5. SIZING CRITERIA

Because of the high performance obtained by the drive/brushless motor set, the dynamic performance of the entire system is strongly influenced by the mechanics of the system itself.

In particular, the following considerations are important:

- the degree of precision depends on the sensor and not on the motor
- the response speed depends on the transmission rigidity (mechanical passband)
- the system audible noise, sometimes very strong, does not depend on the motor and/or on the electronics, but on a mechanical design which is not suitable for the required performance.
- the motor noise is due to continuous acceleration and braking. In such conditions, motor overheating may occur, which may not be due to a too-small motor.
- the passband controlling the drive depends on the mechanics, as it is not possible to stabilize the electronics to a period less than 3 times the ring time of the system mechanical oscillations.

The choice of the mechanical transmission must be carried out, therefore, according to the application. In mandrel applications, with significant transmitted power and marginal dynamic performance, common reducer transmissions are used. In this case, that is the optimum economical choice.

In case of axis applications, where the system dynamic performance is fundamental, the required torque is often equal to the sum of the motor and load inertial torques. The use of a reduction ratio in the transmission reduces, on one side, the load inertia influence, but, on the other, it increases the motor side. In such applications, therefore, direct coupling is normally used.

With direct coupling, the system dynamics are influenced by the shaft torsional rigidity and by the relative resonance frequency. The drive and motor are capable of much higher bandwidth than the mechanics.

After choosing the motor and the transmission, it is necessary to check the application.

In case of applications whose speed and load are constant or variable for periods longer than the motor time constant, it is sufficient to check that the maximum load is within the capacity limits stated for the motor and the drive.

On the contrary, in applications where the load changes according to a faster cycle, do the following:

- Trace a cycle speed/time diagram, remembering that the reaching of a precise position or speed value requires, apart from the time set by the system limit accelerations, a settling period equal to 3 times the period of the system passband.
- Refer the system inertia and loads back to the motor axis.
- Calculate the acceleration cycle and the cycle of the relative inertial torques.
- State the cycle torque/time diagram by adding the inertial torques to the loads.
- Calculate from the torque/time diagram the cycle effective torque. If the cycle is made up of n duration segments $t_1, t_2, \ldots t_n$, and of their corresponding torques $C_1, C_2, \ldots C_n$, the cycle effective torque is given by:

$$C_{eff} = \sqrt{\frac{C_1^2 t_1 + C_2^2 t_2 + \ldots + C_n^2 t_n}{t_1 + t_2 + \ldots + t_n}}$$

- Calculate, with the same formula, the average quadratic speed.
- Calculate the cycle average torque.
- Calculate the maximum duration period of the cycle maximum torque.
- Calculate the torque required with the cycle maximum speed.
- Calculate the cycle maximum torque.

The motor and the electronic have to be checked on the basis of the obtained data.

5.1. MOTOR CHECK

The motor check phases are:
- check of the peak torque
- thermal Sizing
- electrical Sizing

Check of the demagnetization current

Such check is carried out with a direct comparison with the peak current via the formula:

$$I_{demag} = \sqrt{2}\ \frac{C_{pk}}{K_t}$$

where:

I_{demag} = motor demagnetization current
C_{pk} = cycle peak torque
K_t = motor torque constant

Check of the thermal Sizing

Check first that the point C_{eff}, w_{eff} is within the area of the motor continuous operating range.
In particular, calculate the motor temperature increase, given by the relation:

$$\Delta T_{max} = \frac{65}{L_n}\left[\left(\frac{C_{eff}}{T_n}\right)^2 L_n + \left(\frac{\omega_{eff}}{\omega_n}\right)^2 L_0\right]$$

where:

L_n = motor rated losses
T_n = motor rated torque
ω_n = motor rated speed
L_0 = motor rated losses in ω_n

If the maximum temperature is higher than the motor maximum, a bigger motor is needed.

Check of the electric Sizing

In this case, it is necessary to check that at maximum speed, the voltage required by the motor is lower or equal to that supplied by the drive with the minimum expected power supply voltage. The following relation must be satisfied:

$$V_{max} = \sqrt{\left(K_e \omega_{pk} + R_w \frac{C_{pk}}{K_t}\right)^2 + \left(\frac{C_{pk}}{K_t} \frac{PN}{2} \omega_{pk} L_w\right)^2} \leq E_{min}$$

where:

E_{min}	=	minimum voltage supplied by the drive
K_e	=	motor voltage constant
ω_{pk}	=	cycle maximum speed
R_ω	=	motor terminal to terminal resistance
C_{pk}	=	cycle maximum torque
K_t	=	motor torque constant
PN	=	motor pole number
L_ω	=	motor terminal to terminal inductance

If such condition is not satisfied, it is necessary to choose a motor with a winding suitable for a higher speed; in this case a higher current will be needed.

5.2. CHECK OF THE DRIVE SIZE

The drive size is chosen according to the torque to be supplied to the motor with a specific winding, from where the needed energy is derived. The thermal time constant of the drive is only a few seconds, therefore a current supply longer than 2 seconds has to be considered as continuous current.

The peak and average currents required by the drive are provided by:

$$I_{max} = \frac{C_{pk}}{K_t} \qquad I_{med} = \frac{C_{ave}}{K_t}$$

where:

C_{pk}	=	cycle maximum torque
C_{av}	=	cycle average torque
K_t	=	motor torque constant

The drive must be in a position to develop continuous and peak currents higher than the calculated values; remember that the drive maximum current must be compared to I_{max} only if the relative time is lower than 2 seconds; if not, the drive must have a rated current higher than I_{max}.

5.3. APPLICATION EXAMPLE: FLYING CUT

Consider a continuous belt moving cutter.

The cutter is mounted on a carriage. The belt speed is 5 m/s.

The cutter must, with a command, increase its speed till reaching the belt, get synchronized with the belt speed, keep such speed for 300 ms (cutting time), brake and return to the rest position.

The total stroke of the cutter carriage is 5 m. The cutter weighs 80 kilos plus the motor weight.

As the mechanical transmission system is rather complex, it is necessary to provide a speed stabilization time T_{st} with transients to about 150 ms.

The cutting space with a constant speed is given by:

$$S_t = V_t x (T_t + T_{st}) = 5 x (300 x 10^{-3} + 150 x 10^{-3}) = 2.25 m$$

The carriage will run across the remaining space during its acceleration and deceleration phase. If these two spaces are equal:

$$S_{acc} = S_{dec} = (S_{tot} - S_t) / 2 = (5 - 2.25) / 2 = 1.375 m$$

The average speed during the acceleration is:

$$V_{med} = V_{max} / 2 = 5 / 2 = 2.5 m/s$$

The acceleration and deceleration times are:

$$T_{acc} = S_{acc} / V_{med} = 1.375 / 2.5 = 550 ms$$

The acceleration (and deceleration) is:

$$a = V_{max} / T_{acc} = 5 / 0.55 = 9.091 m/s^2$$

Assuming that the motor weight is about 20 kilos, the required inertial power is:

$$F = a x (M_{carr} + M_{mot}) = 9.091 x (80 + 20) = 909.091 N$$

The total semi-cycle time is:

$$T_{sc} = 2 x T_{acc} + T_{st} + T_t = 2 x 0.550 + 0.150 + 0.300 = 1.55 s$$

The transmission is carried out via a pinion and a rack. The pinion dimensions are:

diameter Dp = 40 mm

length hp = 30 mm

The speed, acceleration and inertia brought to the motor axis are:

Speed: $\omega_{max} = V_{max} / (Dp/2) = 5 / (0.04/2) = 250\ rad/s$

Acceleration: $m_a = a / (D_p/2) = 9.091/ (0.04/2) = 454.545\ rad/s^2$

Inertia: $J = M_{tot} x\ (D_p/2)^2 = 100\ x\ (0.04/2)^2 = 0.04\ kgm^2$

The pinion inertia is given by:

$$J_p = (D_p/2)^4\ x\ h_p\ x\ \pi\ x\ \delta = 5.806\ x\ 10^{-5}\ Kgm^2$$

where δ is the density of the material forming the pinion (steel).

Check now a UL7.14.30 motor with an inertia of 0.0017 kgm^2.
The total inertia is:

$$J_{tot} = J + J_p + 0.0017 = 0.04 + 5.806\ x\ 10^{-5} + 0.0017 = 0.0417\ kgm^2$$

Assuming a pinion efficiency equal to 0.95, the maximum torque required to the motor is:

$$C_{max} = ma\ x\ J_{tot} / 0.95 = 454.545\ x\ 0.0417 / 0.95 = 19.98\ Nm$$

The average and effective torques are therefore:

$$C_{med} = C_{max}\ x\ T_{acc}\ x\ 2 / T_{sc} = 14.179\ Nm$$

$$C_{eff} = C_{max}\ x\ (2\ x\ T_{acc} / T_{sc})^{1/2} = 16.832\ Nm$$

As the cycle effective torque is lower than the motor rated torque, a motor of a bigger size must be chosen. Repeating the operations for a UL7.19.30 motor with an inertia of 0.0023 kgm^2, the obtained average torque is 14.383 Nm while the effective torque is 17.073 Nm. The motor is therefore suitable for the application with a high margin.

Given the torque constant Kt = 1.77, the average and maximum current absorbed by the motor are:

$$I_{max} = C_{max} / K_t = 11.4\ A$$

$$I_{med} = C_{med} / K_t = 8.1\ A$$

The drive size to be used with the present application is therefore XVy-10-20.

6. MAINTENANCE

6.1. CARE

The Flexmax drive series must be installed according to the relevant installation regulations. They do not require any particular maintenance. They should not be cleaned with a wet or moist cloth. The power supply must be switched off before cleaning.

6.2. SERVICE

The screws of all terminals on the drive should be re-tightened two weeks after initial commissioning.

This should be repeated each year. If the drives have been stored for more than three years, the capacitance of the intermediate circuit capacitors may have been impaired. Before commissioning these drives, it is advisable to supply power to the drives for at least two hours in order to regain the capacitor original ratings. To this purpose apply an input voltage without **applying any load on the output.**

After these steps, the drive is ready to be installed without limits.

6.3. REPAIRS

Repairs of the drive should only be carried out by qualified personnel (suggested by the manufacturer).

If you carry out a repair on your own, observe the following points:

- When ordering spare parts do not only state the drive type but also the drive serial number. It is also useful to state the type of the regulation card and the system software version.
- When changing the cards ensure that the positions of switches and jumpers are observed!

6.4. CUSTOMER SERVICE

For customer service, please refer to your Powertec Sales office, distributor, or service agent.

7. TROUBLESHOOTING

FIGURE 7.1: LED STATUS AND KEYPAD

In case an alarm occurs, the LED at the top-right is illuminated red. In such a case the alarm code is shown on the keypad display and can be looked up in the manual. If the code is not displayed, push enter to see the code, to clear the alarm, turn off the drive enable and push enter twice to reset the drive.

The default for the keypad on power up is to dispaly speed (n) and load (i) in rpm and amps. Pushing M (Menu) will change the display to the parameter mode, showing the Menu number and the parameter number on the first line and the value of the parameter on the second line. See the keypad addendum for menu structure and number identification, or look at the menu structure in the WinPX tool shipped with every drive. This is a valuable tool to see and learn the menu structure even if you choose not to use the computer connection to the drive itself.

Pushing M (Menu) will result in highlighting the "M". Using the UP and DOWN keys will change the menu number. Pushing M (Menu) again will result in the highlight moving the "P". Using the UP and DOWN keys will change the parameter number. Pushing E (Enter) will highlight the rightmost number of the parameter, use the UP and DOWN keys to set it and push E (Enter), this will move the cursor to the next position, etc. When all the digits have been entered, the next push of the E (Enter) will put the new value in ACTIVE memory only. If the value is to be saved in permanent memory, push M (Menu) until "P" is highlighted, then push M again to display an "S" in the left side of the second line. Depress Enter to save the parameter to permanent memory.

Code 00001 **Error n. 1** ***BRIDGE DESATURATION***

Short circuit on the motor winding or on the power bridge.

Code 00010 **Error n. 2** ***OVERCURRENT***

Overcurrent protection intervention.

The cause could be an incorrect setting of the current regulator gains as compared to the application.

Code 00011 **Error n. 3** ***DC LINK OVERVOLTAGE***

Overvoltage on the intermediate circuit.

The braking resistance is not connected in the right way or it is open.

The threeshold is 950V.

Code 00100 **Error n. 4** ***HEATSINK OVERTEMP***

Drive thermal protection.

The working cycle is too high for the drive size.

Code 00101 **Error n. 5** ***MODULE JUNCTION OVERTEMP***

Thermal protection of the power module.

The working cycle is too high for the drive size.

Code 00110 **Error n. 6** ***BRAKE DESATURATION***

Short circuit on the braking resistance.

Code 00111 **Error n. 7** ***MOTOR OVERTEMP***

Intervention of the motor thermal protection. Overtemperature on the motor winding or PTC sensor not connected to the drive.

Code 01000 **Error n. 8** ***AUX POWER UNDERVOLT***

Too low power supply voltage on the regulation circuit.

Code 01001 **Error n. 9** ***DSP PROG ERROR***

Firmware error.

Code 01010 **Error n. 10** ***PRG 16KHZ OVERTIME***

Firmware error.

Code 01011 **Error n. 11** ***INVALID FLASH PARMS***

The parameter value is not recognized. Do the Parameter Saving and Drive Reset commands with the correct parameters.

Code 01100 **Error n. 12** ***BAD FLASH MEMORY***

Firmware error.

Code 01101 **Error n. 13** ***BRAKE OVERPOWER***

The internal braking resistance is too warm because of a too high working cycle. Wait 30 seconds and give the Drive Reset command. The resistance temperature is calculated by an algorithm of the drive.

Code 01110 **Error n. 14** ***NTC DISCONNECTED***

Alarm intervention on the drive internal NTC sensor; such sensor measures the temperature. The NTC sensor could be damaged or the circuit could be interrupted.

Code 01111 **Error n. 15** ***BRAKE ERROR***

Intervention of braking alarm.

Code 10000 **Error n. 16** ***LOCK DRIVE***

Firmware error.

Code 10001 **Error n. 17** ***DI ENCODER COUNT***

The number of pulses of the feedback digital encoder between two index pulses (zero slot) is not correct. Check the **Encoder pulses** parameter**,** the encoder wiring and the ground and shielding connections.

Code 10010 **Error n. 18** ***AD ENCODER COUNT***

The number of pulses of the feedback sinusoidal encoder between two index pulses (zero slot) is not correct. Check the **Encoder pulses** parameter**,** the encoder wiring and the ground and shielding connections.

Code 10011 **Error n. 19** ***ENCODER SIMULATION***

Encoder simulation alarm. Check the encoder simulation parameters.

Code 10100 **Error n. 20** ***UNDERVOLTAGE***

The function is only checked when the drive is enabled. The error is when the DC bus voltage is less than 400V (default setting). The threeshold can be modified setting the system parameter 18120 "SYS_UV_V_MIN".

Code 11001 **Error n. 25** ***EB-BUS LOSS***

It gets automatically active if the bus communication at a HS or VHS level is not present.

Code 11010 **Error n. 26** ***EB-GENERIC FAIL***

It gets active to signal any card problem: hardware, software, configuration problem etc. In order to state the real problem causing such a condition, see the "EB FAIL CAUSE" parameter.

Code 11011 **Error n. 27** ***SEQUENCE ERROR***

It gets active when the drive is power supplied with an active enable input.

Code 11100 **Error n. 28** ***FAST LINK ALARM***

It occurs in slave drives when the fast link serial communication is phisically interrupted.

Code 11101 **Error n. 29** ***POSITION ERROR***

It occurs in position slave and electrical line shaft slave modes, when the position error is bigger than 8.388.608 counts (equal to 512 encoder pulses). The threeshold level can be modified by setting the system parameter 18108 "SYS_POS_ERR_MAX".

Code 11111 **Error n. 31** ***EXTERNAL FAULT***

External alarm. A digital input has been programmed as an external alarm, but +24V is not available on this terminal.

The alarms 23 and 24 are programmable and they are dedicated only to MDPLC firmware applications.

8. SETTINGS AND COMMISSIONING

8.1. MENU STRUCTURE

MONITOR	
20040	ACTUAL SPEED
20041	MOTOR CURRENT
20043	DC LINK VOLTAGE
20044	DRIVE TEMPERATURE

DRIVE PARAMETERS	
20000	DRIVE MAXIMUM CURRENT
20021	DRIVE ADDRESS
20023	DRIVE CONFIGURATION
20024	DRIVE BAUDRATE
20025	DRIVE SERIAL CONFIG
20026	DRIVE SER DELAY TIME
18110	DRIVE FAST LINK
20022	DRIVE FIRMWARE
29004	DRIVE ACTUAL CONFIG

MOTOR PARAMETERS	
20002	MOTOR NUMBER OF POLES
20003	MOTOR MAXIMUM SPEED

ENCODER PARAMETERS	
20010	ENCODER TYPE
20011	ENCODER PULSES
20012	ENCODER SUPPLY

RAMP	
21102	RAMP ACC CW
21103	RAMP ACC CCW
21104	RAMP DEC CW
21105	RAMP DEC CCW
21210	RAMP ENABLE
21212	RAMP OUTPUT

SPEED	
21200	SPEED REF1
21201	SPEED REF2
21204	SPEED MAX POS
21205	SPEED MAX NEG
21206	SPEED THR
21207	SPEED THR OFFSET
21213	SPEED THR DELAY

CURRENT	
22000	T CURR REF1
22001	T CURR REF2
22004	T CURR LIM +
22005	T CURR LIM -
22007	T CURR THR
22009	MAX SPEED CUR LIM
22010	CURR THR DELAY

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SPEED / POSITION GAINS

23000	GAIN SPEED
23001	GAIN POS
23002	GAIN INT

DIGITAL INPUTS

20100	DIGITAL INPUT 0
20101	DIGITAL INPUT 1
20102	DIGITAL INPUT 2
20103	DIGITAL INPUT 3
20104	DIGITAL INPUT 4
20105	DIGITAL INPUT 5
20106	DIGITAL INPUT 6
20107	DIGITAL INPUT 7
20162	DIG IN NEG
20163	DIG IN STATUS

DIGITAL EXPANSION INPUTS

20150	EXP DIGIT INPUT 0
20151	EXP DIGIT INPUT 1
20152	EXP DIGIT INPUT 2
20153	EXP DIGIT INPUT 3
20154	EXP DIGIT INPUT 4
20155	EXP DIGIT INPUT 5
20156	EXP DIGIT INPUT 6
20157	EXP DIGIT INPUT 7

VIRTUAL DIGITAL INPUTS

20170	VIRT DIGIT INPUT 0
20171	VIRT DIGIT INPUT 1
20172	VIRT DIGIT INPUT 2
20173	VIRT DIGIT INPUT 3
20174	VIRT DIGIT INPUT 4
20175	VIRT DIGIT INPUT 5
20176	VIRT DIGIT INPUT 6
20177	VIRT DIGIT INPUT 7
20178	VIRT DIGIT INPUT 8
20179	VIRT DIGIT INPUT 9
20180	VIRT DIGIT INPUT 10
20181	VIRT DIGIT INPUT 11
20182	VIRT DIGIT INPUT 12
20183	VIRT DIGIT INPUT 13
20184	VIRT DIGIT INPUT 14
20185	VIRT DIGIT INPUT 15
20186	VIRT DI STATUS
20187	VIRT DI AT START
20188	VIRT DI AT DISABLE
20189	VIRT DI RESET AT FAIL

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DIGITAL OUTPUTS

20200	DIGITAL OUTPUT 0
20201	DIGITAL OUTPUT 1
20202	DIGITAL OUTPUT 2
20203	DIGITAL OUTPUT 3
20204	DIGITAL OUTPUT 4
20205	DIGITAL OUTPUT 5
20206	DIGITAL OUTPUT 6
20207	DIGITAL OUTPUT 7
20254	DIG OUT NEG
20255	DIG OUT STATUS

VIRTUAL DIGITAL OUTPUTS

20270	VIRT DIGIT OUTPUT 0
20271	VIRT DIGIT OUTPUT 1
20272	VIRT DIGIT OUTPUT 2
20273	VIRT DIGIT OUTPUT 3
20274	VIRT DIGIT OUTPUT 4
20275	VIRT DIGIT OUTPUT 5
20276	VIRT DIGIT OUTPUT 6
20277	VIRT DIGIT OUTPUT 7
20278	VIRT DIGIT OUTPUT 8
20279	VIRT DIGIT OUTPUT 9
20280	VIRT DIGIT OUTPUT 10
20281	VIRT DIGIT OUTPUT 11
20282	VIRT DIGIT OUTPUT 12
20283	VIRT DIGIT OUTPUT 13
20284	VIRT DIGIT OUTPUT 14
20285	VIRT DIGIT OUTPUT 15
20289	VIRT DO RESET AT FAIL
20290	VIRT DO SET AT FAIL
20286	VIRT DO STATUS

DIGITAL EXPANSION OUTPUTS

20250	EXP DIGIT OUTPUT 0
20251	EXP DIGIT OUTPUT 1
20252	EXP DIGIT OUTPUT 2
20253	EXP DIGIT OUTPUT 3
20256	EXP DIG OUT STATUS

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ANALOG INPUTS

20300	ANALOG INPUT 0
20301	ANALOG INPUT 1
20302	ANALOG INPUT 2

ANALOG INPUT 0

20310	AN INPUT READ 0
20320	AN INPUT OFFSET 0
20330	AN INPUT ZPOS 0
20340	AN INPUT ZNEG 0
20350	AN INPUT SCALE 0
20360	AN INPUT VALUE 0

ANALOG INPUT 1

20311	AN INPUT READ 1
20321	AN INPUT OFFSET 1
20331	AN INPUT ZPOS 1
20341	AN INPUT ZNEG 1
20351	AN INPUT SCALE 1
20361	AN INPUT VALUE 1

ANALOG OUTPUTS

20400	ANALOG OUTPUT 0
20401	ANALOG OUTPUT 1
20402	ANALOG OUTPUT 2
20403	ANALOG OUTPUT 3

ANALOG OUTPUT 0

20410	AN OUTPUT WRITE 0
20420	AN OUTPUT SCALE 0
20430	AN OUTPUT OFFSET 0
20440	AN OUTPUT VALUE 0

ANALOG OUTPUT 1

20411	AN OUTPUT WRITE 1
20421	AN OUTPUT SCALE 1
20431	AN OUTPUT OFFSET 1
20441	AN OUTPUT VALUE 1

ANALOG OUTPUT 2

20412	AN OUTPUT WRITE 2
20422	AN OUTPUT SCALE 2
20432	AN OUTPUT OFFSET 2
20442	AN OUTPUT VALUE 2

ANALOG OUTPUT 3

20413	AN OUTPUT WRITE 3
20423	AN OUTPUT SCALE 3
20433	AN OUTPUT OFFSET 3
20443	AN OUTPUT VALUE 3

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ENCODER REPETITION

20030	ENC PULSES REV
20032	GAIN INDEX STEP
20033	INDEX OFFSET
20034	INDEX OFFSET READ
20035	ENABLE ENC REPETITION

JOG FUNCTION

21000	JOG LIMIT
21001	JOG SET REFERENCE
21002	JOG REFERENCE
21003	JOG ACC CW
21004	JOG ACC CCW
21005	JOG DEC CW
21006	JOG DEC CCW

MULTI SPEED FUNCTION

21301	MULTI SPEED 1
21302	MULTI SPEED 2
21303	MULTI SPEED 3
21304	MULTI SPEED 4
21305	MULTI SPEED 5
21306	MULTI SPEED 6
21307	MULTI SPEED 7
21310	MULTI SPEED INDEX
21311	MULTI SPEED SERIAL

MULTI RAMP FUNCTION

21440	MULTI RAMP INDEX
21441	MULTI RAMP SERIAL

MULTI RAMP 1

21401	MULTI RAMP ACC CW1
21411	MULTI RAMP ACC CCW 1
21421	MULTI RAMP DEC CW 1
21431	MULTI RAMP DEC CCW 1

MULTI RAMP 2

21402	MULTI RAMP ACC CW 2
21412	MULTI RAMP ACC CCW 2
21422	MULTI RAMP DEC CW 2
21432	MULTI RAMP DEC CCW 2

MULTI RAMP 3

21403	MULTI RAMP ACC CW 3
21413	MULTI RAMP ACC CCW 3
21423	MULTI RAMP DEC CW 3
21433	MULTI RAMP DEC CCW 3

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POSITION PARAMETER

30010	POS ACC CW
30011	POS ACC CCW
30012	POS DEC CW
30013	POS DEC CCW
30014	POS SPEED
30015	POS CURRENT
30094	POS STOP DEC
30016	POS ACTUAL POS

POS FUNCTION

30000	MEAS UNIT PER REV
30017	POS MINIMUM PRESET
30018	POS MAXIMUM PRESET
30055	POS MINIMUM ABS
30056	POS MAXIMUM ABS
30090	POS PRESET INDEX
30092	POS PRESET SERIAL
30091	POS ABS
30093	POS CONFIGURATION
30080	POS DEST REV
30081	POS DEST POS

POS THR CONFIG

30050	POS ABSTHR
30051	POS THR
30052	POS THROFF
30053	POS THR NEAR 1
30054	POS THR NEAR 2

POS PRESET [0]

30100	POS PRESET [0]
30200	POS SPEED [0]
30300	POS ACC [0]
30400	POS DEC [0]

POS PRESET [1]

30101	POS PRESET [1]
30201	POS SPEED [1]
30301	POS ACC [1]
30401	POS DEC [1]

POS PRESET [2]

30102	POS PRESET [2]
30202	POS SPEED [2]
30302	POS ACC [2]
30402	POS DEC [2]

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POS PRESET [3]

30103	POS PRESET [3]
30203	POS SPEED [3]
30303	POS ACC [3]
30403	POS DEC [3]

POS PRESET [4]

30104	POS PRESET [4]
30204	POS SPEED [4]
30304	POS ACC [4]
30404	POS DEC [4]

POS PRESET [5]

30105	POS PRESET [5]
30205	POS SPEED [5]
30305	POS ACC [5]
30405	POS DEC [5]

POS PRESET [6]

30106	POS PRESET [6]
30206	POS SPEED [6]
30306	POS ACC [6]
30406	POS DEC [6]

POS PRESET [7]

30107	POS PRESET [7]
30207	POS SPEED [7]
30307	POS ACC [7]
30407	POS DEC [7]

POS PRESET [8...63]

30108	POS PRESET [8]
301..	POS PRESET [...]
30163	POS PRESET [63]

ZERO FOUND CONFIG

30020	POS ACC CW 0
30021	POS ACC CCW 0
30022	POS DEC CW 0
30023	POS DEC CCW 0
30024	POS SPEED MAX 0
30025	POS SPEED REFERENCE 0
30027	POS SPEED FINE 0
30030	POS ZPOS
30031	POS 0 FOUND
30035	POS ZREV OFFSET
30029	POS ZREV

ZERO RETURN CONFIG

30026	POS SPEED RET 0
30032	POS ACC RET 0
30033	POS DEC RET 0
30034	POS DSPEED RET 0

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ELECTRICAL LINE SHAFT

32000	ELS PULS REV MAST
32008	ELS DELTA TIME
32009	ELS MASTER SEL
32014	ELS DELTA RATIO
32020	ELS SLIP
19113	POSITION ERROR

ELECT LINE SHAFT RATIO

32001	ELS RATIO [0]
32002	ELS RATIO [1]
32003	ELS RATIO [2]
32004	ELS RATIO [3]
32005	ELS ACT RATIO
32006	ELS RATIO INDEX
32007	ELS RATIO SERIAL

ELECT LINE SHAFT R BAND

32100	ELS RB SPEED MAX
32104	ELS RB SPEED REF
32101	ELS RB TIME
32102	ELS RB ACC
32103	ELS RB DEC

FAILURE REGISTER

24000	DRIVE FAULT
24001	EXTERNAL FAULT
24002	BRIDGE DESATURATION
24003	OVERCURRENT
24004	DCLINK OVERVOLTAGE
24005	HEATSINK OVERTEMP
24006	MOD JUNCT OVERTEMP
24007	BRAKE DESATURATION
24008	MOTOR OVERTEMP
24009	AUX POWER UNDERVOLT
24010	DSP PROG ERROR
24011	PRG 16KHZ OVERTIME
24012	INVALID FLASH PARMS
24013	BAD FLASH DEVICE
24014	BRAKE OVERPOWER
24015	NTC DISCONNECTED
24016	BRAKE ERROR
24017	LOCK DRIVE
24018	DI ENCODER COUNT
24019	AD ENCODER COUNT
24020	ENCODER SIMULATION
24021	UNDERVOLTAGE
24026	EB-BUS LOSS
24027	EB-GENERIC FAIL
24028	SEQUENCE ERROR
24029	FAST LINK ERROR
24030	POSITION ERROR
24040	FIRST ALARM

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FAILURE QUEUE	
24200	DRIVE FAULT (0)
24201	DRIVE FAULT TIME (0) sec.
24220	DRIVE FAULT (1)
24221	DRIVE FAULT TIME (1) sec.
24240	DRIVE FAULT (2)
24241	DRIVE FAULT TIME (2) sec.
24260	DRIVE FAULT (3)
24261	DRIVE FAULT TIME (3) sec.
24280	DRIVE FAULT (4)
24281	DRIVE FAULT TIME (4) sec.
24300	DRIVE FAULT (5)
24301	DRIVE FAULT TIME (5) sec.
24320	DRIVE FAULT (6)
24321	DRIVE FAULT TIME (6) sec.
24340	DRIVE FAULT (7)
24341	DRIVE FAULT TIME (7) sec.
24360	DRIVE FAULT (8)
24361	DRIVE FAULT TIME (8) sec.
24380	DRIVE FAULT (9)
24381	DRIVE FAULT TIME (9) sec.
24400	DRIVE FAULT (10)
24401	DRIVE FAULT TIME (10) sec.
24420	DRIVE FAULT (11)
24421	DRIVE FAULT TIME (11) sec.
24440	DRIVE FAULT (12)
24441	DRIVE FAULT TIME (12) sec.
24460	DRIVE FAULT (13)
24461	DRIVE FAULT TIME (13) sec.
24480	DRIVE FAULT (14)
24481	DRIVE FAULT TIME (14) sec.
24500	DRIVE FAULT (15)
24501	DRIVE FAULT TIME (15) sec.
24520	DRIVE FAULT (16)
24521	DRIVE FAULT TIME (16) sec.
24540	DRIVE FAULT (17)
24541	DRIVE FAULT TIME (17) sec.
24560	DRIVE FAULT (18)
24561	DRIVE FAULT TIME (18) sec.
24580	DRIVE FAULT (19)
24581	DRIVE FAULT TIME (19) sec.
24600	DRIVE FAULT (20)
24601	DRIVE FAULT TIME (20) sec.
24620	DRIVE FAULT (21)
24621	DRIVE FAULT TIME (21) sec.
24640	DRIVE FAULT (22)
24641	DRIVE FAULT TIME (22) sec.
24660	DRIVE FAULT (23)
24661	DRIVE FAULT TIME (23) sec.
24680	DRIVE FAULT (24)
24681	DRIVE FAULT TIME (24) sec.

PROGRAM ALARM	
24100	ALARMS TO MASK

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SYSTEM

18100	SYS_ IC_P_FAK
18101	SYS _IC_I_ FAK
18102	SYS _IC_D_FAK

BRAKING UNIT

18103	SYS_ OV_CL_LIM
18104	SYS_ OV_MAX_LIM

DIGITAL OUTPUT RESET

20005	SYS_DO_RESET_AT_FAIL
20006	SYS_DO_SET_AT_FAIL

UNDERVOLTAGE LIMITS

18120	SYS_UV_V_MIN
18121	SYS_UV_P_FAK

SERVICE

txv0340

8.2. PC CONFIGURATOR

The configurator WIN PX is a program supplied together with the product.

Its installation requires a PC with a Windows 95 system, with minimum 8 meg RAM. Contact Powertec if you have another operating system.

The configurator communicates with the drive using the Slink-3 protocol.

Together with the drive parameterization, the configurator allows downloading the firmware in order to create some personalized applications using the MDPLC development environment.

8.3. COMISSIONING

Before powering up the drive, carry out the following verifications:

- Check the connections with the line L1, L2, L3
- Check the connections with the motor U, V, W
- Check the breaking resistance connection (if present)
- Check the connections with the encoder S2 and/or S1 (if present)
- Check the input connection 24Vdc
- Check the I/O connections
- Check all the drive and motor ground connections

After having checked as shown above, it's possible now to power the drive; then check:

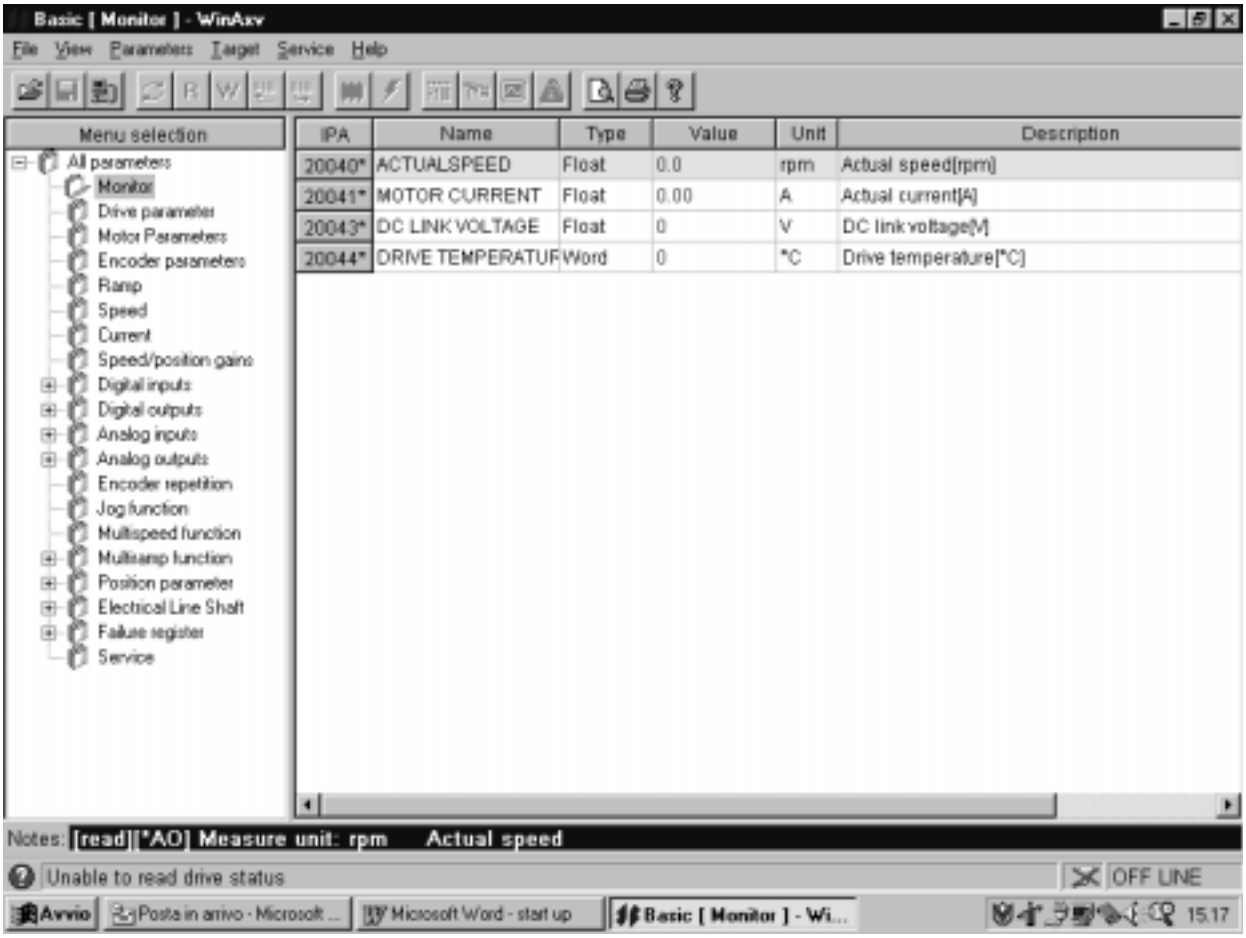
- Line voltage (max permissible voltage 460Vac + 10%)
- Voltage of the intermediate circuit DC bus (270-350 for input voltage 230Vac, 480-650Vdc for input voltage 400Vac, 550-715 for input voltage 460Vac; if the measured voltage is not in the indicated range, check the line voltage)
- Regulation input voltage 24Vdc (term.19-20 of the connector C1) if the voltage is lower than 24Vdc, the drive may not work, if the voltage is higher than 30Vdc the drive could be damaged.

8.3.1. Connection with the PC

The drive is delivered from the factory with a standard configuration in the speed mode. The input and output state is already programmed as in the following example; therefore user is able to start up the drive control and run the motor immediately (when used a motor series BM with encoder sin.cos at 2048 p/r).

To perform the correct parameter settings, it's necessary to use the configurator WIN PX. Connect the drive to your PC using the serial communication as suggested in the manual; check that the termination resistance switch is on the 120 ohm position. In the Windows menu Start/Programs/WIN PX execute the command WinPX to start up the configurator. After starting the configurator, open from the File/Open menu the Basic Vx_xxx.par file, where x_xxx states the version of the Basic firmware.

This file includes the list of all the parameters resident in the drive. The data is split into several windows and a menu tree, typical of the Windows system, therefore easy to understand. When the Basic file has opened, the PC will connected automatically with the drive and communicate. If you see no errors after opening the Basic file, the drive is communicating with the PC (for commands and configurators specifications refer to the instruction manual of WIN PX).



8.3.2. Essential parameters set up

The essential parameters to check before starting the motor are:

MENU	PARAMETER
DRIVE CONFIGURATION	DRIVE MAXIMUM CURRENT
MOTOR PARAMETERS	MOTOR NUMBER OF POLES
	MOTOR MAXIMUM SPEED
ENCODER PARAMETERS	ENCODER TYPE
	ENCODER PULSES
	ENCODER SUPPLY

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It's now possible to enable the drive and rotate the motor in the function of the inputs configuration and setup. As an example three types of configurations are described.

8.3.3. Speed mode configuration example

UNDER CONSTRUCTION

8.3.4. Position mode configuration example

UNDER CONSTRUCTION

8.3.5. Electrical line shaft mode configuration example

UNDER CONSTRUCTION

8.4. DOWNLOAD FIRMWARE

The standard firmware loaded at the factory is an application called Basic.

The Basic application firmware is composed of 2 files.

- the low level firmware or firmware library (**PX Basic VX_XX.sre**).
- the parameters file, used by the user for the drive application settings (**PX Basic VX_XX.par**).

While firmware in the drive can be downloaded in the field by a customer when necessary, it is normally never required, and certainly not for routine use or configuration of the drive. Your Flexmax drive has been set up and run at the factory with the motor you purchased. Virtually nothing is required in the way of set up unless you want to change something that is factory standard default. We encourage you to wire the drive and at least temporarily use the default digital input setup to verify proper operation before changing any program parameters at all

1) To perform a firmware upgrade refer to this AFTER contacting the factory.

- Open the configurator WIN PX.
- Enable communication with the drive from the menu “Target/connect”.
- From the menu “Service/Load firmware” select the command “Browse”.
- The file PX Basic VX_XX.sre of the last version will be indicated default, choose it and select the command “Load”.
- At this time the firmware download is activated, and the data quantity (number Bytes) transferred is shown on the screen. The Basic is composed of nearly 90.000 bytes and the download time is around 60 sec.
- Reset the drive with the command of reset from configurator, or turn off and on the 24 vdc supply.
- In the menu “File/Open” open the PX Basic VX_XX.par file.
- In the menu “Parameters/Write all” copy all the system parameters in the drive.
- In the menu “Parameters/Save parameters” save all the parameters in the drive.
- Reset the drive with the command “reset” configurator, or turn off and on.

At this time the firmware updating has finished, now the user can proceed setting the drive as desired.

2) To set up the drive in the MDPLC mode: Use this ONLY after being directed by the factory.

- Open the configurator WIN PX.
- Enable communication with the drive in the menu “Target/connect”.
- In the menu “Service/Load firmware” select the command Browse.
- Search the file Vplc.sre and select the command Load.
- During the firmware download, the screen displays the data quantity (number Bytes) transferred.
- Reset the drive with the command of reset from configurator, or turn off and on the 24 vdc supply.
- In the menu “File/Open” open the Parameter MDPLC.par file .
- In the menu “Parameters/Write all” copy all the parameters in the drive.
- In the menu “Parameters/Save parameters” save all the parameters in the drive.
- Reset the drive with the command “reset”, or turn off and on the 24 vdc supply.

Now the drive is set up in the MDPLC mode and it's ready to receive the dedicated application created by the specific program.

NOTE ! The drive can be set up in the MDPLC mode only if the user has previously executed the installation of the program in his own PC. That program, distributed with CDRom, includes, as well as the compiler IEC1131, and the firmware file Basic VX_XX.sre.

8.5. ENCODER SIN.COS PHASING

UNDER CONSTRUCTION

8.6. RESOLVER PHASING

1) Free the motor shaft from possible mechanical couplings, in order to let it rotate freely.
   Via the Flexmax WinPX program set the **Drive configuration** (20023) parameter to ***ENCODER PHASING.***
2) After writing the parameter, give the SAVE and RESET command. (lightning bolt)
   (With this functioning condition, the digital input 0 is temporarily defaulted to the ENABLE command while the digital input 1 is temporarily defaulted to the RESET command regardless of your specific settings). Set current limit plus and minus (current menu -60- param T Curr Lim+ and T Curr Lim -) to a value not exceeding 50% of the motor rated current.
3) Enable digital input 0 (apply +24V.) The motor rotates in a clockwise direction, seen from the motor shaft side, it will energize and lock on a motor pole, then rotate some part of a revolution and is then torque-stopped in a fixed point (make sure that the motor rotates in a clockwise direction, otherwise check the wiring). The shaft will sit in this position.
4) Save the parameters BEFORE disabling the drive. (Click on the IC chip symbol)
5) Change the **Drive configuration** (20023) parameter to ***Speed (or what you desire). Change the current limits back to the original settings, not to exceed 150% of the motor nameplate current.***
6) Give a drive-reset command via the digital input 1, or reset using the lightning symbol. Answer yes to all the questions in the pop-up windows.
7) The offset of the resolver is now stored in permanent memory and does not ever have to be set again unless the memory is rewritten with another value. Of course any maintenance in the future may require resetting this index.
8) Make certain you save your file on the computer by clicking File/Save or by clicking the diskette symbol. This way, even a replacement drive can be downloaded with the identical file.

8.7. DIGITAL ENCODER + HALL SENSOR PHASING

Procedure for performing the phasing of a digital encoder + Hall traces. This has already been done by the factory for any drive ordered for a particular motor. There is no need to do this unless the motor has been repaired, encoder replaced or some other situation.

In order to perform such a procedure it is necessary to enable the Motor window function of the Win PX configurator and to pull the HA POSITION (19022) parameter: Service —> serv. HA encoder —> HA POSITION menu.

The encoder configuration (encoder type parameter) has to be digital+hall.

Make sure that the drive has been disabled.

1) Free the motor shaft from possible mechanical couplings, in order to let it rotate freely.
   Via the Flexmax WinPX program set the **Drive configuration** (20023) parameter to ***ENCODER PHASING.***
2) After writing the parameter, give the SAVE and RESET command. (lightning bolt)
   (With this functioning condition, the digital input 0 is temporarily defaulted to the ENABLE command while the digital input 1 is temporarily defaulted to the RESET command regardless of your specific settings). Set current limit plus and minus (current menu -60- param T Curr Lim+ and T Curr Lim -) to a value not exceeding 50% of the motor rated current.
3) Enable digital input 0 (apply +24V.) The motor rotates in a clockwise direction, seen from the motor shaft side, it will energize and lock on a motor pole, then rotate some part of a revolution and is then torque-stopped in a fixed point (make sure that the motor rotates in a clockwise direction, otherwise check the wiring). The shaft will sit in this position.
4) Save the parameters BEFORE disabling the drive. (Click on the IC chip symbol)
5) Change the **Drive configuration** (20023) parameter to ***Speed (or what you desire). Change the current limits back to the original settings, not to exceed 150% of the motor nameplate current.***
6) Give a drive-reset command via the digital input 1, or reset using the lightning symbol. Answer yes to all the questions in the pop-up windows.
7) The offset of the encoder is now stored in permanent memory and does not ever have to be set again unless the memory is rewritten with another value. Of course any maintenance in the future may require resetting this index.
8) Make certain you save your file on the computer by clicking File/Save or by clicking the diskette symbol. This way, even a replacement drive can be downloaded with the identical file.