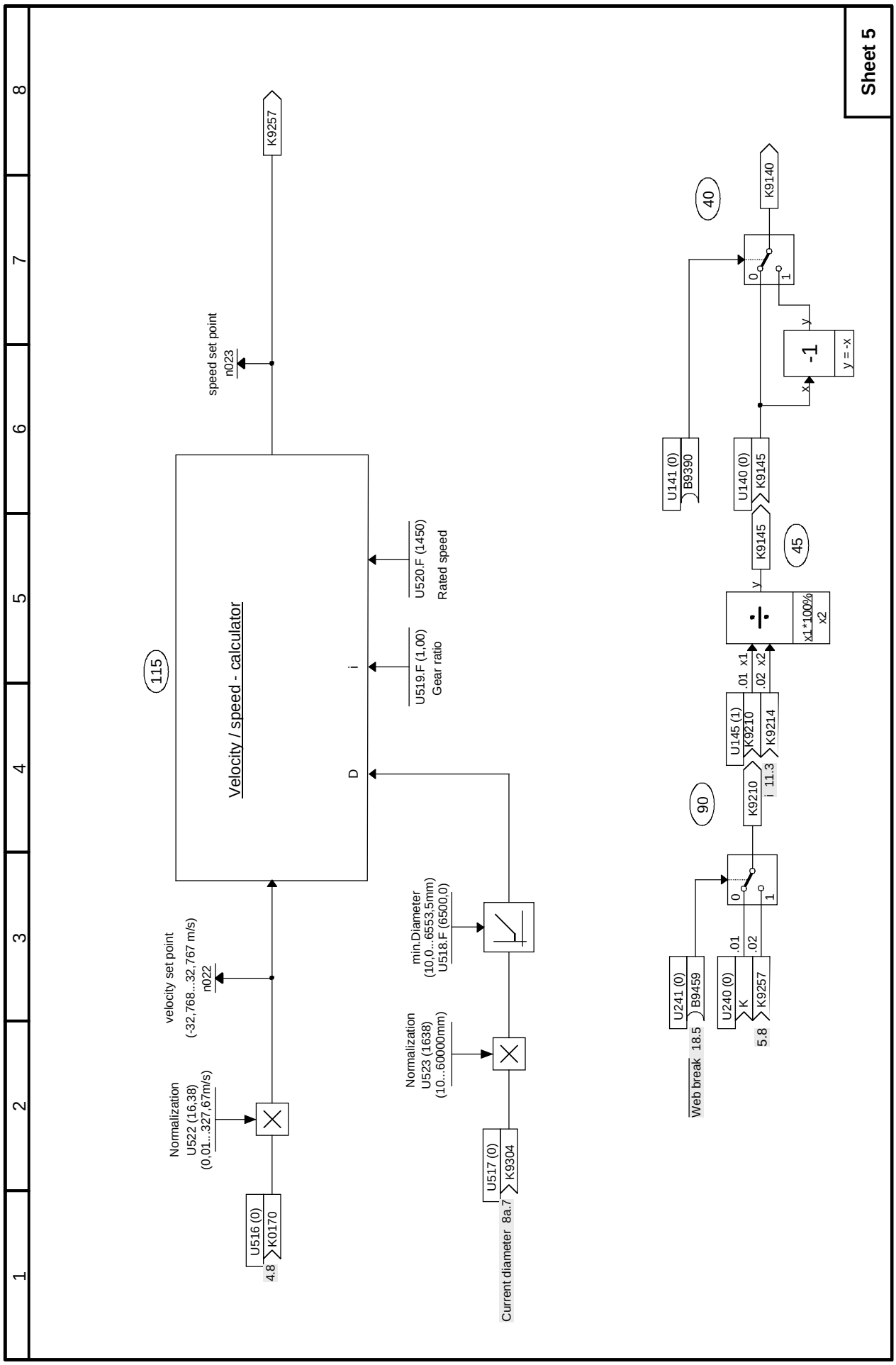
6.4 Detailed schematics

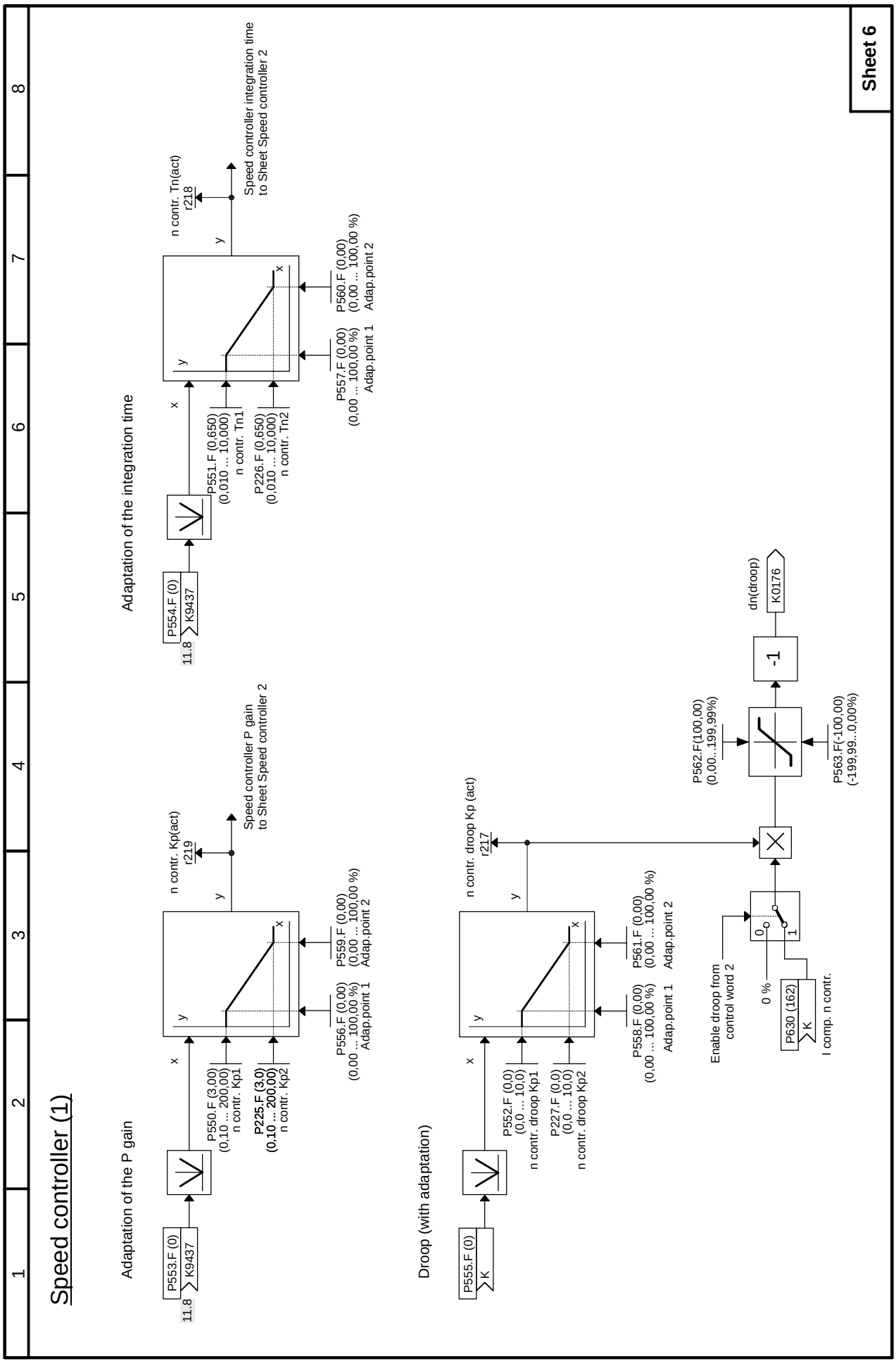


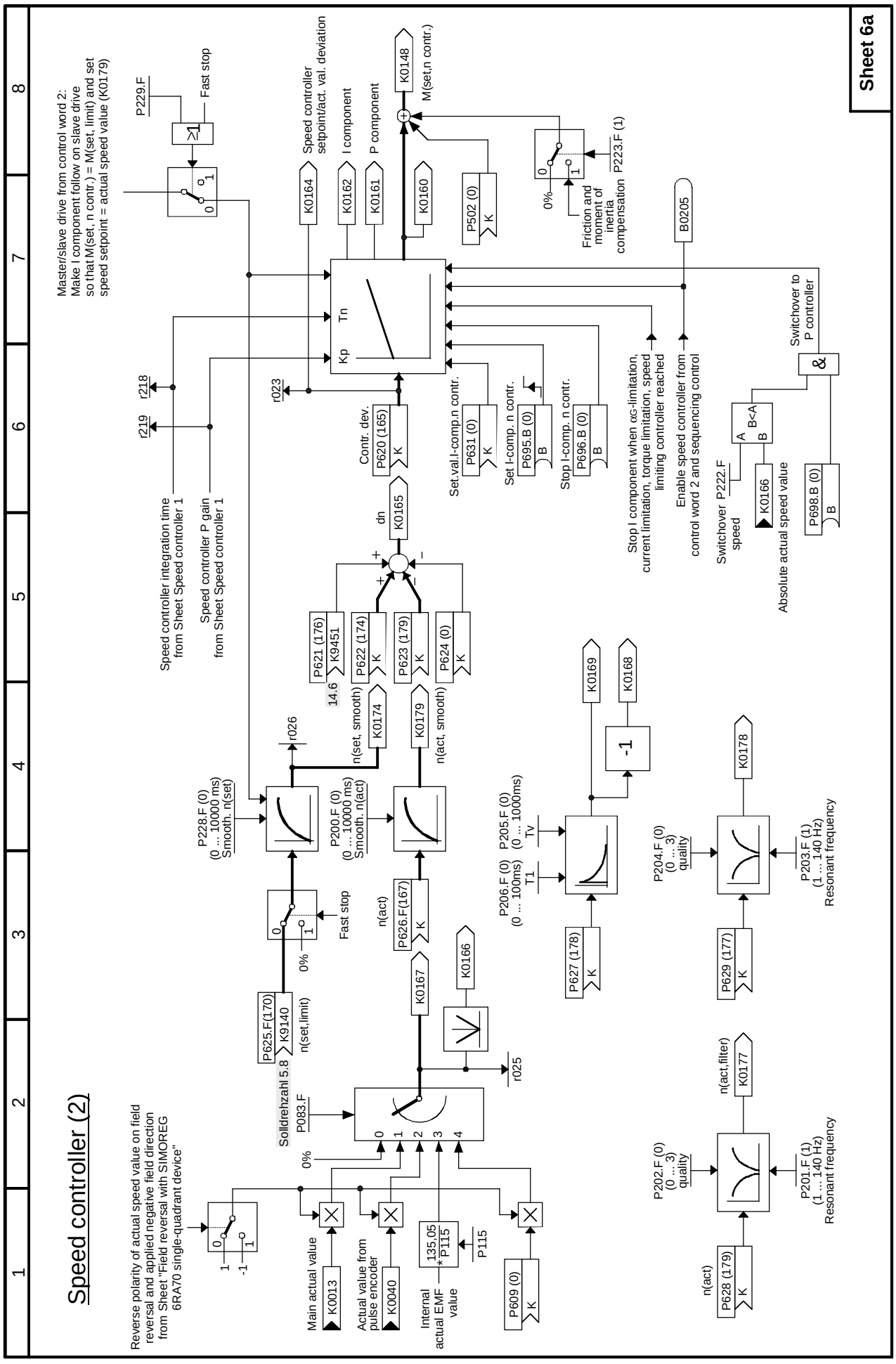

Sheet 2
Crawling setpoint / Terminal 37
Switch-on command from ON/OFF1 (to control word 1)
to sheet "Ramp-function generator"
Bypass ramp-function generator
to sheet "Ramp-function generator"
ON command from CRAWL (to control word 1)
K0201
K0206
<1> Flip-Flops are reset when P445=0
Level/edge P445
P442.01
P442.02
P442.03
P442.04
P442.05
P442.06
P442.07
P442.08
Select crawling setpoint
P441 (0)
K9231
P443.F(207)
Selection for switch-on/shutdown
P654.B (1)
Switch-on/shutdown from terminal 37 (from Sheet "Binary inputs 1")
P444.B (0)
Selection for shutdown
Select injection of crawling setpoint
P440 (0)
B9387
Maneuver 19.5
Y-Values U289.01 bis .10 (0)
X-Values U288.01 bis .10 (0)
U287.01 (0)
K0011
Maneuver-setpoint
108

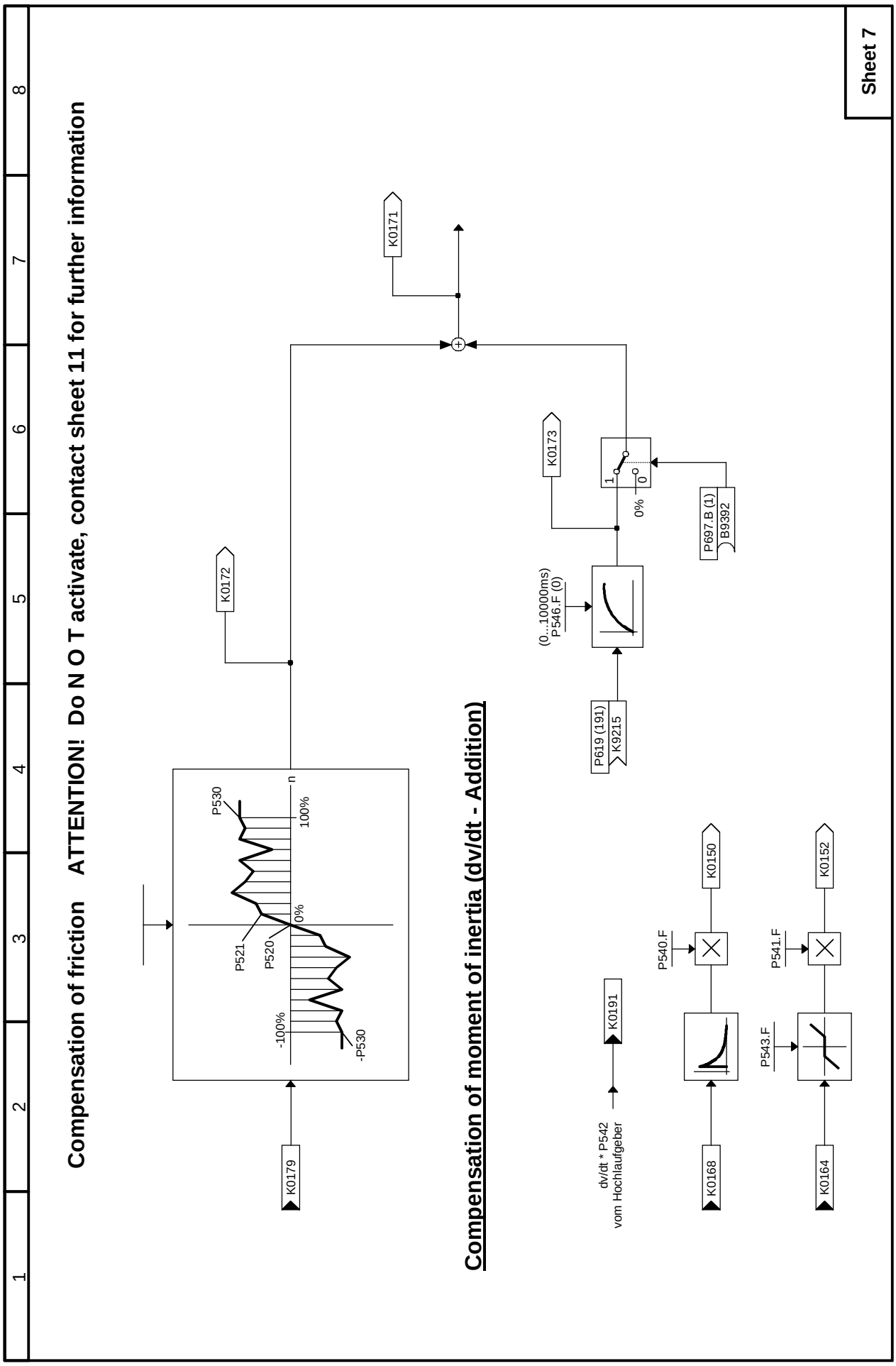

Sheet 3
Setpoint processing
1
2
3
4
5
6
7
8
Main setpoint
P644.F(206)
K0207
P322.F (1)
K
P320.F (100,00)
(-300,00...300,00 %)
r029
K0198
P642 (2)
.01
.02
.03
.04
K
Minimum
K0196
K0195
Normalization
U608.F (15,00%)
K0194
0
1
U607.B(9382)
B
K0197
Maximum
P643 (9)
.01 <1>
.02 <1>
.03 <1>
.04 <1>
<1> When P643.0x=9, the limit selected via P642.0x acts with inverted sign as a negative limit
Additional setpoint
P645.F (0)
P323.F (1)
P321.F (100,00)
(-300,00...300,00 %)
Enable positive direction of rotation from control word 1
Enable negative direction of rotation from control word 1
0 %
0 0
0 1
1 0
1 1
-1
P635.F(194)
K0193
B0210
to ramp-function generator input
no direction of rotation enabled

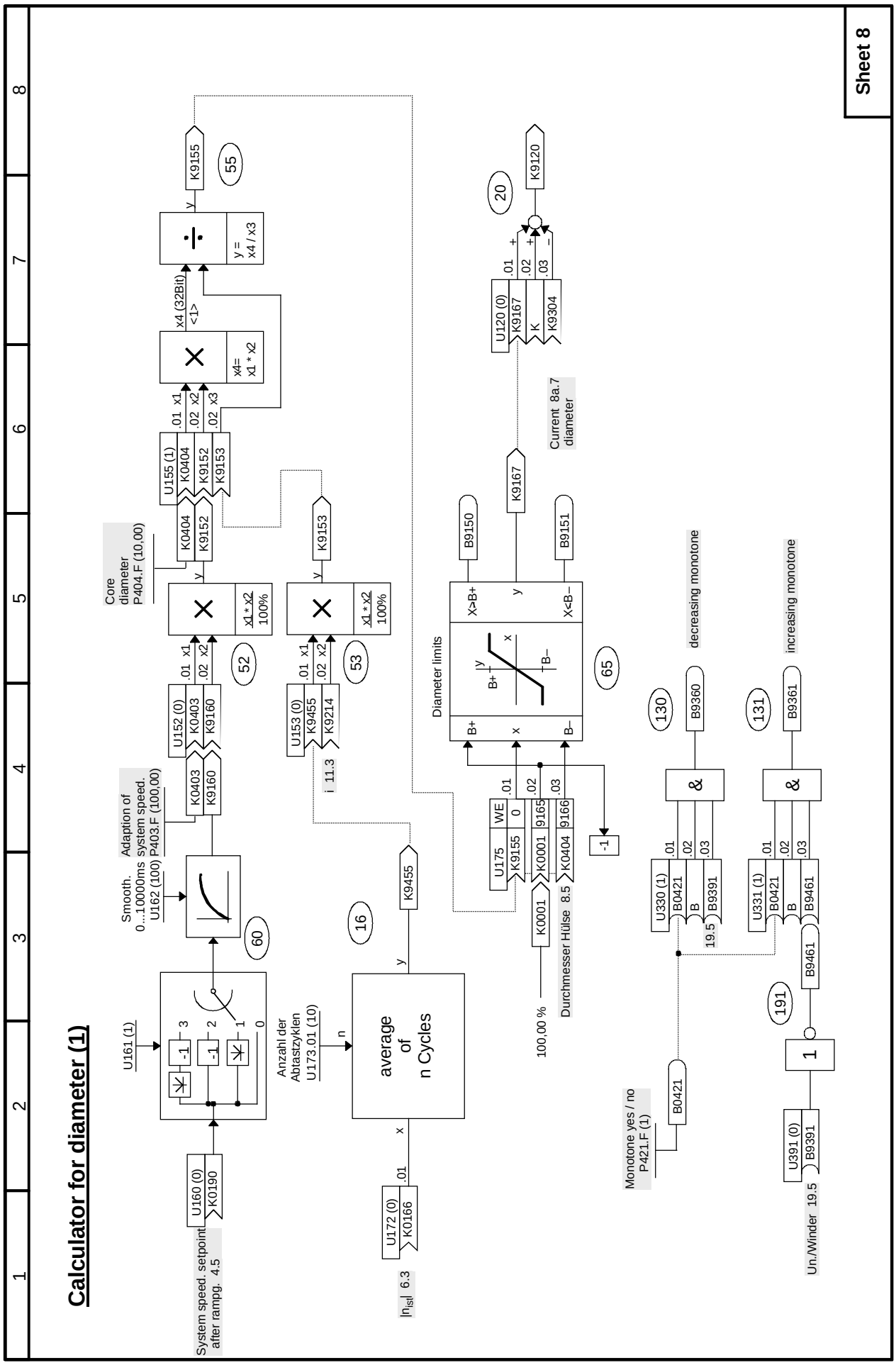

Ramp-function generator
Sheet 4
Ramp-up time
P311.F
P307.F
Ramp-down time
P312.F
P308.F
Upper transition rounding
P314.F
P310.F
Lower transition rounding
P313.F
P309.F
... RFG setting 3 [s]
... RFG setting 2 [s]
... RFG setting 1 [s]
Ramp-function generator setting
Effective parameters
P303 - P306
P311 - P314
P307 - P310
Display of RFG status on r316
0: Ramp-function generator enable
1: Ramp-function generator start
2: Setpoint enable & /OFF1
3: Set ramp-function generator
4: Track ramp-function generator
5: Bypass ramp-function generator
7: Ramp-down
15: Ramp-up
P636 (1)
RFG-setting 2
P637.B (0)
This changeover to RFG settings 2 and 3 has priority over the input of RFG setting 3 by the starting integrator control
RFG setting 3
P638.B (0)
from starting integrator control (see P302)
Ramp-function generator start from control word 1
Ramp-function generator input
K0190 (RFG output)
Operating state - -, I or II
Enable setpoint from control word 1
B0161 Shutdown
P639 (167)
P640.B (0)
Select bypass ramp-function generator
P641.B (0)
P646.B (1)
Enable changeover of starting integrator
Enable ramp-function generator from control word 1 (with "0"-Signal: y=0)
Bypass ramp-function generator from sheets "Fixed setpoint", "Inching setpoint", "Crawling setpoint"
Setting value
Set ramp-function generator
Run
B0104
P319.F (0,00...10,00 s)
ON delay
K0192
Setpoint
r028
0%
P303.F
P304.F
P305.F
P306.F
Rounding
Parameter selection
Ramp-up/down time
r315.4
r315.3
r315.2
r315.1
RFG status r316
Time difference [s]
P542.F
dv/dt
r027
K0191
K0190
y
y = 0
B0207
B0208
B0209
ramp-up
ramp-down
n-act + Δ
n-act - Δ
P317.F RFG tracking
P302.F Starting integrator
P318.F Set RFG on shutdown
RFG active to status word 2
P632 (1)
positive setpoint limit
P300.F
Minimum
Lowest positive setpoint limit
K0181
K0183
K0170
Speed setpoint
Limitation after RFG has responded
B0206
K0182
Highest negative setpoint limit
Maximum
P301.F negative setpoint limit
P633 (9)
P634
WE
190
K0201
2.8
<1> When P633.0x = 9, the positive limit selected via P632.0x acts with inverted sign as negative limit

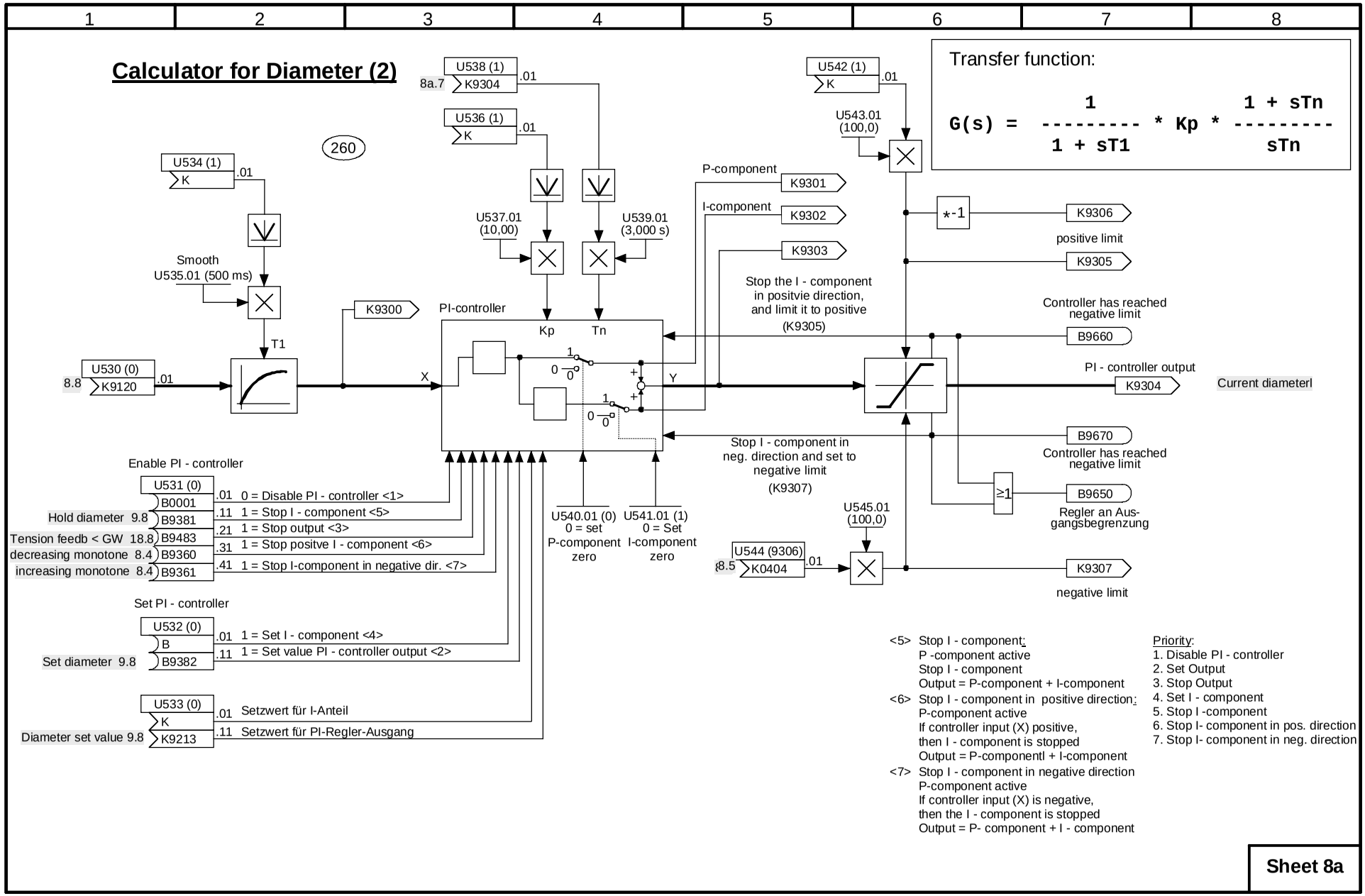

Sheet 5
Velocity / speed - calculator
115
D
i
K9257
speed set point
n023
velocity set point
(-32,768...32,767 m/s)
n022
Normalization
U522 (16,38)
(0,01...327,67m/s)
U516 (0)
K0170
4.8
Normalization
U523 (1638)
(10...60000mm)
min.Diameter
(10,0...6553,5mm)
U518.F (6500,0)
U517 (0)
K9304
Current diameter 8a.7
U519.F (1,00)
Gear ratio
U520.F (1450)
Rated speed
90
40
45
U141 (0)
B9390
U140 (0)
K9145
K9140
-1
y = -x
K9145
x1*100%
x2
U145 (1)
K9210
K9214
.01 x1
.02 x2
K9210
i 11.3
U241 (0)
B9459
Web break 18.5
U240 (0)
K
K9257
5.8
.01
.02

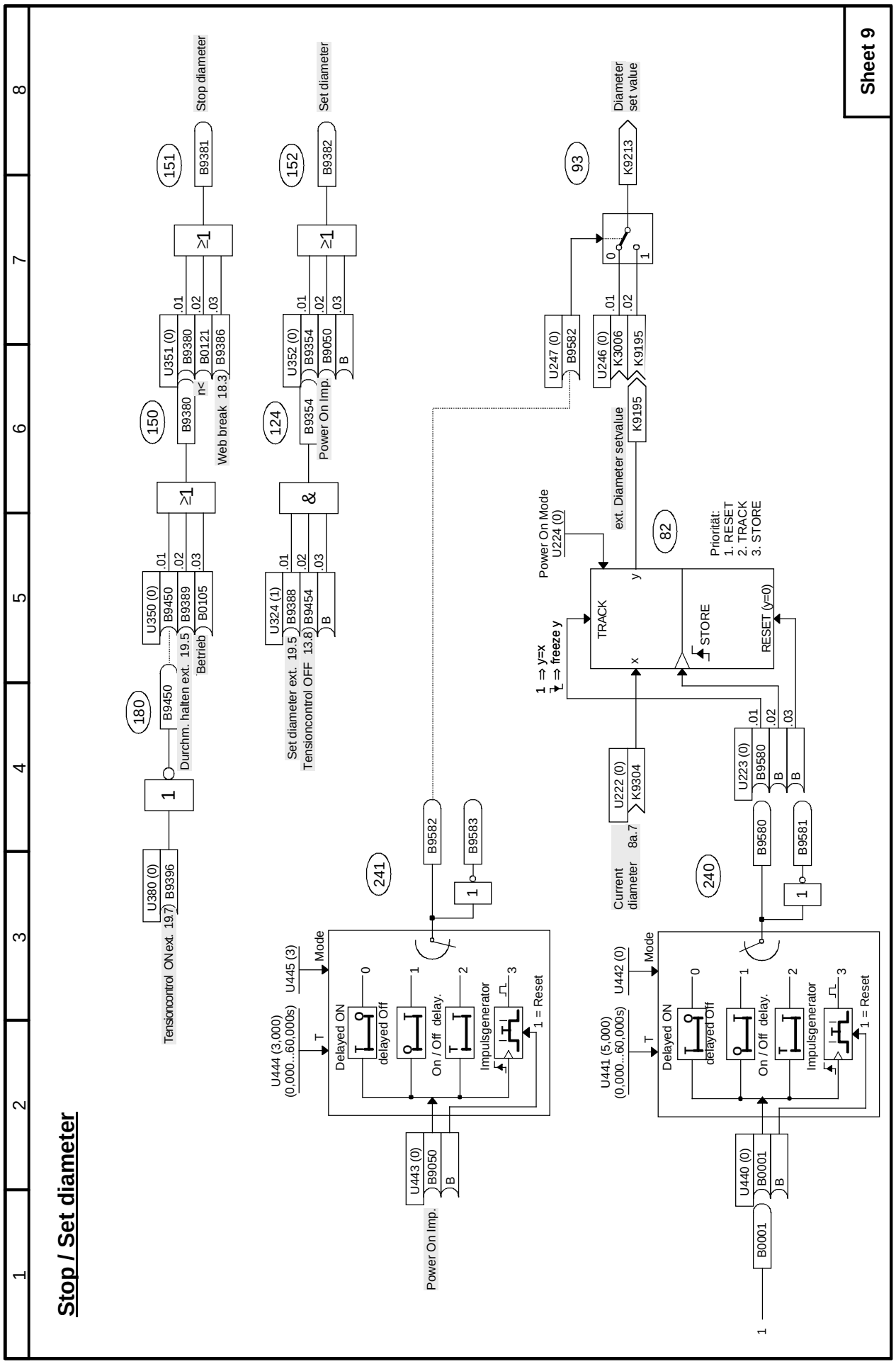

Speed controller (1)
Sheet 6
Adaptation of the P gain
P553.F (0)
K9437
11.8
P550.F (3,00)
(0,10 ... 200,00)
n contr. Kp1
P225.F (3,0)
(0,10 ... 200,00)
n contr. Kp2
P556.F (0,00)
(0,00 ... 100,00 %)
Adap.point 1
P559.F (0,00)
(0,00 ... 100,00 %)
Adap.point 2
n contr. Kp(act)
r219
Speed controller P gain
to Sheet Speed controller 2
Adaptation of the integration time
P554.F (0)
K9437
11.8
P551.F (0,650)
(0,010 ... 10,000)
n contr. Tn1
P226.F (0,650)
(0,010 ... 10,000)
n contr. Tn2
P557.F (0,00)
(0,00 ... 100,00 %)
Adap.point 1
P560.F (0,00)
(0,00 ... 100,00 %)
Adap.point 2
n contr. Tn(act)
r218
Speed controller integration time
to Sheet Speed controller 2
Droop (with adaptation)
P555.F (0)
K
P552.F (0,0)
(0,0 ... 10,0)
n contr. droop Kp1
P227.F (0,0)
(0,0 ... 10,0)
n contr. droop Kp2
P558.F (0,00)
(0,00 ... 100,00 %)
Adap.point 1
P561.F (0,00)
(0,00 ... 100,00 %)
Adap.point 2
n contr. droop Kp (act)
r217
P562.F(100,00)
(0,00...199,99%)
P563.F(-100,00)
(-199,99...0,00%)
Enable droop from
control word 2
0 %
P630 (162)
K
I comp. n contr.
-1
dn(droop)
K0176

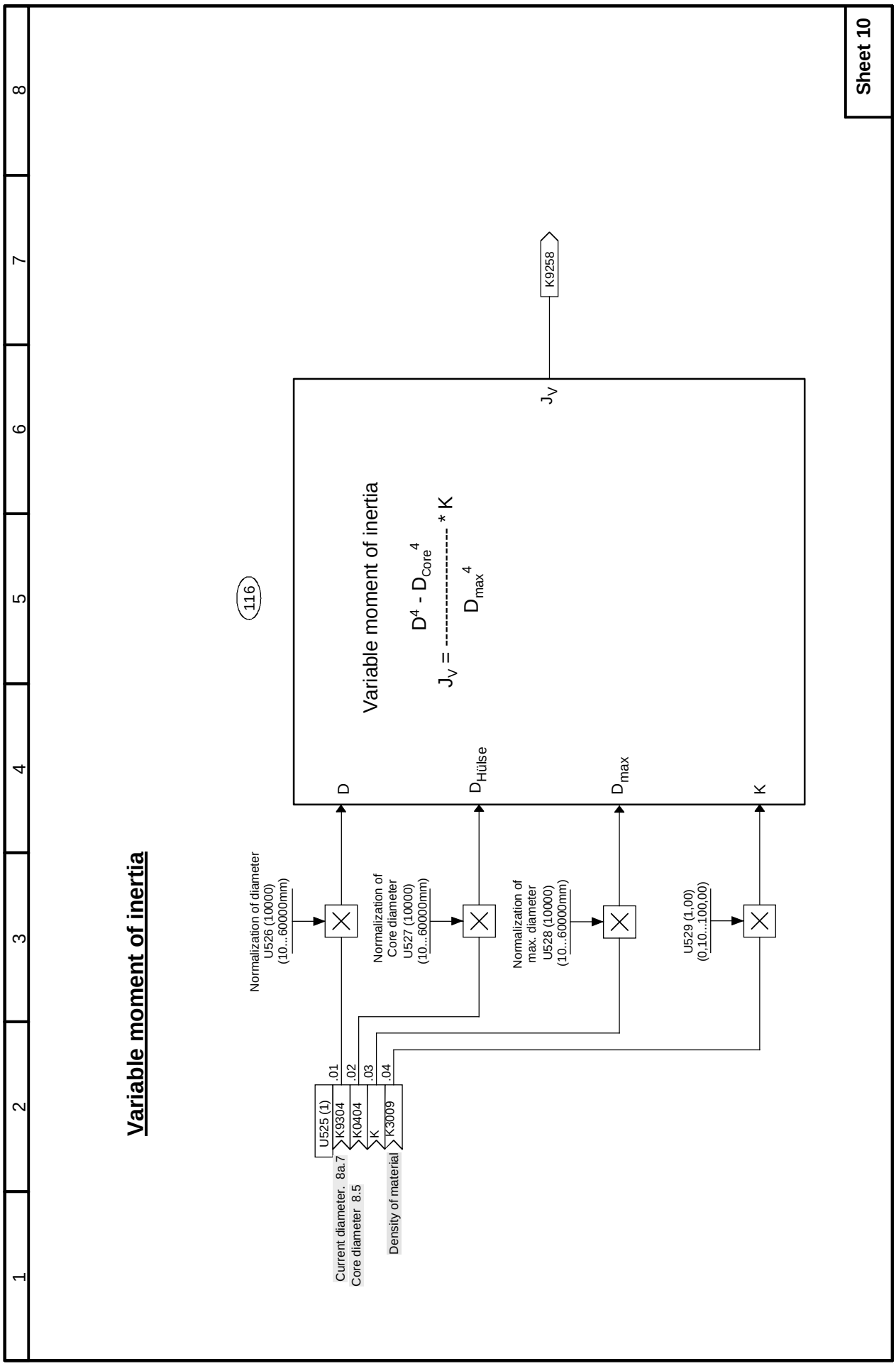

Sheet 6a
Speed controller (2)
Reverse polarity of actual speed value on field reversal and applied negative field direction from Sheet "Field reversal with SIMOREG 6RA70 single-quadrant device"
Main actual value
K0013
Actual value from pulse encoder
K0040
Internal actual EMF value
135.05 * P115
P115
P609 (0) K
Solldrehzahl 5.8
P083.F
0%
P625.F(170) K9140
n(set,limit)
Fast stop
P228.F (0) (0 ... 10000 ms) Smooth. n(set)
P200.F (0) (0 ... 10000 ms) Smooth. n(act)
r026
n(act)
P626.F(167) K
K0167
K0166
r025
Speed controller integration time from Sheet Speed controller 1
Speed controller P gain from Sheet Speed controller 1
r218
r219
r023
P621 (176) K9451
14.6
P622 (174) K
P623 (179) K
P624 (0) K
n(set, smooth)
K0174
n(act, smooth)
K0179
Kp Tn
Contr. dev.
P620 (165) K
dn
K0165
Set.val.I-comp.n contr.
P631 (0) K
Set I-comp. n contr.
P695.B (0) B
Stop I-comp. n contr.
P696.B (0) B
Stop I component when αG-limitation, current limitation, torque limitation, speed limiting controller reached
Enable speed controller from control word 2 and sequencing control
B0205
Switchover P222.F speed
A B<A B
K0166
Absolute actual speed value
P698.B (0) B
Switchover to P controller
&
Speed controller setpoint/act. val. deviation
K0164
I component
K0162
P component
K0161
K0160
K0148
M(set,n contr.)
P502 (0) K
0%
Friction and moment of inertia compensation
P223.F (1)
P229.F
≥1
Fast stop
Master/slave drive from control word 2: Make I component follow on slave drive so that M(set, n contr.) = M(set, limit) and set speed setpoint = actual speed value (K0179)
P206.F (0) (0 ... 100ms) T1
P205.F (0) (0 ... 1000ms) Tv
P627 (178) K
K0169
K0168
-1
P204.F (0) (0 ... 3) quality
P203.F (1) (1 ... 140 Hz) Resonant frequency
P629 (177) K
K0178
P202.F (0) (0 ... 3) quality
P201.F (1) (1 ... 140 Hz) Resonant frequency
n(act.filter)
K0177
n(act)
P628 (179) K

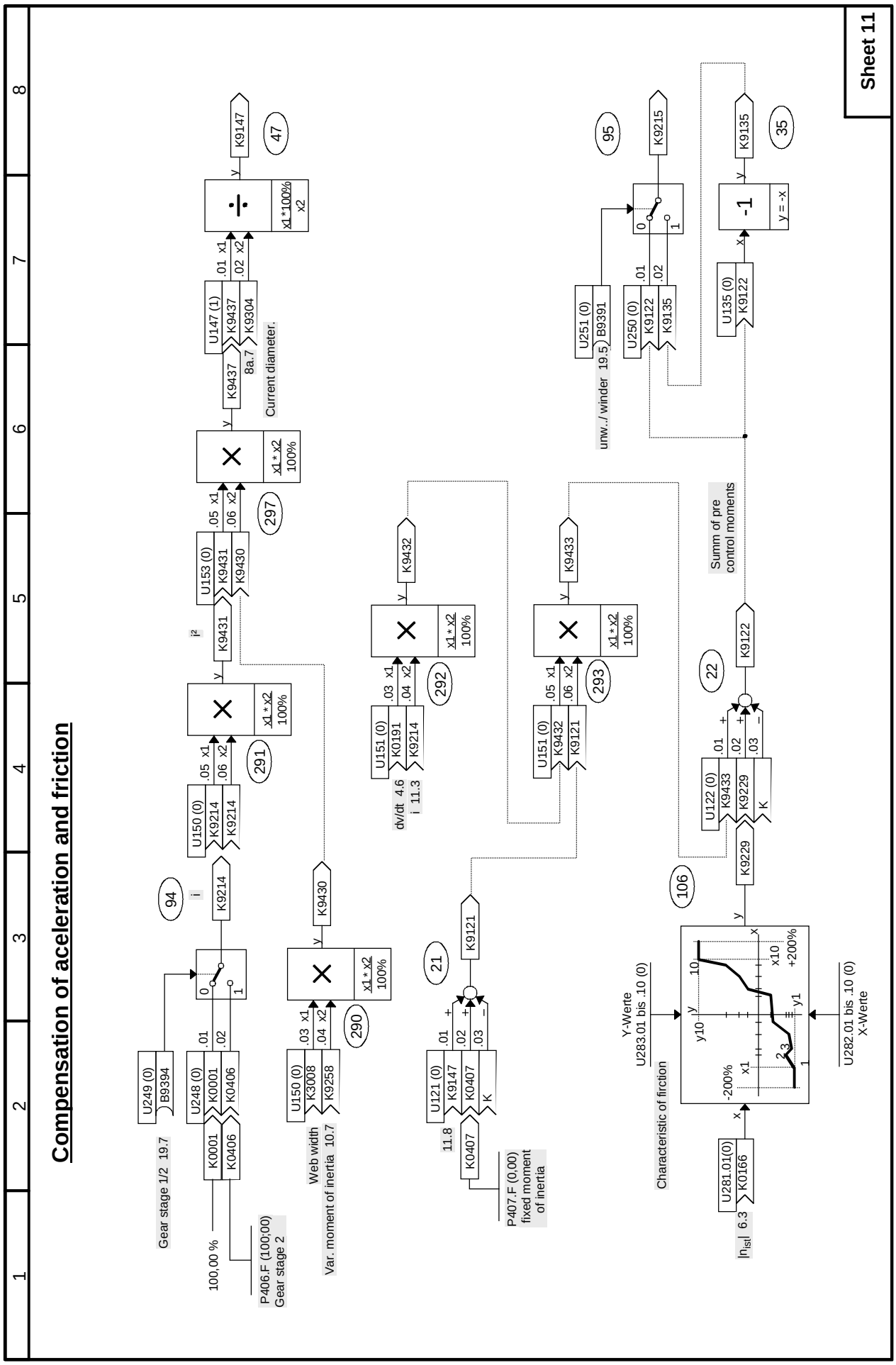

Sheet 7
Compensation of friction ATTENTION! Do N O T activate, contact sheet 11 for further information
K0179
K0172
P530
P521
P520
-P530
100%
0%
-100%
n
K0171
K0173
(0...10000ms)
P546.F (0)
P619 (191)
K9215
1
0
0%
P697.B (1)
B9392
Compensation of moment of inertia (dv/dt - Addition)
dv/dt * P542
vom Hochlaufgeber
K0191
P540.F
K0150
K0168
P541.F
K0152
K0164
P543.F

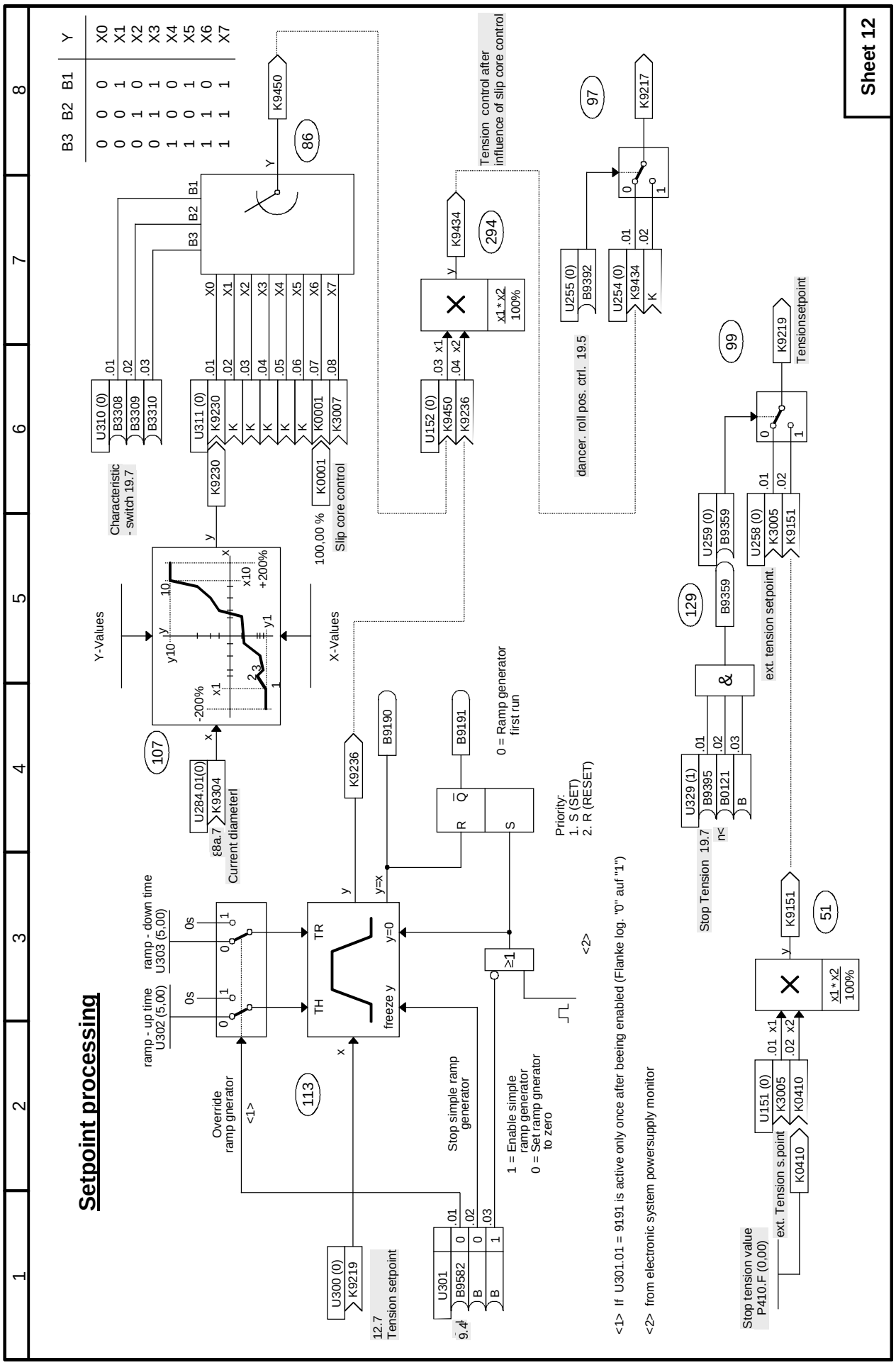

Sheet 8
Calculator for diameter (1)
System speed. setpoint after rampg. 4.5
U160 (0) K0190
U161 (1)
Smooth. 0...10000ms U162 (100)
Adaption of system speed. P403.F (100.00)
60
Anzahl der Abtastzyklen U173.01 (10)
n
average of n Cycles
16
K9455
U172 (0) K0166
|nIst| 6.3
Core diameter P404.F (10.00)
U152 (0) K0403 K9160
U153 (0) K9455 K9214
i 11.3
52
53
U155 (1) K0404 K9152 K9153
x4 (32Bit) <1>
x4= x1 * x2
y = x4 / x3
K9155
55
K0404 K9152
K9153
Diameter limits
B9150
B9151
X>B+
X<B–
65
K9167
Current 8a.7 diameter
20
U120 (0) K9167 K K9304
K9120
U175 WE 0 K9155
K0001 9165
K0404 9166
100.00 %
K0001
Durchmesser Hülse 8.5
-1
130
131
B9360
B9361
decreasing monotone
increasing monotone
U330 (1) B0421 B 19.5 B9391
U331 (1) B0421 B B9461
Monotone yes / no P421.F (1)
B0421
191
1
U391 (0) B9391
Un./Winder 19.5

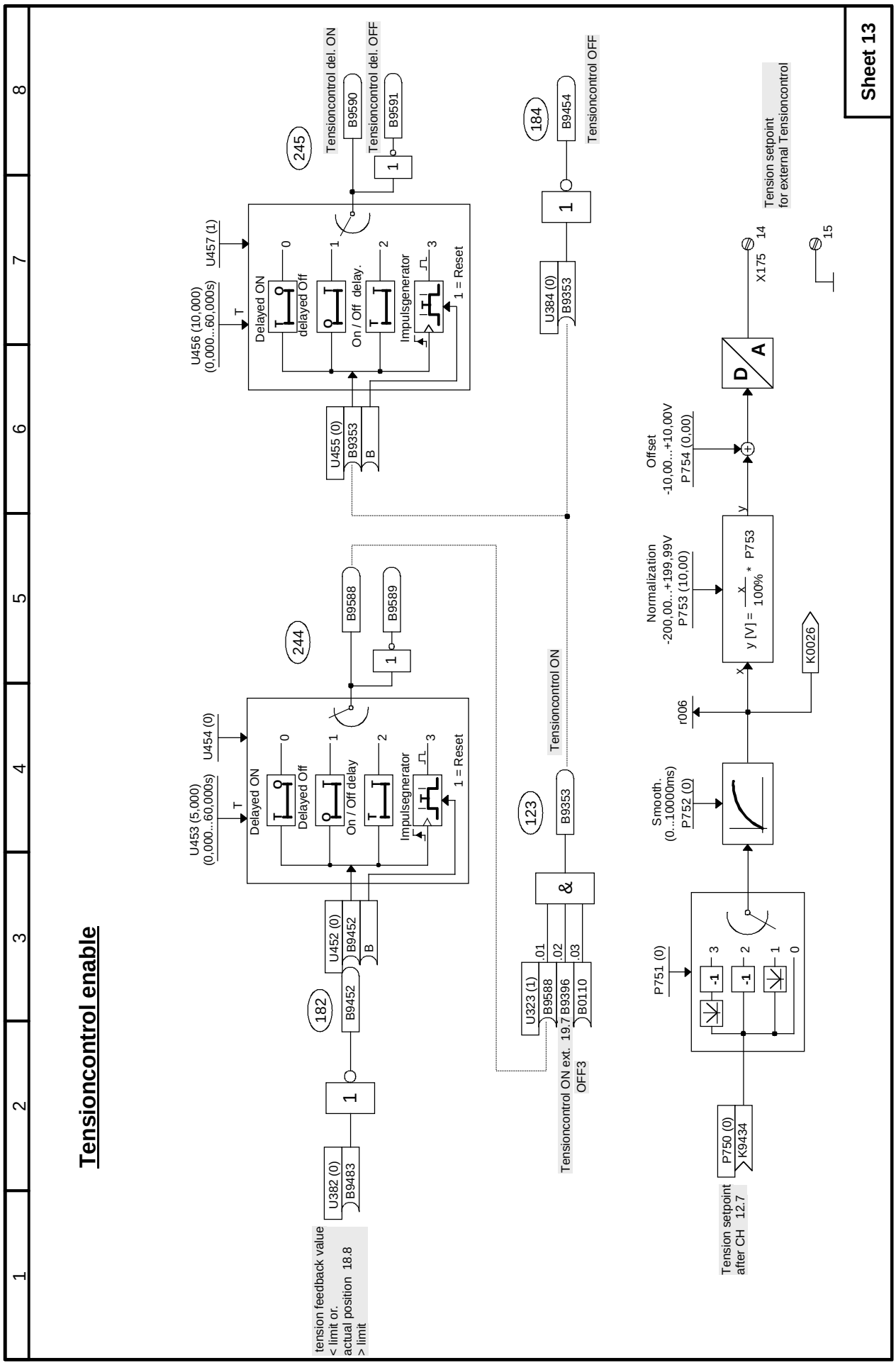

1
2
3
4
5
6
7
8
Calculator for Diameter (2)
260
Transfer function:
G(s) = 1 / (1 + sT1) * Kp * (1 + sTn) / sTn
U538 (1)
8a.7 K9304 .01
U536 (1)
K .01
U534 (1)
K .01
U542 (1)
K .01
U543.01
(100,0)
U537.01
(10,00)
U539.01
(3,000 s)
Smooth
U535.01 (500 ms)
T1
U530 (0)
8.8 K9120 .01
K9300
PI-controller
Kp
Tn
X
Y
P-component K9301
I-component K9302
K9303
Stop the I - component
in positvie direction,
and limit it to positive
(K9305)
*-1
K9306
positive limit
K9305
Controller has reached
negative limit
B9660
PI - controller output
K9304
Current diameterI
Stop I - component in
neg. direction and set to
negative limit
(K9307)
B9670
Controller has reached
negative limit
≥1
B9650
Regler an Aus-
gangsbegrenzung
U545.01
(100,0)
U544 (9306)
8.5 K0404 .01
K9307
negative limit
Enable PI - controller
U531 (0)
B0001 .01 0 = Disable PI - controller <1>
Hold diameter 9.8 B9381 .11 1 = Stop I - component <5>
Tension feedb < GW 18.8 B9483 .21 1 = Stop output <3>
decreasing monotone 8.4 B9360 .31 1 = Stop positve I - component <6>
increasing monotone 8.4 B9361 .41 1 = Stop I-component in negative dir. <7>
U540.01 (0)
0 = set
P-component
zero
U541.01 (1)
0 = Set
I-component
zero
Set PI - controller
U532 (0)
B
Set diameter 9.8 B9382 .01 1 = Set I - component <4>
.11 1 = Set value PI - controller output <2>
U533 (0)
K
Diameter set value 9.8 K9213 .01 Setzwert für I-Anteil
.11 Setzwert für PI-Regler-Ausgang
<5> Stop I - component:
P -component active
Stop I - component
Output = P-component + I-component
<6> Stop I - component in positive direction:
P-component active
If controller input (X) positive,
then I - component is stopped
Output = P-componentl + I-component
<7> Stop I - component in negative direction
P-component active
If controller input (X) is negative,
then the I - component is stopped
Output = P- component + I - component
Priority:
1. Disable PI - controller
2. Set Output
3. Stop Output
4. Set I - component
5. Stop I -component
6. Stop I- component in pos. direction
7. Stop I- component in neg. direction
Sheet 8a

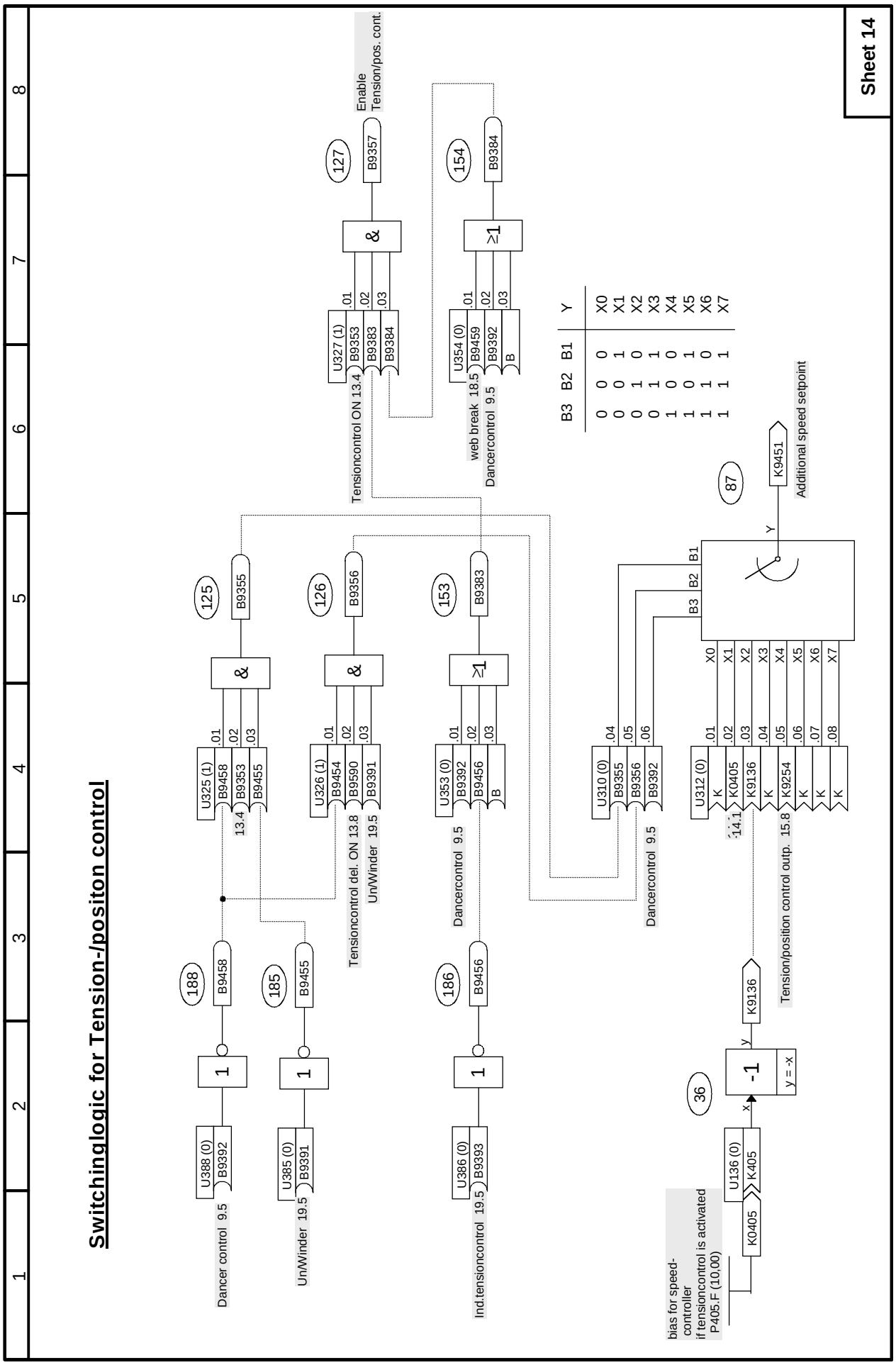

Stop / Set diameter
Sheet 9
Tensioncontrol ON ext. 19.7
U380 (0)
B9396
1
180
B9450
Durchm. halten ext. 19.5
U350 (0)
B9450
B9389
B0105
Betrieb
≥1
150
B9380
n<
Web break 18.3
U351 (0)
B9380
B0121
B9386
≥1
151
B9381
Stop diameter
Set diameter ext. 19.5
Tensioncontrol OFF 13.8
U324 (1)
B9388
B9454
B
&
124
B9354
Power On Imp.
U352 (0)
B9354
B9050
B
≥1
152
B9382
Set diameter
Power On Imp.
U443 (0)
B9050
B
U444 (3,000)
(0,000...60,000s)
T
U445 (3)
Mode
Delayed ON
delayed Off
On / Off delay.
Impulsgenerator
1 = Reset
241
B9582
B9583
1
Current diameter 8a.7
U222 (0)
K9304
1 ⇒ y=x
0 ⇒ freeze y
TRACK
STORE
RESET (y=0)
x
y
Power On Mode
U224 (0)
ext. Diameter setvalue
K9195
82
Priorität:
1. RESET
2. TRACK
3. STORE
U223 (0)
B9580
B
B
B9580
B9581
1
240
U441 (5,000)
(0,000...60,000s)
T
U442 (0)
Mode
Delayed ON
delayed Off
On / Off delay.
Impulsgenerator
1 = Reset
U440 (0)
B0001
B
B0001
1
U247 (0)
B9582
93
U246 (0)
K3006
K9195
0
1
K9213
Diameter set value

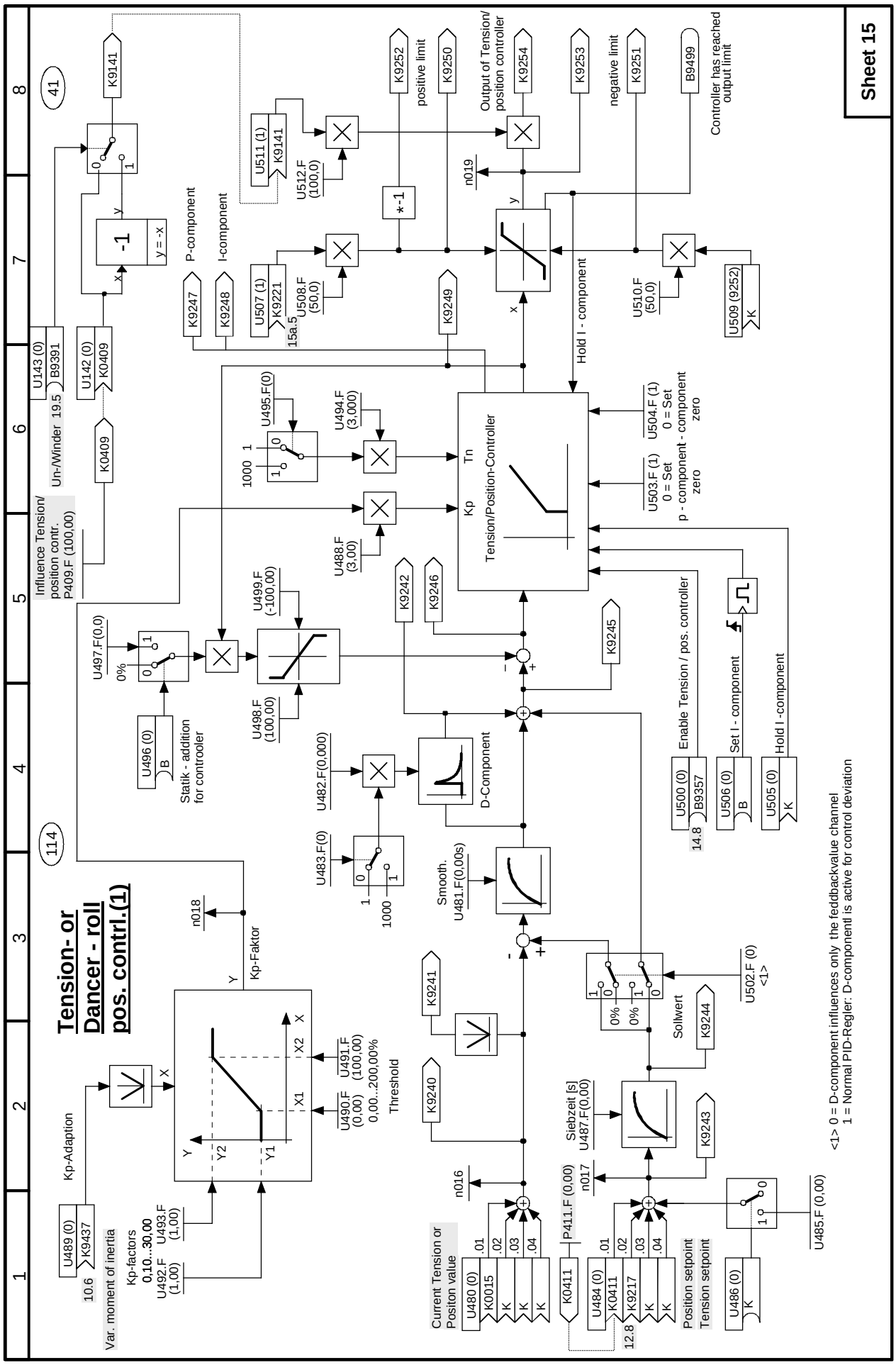

Sheet 10
Variable moment of inertia
116
Variable moment of inertia
$J_V = \frac{D^4 - D_{Core}^4}{D_{max}^4} * K$
D
$D_{Hülse}$
D_{max}
K
J_V
K9258
Normalization of diameter
U526 (10000)
(10...60000mm)
Normalization of
Core diameter
U527 (10000)
(10...60000mm)
Normalization of
max. diameter
U528 (10000)
(10...60000mm)
U529 (1.00)
(0.10...100.00)
U525 (1)
.01
.02
.03
.04
K9304
K0404
K
K3009
Current diameter 8a.7
Core diameter 8.5
Density of material

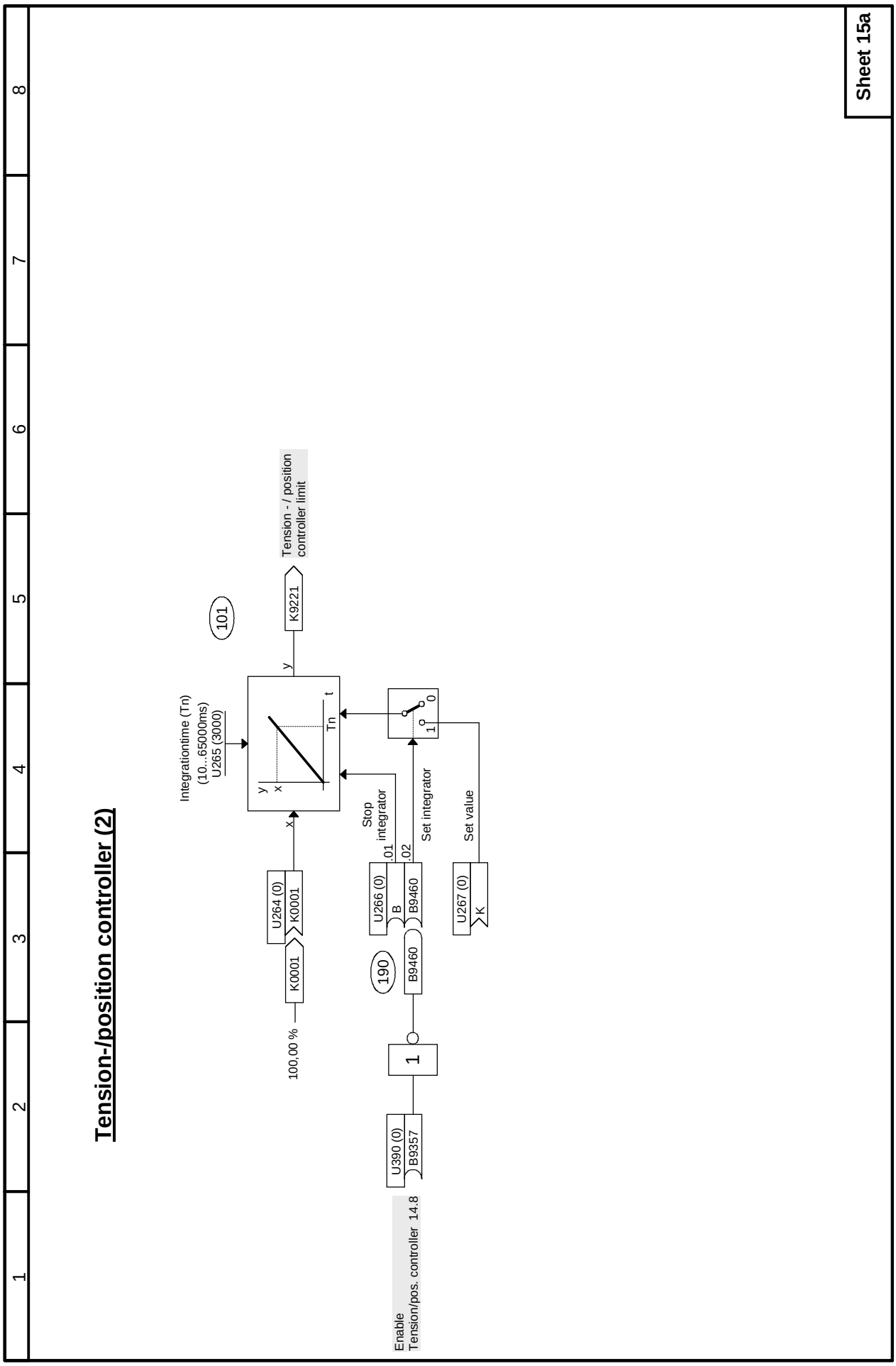

Sheet 11
Compensation of acceleration and friction
1
2
3
4
5
6
7
8
Gear stage 1/2 19.7
U249 (0) B9394
U248 (0) K0001 K0406
K0001
K0406
100,00 %
P406.F (100;00) Gear stage 2
94
i
K9214
U150 (0) K9214 K9214
.05 x1 .06 x2
x1 * x2 100%
291
i²
K9431
U153 (0) K9431 K9430
.05 x1 .06 x2
297
K9437
U147 (1) K9437 K9304
.01 x1 .02 x2
x1*100% x2
K9147
47
Current diameter.
8a.7
Web width 10.7
U150 (0) K3008 K9258
.03 x1 .04 x2
290
K9430
dv/dt 4.6
i 11.3
U151 (0) K0191 K9214
.03 x1 .04 x2
292
K9432
U151 (0) K9432 K9121
.05 x1 .06 x2
293
K9433
21
K9121
11.8
U121 (0) K9147 K0407 K
.01 .02 .03
K0407
P407.F (0,00) fixed moment of inertia
Summ of pre control moments
22
K9122
U122 (0) K9433 K9229 K
.01 .02 .03
K9229
106
Y-Werte U283.01 bis .10 (0)
Characteristic of friction
-200% x1 +200% x10
y10 10
y1 23
U282.01 bis .10 (0) X-Werte
U281.01(0) K0166
|nIst| 6.3
95
K9215
U250 (0) K9122 K9135
.01 .02
0 1
U251 (0) B9391
unw../ winder 19.5
U135 (0) K9122
-1 y = -x
K9135
35

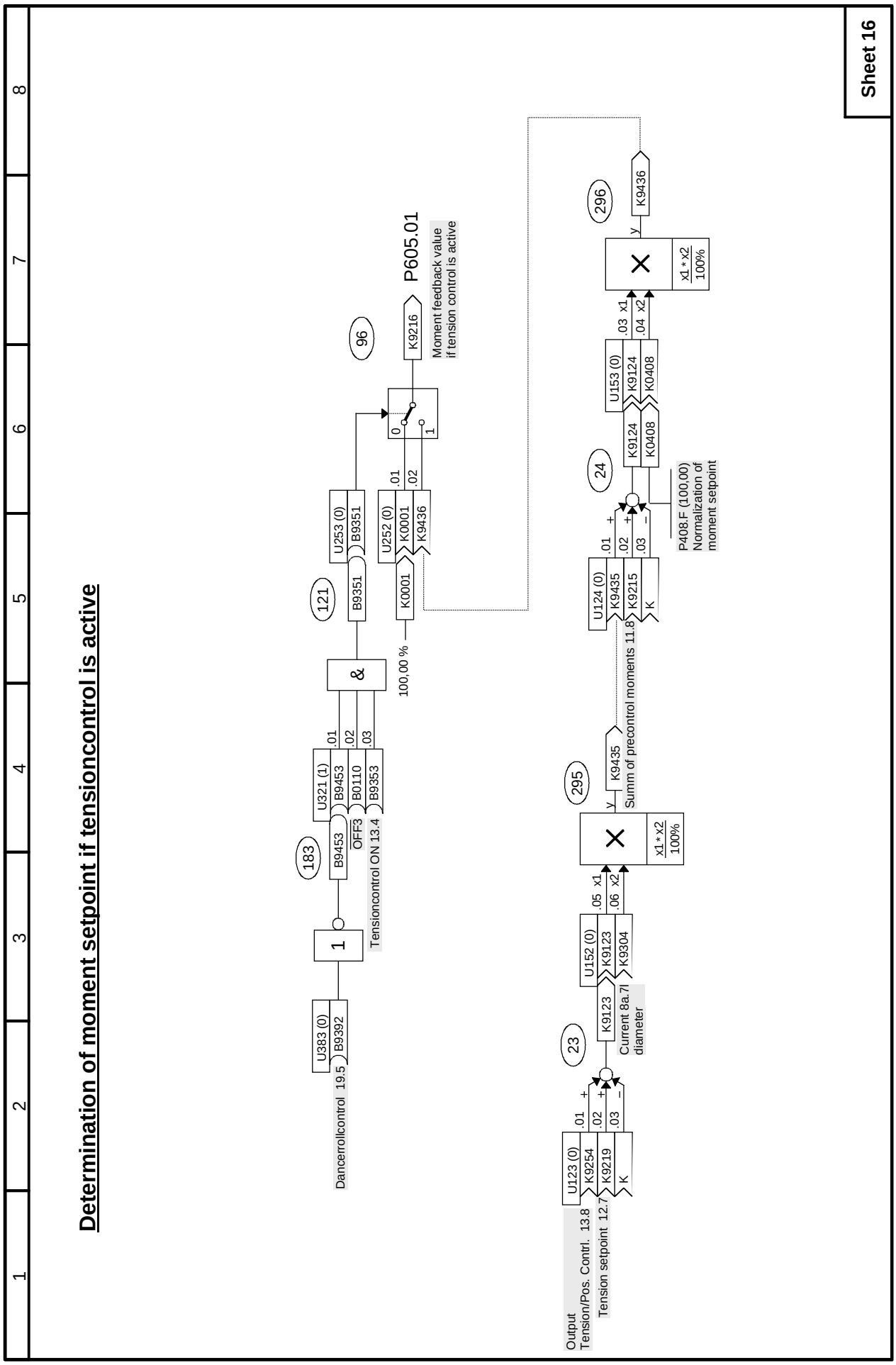

Sheet 12
Setpoint processing
B3 B2 B1 Y
0 0 0 X0
0 0 1 X1
0 1 0 X2
0 1 1 X3
1 0 0 X4
1 0 1 X5
1 1 0 X6
1 1 1 X7
U310 (0) B3308 B3309 B3310
U311 (0) K9230
K0001 K3007
Characteristic - switch 19.7
Slip core control
100.00 %
86
K9450
294
K9434
U152 (0) K9450 K9236
x1*x2 100%
Tension control after influence of slip core control
U255 (0) B9392
U254 (0) K9434
97
K9217
dancer. roll pos. ctrl. 19.5
99
129
U259 (0) B9359
U258 (0) K3005 K9151
ext. tension setpoint.
U329 (1) B9395 B0121
Stop Tension 19.7
K9219 Tensionsetpoint
51
K9151
U151 (0) K3005 K0410
ext. Tension s.point
Stop tension value P410.F (0,00)
K0410
107
Y-Values
X-Values
U284.01(0) K9304
8a.7 Current diameter
K9236
B9190
B9191
0 = Ramp generator first run
Priority:
1. S (SET)
2. R (RESET)
ramp - up time U302 (5.00)
ramp - down time U303 (5.00)
Override ramp gnerator
<1>
113
Stop simple ramp generator
1 = Enable simple ramp generator
0 = Set ramp gnerator to zero
U300 (0) K9219
12.7 Tension setpoint
U301 B9582
9.4
<1> If U301.01 = 9191 is active only once after beeing enabled (Flanke log. "0" auf "1")
<2> from electronic system powersupply monitor

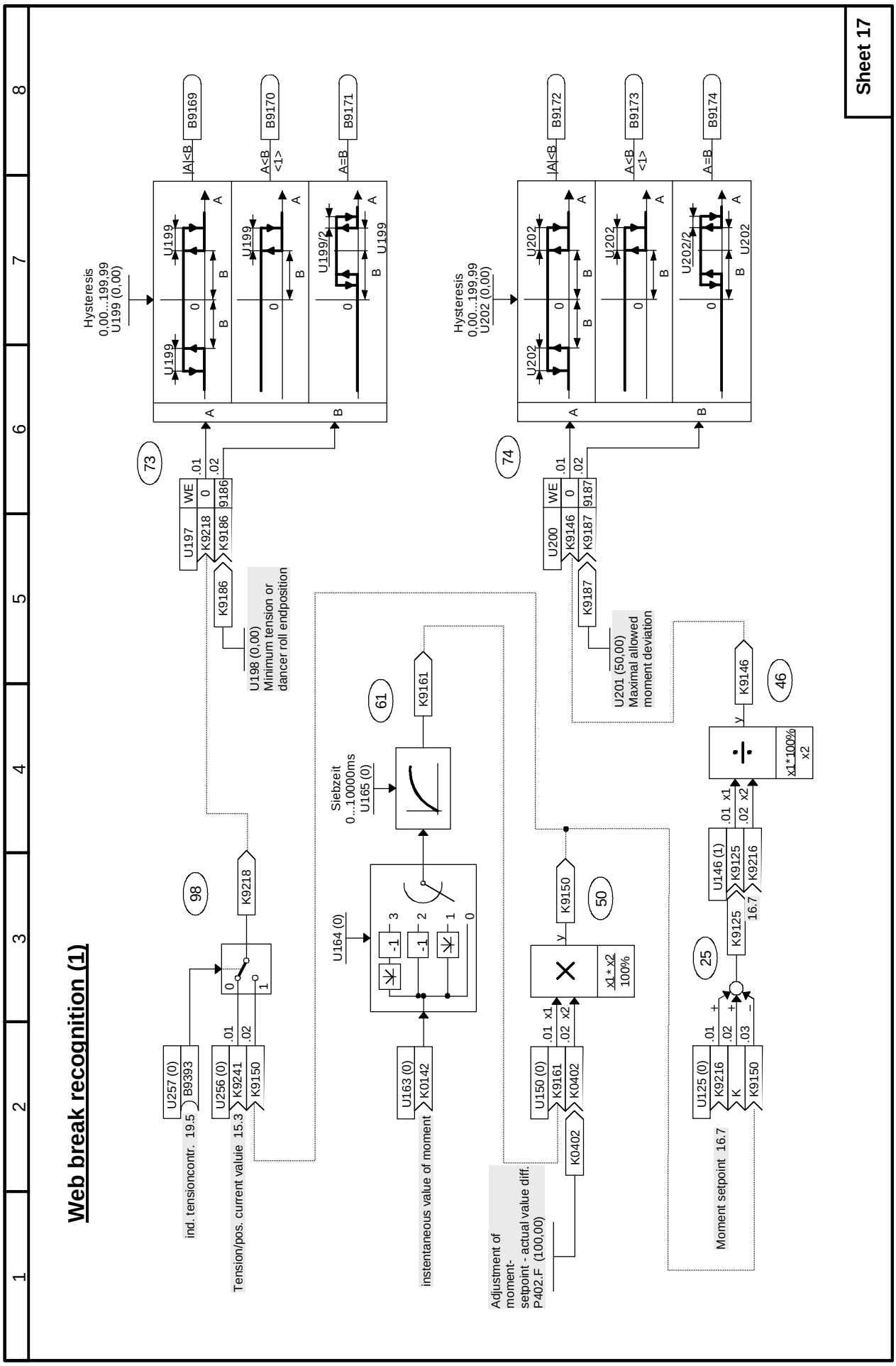

Sheet 13
Tensioncontrol enable
tension feedback value
< limit or.
actual position 18.8
> limit
U382 (0)
B9483
1
182
B9452
U452 (0)
B9452
B
U453 (5,000)
(0,000...60,000s)
T
Delayed ON
Delayed Off
On / Off delay
Impulsegenerator
1 = Reset
U454 (0)
244
B9588
B9589
1
123
B9353
&
U323 (1)
B9588
B9396
B0110
01
02
03
19.7
Tensioncontrol ON ext.
OFF3
Tensioncontrol ON
U456 (10,000)
(0,000...60,000s)
U457 (1)
245
Tensioncontrol del. ON
Tensioncontrol del. OFF
B9590
B9591
U455 (0)
B9353
B
U384 (0)
B9353
184
B9454
Tensioncontrol OFF
P751 (0)
-1
P750 (0)
K9434
Tension setpoint
after CH 12.7
Smooth.
(0...10000ms)
P752 (0)
r006
Normalization
-200,00...+199,99V
P753 (10,00)
y [V] = x / 100% * P753
K0026
Offset
-10,00...+10,00V
P754 (0,00)
D/A
X175
14
15
Tension setpoint
for external Tensioncontrol

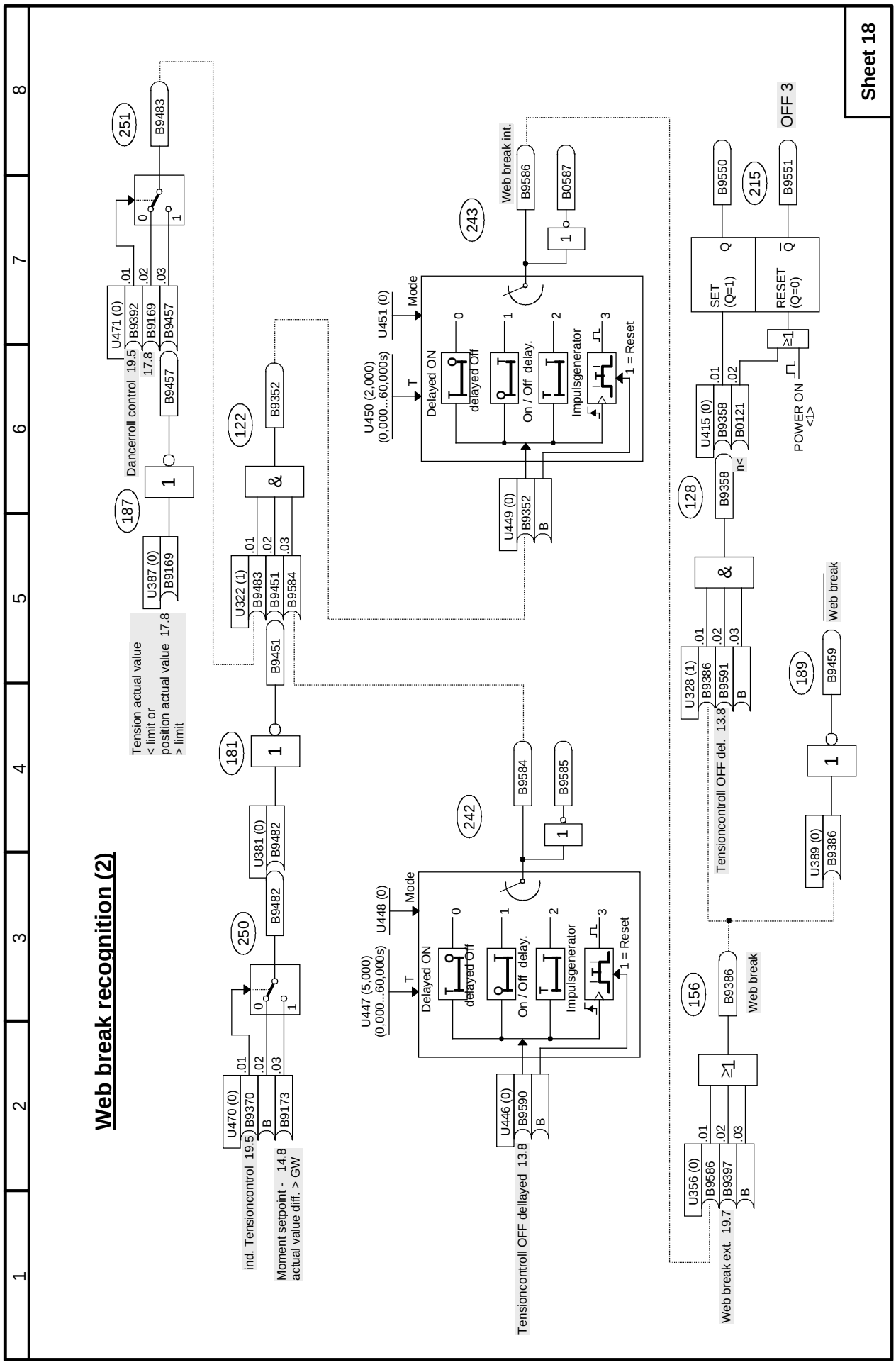

Sheet 14
Switchinglogic for Tension-/positon control
1
2
3
4
5
6
7
8
Enable Tension/pos. cont.
127
B9357
&
U327 (1)
B9353
B9383
B9384
Tensioncontrol ON 13.4
154
B9384
≥1
U354 (0)
B9459
B9392
B
web break 18.5
Dancercontrol 9.5
B3 B2 B1 Y
0 0 0 X0
0 0 1 X1
0 1 0 X2
0 1 1 X3
1 0 0 X4
1 0 1 X5
1 1 0 X6
1 1 1 X7
87
K9451
Additional speed setpoint
125
B9355
&
U325 (1)
B9458
B9353
B9455
13.4
126
B9356
&
U326 (1)
B9454
B9590
B9391
Tensioncontrol del. ON 13.8
Un/Winder 19.5
153
B9383
≥1
U353 (0)
B9392
B9456
B
Dancercontrol 9.5
U310 (0)
B9355
B9356
B9392
Dancercontrol 9.5
B1
B2
B3
Y
U312 (0)
K
K0405
K9136
K
K9254
K
K
K
X0
X1
X2
X3
X4
X5
X6
X7
14.1
Tension/position control outp. 15.8
188
B9458
1
U388 (0)
B9392
Dancer control 9.5
185
B9455
1
U385 (0)
B9391
Un/Winder 19.5
186
B9456
1
U386 (0)
B9393
Ind.tensioncontrol 19.5
36
-1
y = -x
x
y
K9136
U136 (0)
K405
K0405
bias for speed-controller
if tensioncontrol is activated
P405.F (10,00)

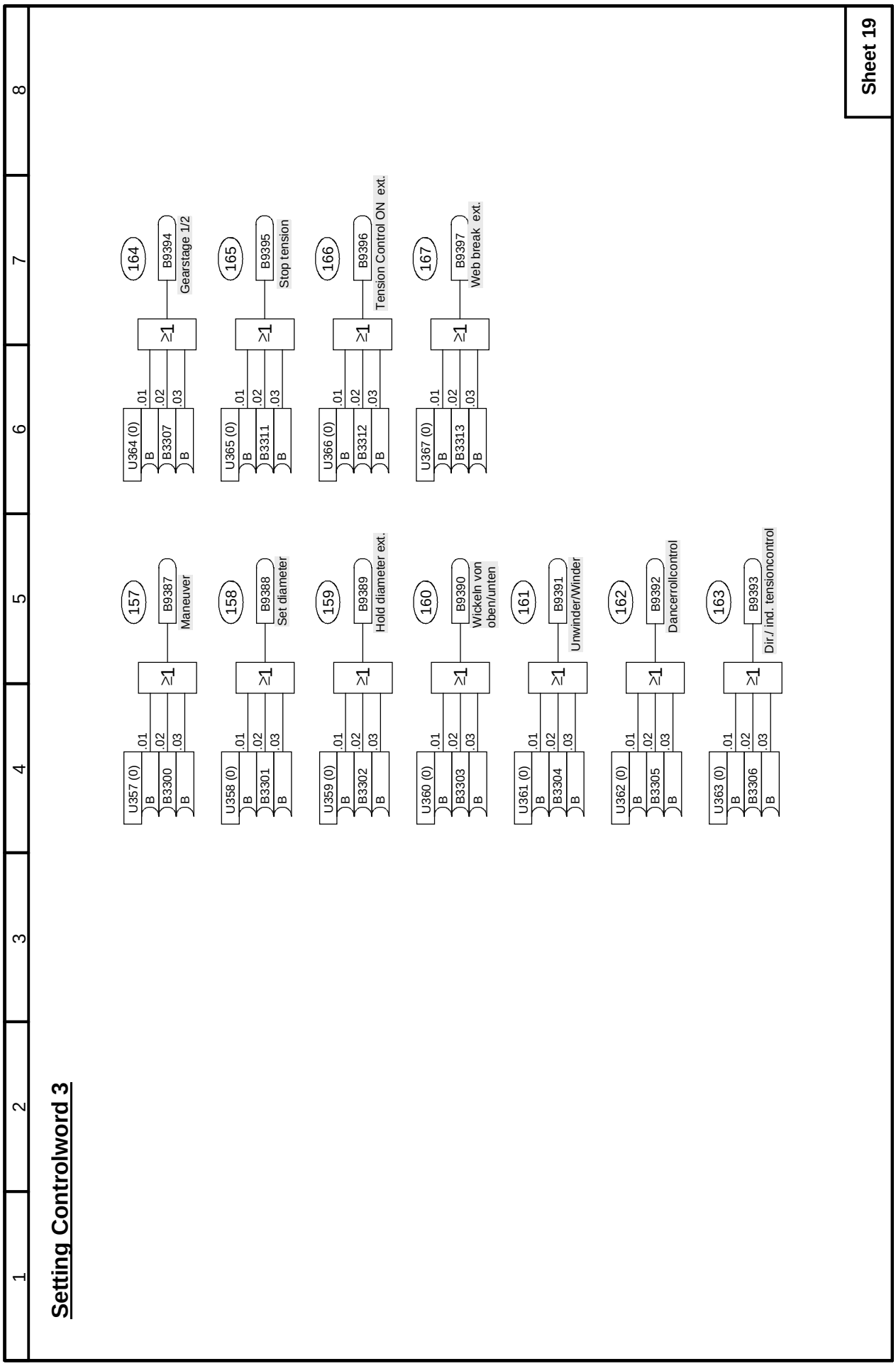

Sheet 15
Tension- or Dancer - roll pos. contrl.(1)
114
41
Kp-Adaption
Var. moment of inertia
Kp-factors 0.10...30.00
Kp-Faktor
Threshold
Influence Tension/ position contr. P409.F (100,00)
Un-/Winder 19.5
Statik - addition for controoler
D-Component
Smooth. U481.F(0.00s)
Tension/Position-Controller
Kp
Tn
P-component
I-component
positive limit
negative limit
Output of Tension/ position controller
Controller has reached output limit
Hold I - component
p - component - component zero
Enable Tension / pos. controller
Set I - component
Hold I -component
Sollwert
Siebzeit [s] U487.F(0.00)
Current Tension or Positon value
Position setpoint
Tension setpoint
<1> 0 = D-component influences only the feddbackvalue channel
1 = Normal PID-Regler: D-component is active for control deviation

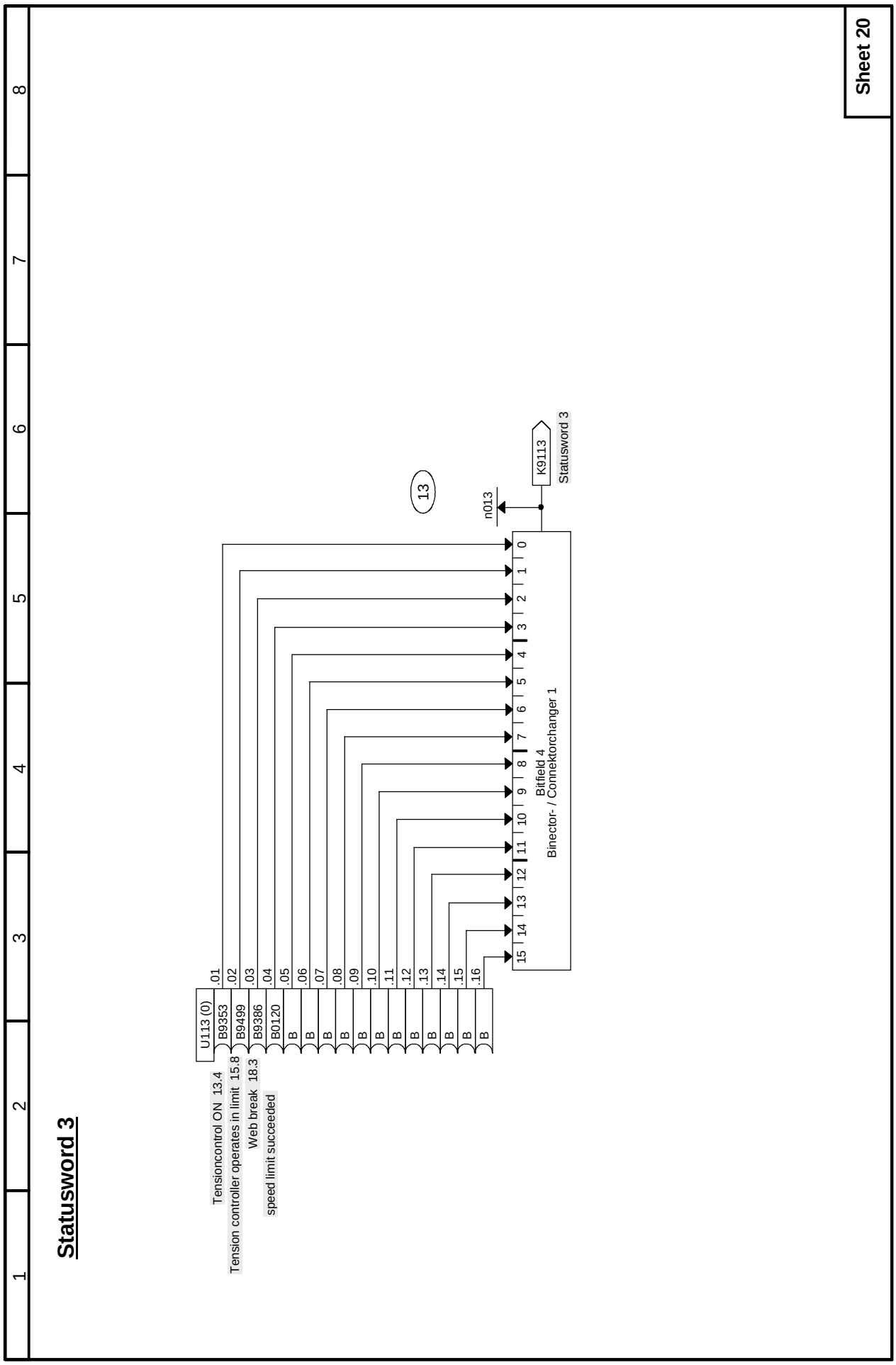

Sheet 15a
Tension-/position controller (2)
Enable
Tension/pos. controller 14.8
U390 (0)
B9357
1
190
B9460
100,00 %
K0001
U264 (0)
K0001
x
Integrationtime (Tn)
(10...65000ms)
U265 (3000)
y
x
Tn
t
101
y
K9221
Tension - / position
controller limit
Stop
integrator
.01
.02
Set integrator
U266 (0)
B
B9460
1
0
Set value
U267 (0)
K


Sheet 16
Determination of moment setpoint if tensioncontrol is active
1
2
3
4
5
6
7
8
U383 (0)
B9392
Dancerrollcontrol 19.5
183
1
B9453
OFF3
Tensioncontrol ON 13.4
U321 (1)
.01
B9453
.02
B0110
.03
B9353
121
&
B9351
U253 (0)
B9351
96
K9216
P605.01
Moment feedback value
if tension control is active
0
1
U252 (0)
.01
K0001
.02
K9436
K0001
100,00 %
U123 (0)
.01 +
K9254
.02 +
K9219
.03 -
K
Output
Tension/Pos. Contrl. 13.8
Tension setpoint 12.7
23
K9123
Current 8a.7I
diameter
U152 (0)
K9123
K9304
.05 x1
.06 x2
295
x1*x2
100%
K9435
Summ of precontrol moments 11.8
U124 (0)
K9435
K9215
K
.01 +
.02 +
.03 -
24
K9124
K0408
P408.F (100.00)
Normalization of
moment setpoint
U153 (0)
K9124
K0408
.03 x1
.04 x2
296
x1*x2
100%
K9436


Sheet 17
Web break recognition (1)
Hysteresis 0,00...199,99 U199 (0,00)
Hysteresis 0,00...199,99 U202 (0,00)
IA|<B
A<B <1>
A=B
B9169
B9170
B9171
B9172
B9173
B9174
U199
U199/2
U202
U202/2
73
74
U197 WE K9218 K9186 9186
U200 WE K9146 K9187 9187
K9186
K9187
U198 (0,00) Minimum tension or dancer roll endposition
U201 (50,00) Maximal allowed moment deviation
98
U257 (0) B9393
ind. tensioncontr. 19.5
U256 (0) K9241 K9150
Tension/pos. current valuie 15.3
K9218
61
Siebzeit 0...10000ms U165 (0)
K9161
U164 (0)
U163 (0) K0142
instentaneous value of moment
50
U150 (0) K9161 K0402
K0402
K9150
x1* x2 100%
Adjustment of moment-setpoint - actual value diff. P402.F (100,00)
25
U125 (0) K9216 K K9150
Moment setpoint 16.7
U146 (1) K9125 K9216
K9125 16.7
K9146
46
x1*100% x2


Sheet 18
Web break recognition (2)
1 2 3 4 5 6 7 8
Tension actual value
< limit or
position actual value 17.8
> limit
Dancerroll control 19.5
17.8
U471 (0)
B9392
B9169
B9457
B9483
B9457
U387 (0)
B9169
187
251
1
0
1
U322 (1)
B9483
B9451
B9584
122
&
B9352
B9451
181
1
U381 (0)
B9482
B9482
250
0
1
U470 (0)
B9370
B9173
ind. Tensioncontrol 19.5
Moment setpoint - 14.8
actual value diff. > GW
U447 (5,000)
(0,000...60,000s)
U448 (0)
Mode
T
Delayed ON
delayed Off
On / Off delay.
Impulsgenerator
1 = Reset
242
B9584
B9585
1
U446 (0)
B9590
Tensioncontroll OFF dellayed 13.8
U450 (2,000)
(0,000...60,000s)
U451 (0)
243
Web break int.
B9586
B0587
U449 (0)
B9352
128
B9358
n<
U415 (0)
B9358
B0121
SET
(Q=1)
RESET
(Q=0)
≥1
POWER ON
<1>
215
B9550
B9551
OFF 3
U328 (1)
B9386
B9591
Tensioncontroll OFF del. 13.8
156
≥1
B9386
Web break
U356 (0)
B9586
B9397
Web break ext. 19.7
189
B9459
Web break
U389 (0)
B9386


Setting Controlword 3
Sheet 19
1
2
3
4
5
6
7
8
U357 (0)
B3300
157
B9387
Maneuver
U358 (0)
B3301
158
B9388
Set diameter
U359 (0)
B3302
159
B9389
Hold diameter ext.
U360 (0)
B3303
160
B9390
Wickeln von oben/unten
U361 (0)
B3304
161
B9391
Unwinder/Winder
U362 (0)
B3305
162
B9392
Dancerrollcontrol
U363 (0)
B3306
163
B9393
Dir./ ind. tensioncontrol
U364 (0)
B3307
164
B9394
Gearstage 1/2
U365 (0)
B3311
165
B9395
Stop tension
U366 (0)
B3312
166
B9396
Tension Control ON ext.
U367 (0)
B3313
167
B9397
Web break ext.
≥1
.01
.02
.03
B


Sheet 20
Statusword 3
13
n013
K9113
Statusword 3
Bitfield 4
Binector- / Connektorchanger 1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
U113 (0)
.01 B9353 Tensioncontrol ON 13.4
.02 B9499 Tension controller operates in limit 15.8
.03 B9386 Web break 18.3
.04 B0120 speed limit succeeded
.05 B
.06 B
.07 B
.08 B
.09 B
.10 B
.11 B
.12 B
.13 B
.14 B
.15 B
.16 B

6.5 Parameter list

The Parameterlist can be found on the SIMOREG DC Master CD-ROM (Order.No.: 6RX1700-0AD64).

Directory: “Applikationen_d”

Filename: “achswickler.dnl”

After the installation of SIMOVIS, the file “achswickler.dnl” has to be copied to the following folder:

\SIMOVIS\PROJECTS\DRIVES\SIMOREG DC MASTER\

The “achswickler.dnl” file can be printed or downloaded to 6RA70 memory. For more SIMOVIS specific information please contact the SIMOVIS manual.

After download file "achswickler.dnl" has been transferred, parameter U969 must be set to 4. This ensures that unconnected function blocks are deselected and any connected function blocks are selected (activated) if they are not selected already.

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