

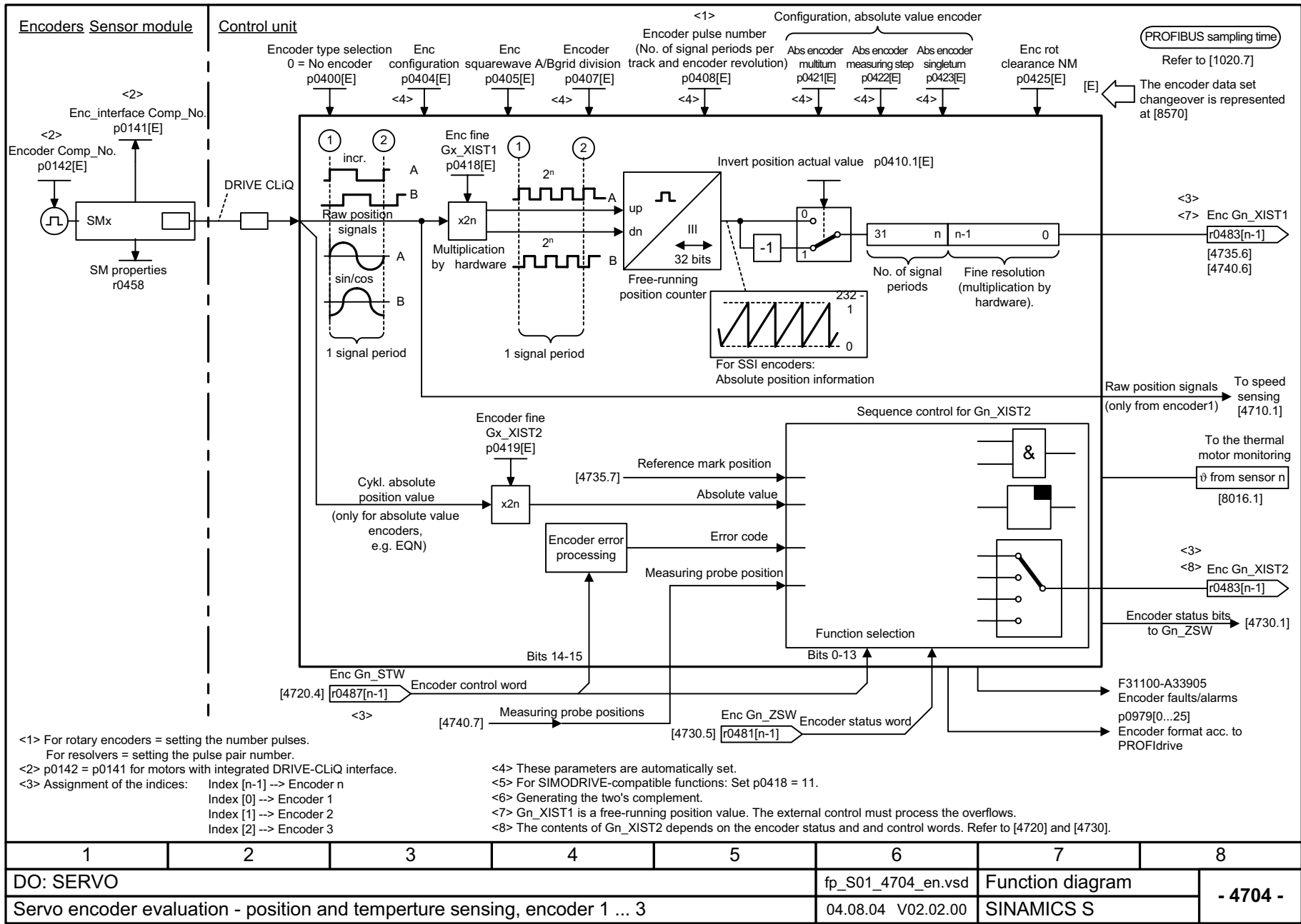
## 2.13 Servo control

### Function diagrams

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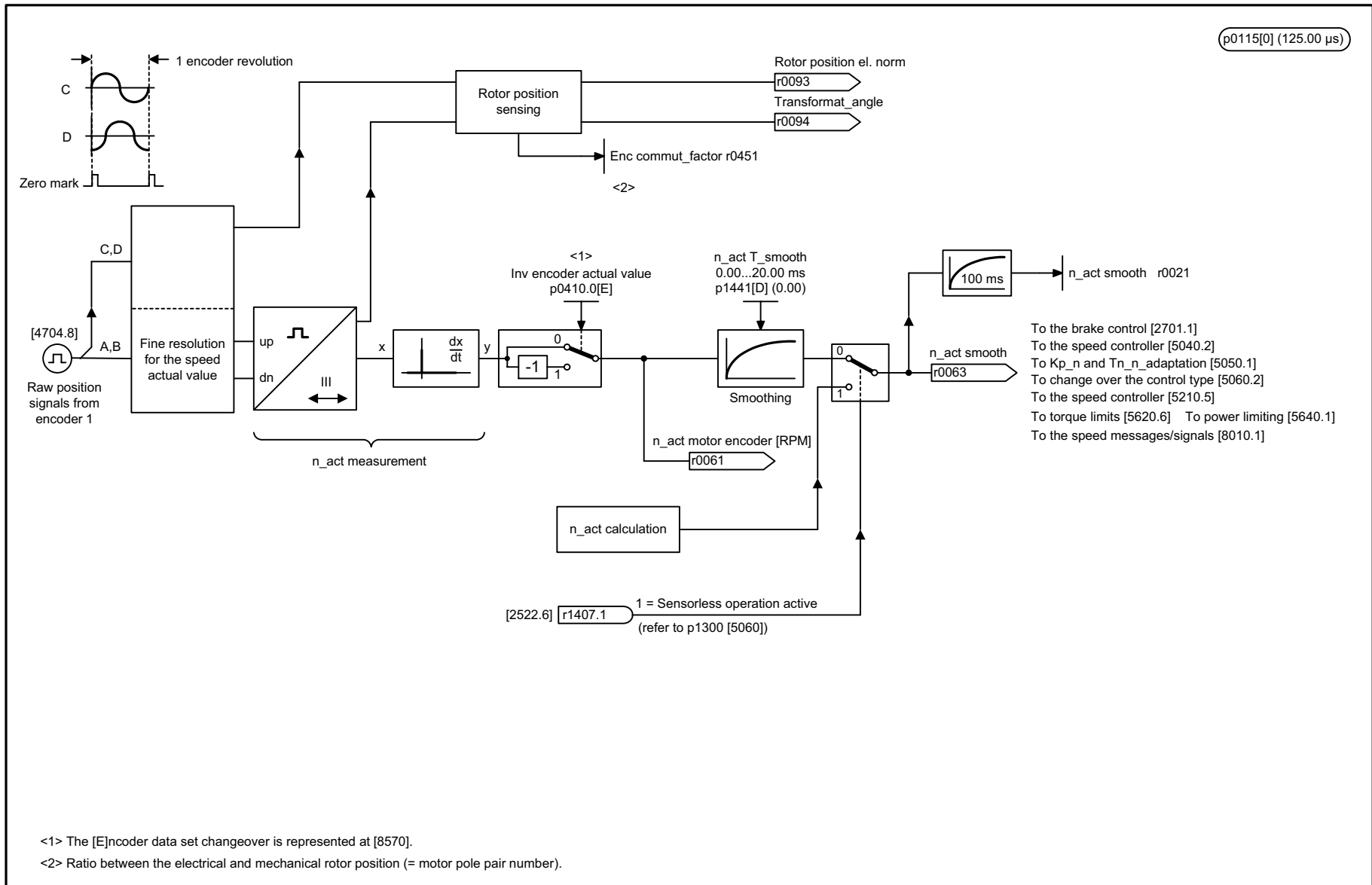
4704 – Position and temperature sensing encoder 1 ... 3	2-643
4710 – Speed actual value and rotor position sensing for motor encoder (encoder 1)	2-644
4720 – Encoder interface, receive signals, encoders 1 ... 3	2-645
4730 – Encoder interface, send signals, encoders 1 ... 3	2-646
4735 – Reference mark search with equivalent zero mark, encoders 1 ... 3	2-647
4740 – Measuring probe evaluation, measured value memory, encoders 1 ... 3	2-648
5020 – Speed setpoint filter and speed pre-control	2-649
5030 – Reference model/pre-control balancing/setpoint n_ctrl.	2-650
5040 – Speed control with encoder	2-651
5050 – Kp_n/Tn_n adaptation	2-652
5060 – Torque setpoint, changeover control type	2-653
5210 – Speed control without encoder	2-654
5300 – V/f control for diagnostics	2-655
5490 – Speed control configuration	2-656
5492 – Control status word 1	2-657
5493 – Control status word 3	2-658
5610 – Torque limiting/reduction/interpolator	2-659
5620 – Motoring/regenerating torque limit	2-660
5630 – Upper/lower torque limits	2-661
5640 – Mode changeover, power/current limiting	2-662
5650 – Vdc_max controller and Vdc_min controller	2-663
5710 – Current setpoint filter	2-664
5714 – Iq and Id controller	2-665
5722 – Field current setpoint, flux controller	2-666
5730 – Interface to the motor module (gating/control signals, current actual values)	2-667

Picture 2-86 4704 – Position and temperature sensing encoder 1 ... 3



Function diagrams  
Servo control

1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_4704_en.vsd	Function diagram	
Servo encoder evaluation - position and temperture sensing, encoder 1 ... 3					04.08.04 V02.02.00	SINAMICS S	
							<b>- 4704 -</b>



p0115[0] (125.00 μs)

1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_4710_en.vsd	Function diagram	
Encoder evaluation functions - speed actual value and rotor position sensing for motor encoder (encoder 1)					02.08.04 V02.02.00	SINAMICS S	
							<b>- 4710 -</b>

Picture 2-87 4710 – Speed actual value and rotor position sensing for motor encoder (encoder 1)

PROFIBUS sampling time  
Refer to [1020.7]

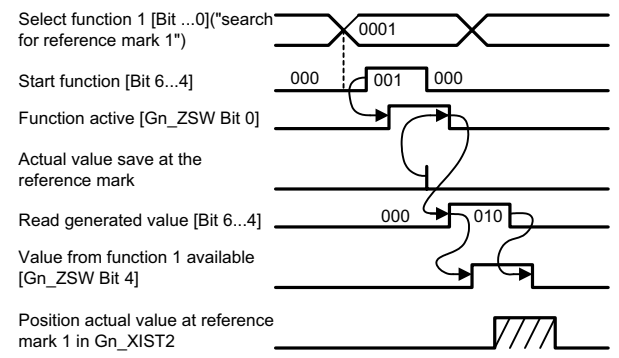
Control word for encoder n (n = 1, 2 or 3)

Bit No.	Meaning															
Selects the function to be activated (with bit value = 1)																
	<table border="1"> <thead> <tr> <th>Function No.</th> <th>Function for bit 7 = 0 (search for reference mark)</th> <th>Function for bit 7 = 1 (flying measurement)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Reference marker 1</td> <td>Measuring probe 1 </td> </tr> <tr> <td>1</td> <td>Reference marker 2&lt;4&gt;</td> <td>Measuring probe 1 </td> </tr> <tr> <td>2</td> <td>Reference marker 3&lt;4&gt;</td> <td>Measuring probe 2 </td> </tr> <tr> <td>3</td> <td>Reference marker 4&lt;4&gt;</td> <td>Measuring probe 2 </td> </tr> </tbody> </table>	Function No.	Function for bit 7 = 0 (search for reference mark)	Function for bit 7 = 1 (flying measurement)	0	Reference marker 1	Measuring probe 1	1	Reference marker 2<4>	Measuring probe 1	2	Reference marker 3<4>	Measuring probe 2	3	Reference marker 4<4>	Measuring probe 2
Function No.	Function for bit 7 = 0 (search for reference mark)	Function for bit 7 = 1 (flying measurement)														
0	Reference marker 1	Measuring probe 1														
1	Reference marker 2<4>	Measuring probe 1														
2	Reference marker 3<4>	Measuring probe 2														
3	Reference marker 4<4>	Measuring probe 2														
Start/stop/read selected function																
4	<table border="1"> <tr><td>0</td><td>1</td><td>0</td><td>1</td></tr> </table>	0	1	0	1											
0	1	0	1													
5	<table border="1"> <tr><td>0</td><td>0</td><td>1</td><td>1</td></tr> </table>	0	0	1	1											
0	0	1	1													
6	<table border="1"> <tr><td>0</td><td>0</td><td>0</td><td>0</td></tr> </table>	0	0	0	0											
0	0	0	0													
	<ul style="list-style-type: none"> <li>Interrupt function</li> <li>Read generated value</li> <li>Activate selected function</li> <li>No function</li> </ul>															
7	Mode of the function to be activated 1 = flying measurement 0 = Search for reference mark (zero mark or BERO)															
8...12	Reserved part															
13	1 = Request cyclic transfer of the absolute position value in Gn_XIST2 (e.g. EQN absolute track; acknowledgment in Gn_ZSW bit 13)															
14	1 = Request parking encoder (handshake with Gn_ZSW bit 14)															
15	= acknowledge encoder fault (located in Gn_ZSW, bit 15; Handshake with Gn_ZSW bit 11)															

<1>  
To position sensing encoder n  
r0487[n-1] [4704.3]

<1> Index [n-1] --> encoder n  
Index [0] --> encoder 1  
Index [1] --> encoder 2  
Index [2] --> encoder 3

<2> The position actual values are read-out of Gn.XIST2 using a handshaking technique. The following pulse diagram shows, as example, reading-in the position at the reference mark (Mode: Bit 7 = 0)



Bits 0...13 control what is transferred in Gn\_XIST 2.  
There are 3 alternatives:  
- Bit 7 = 0: Position actual value at the reference mark <2>  
- Bit 7 = 1: Position actual value when the measuring probe edge is received <2>  
- Bit 13 = 1: Cyclic absolute position value from Absolute encoder

<3> The bits are processed with the following priority sequence (highest priority --> lowest priority bit): Bit 14 --> Bit 15 --> Bit 4-7 --> Bit 12 --> Bit 13.  
<4> Reference marks 2, 3 and 4 are not supported. These bits must be set to 0.  
<5> Feedback signal is provided in Gn\_ZSW bit 14 - however the encoder is not actually parked.

Picture 2-88 4720 – Encoder interface, receive signals, encoders 1 ... 3

Function diagrams  
Servo control

1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_4720_en.vsd	Function diagram	
Servo encoder evaluation function - encoder interface, receive signals, encoders 1 ... 3					29.01.04 V02.02.00	SINAMICS S	
							<b>- 4720 -</b>

PROFIBUS sampling time  
Refer to [1020.7]

Status word from encoder n (n = 1, 2 or 3)

Encoder status bits from the position sensing, encoder n [4704.8]

Gn_ZSW		Meaning
Bit 0	Feedback signal of the active function (1 = function active)	
Bit 1	Function No.	For reference number and flying measurement
	1	reference mark 1 or measuring probe
Bit 2	2	reference mark 2 or measuring probe
	3	reference mark 3 or measuring probe
Bit 3	4	Reference mark 4 or measuring probe
	Generated value in Gn_XIST2 (and can be read)	
Bit 4	1 = Position actual value from function 1	
Bit 5	1 = Position actual value from function 2	
Bit 6	1 = Position actual value from function 3	
Bit 7	1 = Position actual value from function 4	
Bit 8	1 = Measuring probe 1 deflected (high signal)	
Bit 9	1 = Measuring probe 2 deflected (high signal)	
Bit 10	Reserved	
Bit 11	1 = Acknowledge encoder fault active	
Bit 12	Reserved (for reference point offset)	
Bit 13	Absolute value is cyclically transferred	
Bit 14	Parking encoder active (i.e. parking encoder shutdown)	
Bit 15	Encoder fault, the fault is in Gn_XIST2 (r0483)	

To the sequence control for Gn\_XIST2  
r0481[n-1] [4704.5]

<1>

Position value 2 from encoder n

The contents of position actual value 2 (Gn\_XIST2) at [4704] depends on Gn\_STW and Gn\_ZSW. This can be done as follows:

- Undefined for a parking encoder (Gn\_ZSW.14 = 1).
- For Gn\_ZSW.15 = 1 the fault code for encoder faults is located here.
- Position actual value at the reference mark (for Gn\_STW.7 = 0 and Gn\_ZSW.4-7 > 0; with handshake).
- Position actual value due to flying measurement (for Gn\_STW.7 = 1 and Gn\_ZSW.4.7 > 0; with handshake).
- Cyclic absolute position value (free-running value, e.g. from the EQN absolute tract (for Gn\_ZSW.13 = 1).

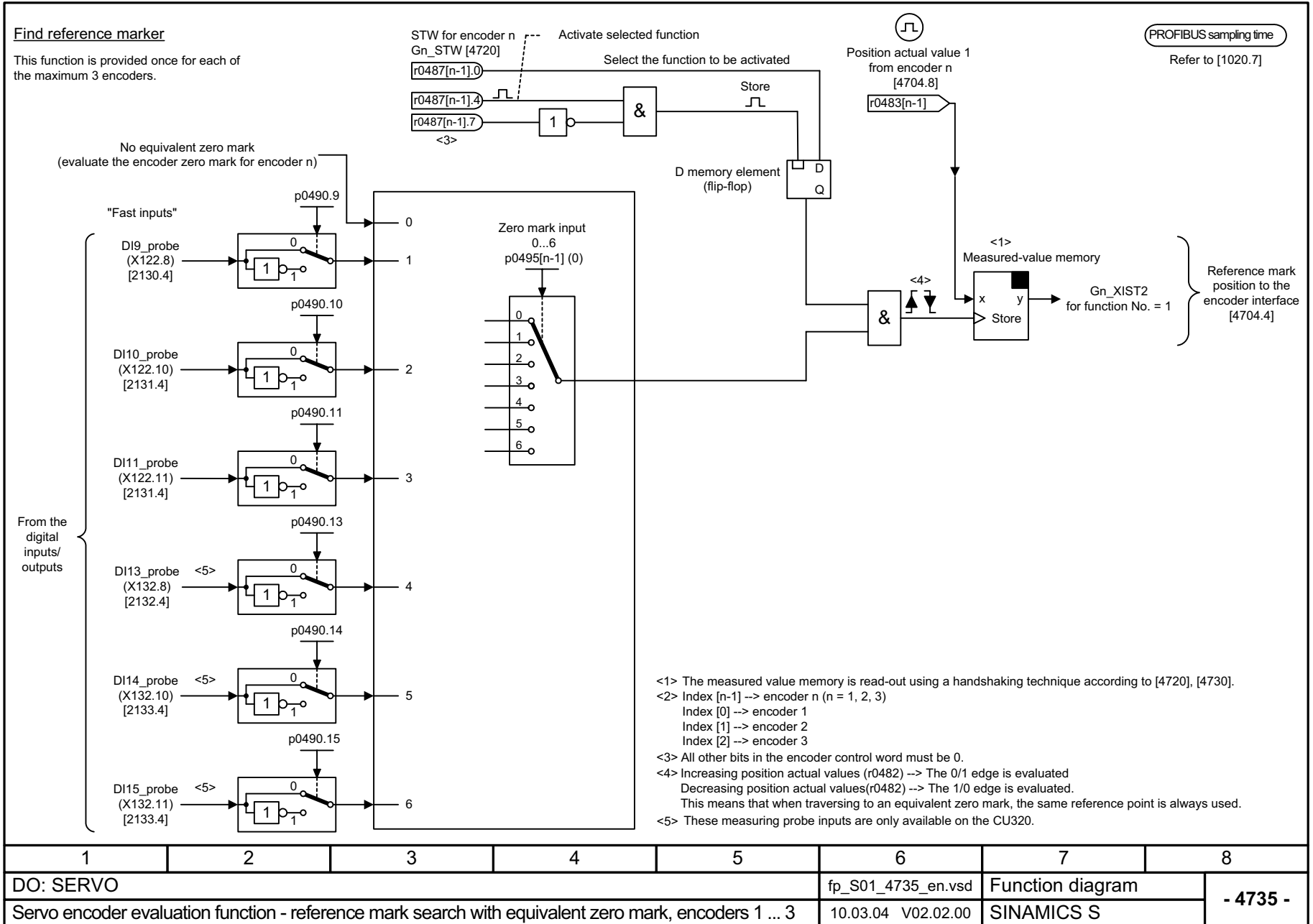
From the measuring probe evaluation [4740.4]

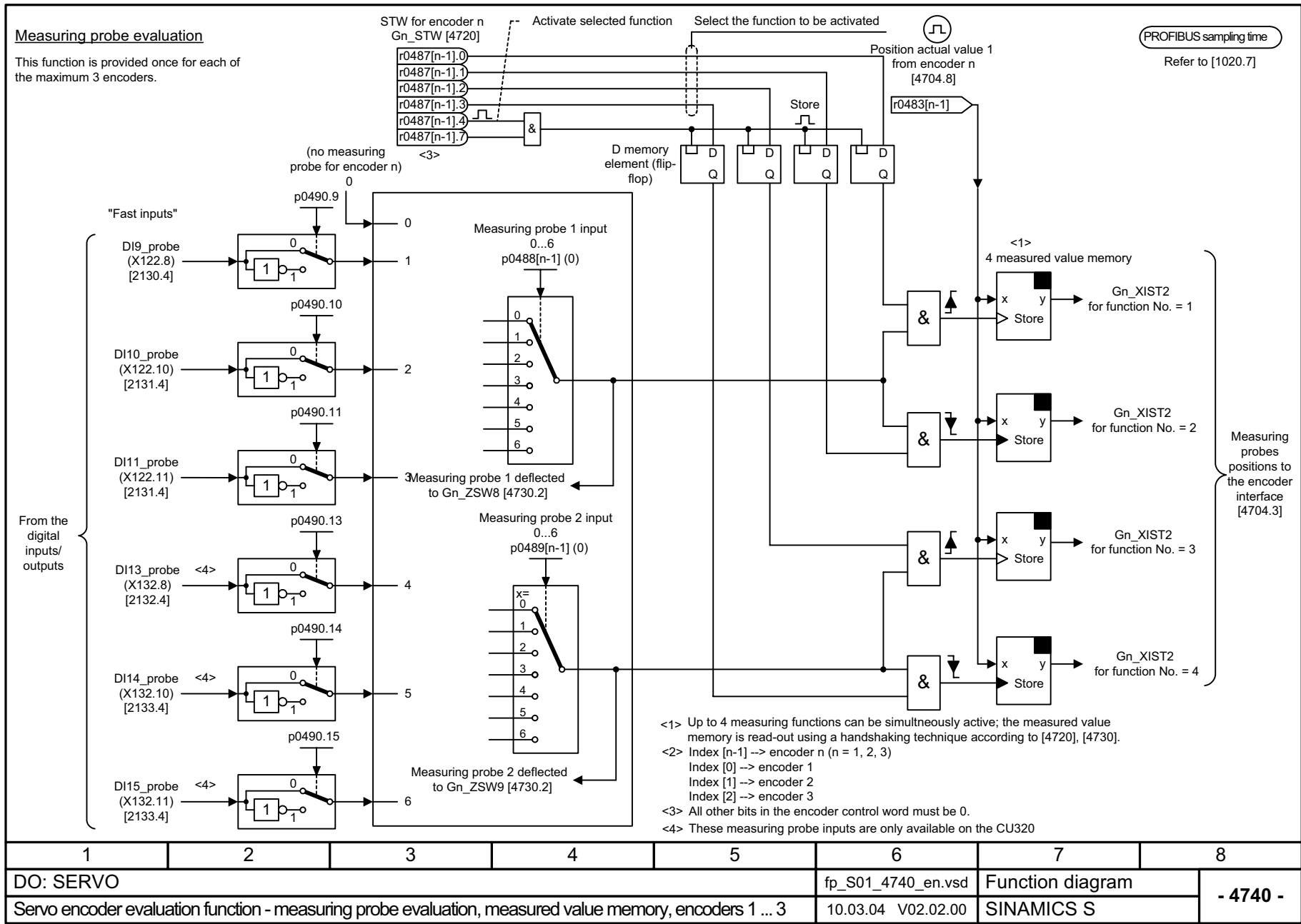
<1> Index [n-1] --> encoder n  
Index [0] --> encoder 1  
Index [1] --> encoder 2  
Index [2] --> encoder 3

1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_4730_en.vsd	Function diagram	
Servo encoder evaluation function - encoder interface, send signals, encoders 1 ... 3					15.10.04 V02.02.00	SINAMICS S	
<b>- 4730 -</b>							

Picture 2-89 4730 – Encoder interface, send signals, encoders 1 ... 3

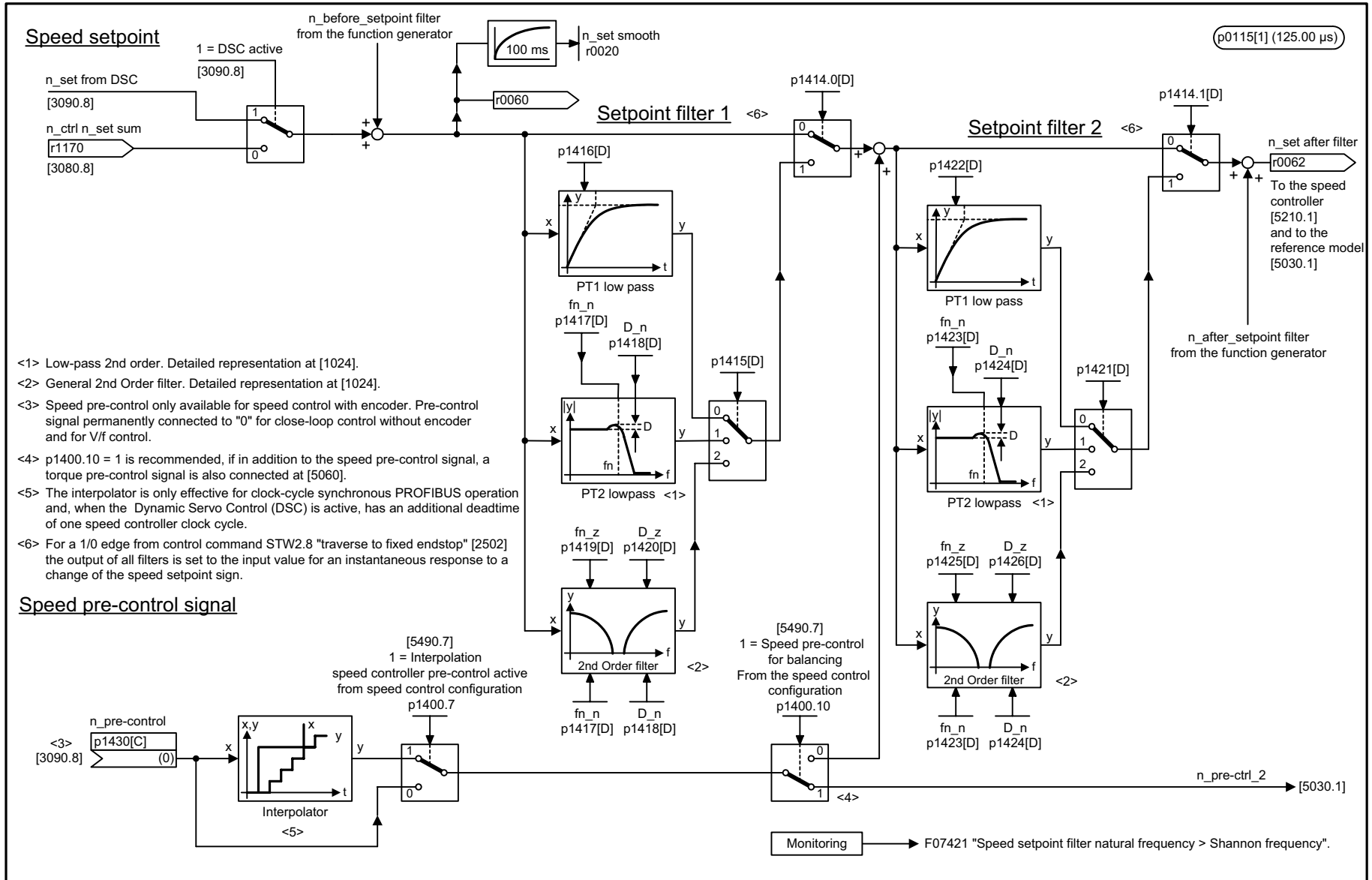
Picture 2-90 4735 – Reference mark search with equivalent zero mark, encoders 1 ... 3





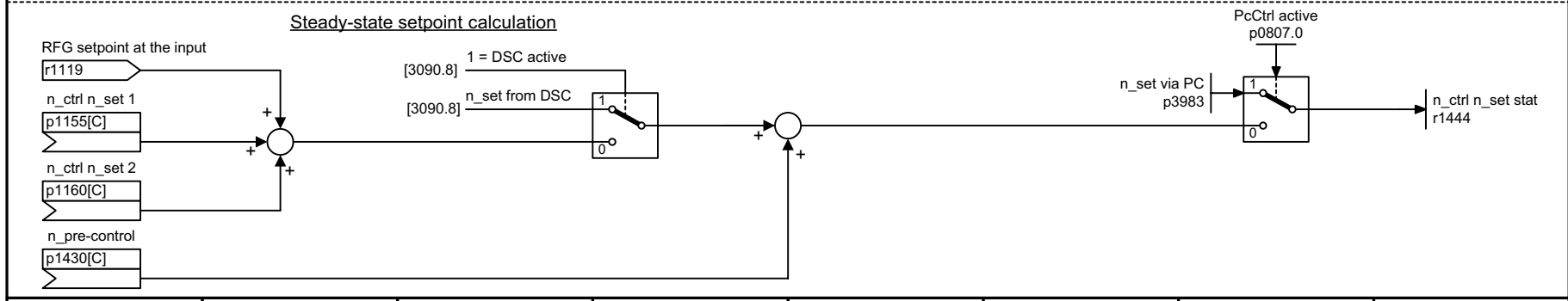
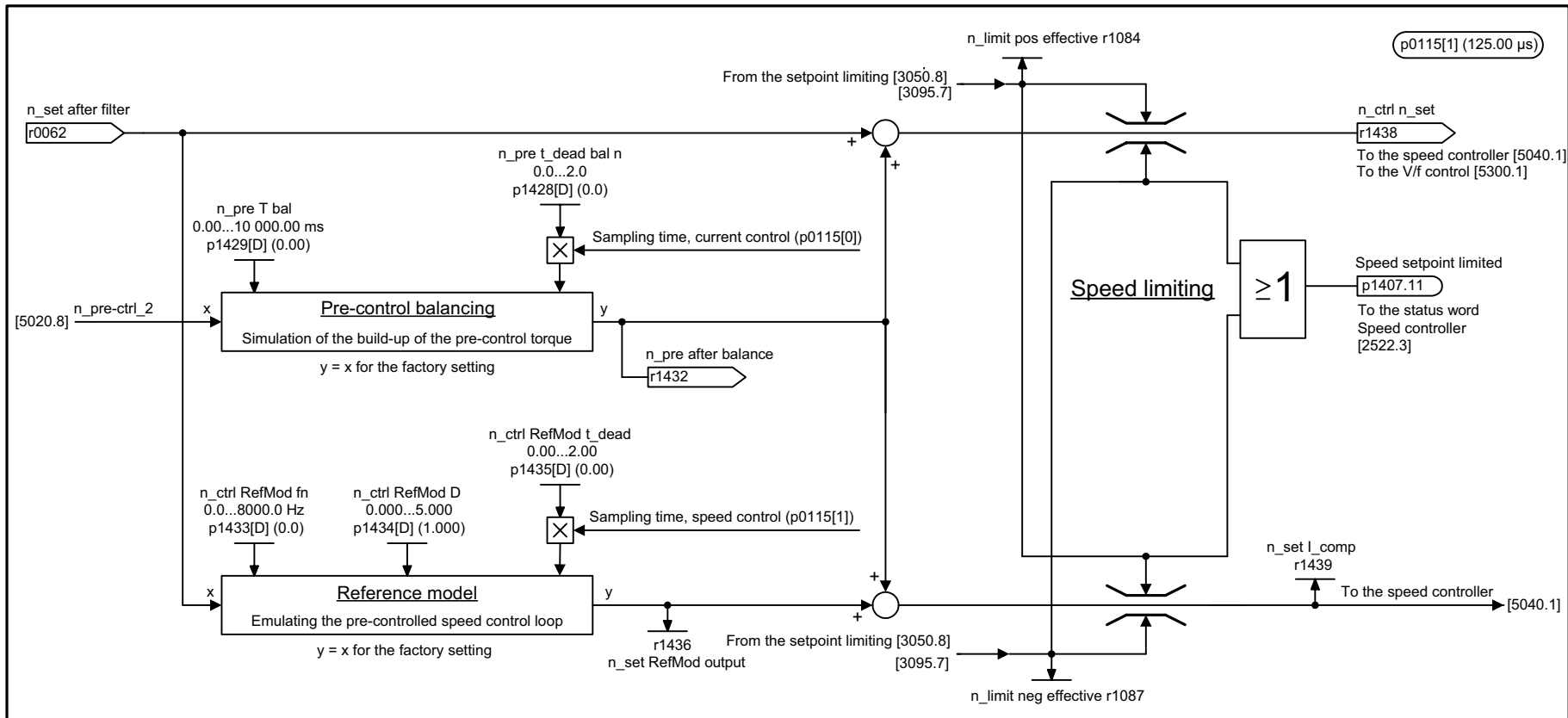
Picture 2-91 4740 – Measuring probe evaluation, measured value memory, encoders 1 ... 3

Picture 2-92 5020 – Speed setpoint filter and speed pre-control



1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5020_en.vsd	Function diagram	
Servo speed control with encoder - speed setpoint filter and speed pre-control					23.09.04 V02.02.00	SINAMICS S	
							<b>- 5020 -</b>



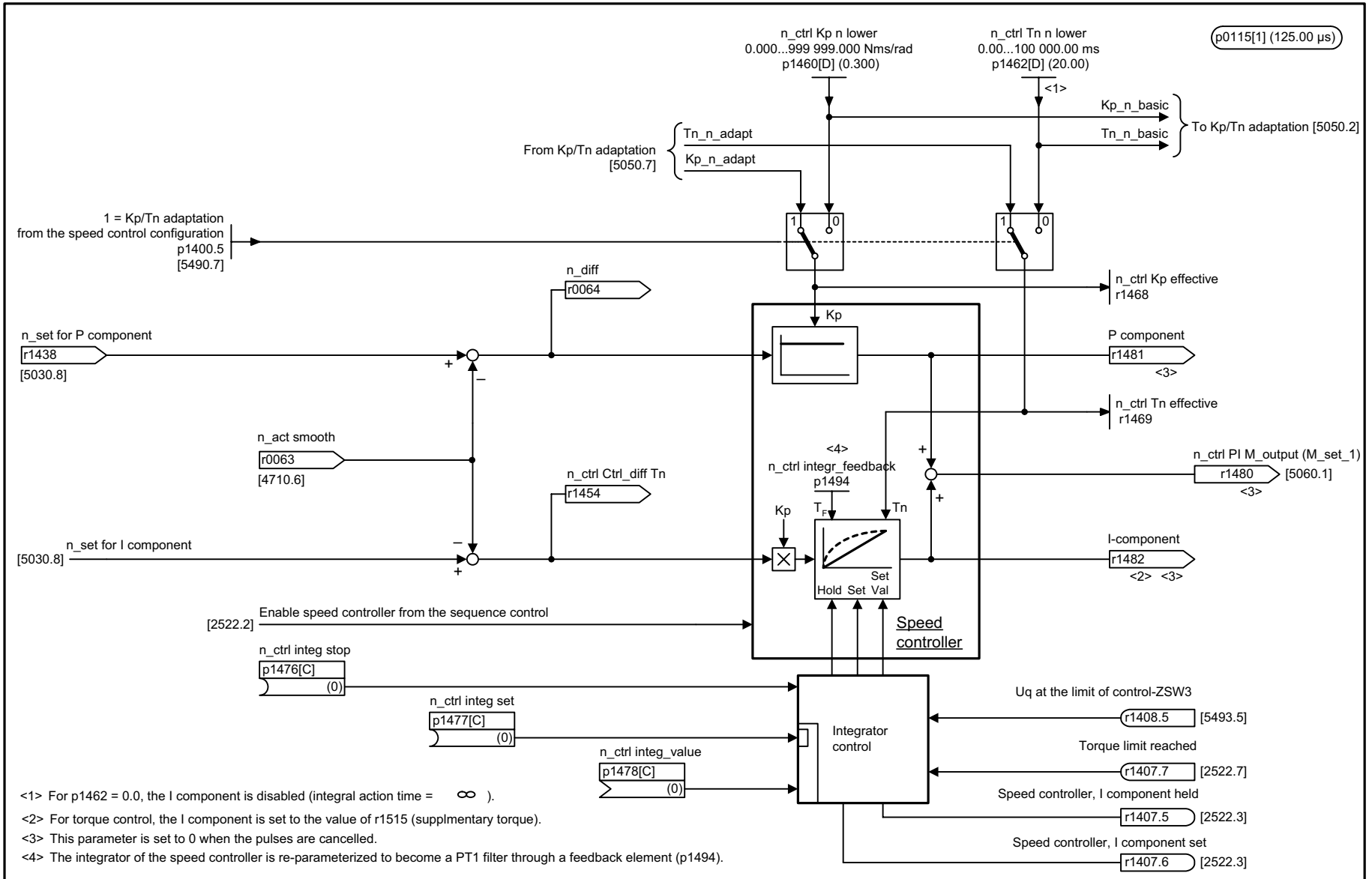


1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5030_en.vsd	Function diagram	
Servo speed control with encoder - reference model/pre-control balancing/setpoint n_ctrl.					23.06.04 V02.02.00	SINAMICS S	

- 5030 -

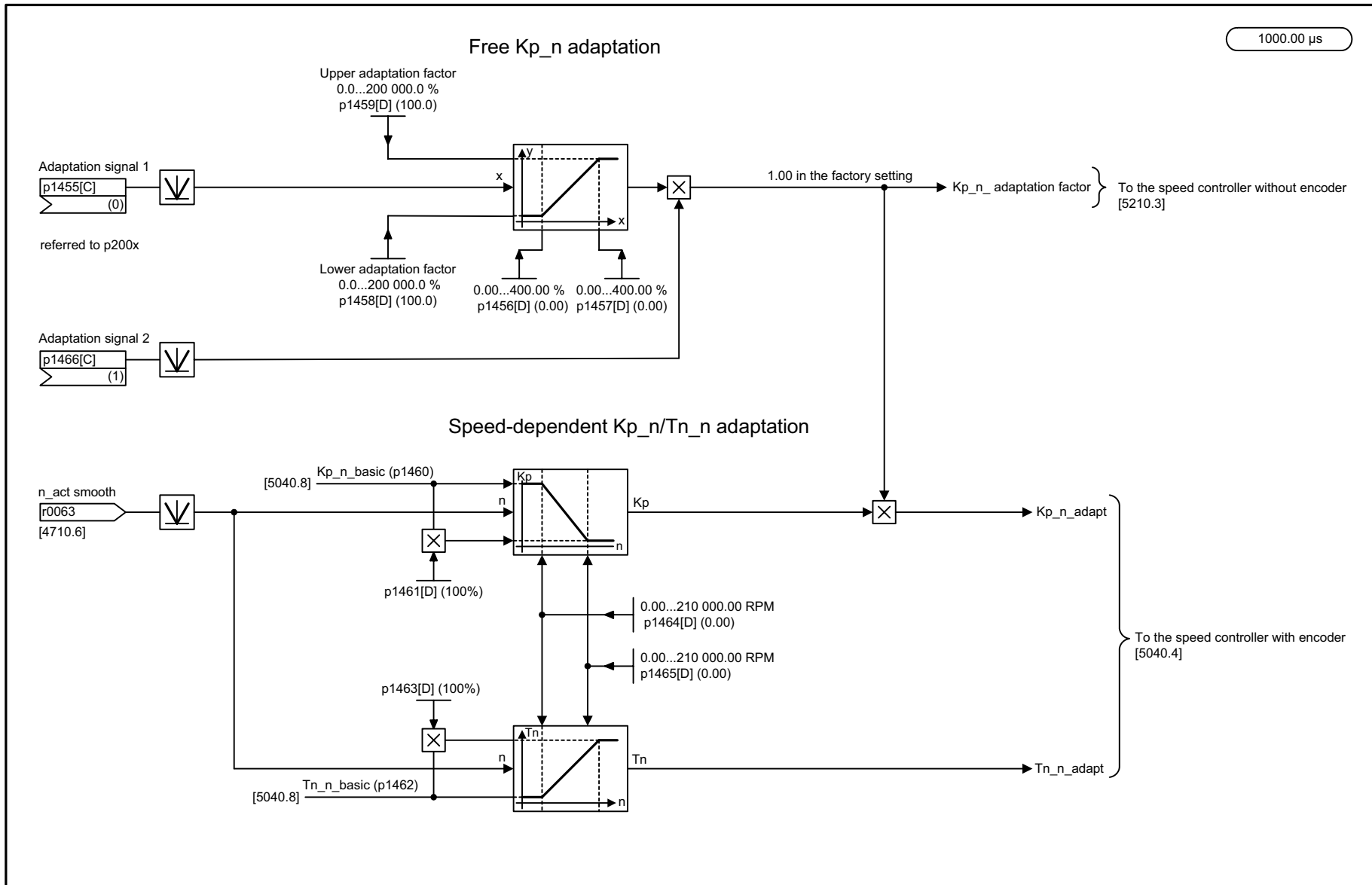
Picture 2-93 5030 – Reference model/pre-control balancing/setpoint n\_ctrl.

Picture 2-94 5040 – Speed control with encoder



<1> For p1462 = 0.0, the I component is disabled (integral action time =  $\infty$  ).  
 <2> For torque control, the I component is set to the value of r1515 (supplementary torque).  
 <3> This parameter is set to 0 when the pulses are cancelled.  
 <4> The integrator of the speed controller is re-parameterized to become a PT1 filter through a feedback element (p1494).

1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5040_en.vsd	Function diagram	
Servo speed control with encoder - speed controller					15.09.04 V02.02.00	SINAMICS S	
							<b>- 5040 -</b>

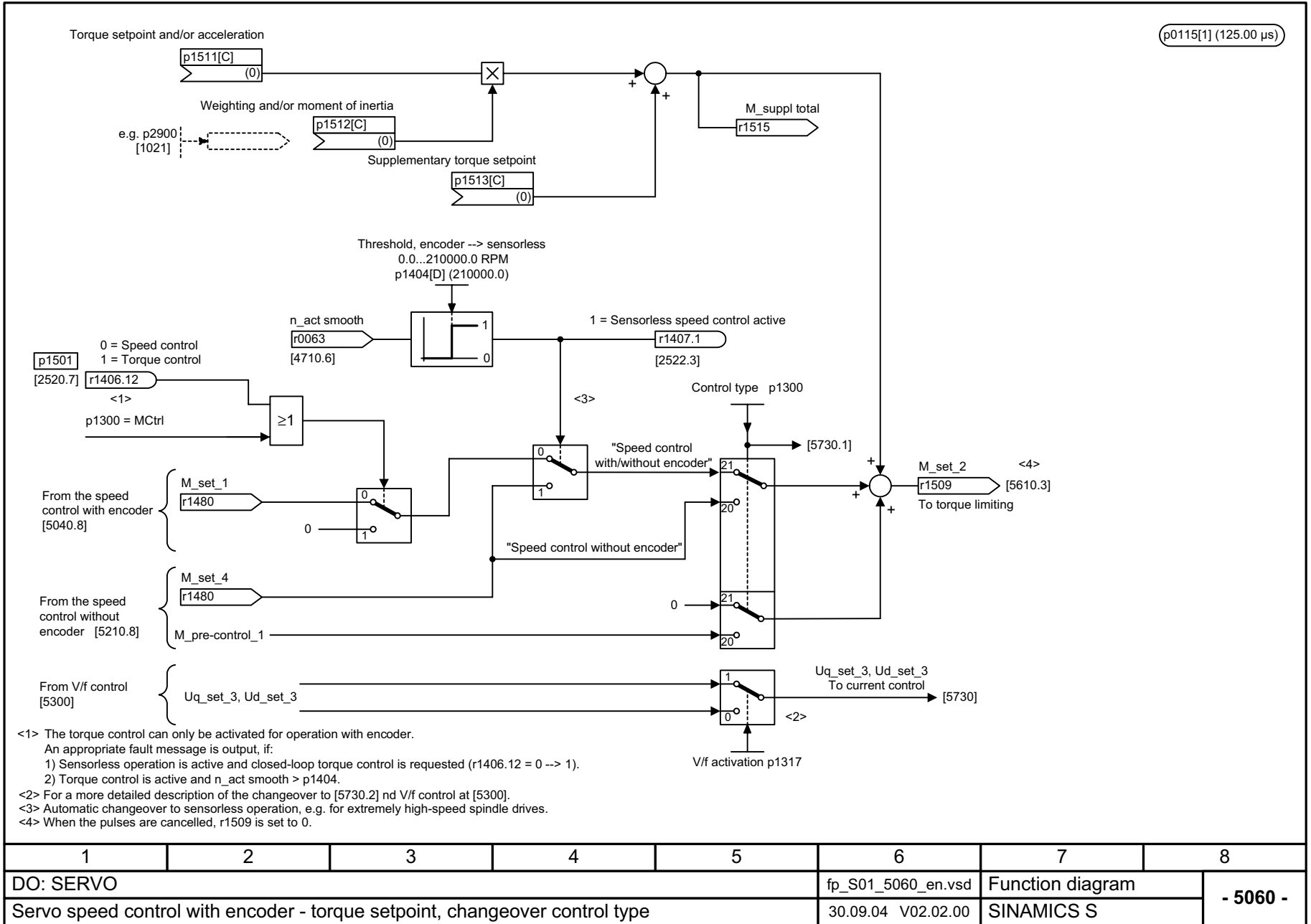


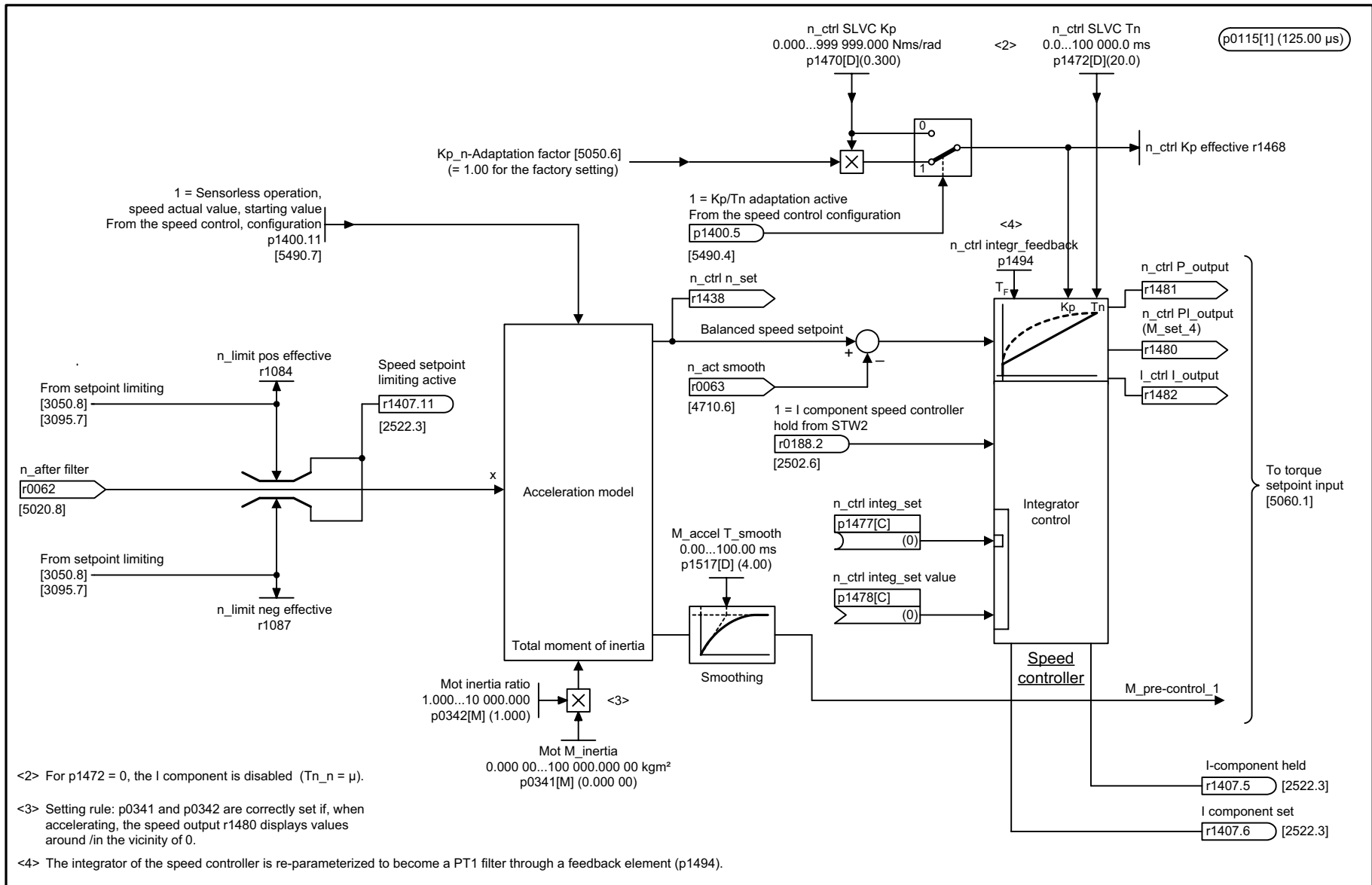
1000.00 μs

Picture 2-95 5050 - Kp<sub>n</sub>/Tn<sub>n</sub> adaptation

1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5050_en.vsd	Function diagram	
Servo speed control without encoder - Kp <sub>n</sub> /Tn <sub>n</sub> adaptation					31.08.04 V02.02.00	SINAMICS S	
							<b>- 5050 -</b>

Picture 2-96 5060 – Torque setpoint, changeover control type

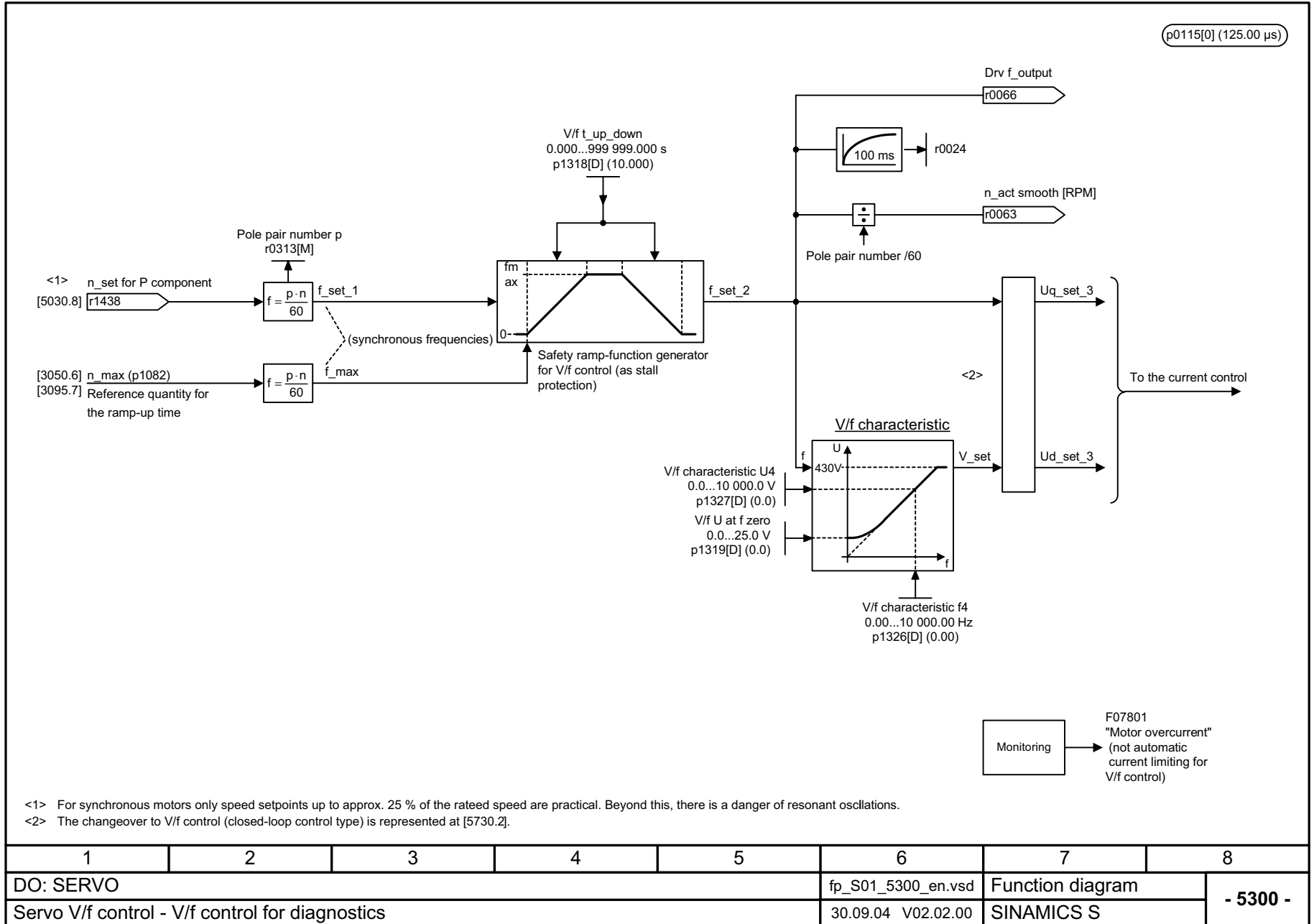




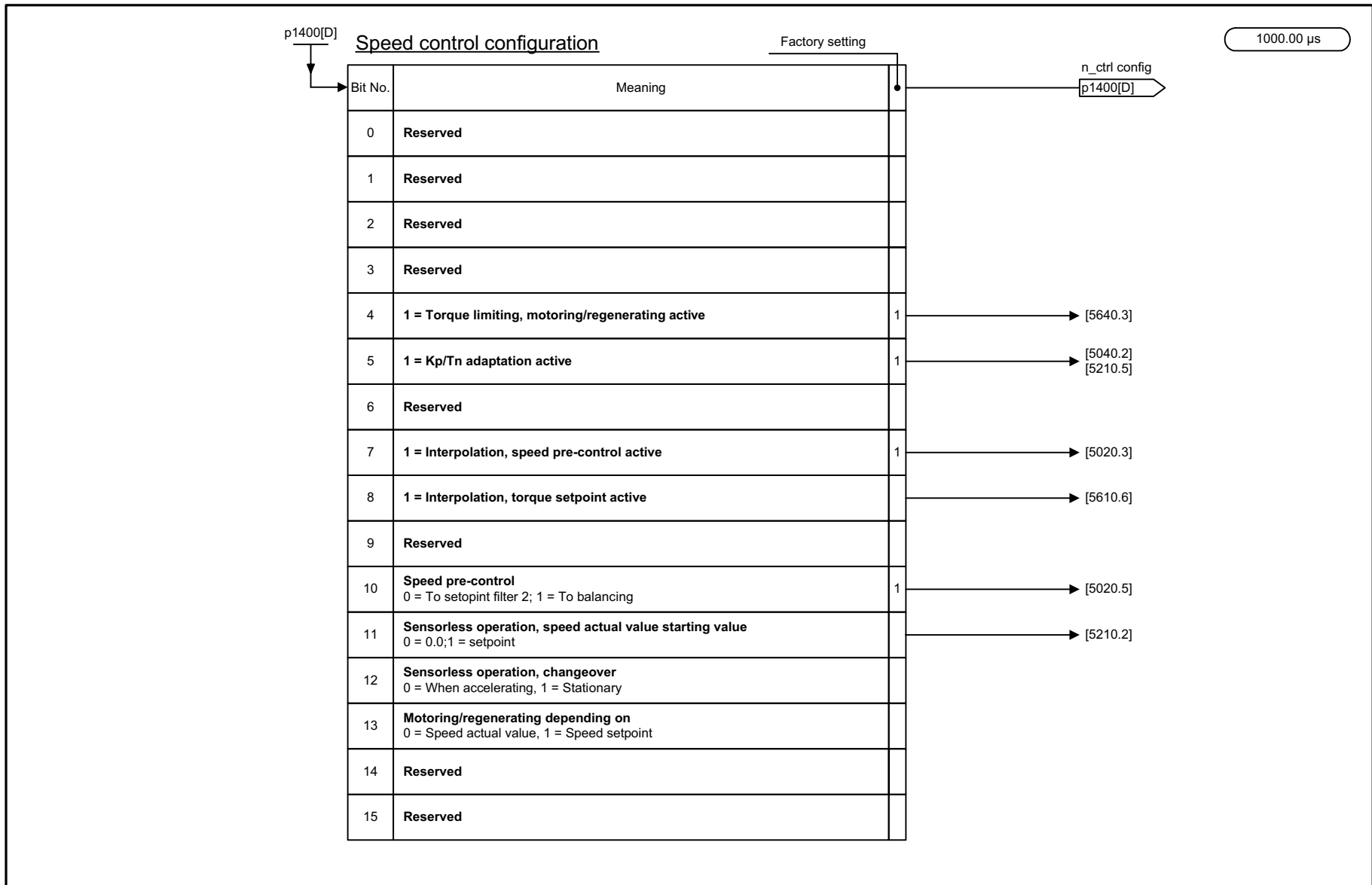
1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5210_en.vsd	Function diagram	
Servo speed control without encoder - speed controller					15.09.04 V02.02.00	SINAMICS S	
							- 5210 -

Picture 2-97 5210 – Speed control without encoder

Picture 2-98 5300 – V/f control for diagnostics



1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5300_en.vsd	Function diagram	
Servo V/f control - V/f control for diagnostics					30.09.04 V02.02.00	SINAMICS S	
							<b>- 5300 -</b>

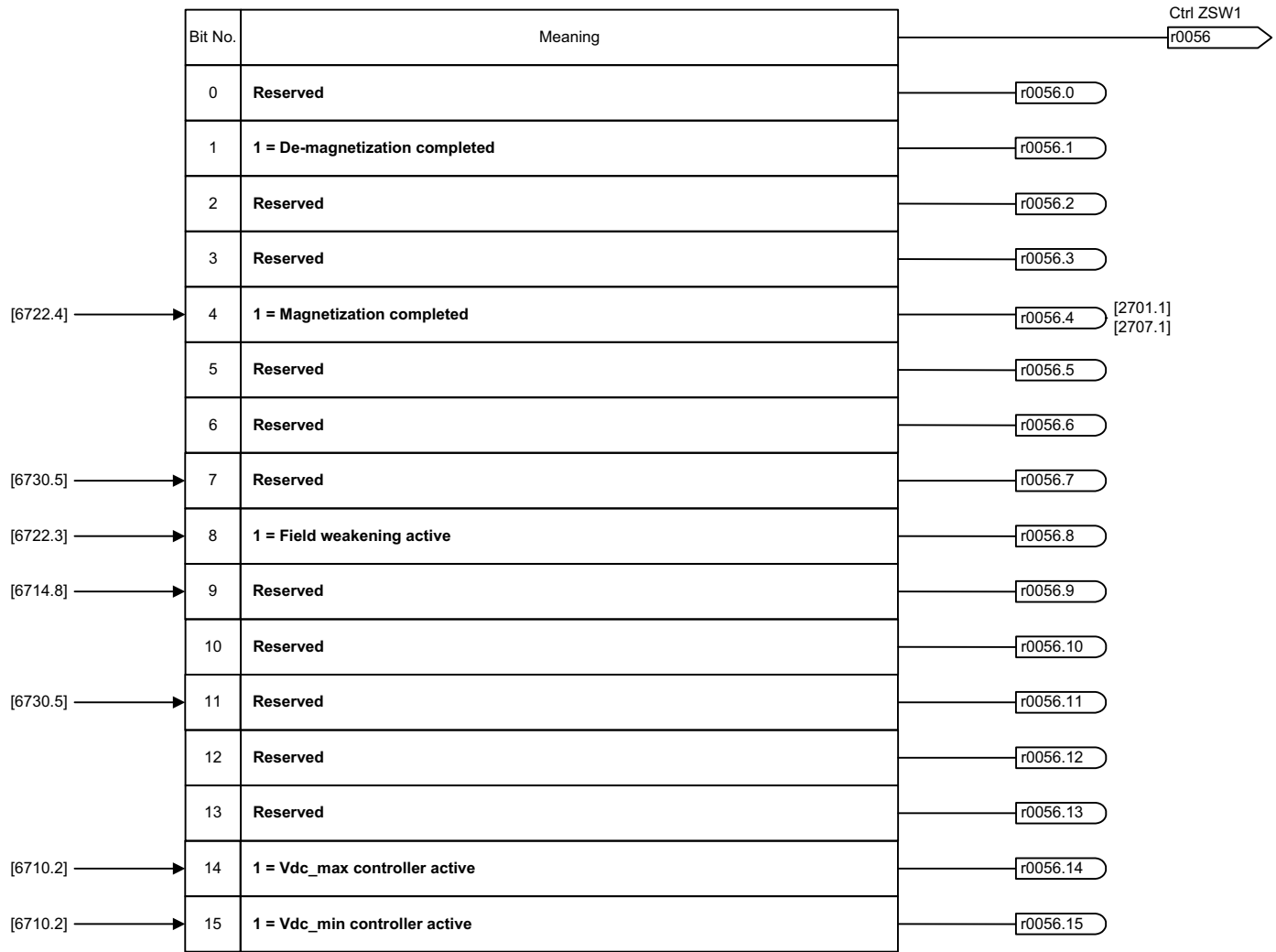


Picture 2-99 5490 – Speed control configuration

1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5490_en.vsd	Function diagram	
Servo closed-loop - open-loop status words - speed control configuration					15.09.04 V02.02.00	SINAMICS S	
							- 5490 -

p0115[y] (MM)  
Refer to [1020.7]

Control status word 1



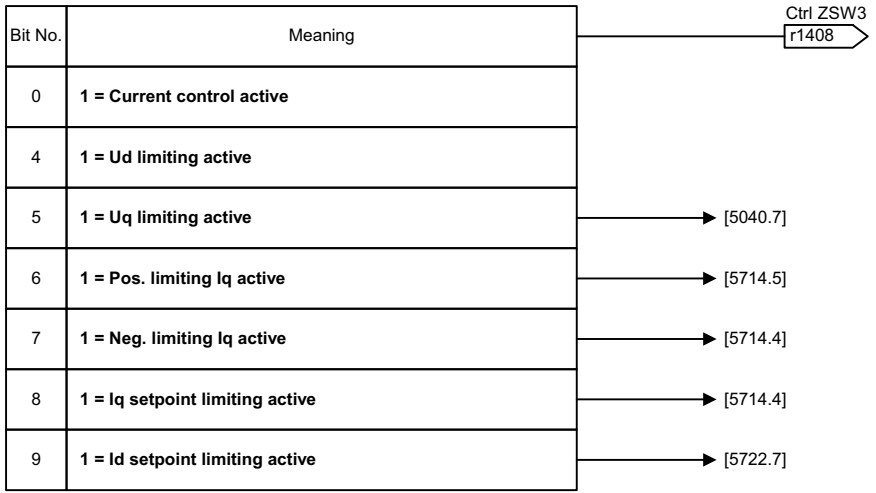
Picture 2-100 5492 – Control status word 1

1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5492_en.vsd	Function diagram	
Servo open-loop - closed-loop control/status words - control status word 1					30.09.04 V02.02.00	SINAMICS S	
							- 5492 -



125.00 µs

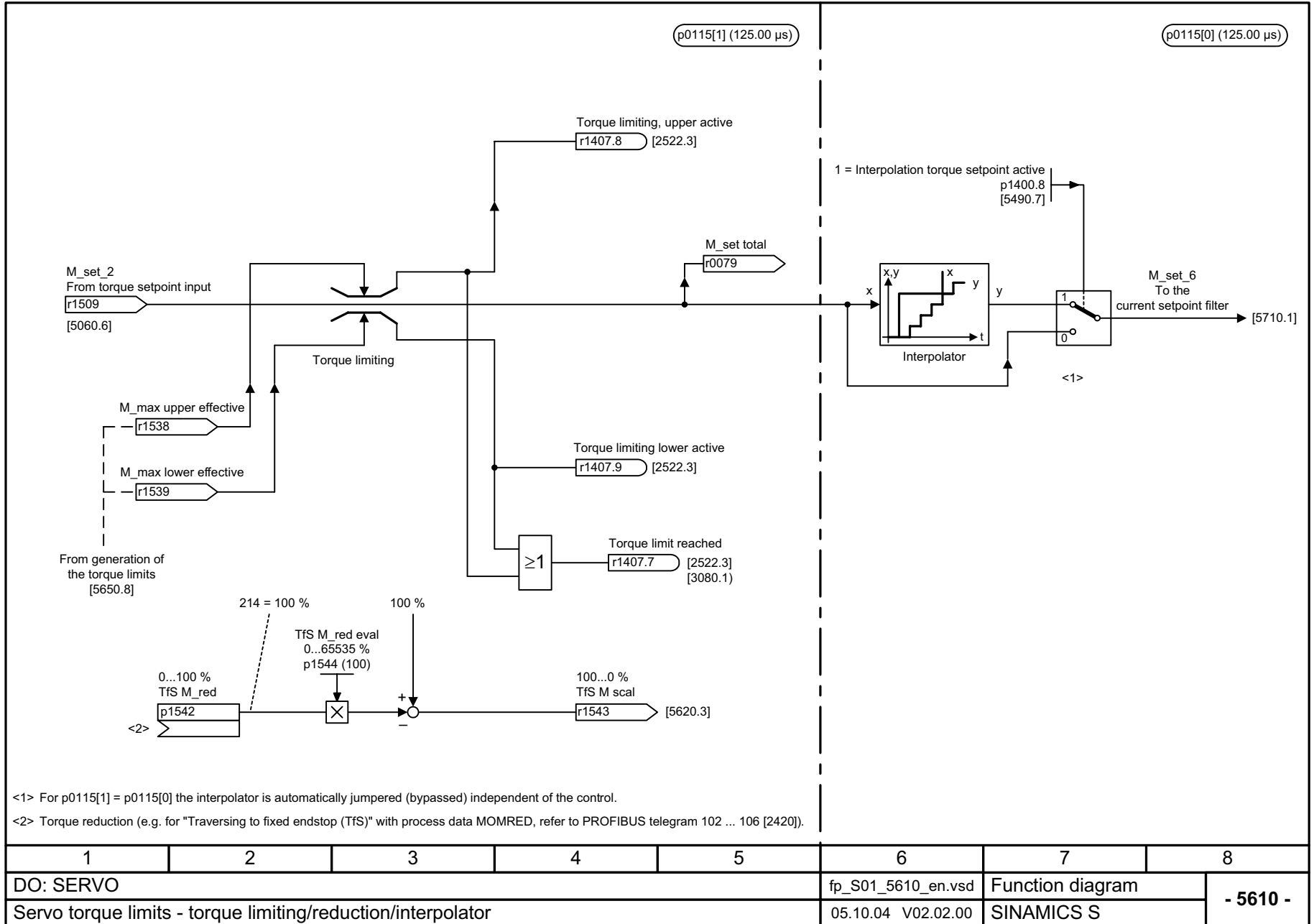
Control status word 3 (for current control)



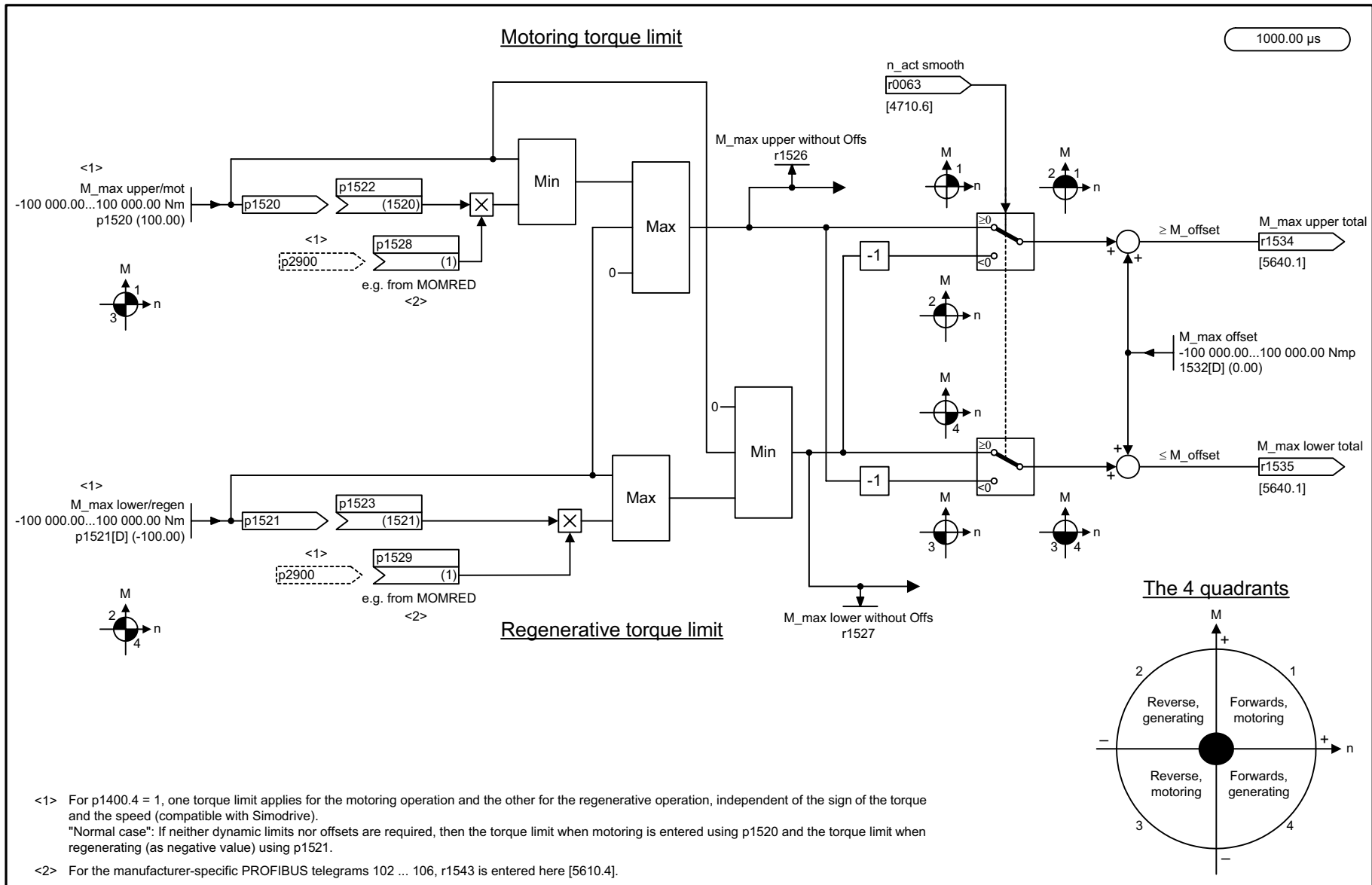
Picture 2-101 5493 – Control status word 3

1	2	3	4	5	6	7	8	
DO: SERVO					fp_S01_5493_en.vsd	Function diagram		- 5493 -
Servo open-loop - closed-loop control/status words - control status word 3					10.12.03 V02.02.00	SINAMICS S		

Picture 2-102 5610 – Torque limiting/reduction/interpolator



1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5610_en.vsd	Function diagram	
Servo torque limits - torque limiting/reduction/interpolator					05.10.04 V02.02.00	SINAMICS S	
							<b>- 5610 -</b>



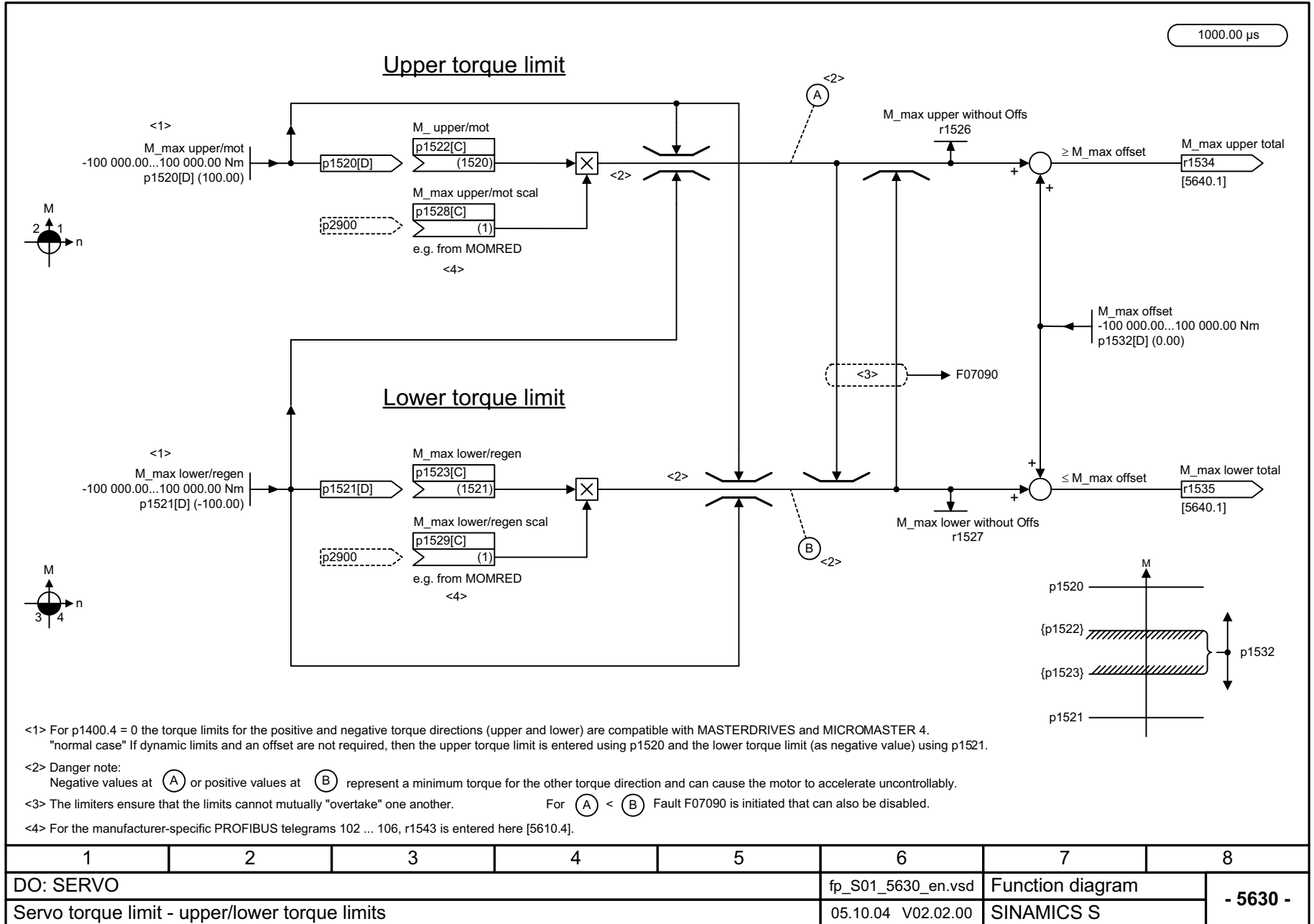
<1> For p1400.4 = 1, one torque limit applies for the motoring operation and the other for the regenerative operation, independent of the sign of the torque and the speed (compatible with Simodrive).  
 "Normal case": If neither dynamic limits nor offsets are required, then the torque limit when motoring is entered using p1520 and the torque limit when regenerating (as negative value) using p1521.

<2> For the manufacturer-specific PROFIBUS telegrams 102 ... 106, r1543 is entered here [5610.4].

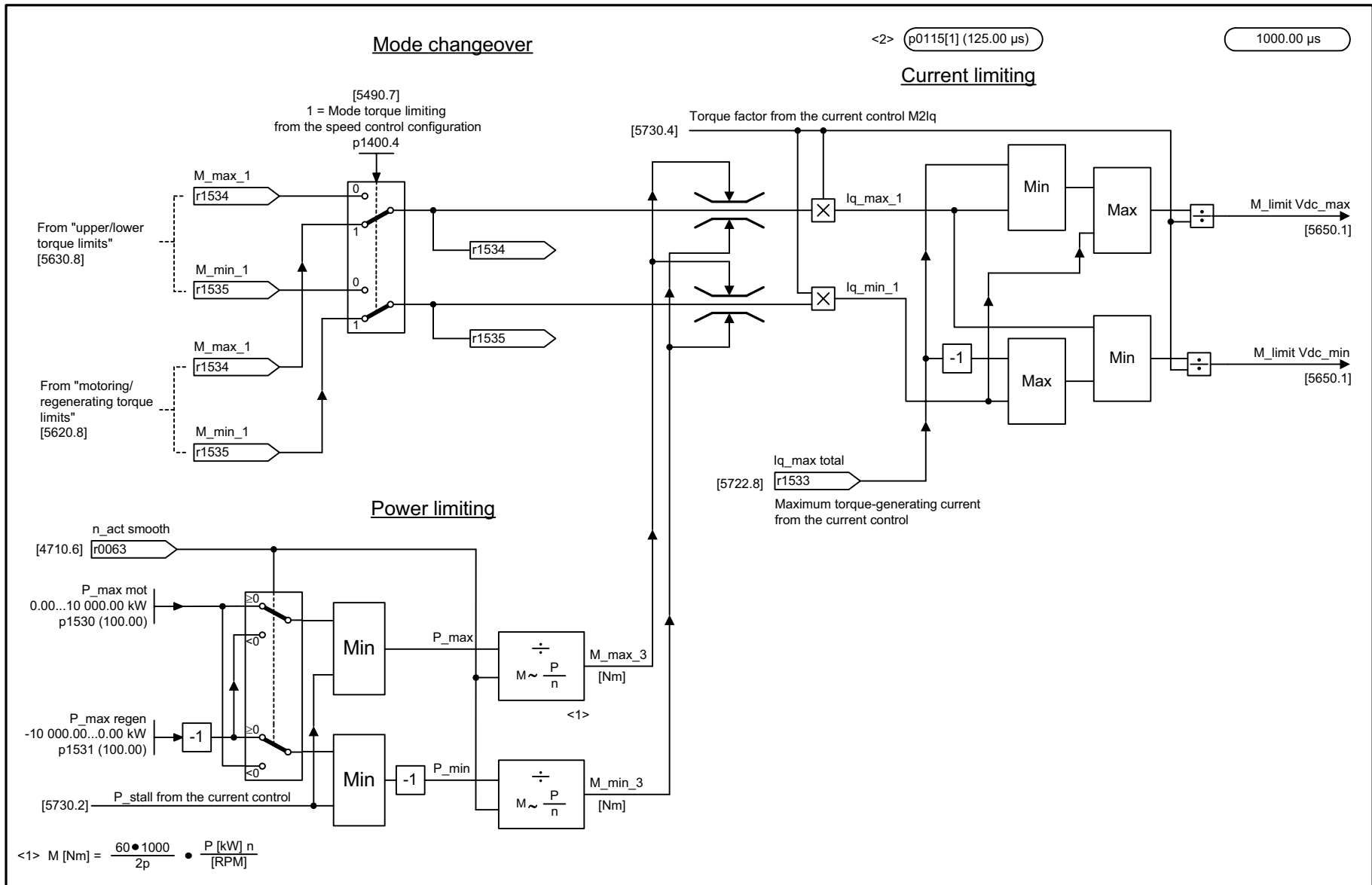
1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5620_en.vsd	Function diagram	
Servo torque limitis - motoring/regenerating torque limit					05.10.04 V02.02.00	SINAMICS S	
							<b>- 5620 -</b>

Picture 2-103 5620 – Motoring/regenerating torque limit

Picture 2-104 5630 – Upper/lower torque limits



1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5630_en.vsd	Function diagram	
Servo torque limit - upper/lower torque limits					05.10.04 V02.02.00	SINAMICS S	
							<b>- 5630 -</b>

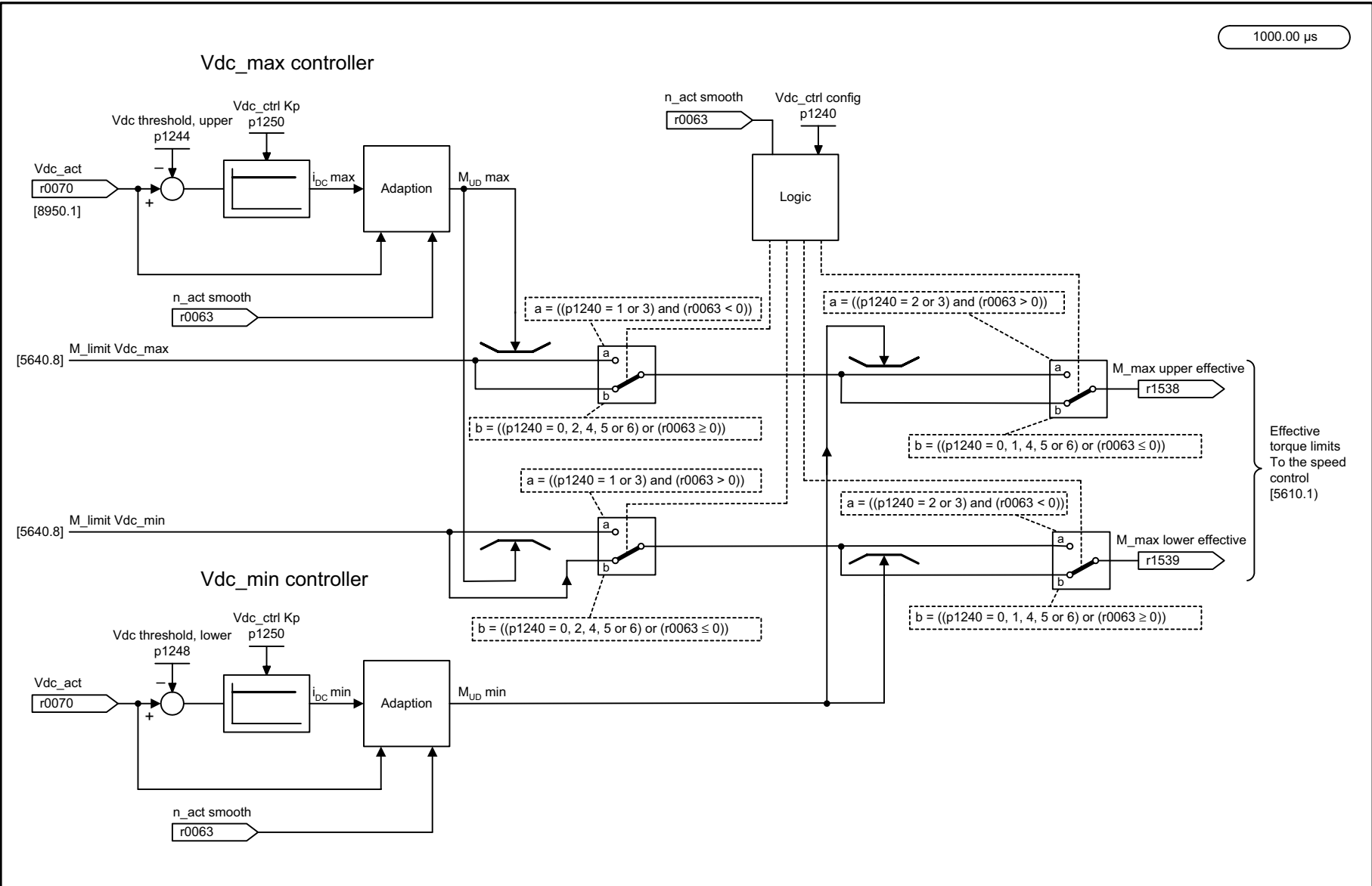


1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5640_en.vsd	Function diagram	
Servo torque limits - mode changeover, power/current limiting					05.10.04 V02.02.00	SINAMICS S	

- 5640 -

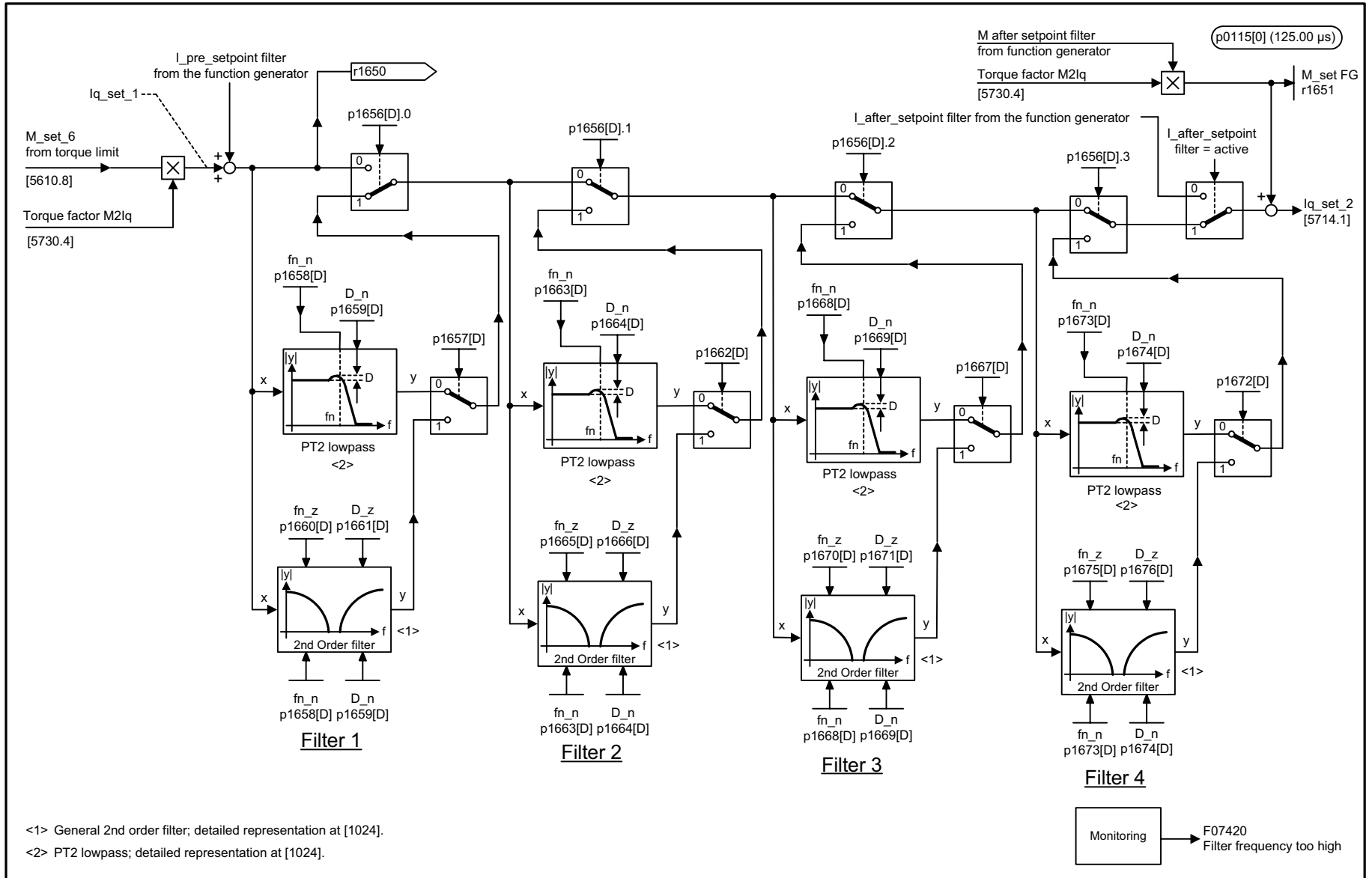
Picture 2-105 5640 – Mode changeover, power/current limiting

1000.00 μs



Picture 2-106 5650 – Vdc\_max controller and Vdc\_min controller

1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5650_en.vsd	Function diagram	
Servo torque limits - Vdc_max controller and Vdc_min controller					05.10.04 V02.02.00	SINAMICS S	
							<b>- 5650 -</b>

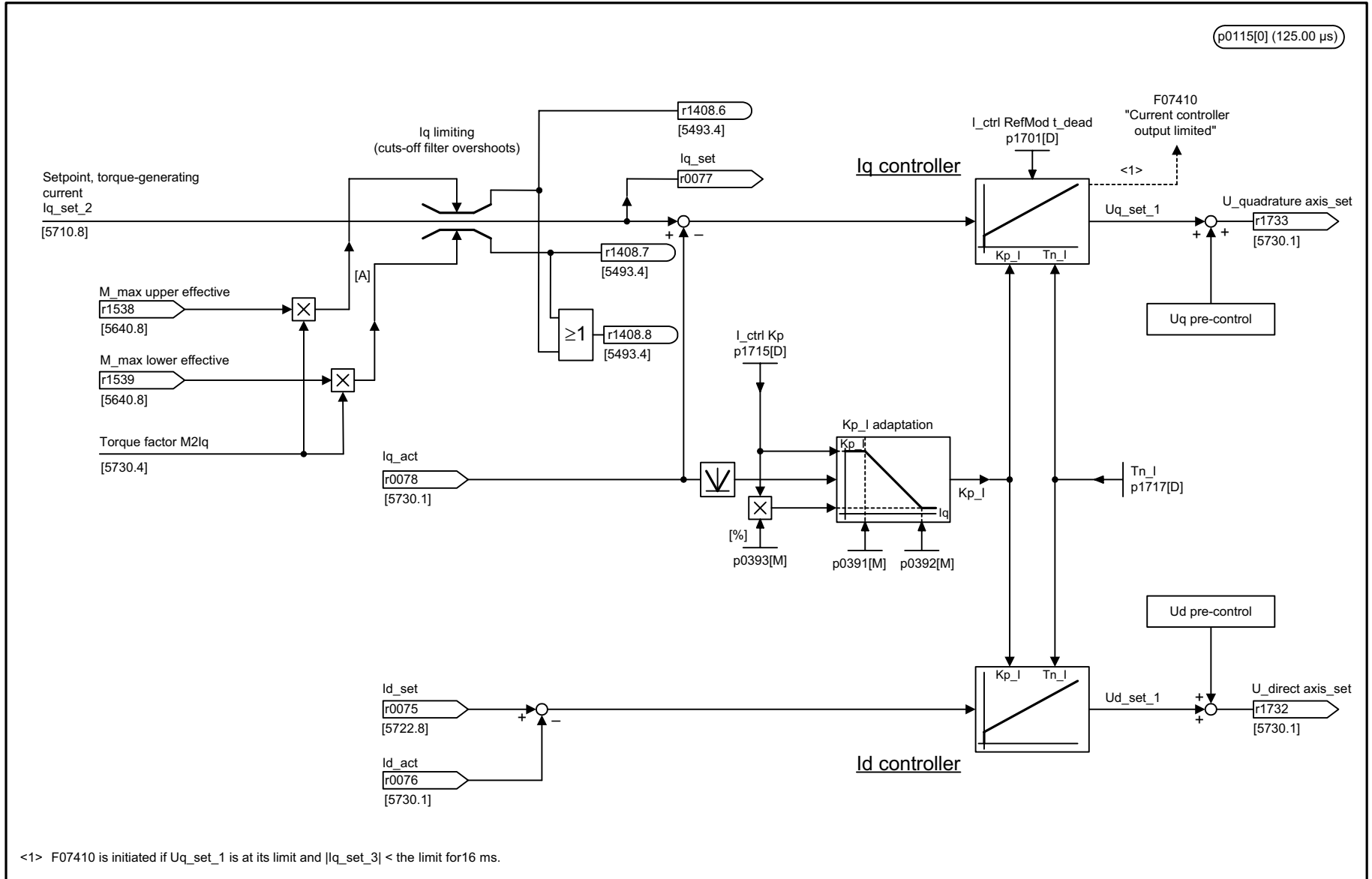


<1> General 2nd order filter; detailed representation at [1024].  
 <2> PT2 lowpass; detailed representation at [1024].

1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5710_en.vsd	Function diagram	
Servo current control - current setpoint filter					30.09.04 V02.02.00	SINAMICS S	
							- 5710 -

Picture 2-107 5710 – Current setpoint filter

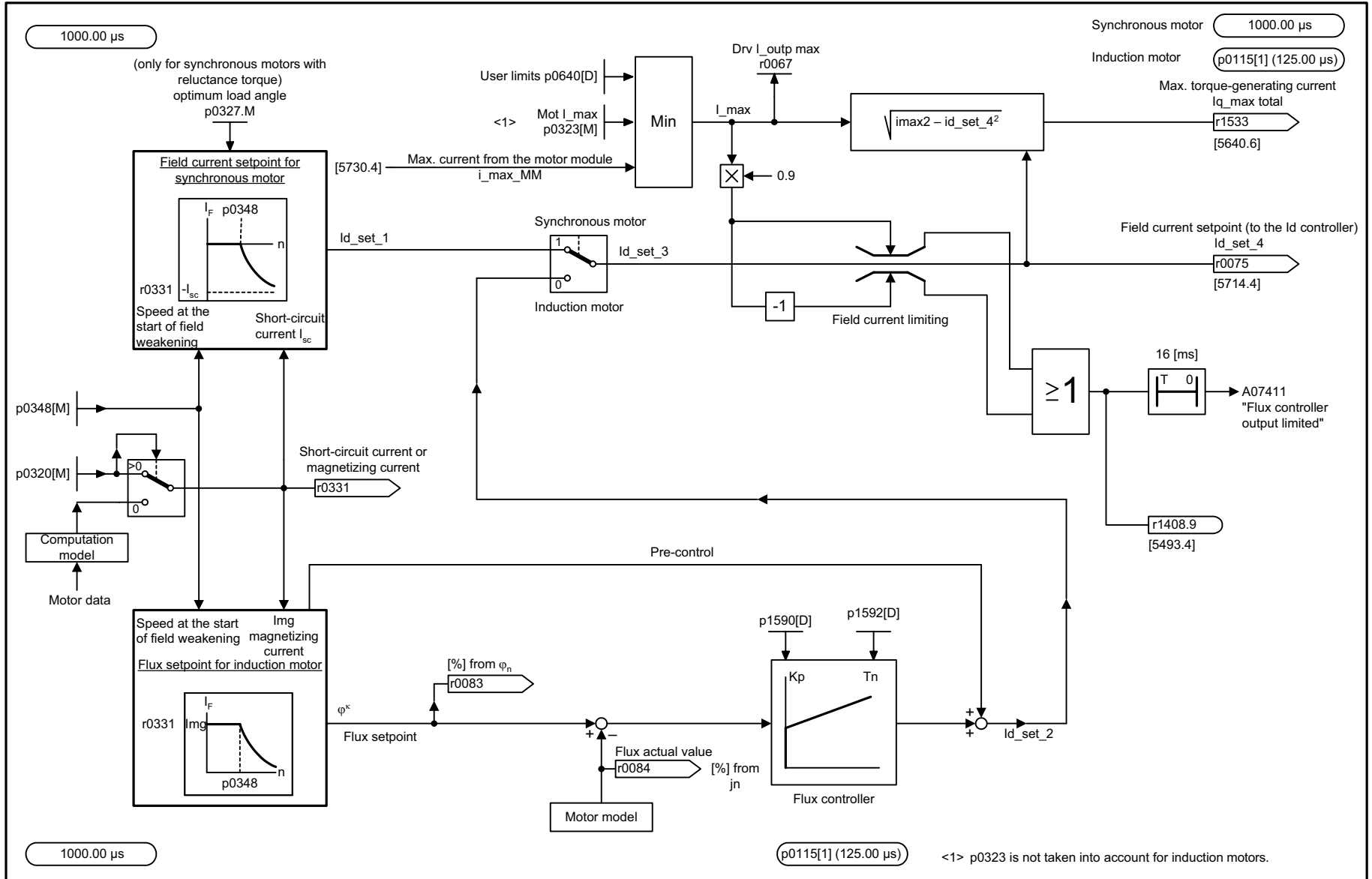
Picture 2-108 5714 – Iq and Id controller



Function diagrams  
 Servo control

1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5714_en.vsd	Function diagram	
Servo current control - Iq and Id controller					05.10.04 V02.02.00	SINAMICS S	
							<b>- 5714 -</b>

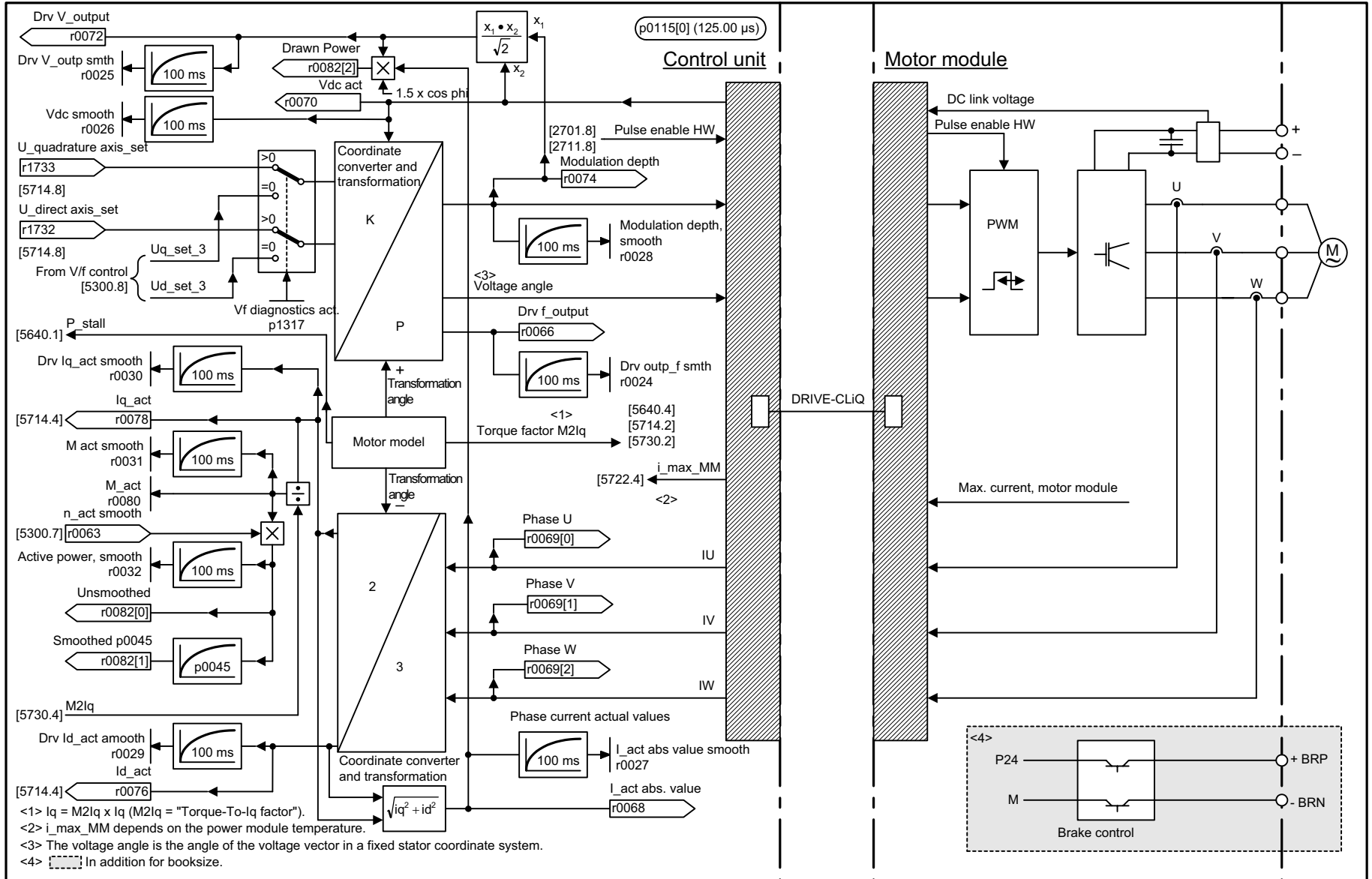




1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5722_en.vsd	Function diagram	
Servo current control - field current setpoint, flux controller					05.10.04 V02.02.00	SINAMICS S	
							<b>- 5722 -</b>

Picture 2-109 5722 – Field current setpoint, flux controller

Picture 2-110 5730 – Interface to the motor module (gating/control signals, current actual values)



1	2	3	4	5	6	7	8
DO: SERVO					fp_S01_5730_en.vsd	Function diagram	
Servo current control - interface to the motor module (gating/control signals, current actual values)					21.10.04 V02.02.00	SINAMICS S	
							<b>- 5730 -</b>

Function diagrams  
Servo control