Firmware Tde Macno

User's manual

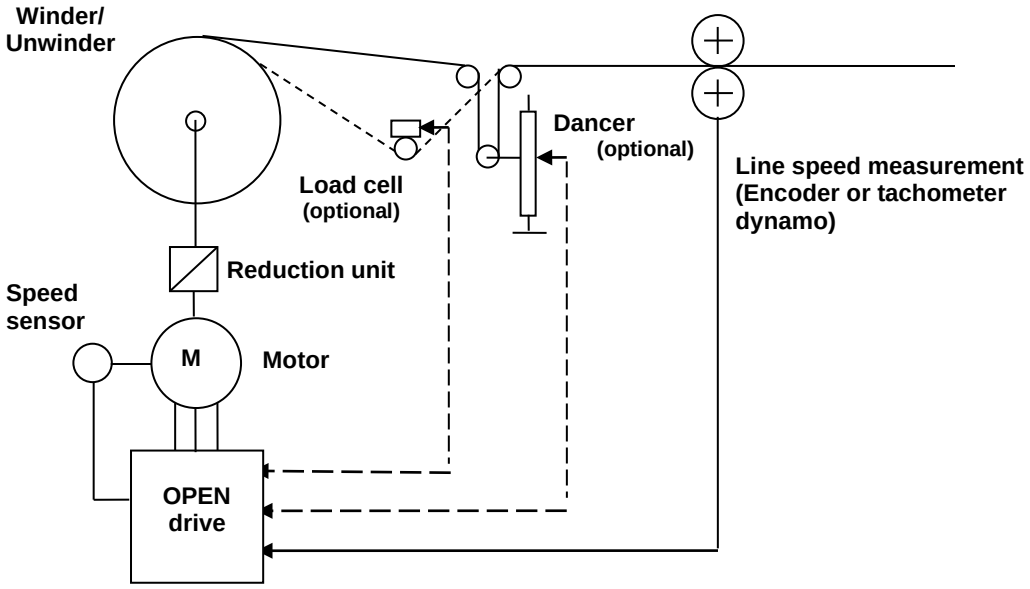
Winder - Unwinder application n°25

Cod. MW00301E00 V_1.3

INDEX

VERSION APPLICATION 25.09

The involved application of the OPDE concerns the wind or unwind a material keeping the tension constant, both indirectly and directly. The control can occur by speed with dancer or by torque with load cell or without feedback. The drive follows the line speed measured by a pulley on which the wire passes (without sliding between them); the signal can be collected from an encoder positioned on the shaft of the pulley or by a tachometer dynamo. The winder/unwinder is equipped with the servodiameter calculation.



1 APPLICATION CONFIGURATION

1.1 APPLICATION PARAMETERS

Name	Description	min	max	def	u.m.	scale
WND_SPD_MAX	E00 - Winder\Unwinder max motor speed	100	30000	2037	rpm	1
SPD_LINE_SEL	E01 - Speed line measure selection	0	1	0		1
LINE_FRQ_MAX	E02 - Maximum frequency measured from the line	0.01	199.99	18.11	KHz	100
LINE_V_MAX	E03 - Voltage corresponding to the maximum speed line	100	10000	10000	mV	1
EN_INV_SPD_LINE	E04 - Reverses line speed measurement			0		1
D_CALC_MIN_SPD_LINE	E05 - Minimum speed line for the diameter calculation	0	100.0	5.0	%SPD_LINE_MAX	163.84
D_CALC_MIN_PLS_COUNT	E06 - Minimum number of pulses to calculate the diameter	1	19000	19000	pulses	1
PRC_DSTART	E07 - Initial diameter	0		50.0	%D_MAX	163.84
D_APPL_TF	E08 - Filter on the correction term of the diameter calculation	0	1999.9	936	ms	10
DMIN_DMAX	E09 - Reel minimum diameter / maximum diameter ratio	0		50.0	%D_MAX	327.68
SPD_LINE_TF	E10 - 2nd order filter time constant on speed line	0	1000.0	100.0	ms	10
EN_TENS_CTRL	E11 - Enable tension control			0		1
TENS_CTRL_SEL	E12 - Tension control selection			0		1
EN_DI_INV_POS_DIR	E13 - Enable digital input management to invert positive direction			0		1
EN_DSTART_APPL	E14 - Preset diameter with start value			0		1
TENS_REF_SEL	E16 - Tension reference selection			0		1
PRC_TENS_REF_DG	E17 - Tension digital reference	0		50.0	%TENS_MAX	163.84
LD_CELL_KP	E18 - Load cell multiplication factor	0.0	100.0	1.0		10

EN_LD_CELL_CTRL	E19 - Enable load cell control			0		1
LD_CELL_REG_KP	E20 - Load cell regulator proportional gain	0.0	100.0	1.0		10
LD_CELL_REG_TI	E21 - Load cell regulator lead time constant	0.1	3000.0	100.0	ms	10
LD_CELL_REG_TF	E22 - Load cell regulator first order filter time constant	0.0	25.0	1.0	ms	10
LD_CELL_REG_LIMIT	E23 - Load cell regulator symmetric output limit	0.0	195.0	100.0		163.84
EN_TRQ_BOOST	E24 - Enable torque boost			0		1
PRC_TRQ_BOOST	E25 - Torque boost	-200.0	200.0	0		40.96
EN_INRT_COMP	E26 - Enable inertial load compensation			0		1
START_TIME_MIN	E27 - Motor and reel with dmin start time	1	60000	1000	ms	1
START_TIME_MAX	E28 - Motor and reel with dmax start time	1	60000	4000	ms	1
EN_FRCT_COMP	E29 - Enable frictions compensation			0		1
PRC_FRCT_START	E30 - Starting friction torque	0.0	200.0	2.0	%MOT_T_NOM	40.96
PRC_FRCT_MAX	E31 - Friction torque at max motor speed	0.0	200.0	5.0	%MOT_T_NOM	40.96
PRC_DELTA_SPD_LINE_0	E32 - Delta line speed reference minimum	0.0	195.0	10.0	%SPD_LINE_MAX	163.84
PRC_DELTA_SPD_LINE_M	E33 - Delta line speed reference maximum	0.0	195.0	20.0	%SPD_LINE_MAX	163.84
PRC_FRCT_SPD	E34 - Motor speed thresold for friction compensation	0.0	100.0	2.0	%MOT_SPD_MAX	163.84
PRC_OFF_LIM_SPD	E35 - Offset speed limitation	0.0	100.0	5.0	%MOT_SPD_MAX	163.84
PRC_DANCER_POS_REF	E36 - Dancer position reference	0.0	100.0	0	%STROKE	163.84
DANCER_REG_KP	E37 - Dancer regulator proportional gain	0.0	100.0	1.0		10
DANCER_REG_TI	E38 - Dancer regulator lead time constant	0.1	3000.0	100.0	ms	10
DANCER_REG_KD	E39 - Dancer regulator derivative term	0.00	100.00	0.00		100
DANCER_REG_TF	E40 - Dancer regulator first order filter time constant	0.0	25.0	1.0	ms	10
EN_DANCER_REG_INV	E41 - Reverse Dancer regulator output					1
DANCER_REG_LIMIT	E42 - Dancer regulator symmetric output limit	0.0	195.0	100.0	%SPD_LINE_MAX	163.84
PID_DEAD_ZONE	E43 - PID regulator error dead zone	0.0	100.0	0	%STROKE	163.84
DANCER_POS_MIN	E44 - Dancer minimum position	-100.0	100.0	0	% 10V	163.84
DANCER_POS_MAX	E45 - Dancer maximum position	-100.0	100.0	0	% 10V	163.84
DANCER_POS_MIN_DO	E46 - Dancer minimum position for digital output o35	0.0	100.0	0	%STROKE	163.84
DANCER_POS_MAX_DO	E47 - Dancer maximum position for digital output o35	0.0	100.0	0	%STROKE	163.84
EN_DANCER_POS_MEM	E48 - Enable digital position memorization			0		1
EN_SPD_LINE_CTRL	E49 - Enable speed line control			0		1
SPD_LINE_REF_SEL	E50 - Speed line reference selection			0		1
PRC_SPD_LINE_REF_DG	E51 - Speed line digital reference	-100.0	100.0	50.0	%SPD_LINE_MAX	163.84
SPD_LINE_REG_KP	E52 - Speed line regulator proportional gain	0	100.0	1.0		10
SPD_LINE_REG_TI	E53 - Speed line regulator lead time constant	0.1	3000.0	100.0	ms	10
SPD_LINE_REG_TF	E54 - Speed line regulator first order filter time constant	0.0	25.0	1.0	ms	10
SPD_LINE_REG_LIMIT	E55 - Speed line regulator symmetric output limit	0.0		100.0	%SPD_LINE_MAX	163.84
EN_SPD_LINE_REG	E56 - Enable speed line regulator			0		1
PRC_SPD_JOG	E60 - Digital speed reference	-100.0	100.0	0.0	%MOT_SPD_MAX	163.84
EN_SPD_JOG	E61 - Enable Digital speed reference			0		1
EN_LINE_REF	E62 - Enable speed reference from line			0		1
EN_LIN_RAMP	E63 - Enable linear ramps			1		1
EN_D_EST	E65 - Enable diameter and speed line estimation			0		1
GEARBOX_NUM	E66 - Gearbox ratio numerator	1	30000	100		1
GEARBOX_DEN	E67 - Gearbox ratio denominator	1	30000	100		1
TURNS_THICK_DEF	E68 - Revolution number characterizing the material thickness	1	30000	1000		1
PRC_D_VAR_THICK_DEF	E69 - Diameter change in the characterization revolutions	0.0		50.0	%D_MAX	163.84
EN_CAN_CORR	E70 - Enable estimation CAN correction			0		1
PRC_SPD_LINE_MIN_CAN	E71 - Minimum speed line for the diameter correction via CAN	0.0	100.0	10.0	%SPD_LINE_MAX	163.84
CAN_SPD_TF	E72 – Motor speed filter time constant for CAN correction	0.0	1999.9	20.0	ms	10

EN_AVRG_D	E76 - Enable average diameter calculation and variation control			0		1
AVRG_D_FREE_SMPLS	E77 - Number of free samples diameter calculation	0	500	100		1
AVRG_D_SMPLS	E78 - Number of samples used for diameter calculation	0	500	1		1
PRC_MAX_D_VAR	E79 - Max diameter variation admitted in E80 ms	0.0	100.0	10.0	%D_MAX	163.84
TIME_MAX_D_VAR	E80 - Time to test max diameter variation admitted	0.0	100.0	10.0	ms	10
EN_D_FREEZE	E81 - Enable freeze diameter value			0		1
PRC_DMIN	E82 - Minimum diameter calculated	0.0		1.0	%D_MAX	163.84
PRC_DMAX	E83 - Maximum diameter calculated	0.0		199.9	%D_MAX	163.84
D_FREE_APP_RAMP	E84 - Free samples diameter calculation linear ramp time	0.1	1800.0	10.0	s	10
SPD_LINE_MAX	E85 - Max speed line	0.0	1000.0	0	m/min	10
DMIN	E86 - Minimum diameter	0	30000	100	mm	1
DMAX	E87 - Max diameter	0	30000	200	mm	1
EN_PAR_CALC	E88 - Parameters calculation using absolute data			0		1
EN_PID_FREEZE	E90 - Enable PID freeze			0		1
EN_PID_FORCE	E91 - Enable PID force			0		1
PRC_PID_FORCE	E92 - PID force value	-400.0	400.0	0		40.96

1.2 APPLICATION LOGIC INPUTS

Input	Logical Input Functions
I00	Run command
I02	External enable
I05	Enable speed jog
I08	Alarms reset
I16	Enable second parameter bank
I21	Enable line reference
I22	Enable linear ramps
I23	Enables tension control
I24	Selection of control type (L=speed; H=torque)
I25	Force diameter initial value (E07) (“Preset speed ratio”)
I26	Modify the positive rotation direction (C76) only if E13=1
I27	Clear PID output
I28	Enables torque boost
I29	Freeze diameter value
I30	Freeze PID value
I31	Force PID value

1.3 APPLICATION LOGIC OUTPUTS

Output	Assigned Logic Function
O32	Active Diameter calculation
O33	Active Diameter estimation
O34	Force Start Diameter value
O35	Dancer position out of range
O36	Active Load Cell Regulator
O37	Active Dancer Regulator
O38	Active Speed Line Regulator
O39	CAN message received
O40	PID output freezed
O41	PID output forced
O42	Active Motor Speed limitation

1.4 APPLICATION ANALOG INPUTS (NOT MODIFIABLE)

Input	Meaning	
A.I.1	Tachometer dynamo on the line	
A.I.2	Analog tension reference	Dancer position
A.I.3	Feedback from load cell	Line speed reference

1.5 ANALOG OUTPUTS AND APPLICATION MONITOR

Output	Assigned Internal Variable	u.m.	scale.
O69	Speed Line measured	%SPD_LINE_MAX	163.83
O70	Filtered Speed Line	%SPD_LINE_MAX	163.83
O71	Diameter calculated	%D_MAX	163.83
O72	Diameter applied	%D_MAX	163.83
O73	Dmin/Dcalc applied	%	163.83
O74	Motor pulses counted		1
O75	Line speed pulse counter		1
O76	Tension Reference for Torque Control	%TENS_MAX	163.83
O77	Tension measured by load cell	%TENS_MAX	163.83
O78	Load cell regulator output	%TENS_MAX	163.83
O79	Positive Motor torque limit	%MOT_T_NOM	40.96
O80	Inertial load compensation term	%TENS_MAX	40.96
O81	Friction compensation term	%MOT_T_NOM	40.96
O82	Dancer position	%STROKE	163.83
O83	Dancer regulator output	%SPD_LINE_MAX	163.83
O84	Proportional gain speed regulator multiplication factor		16
O85	Speed line reference	%SPD_LINE_MAX	163.83
O86	Speed line regulator output	%SPD_LINE_MAX	163.83

1.6 APPLICATION INTERNAL QUANTITIES

Name	Description	u.m.	scale
MAX_RATIO	D68 - Ratio between max winder speed and motor speed	%	163.84
ACTIVE_MODE	D69 - Active Control mode	0 = DISABLED 1 = TENS_TRQ_CTRL 2 = TENS_SPD_CTRL 3 = SPD_LINE_CTRL 4 = SPD_CTRL	1
PRC_SPD_LINE	D70 - Speed line measured	%SPD_LINE_MAX	163.84
PRC_D_CALC	D71 - Diameter calculated	%D_MAX	163.84
PRC_D_APPL	D72 – Diamete\r applied	%D_MAX	163.84
PRC_DMIN_D_APPL	D73 - Diameter applied (related to DMIN)	%	40.96
FREE_D_SMPLS_RD	D74 - Number of free samples		1
AVRG_D_SMPLS_RD	D75 - Number of average diameter samples		1
PRC_TENS_REF	D76 - Tension Reference	%TENS_MAX	163.84
PRC_LD_CELL	D77 - Tension measured by load cell	%TENS_MAX	163.84
PRC_LD_CELL_REG_OUT	D78 - Load cell regulator output	%TENS_MAX	163.84
PRC_TRQ_REF	D79 - Torque Reference	%MOT_T_NOM	40.96
PRC_INRT_COMP	D80 - Inertial load compensation term	%TENS_MAX	163.84
PRC_FRCT_COMP	D81 - Friction compensation term	%MOT_T_NOM	40.96

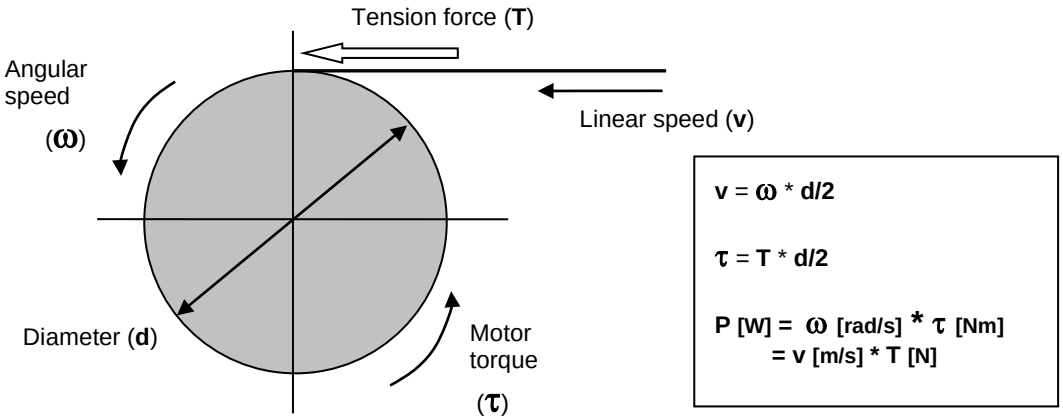
PRC_DANCER_POS	D82 - Dancer position	%STROKE	163.84
PRC_DANCER_REG_OUT	D83 - Dancer regulator output	%SPD_LINE_MAX	163.84
MUL_SPD_REG_KP	D84 - Proportional gain Speed regulator multiplication factor		100
PRC_SPD_LINE_REF	D85 - Speed line reference	%SPD_LINE_MAX	163.84
SPD_LINE_REG_OUT	D86 - Speed line regulator output	%SPD_LINE_MAX	163.84
WND_SPD_MIN_CALC	D87 - Minimum winder speed calc	rpm	1
TENS_MAX	D88 - Maximum tension	Kg	10
WND_SPD_MAX_CALC	D89 - Max winder speed calc	rpm	1
SPD_LINE	D90 - Speed line measured	m/min	10
D_CALC	D91 - Diameter calculated	mm	1
D_APPL	D92 - Diameter applied	mm	1
TENS_REF	D93 - Tension Reference	Kg	10
LD_CELL	D94 - Tension measured	Kg	10
PRC_SPD_MAX	D95 - Max motor speed	%MOT_SPD_MAX	163.84
PRC_SPD_MIN	D96 - Min motor speed	%MOT_SPD_MAX	163.84

1.7 APPLICATION ALARMS

All	Description
A04 code 1	Excessive variation in diameter calculation (over PRC_MAX_D_VAR E79)

2 TENSION CONTROL BY TORQUE

In the tension control the adjustment system has to keep the tension constant on the material that is wound or unwound independently from the changes in the linear speed of the material to be coiled and from the roll diameter.



The material line speed is kept constant by the machine pilot drive; therefore, when the diameter of the material to be wound changes, the angular speed of the winder/unwinder has to change too. As a consequence, considering the ratio between the line speed and the angular speed, it is possible to estimate the value of the diameter instant after instant. Once the diameter is known, it is possible to calculate the torque that the motor has to supply to reach the desired tension.

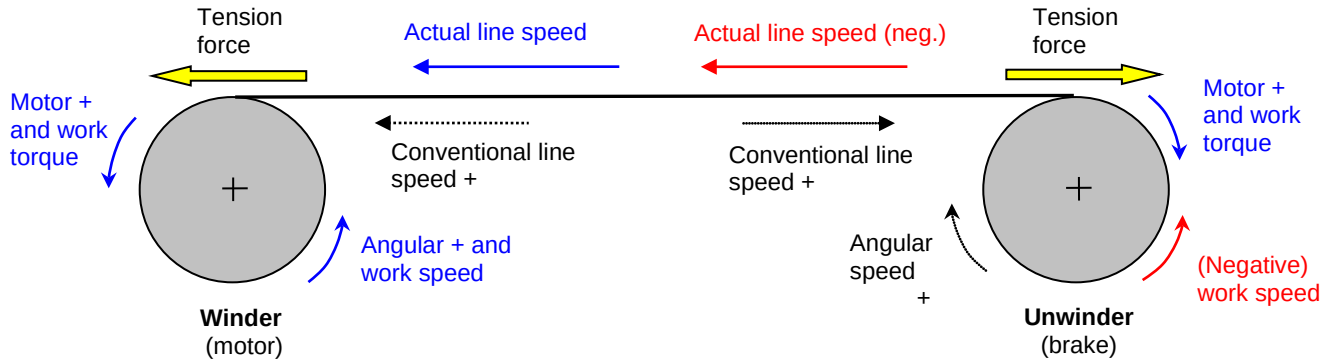
The **tension control** is called **direct** if there is a tension force transducer (load cell) that shall then supply a feedback to the tension regulator so that by means of a PI regulator it is possible to obtain exactly the wished tension.

The **tension control** is **indirect** if there is not any tension force transducer; therefore, the tension regulator works with an open loop. Above all in this case, it is very important to compensate directly those components of the supplied torque, which do not contribute to the actual tension (friction and inertial torques).

The tension control by torque is particularly indicated for non elastic materials, where one wishes to adjust the tension accurately.

2.1 CONVENTIONS ADOPTED IN CASE OF TENSION CONTROL BY TORQUE

The convention adopted by the OPDE in the tension control assures the correct operation both as coiler and uncoiler without need of setting any configuration:



As it can be observed looking at the picture above, the following conventions do apply:

- It is considered as positive torque direction supplied by the motor the one produced by the tension force in the expected direction.
- The line speed is positive when the incoming direction is to the reel:
  - For the winder, the work line speed is positive
  - For the unwinder, the work line speed is negative
- The reel motor angular speed must always match the line speed

Following these conventions, the reel motor always works with positive supplied torque. It is not necessary to set the operation as winder or unwinder, since it is sufficient to look at the line speed direction (positive for the winder and negative for the unwinder) and the inertial compensation and friction terms are current.

During the commissioning, it is necessary to provide for the following aspects:

1. The measured line speed has to be positive when the material is incoming to the reel. If necessary, act on the **E04** connection to reverse its sign.
2. The positive motor rotation direction has to match the line speed. Should this not be the case, reverse the positive motor rotation direction setting **C76=1**.

3 TENSION CONTROL BY SPEED

The tension control by speed actually is the control of the dancer position: if this latter remains constant, it means that the reel is perfectly synchronized with the line speed. The tension control by speed is recommended for elastic and non elastic materials, where a very low tension has to be set. The dancer act as a reserve, until the speed of the reel is perfectly hooked to the line according to the available diameter.

The conventions on the signs seen for the torque control are valid also in the speed control, even if in this case, the limitations are less strict: the important thing is that the measured line speed and the reel rotation speed do always match. Then, it is necessary to set the output of the dancer PID (E041) properly, so that it can work in the correct direction:

- With positive work line speed: E41=0 for the Winder; E41=1 for the Unwinder
- With negative work line speed: E41=0 per the Unwinder; E41=1 for the Winder

After having properly configured the system, it is reversible; therefore, it can work both as a winder and as an unwinder witout any modification to the settings.

4 WINDER DEFINITION

Name	Description	min	max	def	u.m.	scale
SPD_LINE_MAX	E85 - Max speed line	0.0	1000.0	0	m/min	10
DMIN	E86 - Minimum diameter	0	30000	100	mm	1
DMAX	E87 - Max diameter	0	30000	200	mm	1
GEARBOX_NUM	E66 - Gearbox ratio numerator	1	30000	100		1
GEARBOX_DEN	E67 - Gearbox ratio denominator	1	30000	100		1
WND_SPD_MIN_CALC	D87 - Minimum winder speed calc				rpm	1
WND_SPD_MAX_CALC	D89 - Max winder speed calc				rpm	1
TENS_MAX	D88 - Maximum tension				Kg	10
EN_PAR_CALC	E88 - Parameters calculation using absolute data			0		1
DMIN_DMAX	E09 - Reel minimum diameter / maximum diameter ratio	0		50.0	%D_MAX	327.68
WND_SPD_MAX	E00 - Winder\Unwinder max motor speed	100	30000	2037	rpm	1

Some parameters can be used to determine the working motor speed range and the maximum tension that could be reached. In order to obtain this, set the max speed line (E85), the minimum and maximum diameter (E86, E87) and the gearbox ratio (E66,E67). At that point will be available the minimum winder motor speed in the internal value D87 (rpm), the maximum winder motor speed in the internal value D89(rpm) and the maximum tension “TENS_MAX” in D88 (kg).
This data can be used to set two important parameters E00 (winder\unwinder max motor speed) and E09 (minimum and maximum diameter ratio): to do this set E88=1.

5 SPEED LINE MEASURE

Name	Description	min	max	def	u.m.	scale
SPD_LINE_SEL	E01 - Speed line measure selection	0	1	0		1
LINE_FRQ_MAX	E02 - Maximum frequency measured from the line	0.01	199.99	18.11	KHz	100
LINE_V_MAX	E03 - Voltage corresponding to the maximum speed line	100	10000	10000	mV	1
EN_INV_SPD_LINE	E04 - Reverses line speed measurement	0	1	0		1
SPD_LINE_TF	E10 - 2nd order filter time constant on speed line	0.0	1000.0	100.0	ms	10
PRC_SPD_LINE	D70 - Speed line measured				%SPD_LINE_MAX	163.84
SPD_LINE	D90 - Speed line measured				m/min	10

Line speed can be measured both using a tachometer dynamo and having a digital signal coming from an Encoder. The selection is performed by setting the connection **E01** properly: if = 0, the control manages a signal from Encoder; if = 1, an analog signal (connected to A.I.1) coming from a tachometer dynamo is used.
In both cases, by means of the connection **E04=1** it is possible to reverse the sign of the measured line speed.
On the line speed measured there is also a II° filter with a time constant set with parameter **E04.**

5.1 ENCODER (E01=0)

With connection **C09** it's possible to select the encoder type:

C09 Description Mode of working

1 Digital encoder 4 track frequency reference (default)
2 Digital f/s Frequency reference (freq. and up/down) counting all edges
3 Digital f/s 1 edge Frequency reference (freq. and up/down) counting one edge

In this case, it is necessary to set under the parameter **E02** in KHz the frequency per channel that is attained at maximum line speed.
Once the maximum line speed in m/min (Line_speed $_{MAX}$), the diameter of the measurement pulley in m (dpul) and the number of revolution pulses of the Encoder N_{ENC} are known, the maximum measurement frequency per channel is:

$$f_{mes\ MAX\ [Hz]} = \frac{\text{Line\_speed}_{MAX[m/min]}}{60} \cdot \frac{N_{ENC}}{\pi \cdot d_{pul}[m]}$$

Example:

Line_speed $_{MAX}$ = 400m/min
dpul = 0,12m
N_{ENC} = 1024 ppr

} f mes $_{MAX}$ = 18,11 KHz $\rightarrow$ E02

Considering that all Encoder signal commutation fronts are counted, the maximum frequency managed within the converter is 4 times that stated under E02.

5.2 TACHOMETER DYNAMO (E01=1)

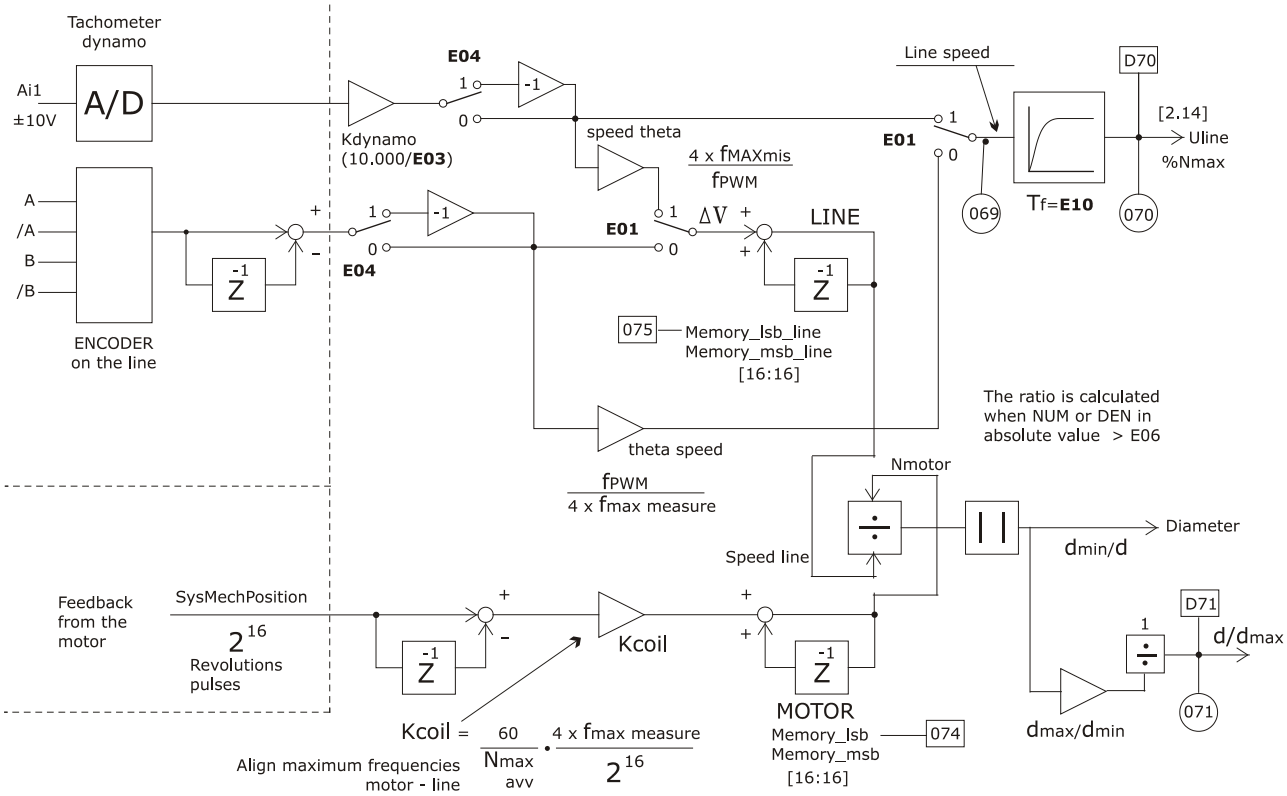
In this case, it is necessary to set for the parameter **E03** in mV the voltage produced by the tachometer dynamo at maximum line speed.

Not having any limitation on the internal representation of the line frequency corresponding to the maximum speed, it has been selected to use the parameter **E02** to set it. Therefore, to the maximum line speed indicated by the tachometer dynamo an internal line frequency equal to 4 x E02 KHz corresponds. (Obviously, this is valid only for the diameter calculation).

6 DIAMETER CALCULATION

Name	Description	min	max	def	u.m.	scale
WND_SPD_MAX	E00 - Winder\Unwinder max motor speed	100	30000	2037	rpm	1
DMIN_DMAX	E09 - Reel minimum diameter / maximum diameter ratio	0.0	100.0	50.0	%D_MAX	327.67
D_CALC_MIN_SPD_LINE	E05 - Minimum speed line for the diameter calculation	0.0	100.0	5.0	%SPD_LINE_MAX	163.84
D_CALC_MIN_PLS_COUNT	E06 - Minimum number of pulses to calculate the diameter	1	19000	19000	pulses	1
D_APPL_TF	E08 - Filter on the correction term of the diameter calculation	0.0	1999.9	936.0	ms	10
EN_DSTART_APPL	E14 - Preset diameter with start value	0	1	0		1
PRC_DSTART	E07 - Initial diameter	0.0	200.0	50.0	%D_MAX	163.83
EN_D_FREEZE	E81 - Enable freeze diameter value	0	1	0		1
EN_AVRG_D	E76 - Enable average diameter calculation and variation control	0	1	0		1
AVRG_D_SMPLS	E78 - Number of samples used for diameter calculation	0	19999	1		1
AVRG_D_FREE_SMPLS	E77 - Number of free samples diameter calculation	0	19999	100		1
D_FREE_APP_RAMP	E84 – Free samples diameter calculation linear ramp time	0.1	1800.0	10.0	s	10
PRC_MAX_D_VAR	E79 - Max diameter variation admitted in E80 ms	0.0	100.0	10.0	%D_MAX	163.84

TIME_MAX_D_VAR	E80 - Time to test max diameter variation admitted	0.1	100.0	10.0	ms	10
PRC_DMIN	E82 - Minimum diameter calculated	0.0	200.0	1.0	%D_MAX	163.83
PRC_DMAX	E83 - Maximum diameter calculated	0.0	200.0	200.0	%D_MAX	163.83
PRC_D_CALC	D71 - Diameter calculated				%D_MAX	163.84
PRC_D_APPL	D72 - Diameter applied				%D_MAX	163.84
PRC_DMIN_D_APPL	D73 - Diameter applied (related to DMIN)				%	40.96
FREE_D_SMPLS_RD	D74 - Number of free samples					1
AVRG_D_SMPLS_RD	D75 - Number of average diameter samples					1
D_CALC	D91 - Diameter calculated				mm	1
D_APPL	D92 - Diameter applied				mm	1



From the point of view of the parameterization, it is essential to set the parameters **E00** and **E02** correctly, since then the equipment works in percentage according to these values.

The data to be entered for **E00** is the maximum speed of the winder/unwinder motor in rpm. (see par.4.0).
Once the maximum line speed in m/min (Line_speed $_{MAX}$), the minimum diameter of the winder in m (dmin), and the reduction ratio (R) are known, the motor rotation speed in rpm (n wind. $_{MAX}$) is:

$$n_{\text{wind. MAX [rpm]}} = \frac{\text{Line\_speed}_{\text{MAX[m/min]}} \cdot R}{\pi \cdot d\,\text{min}[_m]}$$

Example:

Line_speed $_{MAX}$ = 400m/min
d min = 0.3m
R = 4.8

} n wind. $_{MAX}$ = 2037 rpm → E00

The diameter calculation is performed through the ratio between the line speed and the motor angular speed. Both speeds are managed in terms of frequency by the converter (as previously explained in this paragraph) and internally it was set a multiplication coefficient (Kcoil) the motor frequency to align the frequency of the line and of the motor in case of operation at maximum line speed and minimum reel diameter: in such case, in fact, the maximum motor rotation speed (E00) is reached. Thus, proceeding in this way, it is possible to measure the diameter with reference to its minimum value.
To have a precise and stable calculation of the diameter, as a matter of fact, the ratio between the accumulated pulses of the two frequencies is calculated, thus working in terms of space: the diameter is calculated only when one of the two counters exceeds in absolute value a threshold set by the parameter **E06** (default 19000 pulses).

The selection of the value to be set for the parameter E06 has to be performed by making a compromise between:

Diameter measurement refresh time (E06 low) ←→ Diameter measurement resolution (E06 high)

To obtain a good resolution, the threshold has to be higher than 1000 pulses, but the refreshing of the diameter cannot be too low, above all in case of thick rolled materials: E06 has to be selected according to the application.

The following considerations are very important when the diameter of the reel changes quickly; otherwise, it is possible to work with the default value of E06=19000 i.e. with maximum resolution.

In the diameter calculation, line pulses are always the first to reach the E06 threshold, since the line and motor frequencies are the same only at minimum diameter – in the other cases, line frequency is always higher.

Pulses per material meter **Im** = $\frac{\text{line f} \times 4}{\text{max line speed}/60}$ with line f = line measurement frequency in Hz

max line speed = maximum line speed in m/min

Material length per diameter refresh **Lm** = $\frac{\text{Threshold}}{\text{Pulses per meter}} = \frac{\text{P206}}{\text{Im}}$ in meters

The worst case occurs at minimum reel diameter because a higher revolution value corresponds to it and therefore a greater diameter change:

Maximum reel revolution number **n rev.** $_{\text{MAX}}$ = $\frac{\text{Material length for refresh}}{\text{Minimum circumference}} = \frac{\text{Lm}}{\pi \times \text{dmin}} = \frac{\text{P206}}{\text{Im} \times \pi \times \text{dmin}}$

The limitation is given therefore by the revolutions tolerated by the reel before the diameter calculation is updated and in this way it is possible to set the upper limit to the threshold. The lower limit (1000) is instead given by the resolution:

$$1000 \le \text{P206} \le \text{Pulses per meterl} \times \text{Maximum aspo rev. number} \times \text{Min. circumference} = \text{Im} \times \text{n rev.}_{\text{MAX}} \times \pi \times \text{dmin}$$

The minimum diameter is a process data, the number of maximum reel revolutions is set as limitation on the diameter refresh speed; while the Pulses per meter depend on the line speed measurement.
Should the explained condition not be observed, it is necessary to increase the pulses per material meter or to increase the line Encoder resolution or decrease the measurement pulley diameter.

The diameter is calculated periodically only if :

- The drive is running
- The speed line (**d70**) is greater than a threshold set by parameter **E05** (in % of the maximum line speed).
- The function freeze diameter is not active, so **E82**=0 and **I29**=L.

When the diameter calculation is active the logical output function **o32** goes at high level.
With parameters **E82** (minimum) an **E83** (maximum) it's possible to limit the diameter range admitted.
Diameter calculated is displayed in the internal quantity **d71** in percentage of the maximum diameter.

With parameter **E76**=1 it's possible to enable the moving average diameter calculation and its variation control.
In this mode the first **E77** diameter measures are stored without be applied. The internal value **d74** show the number of this free samples. After these samples, the diameter is refreshed with its moving average using **E78** samples and transition between free samples and average values is managed with a linear ramp on diameter applied, with a time duration that can be set on parameter **E84**. The internal value **d75** show the number of this average samples.
When this average function is enabled there is also a variation diameter control: after the free samples every **E80** ms it's checked the diameter variation, if this is great than **E79** threshold the drive goes in alarm A04 with code 1.

The actual diameter used in the tension control is displayed in the internal quantity **d72** in percentage of the maximum diameter.

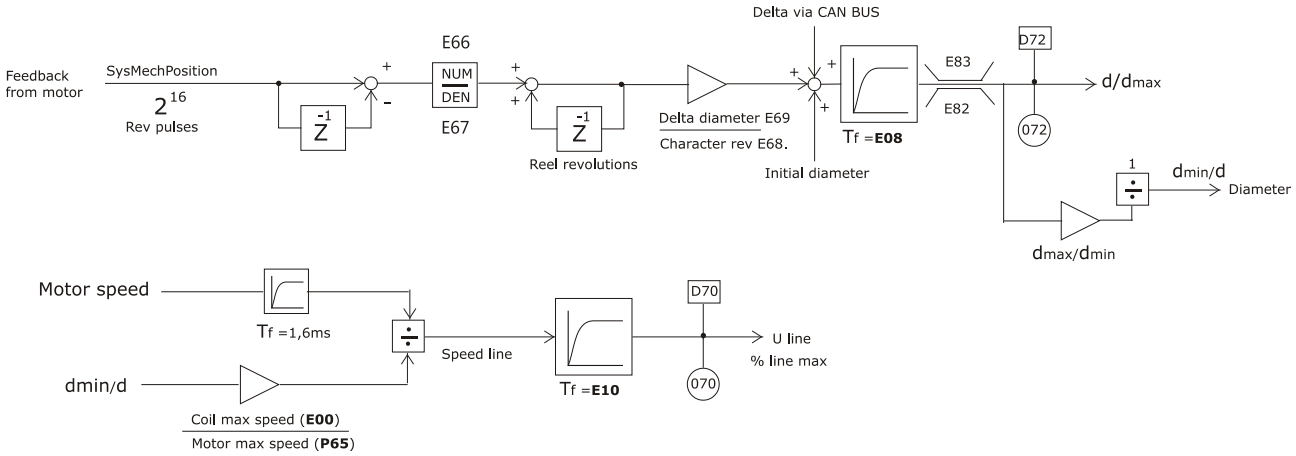
During the switching-on of drive, the actual diameter is automatically loaded by means of parameter **E07**.
It is possible to force the initial value of the actual diameter using the logic input **I25** ("Preset speed ratio") or with parameter **E14** set to 1: on the high active level, the value set for parameter **E07** is set for the current diameter.
When the actual diameter is forced to initial value, the logical output function **o34** goes at high level.

Then, there is a 1st level filter with time constant that can be set in ms in **E08,** to make the correction of the servodiameter smoother, above all if the initial data differ from the actual ones.

NB: In the adjustment of the tension control it is important to know also which is the ratio between the current diameter and the maximum possible value. Considering that it is possible to measure the current diameter with reference to the minimum one, it is essential to set the parameter **E09** properly, which defines the ratio between the minimum diameter and the maximum expected one.

7 DIAMETER ESTIMATION

Name	Description	min	max	def	u.m.	scale
EN_D_EST	E65 - Enable diameter and speed line estimation	0	1	0		1
GEARBOX_NUM	E66 - Gearbox ratio numerator	1	30000	100		1
GEARBOX_DEN	E67 - Gearbox ratio denominator	1	30000	100		1
TURNS_THICK_DEF	E68 - Revolution number characterizing the material thickness	1	30000	1000		1
PRC_D_VAR_THICK_DEF	E69 - Diameter change in the characterization revolutions	0.0	200.0	50.0	%D_MAX	163.84
EN_CAN_CORR	E70 - Enable estimation CAN correction	0	1	0		1
PRC_SPD_LINE_MIN_CAN	E71 - Minimum speed line for the diameter correction via CAN	0.0	100.0	10.0	%SPD_LINE_MAX	163.84



Should it not be possible to measure the line speed, there is the possibility of estimating the diameter of the material present on the reel knowing the thickness of the material itself and the initial diameter.

To enable this function set **E65**=1. Indicate under **E66** and **E67** the reduction ratio available to calculate the reel speed. Under parameter **E69** define the change in the diameter of the reel (in % of the maximum diameter) that is obtained when the numbers of reel revolutions indicated by parameter **E68** is reached.

- At the beginning, it is essential to reset the diameter at the actual value (**E07**) using the logic input **I31** or with parameter **E14**.
- The sign of the motor work speed has to be compatible with the conventions indicated under paragraph 2.1, i.e. positive when the equipment works as winder and negative when it works as unwinder.

Starting from the diameter estimation, it is possible to calculate the expected line speed, knowing the motor rotation speed. The quantity **d70** displays the filtered line speed in percentage of its maximum value.

7.1 DIAMETER CALCULATION VIA CAN BUS

By setting **E70**=1, the re-calculation of the diameter is enabled using the data coming from the CAN BUS line, if:

- The speed control by diameter estimation is enabled
- The speed line is in absolute value greater than the threshold **E71**

If all conditions are respected, the diameter is recalculated every 100 ms with a remarkable precision, independently from the exact thickness setting (E68 and E69). The speeds used for diameter calculation are filtered with **E72** time constant and with parameter **E76**=1, it's possible to enable also the moving average diameter calculation (**E78** samples).
The digital output function O39 goes high if CAN message is received correctly.

8 WINDER\UNWINDER CONTROL

Name	Description	min	max	def	u.m.	scale
EN_TENS_CTRL	E11 - Enable tension control	0	1	0		1
TENS_CTRL_SEL	E12 - Tension control selection	0	1	0		1
EN_DI_INV_POS_DIR	E13 - Enable digital input management to invert positive direction	0	1	0		1
EN_SPD_LINE_CTRL	E49 - Enable speed line control	0	1	0		1
EN_LIN_RAMP	E63 - Enable linear ramps			1		1
ACTIVE_MODE	D69 - Active Control mode					

There are many mode of operation that can be selected with this parameters or with digital input functions.
With parameter **E11**=1 or with digital input function **I23**=H it's possible to enable Tension Control, after that with parameter **E12** or with digital input function **I24** it's possible so choose speed control (0) or torque control (1). If Tension Control is disabled there are other 2 choice, setting **E49**=1 enable Speed Line Control, and E49=0 enable only Speed Control.
Every time is possible to see the actual active mode in internal display **d69.**

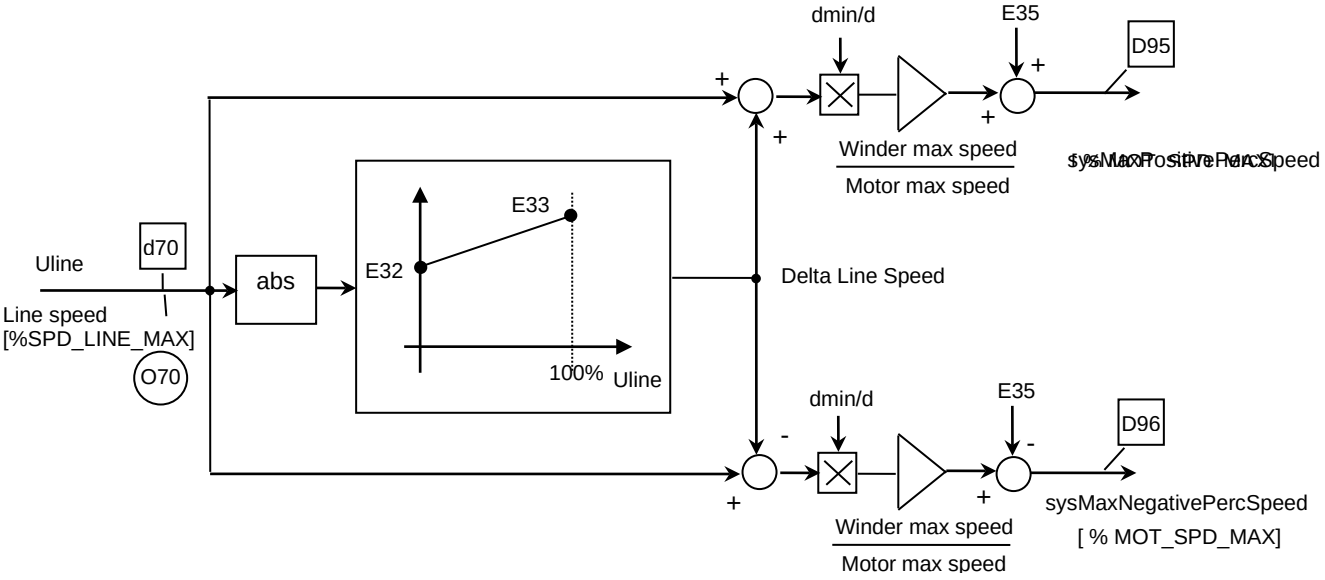
9 MOTOR SPEED LIMIT

Name	Description	min	max	def	u.m.	scale
PRC_DELTA_SPD_LINE_0	E32 - Delta line speed reference minimum	0.0	195.0	10.0	%SPD_LINE_MAX	163.84
PRC_DELTA_SPD_LINE_M	E33 - Delta line speed reference maximum	0.0	195.0	20.0	%SPD_LINE_MAX	163.84
PRC_OFF_LIM_SPD	E35 - Offset speed limitation	0.0	100.0	5.0	%MOT_SPD_MAX	163.84
PRC_SPD_LINE	D70 - Speed line measured				%SPD_LINE_MAX	163.84
PRC_SPD_MAX	D95 - Max motor speed				%MOT_SPD_MAX	163.84
PRC_SPD_MIN	D96 - Min motor speed				%MOT_SPD_MAX	163.84

In tension control modes (torque or speed) is always enabled a speed limitation circuit:

- o in Tension Torque Control the speed regulator works in speed limit control, reducing the torque reference if the maximum speed is reached.
- o In Tension Speed Control the speed reference from tension control is limited by maximum speed admitted.

When the motor speed limitation is active, start to work also the Tension PI Regulator anti wind-up function.



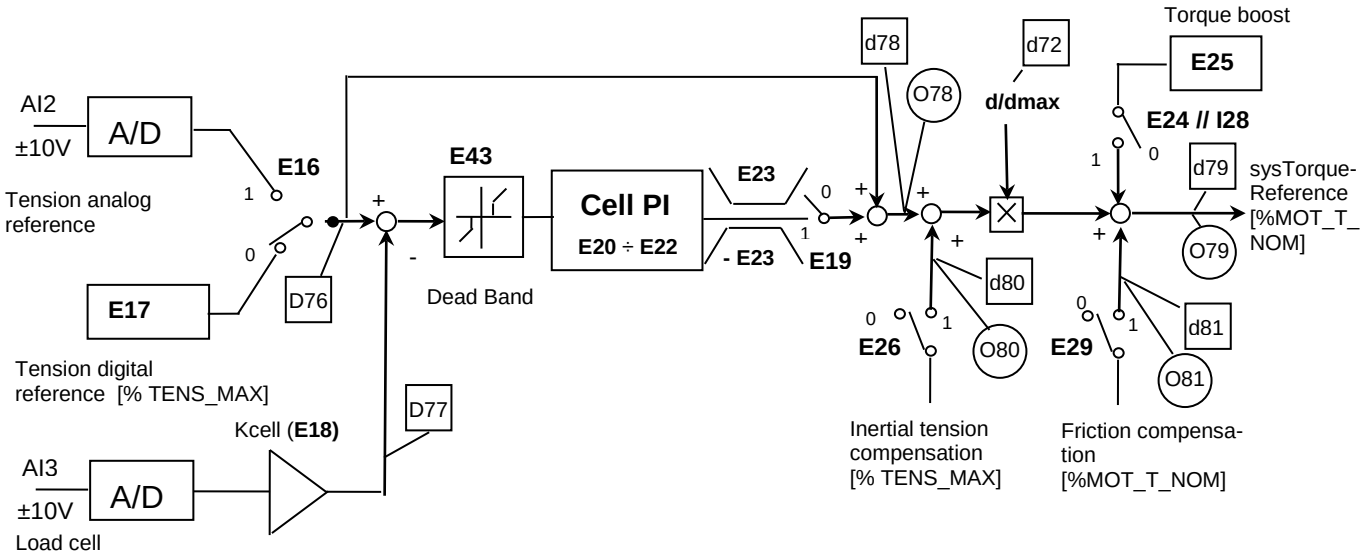
When the line is stopped the delta line speed is equals to parameter E32.
When the line is at max value (D70=100%) the delta line speed is equal to E33.
Usually when the line is stopped is better to execute material recovery at limited speed (E32). When the machine is running the speed limits are useful only to prevent high speed if the material is broken, for this reason is better to increase the delta line speed admitted (E33).
At the end an offset is added (E35) because is not recommended to work with Max Positive Speed Limit equals to Max Negative Speed Limit.

10 TENSION TORQUE CONTROL

Name	Description	min	max	def	u.m.	scale
TENS_REF_SEL	E16 - Tension reference selection	0	1	0		1
PRC_TENS_REF_DG	E17 - Tension digital reference	0.0	200.0	50.0	%TENS_MAX	163.83
PRC_TENS_REF	D76 - Tension Reference				%TENS_MAX	163.84
LD_CELL_KP	E18 - Load cell multiplication factor	0	100.0	100.0	%	10
PRC_LD_CELL	D77 - Tension measured by load cell				%TENS_MAX	163.84
EN_LD_CELL_CTRL	E19 - Enable load cell control	0	1	0		1
EN_PID_FREEZE	E90 - Enable PID freeze			0		1
EN_PID_FORCE	E91 - Enable PID force			0		1
PRC_PID_FORCE	E92 - PID force value	-400.0	400.0	0		40.96
PID_DEAD_ZONE	E43 - PID regulator error dead zone	0.0	100.0	0	%TENS_MAX	163.84
LD_CELL_REG_KP	E20 - Load cell regulator proportional gain	0	100.0	0		10
LD_CELL_REG_TI	E21 - Load cell regulator lead time constant	0.1	3000.0	100.0	ms	10
LD_CELL_REG_TF	E22 - Load cell regulator first order filter time constant	0.0	25.0	1.0	ms	10
LD_CELL_REG_LIMIT	E23 - Load cell regulator symmetric output limit	0	195.0	100.0		163.83
PRC_LD_CELL_REG_OUT	D78 - Load cell regulator output				%TENS_MAX	163.84
EN_INRT_COMP	E26 - Enable inertial load compensation	0	1	0		1
START_TIME_MIN	E27 - Motor and reel with dmin start time	1	60000	1000	ms	1
START_TIME_MAX	E28 - Motor and reel with dmax start time	1	60000	20000	ms	1
PRC_INRT_COMP	D80 - Inertial load compensation term				%TENS_MAX	163.84

PRC_D_APPL	D72 - Diameter applied				%D_MAX	163.84
EN_FRCT_COMP	E29 - Enable frictions compensation	0	1	0		1
PRC_FRCT_START	E30 - Starting friction torque	0.0	200.0	2.0	%MOT_T_NOM	40.96
PRC_FRCT_SPD	E34 - Motor speed thresold for friction compensation	0.0	100.0	2.0	%MOT_SPD_MAX	163.84
PRC_FRCT_MAX	E31 - Friction torque at max motor speed	0.0	200.0	5.0	%MOT_T_NOM	40.96
PRC_FRCT_COMP	D81 - Friction compensation term				%MOT_T_NOM	40.96
EN_TRQ_BOOST	E24 - Enable torque boost	0	1	0		1
PRC_TRQ_BOOST	E25 - Torque boost	-200.0	200.0	0		40.96
PRC_TRQ_REF	D79 - Torque Reference				%MOT_T_NOM	40.96

The adjustment of the tension is substantially a reel motor torque control, which considers the diameter to calculate the torque to be applied to achieve the wished tension. To enable the adjustment of the tension set **E11=1** or **I23=H** and to enable the adjustment by torque set **E12=1** or **I24=H**.



10.1 TENSION REFERENCE

The tension reference is in percentage of the maximum tension and can be displayed in the internal quantity d76.

Maximum tension is equal to: $T_{MAX}[N] = \frac{\tau_{nom}[Nm] \times R}{d_{MAX}[m]/2}$ and obviously $T_{MAX[Kg]} = \frac{T_{MAX[N]}}{9.81}$

Starting from 25.04 revision it's possible to see maximum tension calculated in D88 [kg].

For example:

τ nom = 35Nm ; R = 15 ; d_{MAX} = 800mm → T_{MAX} = 1312.5N = 133.8 Kg

The tension reference can be digital, by properly setting the parameter **E17** or can come from the analog input AI2 that is considered in absolute value. The connection **E16** allows selecting the active reference: 0 for digital, 1 for analog.

10.2 DIRECT TENSION CONTROL (WITH LOAD CELL)

To enable the direct tension control set **E19=1**. In this case, it is necessary to have a load cell available whose feedback under voltage has to be calculated at the analog input AI3. By means of the parameter **E18** it is possible to set the input voltage corresponding to the maximum wished tension. Under the internal quantity **d77** it is possible to display the feedback from the load cell in percentage of the maximum tension.

NB: Pay attention to the sign in the feedback from the load cell – a force acting in the correct work for the winder/unwinder shall correspond to a positive sign.

At the PI input there is a 1st level filter with time constant that can be set in ms in **E22**.
The gain of the proportional part is set in **E20**, the anticipation constant in ms in **E21.** The limit of the PI output can be set by means of the parameter **E23**. The PI is equipped with an anti wind-up circuit to avoid uselessly accumulating errors in the memory of the integral part when the output is saturated.

In the case of direct tension control, the compensations of frictions and inertial load are less relevant, which can however be used as compensations in feed forward.

10.3 INDIRECT TENSION CONTROL

To enable the indirect tension control set **E19=0.** In this case, the tension control acts by open loop; therefore, it is extremely important to estimate the value of the diameter very precisely and compensate both inertial loads and frictions.

10.3.1 COMPENSATION OF THE INERTIAL LOAD

In the speed transistors part of the torque supplied by the reel motor is destined to the inertial loads and this phenomenon depends on the overall reel inertia and on the material, which changes when the diameter changes.
To compensate the inertial loads correctly it is necessary to set the following parameters:

- **E27** = Fixed part start time
  This is the time necessary in seconds for the fixed inertia part (motor + reduction unit + reel with minimum diameter) to go from 0 to the maximum winder/unwinder speed (E00) at motor nominal torque.

- **E28** = Start time with winder at maximum diameter
  This is the time necessary in seconds for the system with its maximum inertia to go from 0 to the maximum winder/unwinder speed (E00) at motor nominal torque.

- **E10** = 2nd level filter time constant on the line speed in ms
  Since the inertia compensation is proportional to the speed derivate, it is essential to have a high-pass filter; therefore, it is essential to filter the line speed properly to avoid excessive noise at compensation term.

To help the measure of E27 and E28 user can enable Autotuning test C53 “EN_TEST_SPD” = 1 (“Start-up”) with right mechanical load (no load for E27 and maximum load for E28). When the test is completed will be necessary to copy the START TIME measured (P169) in the corresponding parameter (E27 or E28).
Please refer to OPDExp User manual for more information about this autotuning.

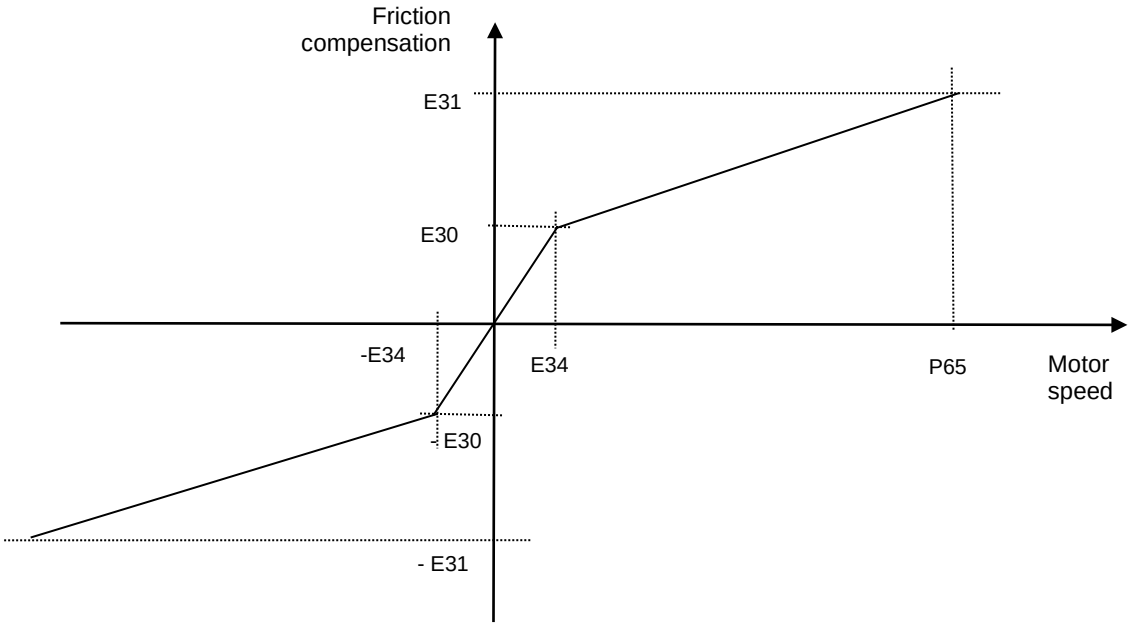
The compensation of the inertial load has to be enabled by setting **E26=1**. It is possible to display the compensation term in percentage of the maximum tension under the internal quantity **d80** and under the analog quantity **o80**.

10.3.2 FRICTION COMPENSATION

According to the motor rotation speed part of the supplied torque is used to win over the frictions.
To compensate the frictions correctly it is necessary to set the following parameters:

- **E30** = Starting friction torque in percentage of the motor nominal torque
- **E31** = Friction torque close to the maximum motor speed (P65)
- **E34** = Motor speed threshold for friction compensation

The compensation characteristic is as follows:



The friction compensation has to be enabled by setting **E29=1**. It is possible to display the compensation term in percentage of the motor nominal torque under the internal quantity **d81** and under the analog quantity **o81**

10.4 DIGITAL OUTPUTS

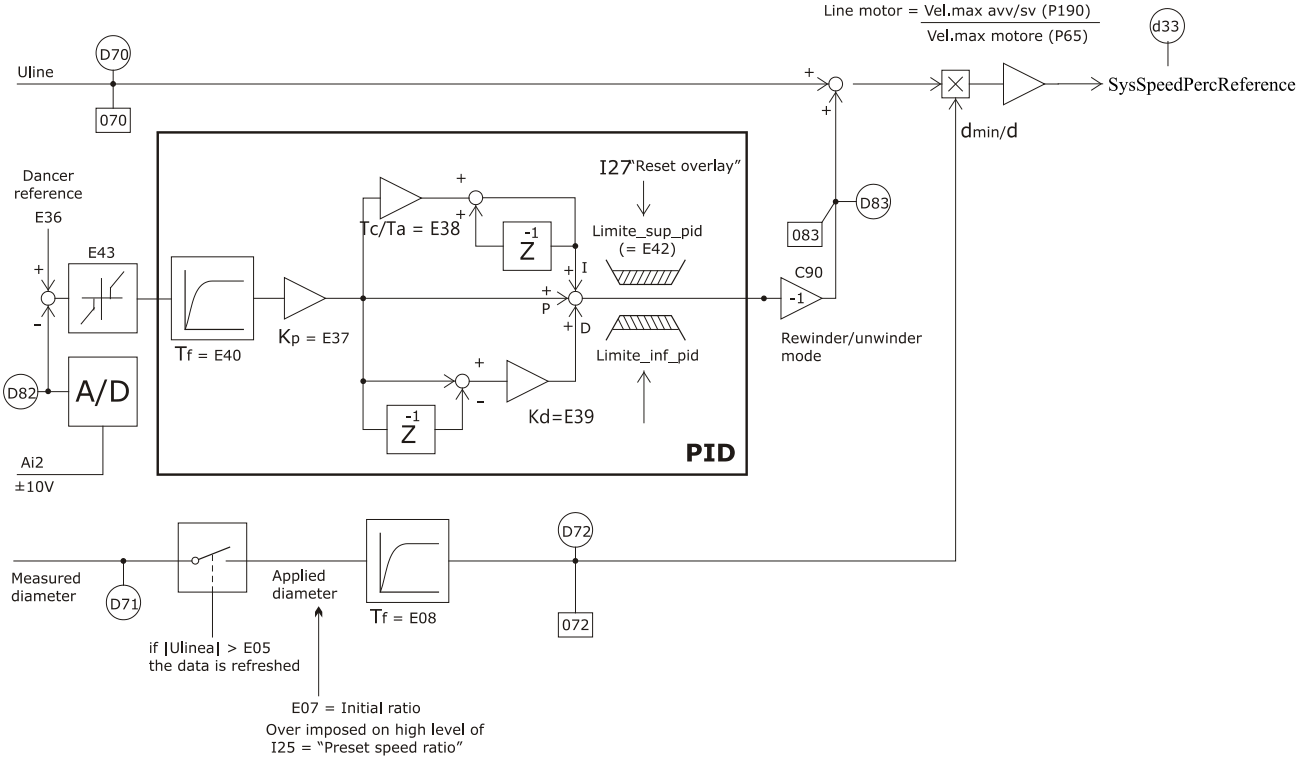
In tension torque control is available one output digital function:

O36 that goes at high level when load cell regulator is working, that is with drive in run state and if the load cell regulator is enabled with E19=1.

11 TENSION SPEED CONTROL

Name	Description	min	max	def	u.m.	scale
PRC_DANCER_POS_REF	E36 - Dancer position reference	-100.0	100.0	0.0	%STROKE	163.84
DANCER_POS_MIN	E44 - Dancer minimum position	-100.0	100.0	0.0	% 10V	163.84
DANCER_POS_MAX	E45 - Dancer maximum position	-100.0	100.0	0.0	% 10V	163.84
PRC_DANCER_POS	D82 - Dancer position				%STROKE	163.84
EN_PID_FREEZE	E90 - Enable PID freeze			0		1
EN_PID_FORCE	E91 - Enable PID force			0		1
PRC_PID_FORCE	E92 - PID force value	-400.0	400.0	0		40.96
PID_DEAD_ZONE	E43 - PID regulator error dead zone	0.0	100.0	0	%STROKE	163.84
DANCER_REG_KP	E37 - Dancer regulator proportional gain	0	100.0	0		10
DANCER_REG_TI	E38 - Dancer regulator lead time constant	0.1	3000.0	100.0	ms	10
DANCER_REG_KD	E39 - Dancer regulator derivative term	0	100.0	0		100
DANCER_REG_TF	E40 - Dancer regulator first order filter time constant	0.0	25.0	1.0	ms	10
DANCER_REG_LIMIT	E42 - Dancer regulator symmetric output limit	0	195.0	100.0		163.84
EN_DANCER_REG_INV	E41 - Reverse Dancer regulator output	0	1	0		1
PRC_DANCER_REG_OUT	D83 - Dancer regulator output				%SPD_LINE_MAX	163.84
EN_INRT_COMP	E26 - Enable inertial load compensation	0	1	0		1
START_TIME_MIN	E27 - Motor and reel with dmin start time	1	60000	1000	ms	1
START_TIME_MAX	E28 - Motor and reel with dmax start time	1	60000	4000	ms	1
MUL_SPD_REG_KP	D84 - Proportional gain Speed regulator multiplication factor					100
EN_DANCER_POS_MEM	E48 - Enable digital position memorization	0	2	0.0		1
DANCER_POS_MIN_DO	E46 - Dancer minimum position for digital output o35	-100.0	100.0	0.0	%STROKE	163.84
DANCER_POS_MAX_DO	E47 - Dancer maximum position for digital output o35	-100.0	100.0	0.0	%STROKE	163.84

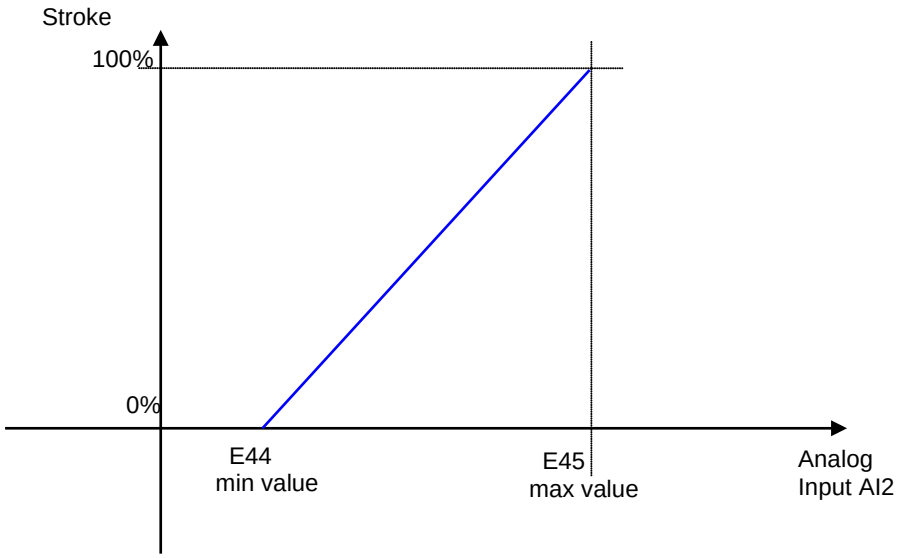
To enable the adjustment of the tension set **E11=1** or **I23=H** and to enable the adjustment by speed set **E12=0** and **I24=L**.



11.1 ADJUSTMENT OF THE DANCER

11.1.1 DEFINE DANCER STROKE

First of all it's necessary to define the real dancer stroke. To do this job parameters E44 and E45 have to be set with the analog input value corresponding to stroke limit.



There is a procedure to help this setting:

- Set E48 "EN_DANCER_POS_MEM" to 1 (STORE_MIN) in order to memorize dancer minimum value. Bring the dancer to its lower position and than clear to 0 E48. Automatically E44 is load with actual analog input value.
- Set E48 "EN_DANCER_POS_MEM" to 2 (STORE_MAX) in order to memorize dancer maximum value. Bring the dancer to its upper position and than clear to 0 E48. Automatically E45 is load with actual analog input value.

A this point it's possible to define dancer position and reference referred to real stroke available.

11.1.2 DANCER CONTROL

The PID of the dancer manages the error between the dancer reference set in **E36** and the measurement of the actual position (displayable in d82).

A dead area was implemented on the position error settable in terms of amplitude under **E43** in percentage of the stroke. This dead area is used to keep the dancer perfectly still in position also when the line is at zero speed.

At PID input there is a 1st filter with time constant settable in ms under **E40.**
The gain of the proportional part is set in **E37**, the anticipation constant in ms in **E38** and the gain of the derivative part in **E39**.
The maximum and minimum correction limit of the PID is set by means of the parameter **E42** unless the logic input **I27** is active ("Reset overlay"), which zeroes the limit.
The PID is equipped with an anti wind-up circuit to avoid uselessly accumulating errors in the memory of the integral part when the output is saturated.

By means of the connection **E41** it is possible to reverse the PID output to adapt the control to the operation as winder or unwinder.

11.1.3 VARIABLE GAINS ACCORDING TO THE DIAMETER

In the winder/unwinder application, the overall inertia brought t the motor axle can change remarkably during the processing. A compensation term was introduced to assure the stability and the dynamic feedback of our converter at any time.

To compensate the inertial loads change it is necessary to set the following parameters:

- **E27** = Fixed part start time
  This is the time necessary in seconds for the fixed inertia part (motor + reduction unit + reel with minimum diameter) to go from 0 to the maximum winder/unwinder speed (E00) at motor nominal torque.

- **E28** = Start time with winder at maximum diameter
  This is the time necessary in seconds for the system with its maximum inertia to go from 0 to the maximum winder/unwinder speed (E00) at motor nominal torque.

To help the measure of E27 and E28 user can enable Autotuning test **C53** "EN_TEST_SPD" = 1 ("Start-up") with right mechanical load (no load for E27 and maximum load for E28). When the test is completed will be necessary to copy the START TIME measured (P169) in the corresponding parameter (E27 or E28).
Please refer to OPDExp User manual for more information about this autotuning.

Upon commissioning of the machine, it is necessary to find the right speed regulator gains with the minimum diameter.
The compensation of the inertial load change has to be enabled by setting **E26=1**. It is possible to display the compensation term in the internal quantity **d84** that shows the proportional gain speed regulator multiplication factor.

11.1.4 DIGITAL OUTPUTS

In tension speed control are available two output digital function:

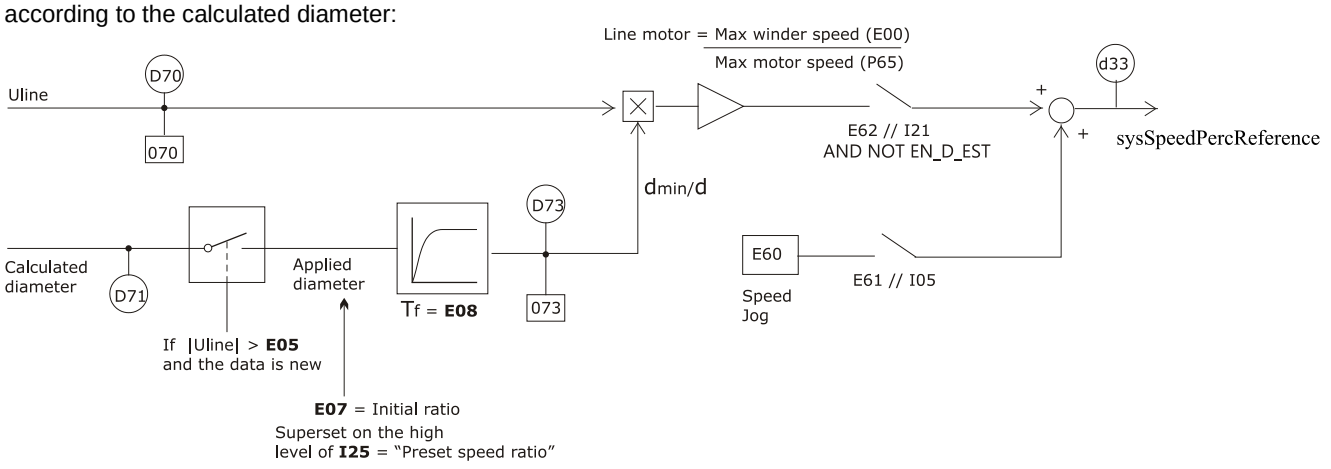
- **O35** Dancer position out of range: this output goes at high level if dancer position is great than maximum position for digital output E47 or if dancer position is lower than minimum position for digital output E46
- **O37** that goes at high level when dancer regulator is working, that is with drive in run state and when dead band disabled

12 SPEED CONTROL

Name	Description	min	max	def	u.m.	scale
PRC_SPD_JOG	E60 - Digital speed reference	0.0	100.0	0.0	%MOT_SPD_MAX	163.84
EN_SPD_JOG	E61 - Enable Digital speed reference	0	1	0		1
EN_LINE_REF	E62 - Enable speed reference from line	0	1	0		1

To disable the adjustment of the tension set **E11=0** and **I23=L.**

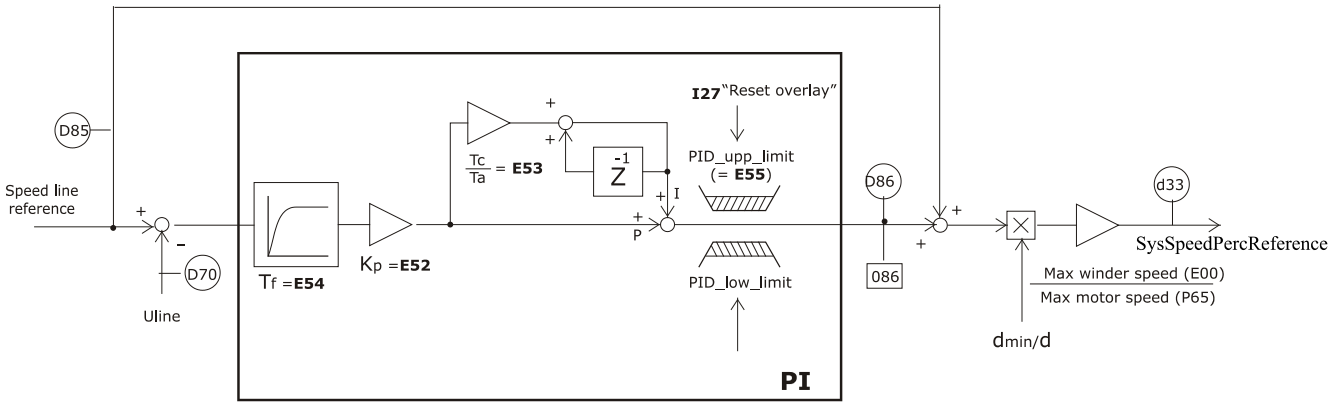
For enable only speed control set **E49**=0.
In this processing mode, it is possible to manage a speed jog that can be added to the line reference measured and adapted according to the calculated diameter:



12.1 SPEED LINE CONTROL

Name	Description	min	max	def	u.m.	scale
SPD_LINE_REF_SEL	E50 - Speed line reference selection	0	1	0		1
PRC_SPD_LINE_REF_DG	E51 - Speed line digital reference	-100.0	100.0	50.0	%SPD_LINE_MAX	163.84
SPD_LINE_REG_KP	E52 - Speed line regulator proportional gain	0	100.0	0		10
SPD_LINE_REG_TI	E53 - Speed line regulator lead time constant	0.1	3000.0	100.0	ms	10
SPD_LINE_REG_TF	E54 - Speed line regulator first order filter time constant	0.0	25.0	1.0	ms	10
SPD_LINE_REG_LIMIT	E55 - Speed line regulator symmetric output limit	0	200.0	100.0		163.83
EN_SPD_LINE_REG	E56 - Enable speed line regulator	0	1	0		1
EN_INRT_COMP	E26 - Enable inertial load compensation	0	1	0		1
START_TIME_MIN	E27 - Motor and reel with dmin start time	1	60000	1000	ms	1
START_TIME_MAX	E28 - Motor and reel with dmax start time	1	60000	20000	ms	1

Having disabled the adjustment of the tension with **E11=0** and **I23=L**, it is possible to enable the control of the line speed with the servodiameter management, by setting **E49=1**.



The line speed reference can be digital (**E51**) if **E50=0** or analog on A.I.3 if **E50=1**.
In both cases it is meant that the reference is standardized with regards to the maximum line speed used for the calculation of the maximum winder speed E00.

NB: in this working mode the diameter could only be estimated !

Under the internal quantity **d85** it is possible to display the current line speed reference.

12.1.1 LINE SPEED MEASUREMENT AVAILABLE (E65=0)

When the line speed measurement is available, a PI regulator is active in order to adjust the line speed to the wished value. The gain of the proportional part is set in **E52**, the anticipation constant in ms in **E53** and the filter time constant in **E54**. The maximum and minimum correction limit of the PI is set by means of the parameter **E55** unless the logic input **I27** is active ("Reset overlay"), which zeroes the limit itself.

Thanks to the measurement of the diameter, the PI regulator has just to compensate any imprecision in the diameter calculation.

12.1.2 LINE SPEED MEASUREMENT NOT AVAILABLE (E65=1)

When the line speed measurement is not available, the PI regulator is disabled and the line speed reference acts directly to impose the speed reference to the motor using the estimated diameter.
The precision in the adjustment depends very much on the precision of the diameter estimate.

12.1.3 DIGITAL OUTPUTS

In tension torque control is available one output digital function:

O38 that goes at high level when speed line regulator is working, that is with drive in run state, if speed line regulator is enabled with E19=1 and diameter estimation is disabled.

13 APPLICATION REVISION HISTORY

Rev. 25.07 (28/11/2013), Minimum core target: Opendrive Brushless 21.9/ Async 11.9

Issues fixed

1	**CanOpen collision**: with previous versions, the Can1 line was used for drive to drive communication in Jigger Control Mode, but this could create a CAN messages collision on the line. If "E70 - Enable estimation CAN correction" was disabled, the Drive Can node could not switch on Operational mode. With E70=1, the Drive Can node switched to Operational mode, but, depending on working mode, some PDOs were transmitted on the line with COB-ID of 0x181 (the default TPDO COB-ID for slave with address 1). With the 25.07 revision there are this news: o With E70=0 the Drive Can Node behavior is exactly the same of OPDE with standard application. No limitations about CAN functions. o With E70=1, TPDO1 and RPDO1 are used to send messages between drives, but now the COB-ID used is 0x681, in order to avoid any CAN collisions.

New Functionality

1	**Tension Torque Control PID limit:** now the parameter **"**E23 - Load cell regulator symmetric output limit" works only to limit the PID output, the tension reference is added after limitation.

Rev. 25.08 (28/01/2014), Minimum core target: Opendrive Brushless 21.9/ Async 11.9

New Functionality

1	**Diameter calculation via CAN Bus: in order to increase robustness of estimation , it is been introduced a new parameter (E72) for filtering the speeds before use it in diameter calculation**

Rev. 25.09 (30/01/2014), Minimum core target: Opendrive Brushless 21.9/ Async 11.9

Issues fixed

1	**Diameter calculation via CAN Bus**: with previous versions, the diameter estimated with CAN correction had an error of about 10%, especially with high ratio dmin to dmax. Now the calculation is right..

New Functionality

1	**Diameter calculation via CAN Bus: in order to increase robustness of estimation , now it's possible to enable, with E76=1, the moving average diameter calculation , with E78 samples.**

Via dell'Oreficeria, 41
36100 Vicenza - Italy
Tel +39 0444 343555
Fax +39 0444 343509
www.bdfdigital.com