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Specification of products are subject to change without notification

1. PLC/PC with analog interface Move to freely adjustable positions

Task description

An adjustable linear movement is needed for laboratory equipment. The movement is calculated on-line by a PC or by a PLC and takes place within the range 20 mm to 70 mm. It should be possible to move to every position within this range.

For safety reasons acceleration should never be greater than 75 m/s2 and the velocity should never exceed 1,6 m/s

Additional task

Reduce the max velocity to 0,2 m/s.



Position 1: 22 mm Position 2: 55 mm Position 3: 27 mm Position 4: 55 mm

Position xx: 48 mm



E400-AT



Analog Outputs

Education_Examples-V1.4e.doc

Position specification over 0 -10 V interface with limitation of acceleration and velocity.

1. Selection of 'Run' mode

Туре	Run Mode	O Serial
Initialization	Set Value Configuration	👂 🔘 Analog
Set Value Generation	Filter Parameter	Continuous Curve
Position Monitoring	>	O Trigger Curve
Control Switches	>	O Two Point

2. Specification of the scaling range 0 -10V \rightarrow 0 -70 mm

Туре	Run Mode	Þ	Minimal Position:	-160.009 mm
Initialization	Set Value Configuration		Maximal Position:	160.009 mm
Set Value Generation	Filter Parameter		'0' Position:	21.991 mm
Position Monitoring			L '1' Position:	69.996 mm

3. Limitation of velocity and acceleration

Туре	Run Mode	⊳	Max Velocity:	1.6 m/s
Initialization	Set Value Configuration	⊳	Max Acceleration:	75.102 m/s^2
Set Value Generation	Filter Parameter	Þ		



Other solution: Use RS-232/485 or Profibus

2. PLC/PC with digital output Replacement of pneumatic cylinder

Task description

In an automation mechanism, a point to point movement from 22 mm to 68mm is needed. Acceleration may never become larger than 20 m/s2 and the velocity should be limited to 0,5 m/s. The superordinate control consists of a small PLC, which has four free digital outputs.

Additional task

Now make the same PLC control up to 10 different positions. Every position should have a dedicated acceleration and velocity limitation.



Position 1: 22 mm Position 2: 68 mm



Use 'Two point' digital mode and limit acceleration and velocity.

1. Mode 'Two Point'



2. Define the positions

Туре	▶	Run Mode 🕴	D		linimal Position:	-160.009 mm
Initialization	Þ	Set Value Configuration		ШМ	laximal Position:	160.009 mm
Set Value Generation	۲	Filter Parameter		0' 🗖)' Position:	21.991 mm
Position Monitoring	⊳			L '1	' Position:	68.003 mm

3. Define acceleration and velocity limitations

Туре	Run Mode	⊳	Max Velocity:	0.5 m/s
Initialization	Set Value Configuration	⊳	Max Acceleration:	21.935 m/s^2
Set Value Generation	Filter Parameter			



Additional task :

Use Multitrigger Electronics and all four digital outputs of the PLC

3. PLC/PC run profile movement Pick and Place application

Task description

In an automated mechanism a 'pick and place' movement is needed. The first movement goes from 30 mm to 70 mm, whereby the moving time may amount to 50ms. In order to avoid damage, the return motion must occur relatively slowly. Therefore a max. acceleration of 20 m/s2 and a deceleration of 10 m/s2 are specified. The velocity should never exceed 1,5 m/s.

The superordinate control consists of a small SPS, which has four free digital outputs.

Additional Task

How could the same PLC drive up to 9 different pick and place movements ?



Move: $30 \rightarrow 70 \text{ mm} / 50 \text{ ms}$

Move : 70 \rightarrow 30 mm / 20 m/s² and 10 m/s² v_{max}: 1.5m/s

4 digital Outputs





Position specification over trigger mode. The pick profile is produced with 'minimum jerk '. For the place movement, the 'Point to point' function in the Curve Inspector is used.

1. Select : Trigger Curve

Туре	Run Mode 🛛 🔊	O Serial
Initialization 🛛 🔰	Set Value Configuration 🔋 👂	O Analog
Set Value Generation	Filter Parameter 🛛 👂	O Continuous Curve
Position Monitoring		© Trigger Curve
Control Switches		O Two Point

2. Rising edge enables curve 1, falling edge is going to start curve 2

Туре	Run Mode	Minimal Position:	-160.009 mm
Initialization	Set Value Configuration	Maximal Position:	160.009 mm
Set Value Generation	Filter Parameter	Rise Curve Number:	1
Position Monitoring		Fall Curve Number:	2

3. Create curves using the 'Curve Inspector'







Place movement: Point to Point



Additional task:

Use Multitrigger electronic unit and all four digital outputs of the PLC

4. Velocity control by PLC/PC Synchronization to conveyer velocity

Task description

In an automated mechanism a candy is to be shifted onto a conveyor belt moving at a velocity of 0,8 m/s. In order to avoid damages or in order an exact adjustment of the candies, the shifting movement should be done at almost the same velocity of the conveyor. The superordinate control unit consists of a small PLC, which has only digital outputs.

Additional task

How could the production speed be improved?



Length of the candy ca. 50 mm Velocity of the conveyer: V:= 0.8 m/s



Use 'two point' mode and limit the velocity to 0.8 m/s.

1. Mode: Two Point

Туре	Þ	Run Mode 🛛 🔊	Γ	O Serial
Initialization	Þ	Set Value Configuration 🛛 👂	ŀ	🔿 Analog
Set Value Generation		Filter Parameter 🛛 👂	Ŀ	Continuous Curve
Position Monitoring	▶		Ŀ	O Trigger Curve
Control Switches	⊳∥		ŀ	⊛ Two Point

2. Limitof the velocity to 0.8 m/s

Туре	Þ	Run Mode	Þ	Max Velocity:	0.8 m/s
Initialization	⊳	Set Value Configuration	⊳	Max Acceleration:	75.102 m/s^2
Set Value Generation	Þ	Filter Parameter	Þ		



Additional task

By using a profile (curve mode) instead of a simple two point movement the speed of the returnmovement could be increased

5. Supervision of trailing errors (following error) Detection of blocked packets

Task description

Packages are placed in a handling machine. Some of the packages are badly assembled, so there is a risk that some of them block the mechanism. When this happens, the handling machine must be stopped immediately.

Stroke: 120 mm Velocity: 1.1 m/s

Acceleration: 30 m/s²

There is only an E400-AT electronic unit available to do the task.

Additional task

How can you ensure that the blocked packages are not destroyed as they pass through the motors?



Use two point mode. Adjust the max. velocity to 1.1 m/s. Set max. acceleration to 30 m/s2. Monitor the error limit. As soon as the trailing error is larger than 2 mm, a warning will be sent. The superordinate control unit can stop the machine.

1. Select mode: Two Point and specify the stroke

1	Drive A	Туре	▶	Run Mode 🛛 🔊	〗	Minimal Position:	-160.009 mm
	Drive B	Initialization	⊳∥	Set Value Configuration		Maximal Position:	160.009 mm
	Drive C	Set Value Generation	Þ	Filter Parameter 🛛 👂	2	'0' Position:	19.999 mm
	Drive D	Position Monitoring	Þ			'1' Position:	139.991 mm

2. Limit velocity and acceleration

I	Drive A	Þ	Туре 👂	Run Mode 👂	Max Velocity: 1.1	m/s
Γ	Drive B	Þ	Initialization 👂	Set Value Configuration	Max Acceleration: 30.041 m.	/s^2
L	Drive C	Þ	Set Value Generation	Filter Parameter 🛛 🗎 🕨		

3. Define trailing error band (called following error)

Drive A	Þ	Туре	▶	Pos Range Min :	0 mm
Drive B	⊳	Initialization	₽	🖪 Pos Range Max:	39.997 mm
Drive C	⊳	Set Value Generation	₽	In Position -:	0.996 mm
Drive D	⊳	Position Monitoring		In Position +:	0.996 mm
		Control Switches	⊳	🖪 Following Error - :	1.992 mm
		Control Parameters	▶	Following Error + :	1.992 mm
		la	× 1		

4. Enable ,Warn Mask' on drive level

Drive A	►	Туре	Þ	Error Mask	₽	🗆 Slider Missing
Drive B	⊳	Initialization	▶	Warn Mask	Þ	🛿 Drive Init Not Done
Drive C	⊳	Set Value Generation	▶	Emergency Stop	⊳	🛛 Drive Following Error
Drive D	⊳	Position Monitoring				Pos Range Indicator
		Control Switches				Drive Hot Calculated
		Control Parameters				🗆 Drive Hot Sensor
		Commutation				
1		Error Handling	Þ			

5. Disable additional possibilities of the ,Warn Mask' on system level

System	Þ	Info 🛛 🔊	Error Mask) DCLV Power Low
Drives	⊳	Passwords 🛛 👂	🛛 Warn Mask 🛛 🕞 🖗	l c) DCLV Power High
		Error Handling 🛛 🔋 🛛	Relais Mask 🛛 🔊] c) DCLV Signal Low
		Startup Mode 🛛 👂	Logging Mask 🛛 🔊 🖡	ll c) DCLV Signal High
		10 Configuration	DCLV Monitoring	C) Electronic Hot

Additional task

Activate force limiter (max. current)

6. Position-Feedback to PLC/PC Collision safety

Task description

two movements interlink in a handling machine. In order to be certain of avoiding a collisionthe linear motor will generate a signal, if the two movements pass within a distance of between 50 to 75 mm. The stroke range of the linear motor is from 20 to 90 mm, whereby the velocity must be limited to 0,5 m/s.

the only control unit available is the E400-AT .



Use two point mode. Limit velocity and acceleration (0.5 m/s, e.g. to 30 m/s2). Set 'Pos Range ' to 50 to 75 mm. As soon as the slider is in the area between 50 to 75 mm, a 'pos error ' signal is activated.

1. Select the stroke using Two Point mode

Drive A	Туре 👂	Run Mode 🛛 🕨	Minimal Position:	-160.009 mm
Drive B	Initialization	Set Value Configuration	Maximal Position:	160.009 mm
Drive C	Set Value Generation	Filter Parameter 🛛 👂	'0' Position:	19.999 mm
Drive D	Position Monitoring		I '1' Position:	89.994 mm

3. Limit velocity and acceleration

Drive A	Þ	Туре	0	Run Mode 🛛 👂	7	L Max Velocity:	0.5 m/s
Drive B		Initialization 🔅	⊳∥	Set Value Configuration	۶I	Max Acceleration:	30.041 m/s^2
Drive C	⊳	Set Value Generation	\geq	Filter Parameter	ĕ		

4. Adjust the position band

Drive A	Þ	Туре	▶	🖪 Pos Range Min :	49.997 mm
Drive B	⊳	Initialization	▶	Pos Range Max:	74.995 mm
Drive C	▶	Set Value Generation	▶	In Position -:	0.996 mm
Drive D	▶	Position Monitoring		In Position +:	0.996 mm
		Control Switches	⊳	Following Error - :	2.5 mm
		Control Parameters	Þ	Following Error + :	2.5 mm

5. Enable Pos Range Indicator inside the ,Warn Mask' on drive level

Drive A	▶	Туре	⊳	Error Mask	₽	Γο	Slider Missing
Drive B	⊳	Initialization	⊳	Warn Mask	۲	⊠	Drive Init Not Done
Drive C	⊳	Set Value Generation	⊳	Emergency Stop	⊳	0	Drive Following Error
Drive D	⊳	Position Monitoring	⊳			\otimes	Pos Range Indicator
		Control Switches	⊳			Γ	Drive Hot Calculated
		Control Parameters	⊳			lo	Drive Hot Sensor
		Commutation	⊳				
		Error Handling	۲				

Remark: The position range signal is linked to the output 'Pos Error Output' and not to the ,Warn Output'! But it must be enabled inside of the ,Warn Mask'.

6. Enable the hardware of the ,Pos Error Output'

System 🕨	Info 👂	🗆 Run Input
Drives 👂	Passwords 👂	🗆 Init Input
	Error Handling 🛛 👂	Freeze Input
	Startup Mode 🛛 👂	Emerg Stop Input
	10 Configuration 🛛 🔋 🕨	🛛 Analog/Trig Drive A
	Command Interface 🛛 👂	🛛 Analog/Trig Drive B
	Time 👂	🛛 Analog/Trig Drive C
		🛛 Analog/Trig Drive D
		🛛 Error Output
		🛛 Warn Output
		🐵 Pos Error Output

7. End position feedback (AT-electronic unit) Monitoring of the end position

Task description

The superordinate control is to receive a signal, at exactly the moment the linear motor exactly achieves its final position (range 0,5 mm). The movement goes from 20 mm to 77 mm with a velocity of 0,3 m/s and acceleration of 20 m/s2.

Use an AT-electronic unit.



Use Two point mode. Limit velocity and acceleration. Set , Pos Range' to 76.5 and 77.5 mm. As soon as the slider will be in the range between 76.5 and 77.5 mm a ,Pos Error' signal will be canceled.

1. Use Two Point mode and adjust the stroke

Drive A	Туре 👂	Run Mode 👂	Minimal Position:	-160.009 mm
Drive B 👂	Initialization 🛛 🔋 🕨	Set Value Configuration	Maximal Position:	160.009 mm
Drive C 👂	Set Value Generation 🛛 🔋 🕨	Filter Parameter 🛛 👂	OV Position:	19.999 mm
Drive D 👂	Position Monitoring		10V Position:	77.007 mm

3. Limit velocity and acceleration

1	Drive A	▶ Ty	уре 👂	2	Run Mode	Ы	L	Max Velocity:		0.5 m/s
	Drive B	⊳∥lni	itialization 🛛 🔋 🕨	۶II	Set Value Configuration		L	Max Acceleration:	30.041	m/s^2
	Drive C)	⊳ Se	et Value Generation 🛛 🔋 🕨	>	Filter Parameter					

4. Set the position band

Drive A	Туре	Pos Range Min :	76.499 mm
Drive B	Initialization 🛛	L Pos Range Max:	77.495 mm
Drive C 👂	Set Value Generation	In Position -:	0.996 mm
Drive D 👂	Position Monitoring	In Position +:	0.996 mm
	Control Switches	Following Error - :	2.5 mm
	Control Parameters	Following Error + :	2.5 mm
	Commutation 👂		
	Error Handling		

5. Enable Pos Range Indicator inside of the ,Warn Mask' on drive level

Drive A	Туре 👂	Error Mask	🗆 Slider Missing
Drive B	Initialization	🛛 Warn Mask 🛛 🔊 🔊	🛿 Drive Init Not Done
Drive C	Set Value Generation	Emergency Stop	Drive Following Error
Drive D	Position Monitoring	•	Pos Range Indicator
	Control Switches		Drive Hot Calculated
	Control Parameters		Drive Hot Sensor
	Commutation 👂		
1	Error Handling		

Remark: The position range signal is linked to the output 'Pos Error Output' and not to the ,Warn Output'! But it must be enabled inside the ,Warn Mask'.

6. Enable the hardware of the ,Pos Error Output

System	▶	Info	₽	🗆 Run Input
Drives	Þ	Passwords	⊳	🗆 Init Input
		Error Handling	⊳	Freeze Input
		Startup Mode	⊳	Emerg Stop Input
		10 Configuration	۲	🛛 Analog/Trig Drive A
	F	Command Interface	⊳	🛛 Analog/Trig Drive B
	· · · · · · · · · · · · · · · · · · ·	Time	⊳	🛛 Analog/Trig Drive C
			_	🛛 Analog/Trig Drive D
				🛛 Error Output
				🛛 Warn Output
				Pos Error Output

8. PLC/PC controls multiple positions/profiles Change between different tasks

Task description

A handling machine assembles different parts during the day. Because of this, the stroke of the motor must be switched as well as all the velocity and acceleration values.

Small parts:	20 mm to 80 mm	v _{max} = 1.5 m/s	$a_{max} = 50 \text{ m/s}^2$
Big parts:	35 mm to 65 mm	v _{max} = 1.0 m/s	a _{max} := 20 m/s ²

For this application, the PLC possesses only digital outputs with no serial or analog interface.



Solution Use the multitrigger functionality. Create a multitrigger table with the following inputs:

Position 0 (State 0):	20mm	v _{max} = 1.5 m/s	$a_{max} = 50 \text{ m/s}^2$
Position 1 (State 2):	35mm	v _{max} = 1.0 m/s	$a_{max} = 20 \text{ m/s}^2$
Position 3 (State 3):	65mm	v _{max} = 1.0 m/s	$a_{max} = 20 \text{ m/s}^2$
Position 4 (State 4):	80mm	v _{max} = 1.5 m/s	$a_{max} = 50 \text{ m/s}^2$

1. Switch electronic unit to 'Multitrigger'

Info	₽	O AT
Passwords	⊳	O MT
Error Handling	▶	O ASCII RS232
Startup Mode	⊳	O ASCII RS485
10 Configuration	⊳	O Application
Command Interface	▶	
Time	▶	
	 Info Passwords Error Handling Startup Mode IO Configuration Command Interface Time 	 Info Passwords Error Handling Startup Mode IO Configuration Command Interface Time

2. Create Multitrigger Table (use the built in 'curve inspector')

Edit Multi Tripper Table	16			X
Active Input Signah	DCBA	HEX	DEC	
F TaggerA	0000	0	0	No operation
IN Tagger®	0001	1	1	Goto next state
PX TeggerC		$ \land$	2	Goto provious state
px raggero	0011		1	Repeat actual state
Active Tagger Signals	0100	7 -	7	Goto state
N Tigger A	6101	E	5	Coto state
X Tegger 8	0110	-		Contraction 2 14
DK Tigger C	0110	-		
DK Tingger D	0111			
Name	1000	12	e Hahi Te	inger Tuliki
Fornatab	1001	Chat	1217	
	1010	Cold.	Dama	
Pas	1011		Lone A.	
e	1100	0	Abr. Po Position	
	1101		Speed 1	Envi or
	1110	-	Acc. 50.	
	1111		Position 2	14 299 mm
Settings State Table		_	Speed 1 Acc. 201	107 m/c7
		2	Abs. Po	
		1	Position	64,336 we
			Acc. 20/	802 007 m/r '2
		3	Abr. Po	niton
			Position	73.225 mm
			Acc. 50.	
		Edd	State () - D	live A
		-40	e. Position	 Pastion 19.939 (wn) Speed 1.6 (m/d) [transmit
				Treating Acc 30.000 (m/s*2)
		_		
		15ml	ings) State	Table/

9. PLC/PC starts incremental movement Linear motor plays stepper motor

Task description

A linear motor is integrated into an existing application; the control is made by digital signal lines of a PLC. The idea is that the PLC should operate the linear motor like a stepper motor. On a pulse signal generated by the PLC, the linear motor moves 1 mm forwards or backwards (relative motion).

Since the signals coming from the PLC possess a jitter, the jitter filter is set on 100 ms.



Create a multitrigger table which defines the relative movement (steps) forwards and backwards (state 0 and 1).

1. Turn on multitrigger functionality

System	Info	₽	O AT
Drives	Passwords	▶	O MT
Multi Trigger)	Error Handling	▶	O ASCII RS232
	Startup Mode	▶	O ASCII RS485
	10 Configuration	▶	O Application
	Command Interface	Þ	
	Time	⊳	

2. Adjust jitter filter

Drives Dutput Configuration	N		
p locher comparement			
Multi Trigger 🛛 🕑			

3. Create multitrigger table (use Curve Inspector)

Cdit Malli Trigger Table	6			×
Active Input Signals	DCBA	HEX	DEC	
PK TRODHLA	0000	0	0	No operation
W Trapel	6001	1	1	Goto next state
R Texes0	-	\wedge	2	Goto previous state
and the second s	abri	$\overline{}$	1	Repeat actual state
Active Trigger Signals	0100		71	Goto state
A Tagget A	6101	4	5	Goto state
K Texes	0110	5	6	Goto state + 2
K Tager D	0111	7	7	Goto state
	1000		8	No operation
Nawe	1001		9	No operation
Fomatab	1010	4	10	
Pair	1017	8	11	E de Rue Trippe Table
A	1100	0	10	State 2 21 21 Cat 22 21 BACK
	1105	0	17	- State Dove A -Labor
	1101	E	14	I Ref. Pasifies
	1110	E .	19	- Speed () faith and a second s
\ <u>Setings</u> /State Table/				I Rel. Parities Incarant 0.500 ms Seed 0.5 m/s Acc. 20.027 m/r ⁻² Z No Operation 2 No Operation
				Eds State D-Dree A Ref. Proton Image: second fill

It is possible to define steps with different increments so that very flexible solutions are possible.

10. Teach-In procedure (MT-Mode) Roboter and handling applications with teach-in

Task description

In an automation mechanism different positions must be programmed. The Teach-In procedures are used for the specification of the values.

(For practice the teach-in positions are written below

Stop outside 75 mm Stop inside 20 mm Position 1 33 mm Position 2 65 mm

Movements to the stops: 0.3 m/s and 10 m/s² Movements to position 1 and 2: 1.8 m/s und 80 m/s²

Use a multitrigger electronic and a small PLC with 4 digital outputs.



A multi-trigger table is created, in which the position with the ' Take position ' function are read in. In addition, electronics switches on and off after the initialization over the RUN button. Afterwards the slider can be moved freely and the positions can be read in.

1. Switch on multitrigger functionality

System	Info	▶	O AT
Drives	Passwords	▶	O MT
Multi Trigger	Error Handling	▶	O ASCII RS232
	Startup Mode	▶	O ASCII RS485
	10 Configuration	▶	O Application
	Command Interface	Þ	
1	Time	⊳	

3. Create multitrigger table



11. End position feedback (MT-Mode) Monitoring of the end position

Task description

In an automation mechanism small and large parts are to be installed. For the controlling of the machine the superordinate control unit needs in each case a feedback signal, as soon as the linear motors has finished its movement.

Strokes and parameters:

Small parts:	20 mm to 80 mm	v _{max} = 1.5 m/s	$a_{max} = 50 \text{ m/s}^2$
Big parts:	35 mm to 65 mm	_{max} = 1.0 m/s	$a_{max} = 20 \text{ m/s}^2$

Use a multitrigger electronic unit.



Create a multitrigger table and program the positions into 4 states.

1. Multitrigger table with:

Position 0 (State 0):	20mm	v _{max} = 1.5 m/s	$a_{max} = 50 \text{ m/s}^2$
Position 1 (State 2):	35mm	v _{max} = 1.0 m/s	$a_{max} = 20 \text{ m/s}^2$
Position 3 (State 3):	65mm	v _{max} = 1.0 m/s	$a_{max} = 20 \text{ m/s}^2$
Position 4 (State 4):	20mm	v _{max} = 1.5 m/s	a _{max} := 50 m/s ²



2. Adjust ,In Position'Signal

System	Drive A 🛛 🕨	Туре 👂	Pos Range Min :	76.499 mm
Drives	Drive B 👂	Initialization 👂	Pos Range Max:	79.995 mm
Multi Trigger	Drive C 🛛 🖡	Set Value Generation 🛛 🔋 👂	In Position -:	0.508 mm
	Drive D 👂	Position Monitoring	In Position +:	0.508 mm
		Control Switches	Following Error - :	2.5 mm
		Control Parameters 🛛 👂	Following Error + :	2.5 mm

3. Link 'In Position' signal of drive A to output 3

System 👂	Jitter Filter 👂	Output 3 🛛 🕨	O None
Drives 👂	Output Configuration 🛛 🔋 🕨	Output 4 🛛 🗼	🔘 In Pos. A
Multi Trigger 🛛 🕑			O In Pos. B
			O In Pos. C

Remark: Compare hardware configuration (manual chapter 4.8.1). Output 3 must be an output and not be configured as a relay driver.

12. PLC/PC controls force Press part into form

Task description

In an automation mechanism an assembly part is to be moved to a certain position. Subsequently, the moved part must be pressed in.

Strokes and parameters:

Stroke: 20 to 80 mm, v:=1.6 m/s, a:= 50 m/s², force:= 100% Force to press: ca. 15% of maximum force

Use MT-Electronic unit





Using multitrigger, the force can be programmed on-line. The basic idea consists in reducing the force to 15 % of its original value after the part is moved to position. Then move to a position behind of the form. The result will be that the motor will be blocked through the form and the force will go up to maximum (now 15%) and press the part into the form. (Make sure that the I-parameter of the PID-controller is switched on)

1. Switch on multitrigger functionality



2. Create multitrigger table with positions and force limitations

Sequence: State $0 \rightarrow$ State $1 \rightarrow$ State $3 \rightarrow$ State $2 \rightarrow$ State $3 \rightarrow$ State $4 \rightarrow$ State $0 \dots$

13. Unlimited number of steps (stepper motor) Stepper motor continuously rotating

Task description

A stepper motor is used in an automated mechanism. The number of revolutions in the same direction is unlimited. (The number of steps is limited in the LinMot® SW !) ???.

Stepper Motor: 1.8°/step

(This is similar to if linear motors with strokes longer than 1260 mm are used. Moving the 'Home Position' enables to run longer movements)

Serial interfacing (RS-232):

After each movement use the command !ZD, which resets the counter to zero.

Multitrigger-electronic

1. Link Drive A to stepper motor

Drive A	Туре 🔊	O No Drive
Drive B	Initialization 👂	O LinMot P0x-23
Drive C 🔰	Set Value Generation 🛛 🔋 🔊	O LinMot P1x-23
Drive D	Position Monitoring	O LinMot P0x-37
	Control Switches	O LinMot P1x-37
	Control Parameters	🔘 Stepper
	Commutation 👂	O Magnet
	Error Handling	

2. Create multitrigger table

State	Drive A - Stepper	
0	Rel. Position Increment 100 Steps Speed 100.365 Steps/s Acc. 2002.861 Steps/s ²	
1	Redefine Pos. Position 0 Steps	
2	No Operation	
3	No Operation	
	_	
Edit:	State 3 - Drive A	
No	Operation 🗾	Update
		Cancel
Setti	ngs/(State Lable/	

State 0 turns 180 ° State 1 reset the counter to 0

14. Multiple axle application Handling machine with round table

Task description

In an automated mechanism a lid is to be placed and pressed onto a box. Drives B and C are pushing the box and the lid into position. Drive A will press the lid onto the box using a profile. After this procedure the box will be moved on the round table (incremental movement). Drives A, B and C are going back to the start position, Drive D (stepper motor) turns 180°.

- Drive A: P01-37x240 type using profiles 'Point to Point': 30 mm to 100mm in about 60 ms 100 mm back to 30 mm in ca 180 ms
- Drive B: Push box: 10 mm to 50 mm (2 m/s and 50 m/s2) Push box another 10 mm to the table (0.1 m/s and 1.9 m/s²)
- Drive C: Position lid: 10 mm to 40 mm (2 m/s and 60 m/s²)
- Drive D: Stepper motor with 1.8°/step



- 1. Select multitrigger mode
- 2. Select drives
- 3. Create profile (curve) for drive A. (create two curves and join them together)



4. Create multitrigger table

🔐 Edit Multi Trigger Table				
Active Input Signals	DCBA	HEX	DEC	
X Trigger A	0000	0	0	No operation
Trigger 6	0001	1	1	Goto next state
Trigger D	0010	2	2	Goto previous state
	0011	3	3	Repeat actual state
Active Trigger Signals	0100	4	4	Goto state
Trigger B	0101	5	5	Goto state 🗾 1 🚔
Trigger C	0110	6	6	Goto state 🔽 🛓
🗵 Trigger D	0111	7	7	No operation
	1000	8	8	No operation
	1001	9	9	No operation
мпозрі	1010	А	10	No operation
Print	1011	В	11	No operation
	1100	С	12	No operation
	1101	D	13	No operation
	1110	E	14	No operation
	1111	F	15	Goto state 🔽 🗸 🗘
Settings (State Table /				

State: 💷 📰 Col: 🎦 🎦 🛤 🖼							
State	Drive A - LinMot	Drive B - LinMot	Drive C - LinMot	Drive D - Stepper			
1	No Operation	Abs. Position Position 49.997 mm Speed 2 m/s Acc. 50.068 m/s ²	Abs. Position Position 39.997 mm Speed 2 m/s Acc. 60.082 m/s^2	No Operation			
2	Curve Curve number 1	No Operation	No Operation	No Operation			
3	No Operation	Rel. Position Increment 29.998 mm Speed 0.1 m/s Acc. 1.907 m/s ²	No Operation	No Operation			
4	Abs. Position Position 9.999 mm Speed 0.502 m/s Acc. 10.014 m/s ²	Abs. Position Position 9.999 mm Speed 0.502 m/s Acc. 10.014 m/s ²	Abs. Position Position 9.999 mm Speed 0.502 m/s Acc. 10.014 m/s ²	Abs. Position Position 100 Steps Speed 900.002 Steps/s Acc. 2002.861 Steps/s^2			
5	No Operation	No Operation	No Operation	Redefine Pos. Position 0 Steps			
Edit: No	State 5 - Drive B Operation	Update Cancel					
_\Settir	ngs∖/State Table /						

Sequence: State 0, next state (1), next state (2), next state (3), next state (4), next state (5), state 0

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15. RS-232 interfacing Press part into form

Task description

In an automated mechanism an assembly part is to be moved to a certain position. Subsequently, the moved part must be pressed in.

Strokes and parameters:

Stroke: 20 to 80 mm, v:=1.6 m/s, a:= 50 m/s², force:= 100% Force to press: ca 15% of maximum force

Use RS-232 interface technology



Sequence

Limit velocity to 1.6 m/s

Limit acceleration to 50 m/s2

Move to position 80 mm

Request and check actual position

Reduce force (current) to 15%

Increment position by 10 mm

Move to position 20 mm

Increase force to 100 %

- 1. Check button position of your electronic unit: RS-232 needs ID1=0, ID0=1 (see manual R1.0 and manual R1.2), In this example the electronic unit has the ID nr. 1.
- 2. Set serial mode for the system with LinMot® Talk Mit LinMot®

System	▶ Info	TA O
Drives	Passwords) OMT
	Error Handling	ASCII RS232
	Startup Mode	ASCII RS485
	10 Configuration	Application
	Command Interface	

3. Set serial mode for Drive A with *LinMot®* Talk

Туре	▶ F	Run Mode	Þ	© Serial
Initialization	⊳ S	Set Value Configuration	⊳	🔿 Analog
Set Value Generation	🕞 F	Filter Parameter	⊳	O Continuous Curve
Position Monitoring	▶			O Trigger Curve
Control Switches	▶			⊖ Two Point

4. Disable all inputs. Controlling will be done only by RS-232 (in this example)

System 🛛 🔋	Info 🛛 🔋	🖸 Run Input
Drives 👂	Passwords 🛛 🔊	🗆 Init Input
	Error Handling 🛛 🔋 🕨	Freeze Input
	Startup Mode 🛛 🔊 👂	Emerg Stop Input
	10 Configuration 🛛 🔋 🕅	🛛 Analog/Trig Drive A

- 5. Shut down *LinMot*® Talk (→ interface will be ready for RS-232 direct control)
- 6. Log in using a communication program of your computer (e.g. Hyperterminal 9600 Baud). You will find an example in the folder ,examples' of LinMot® Talk, which configure your communication port (use ASCII_C1 for COM1 and ASCII_C2 for COM2).

Properties	7 ×
Connect To Saltings	
Function, arrow, and chilkage act as	ASCEL Sector
Envlation: Auto detect	Send line ends with line feeds Eche band sharacters locally Line data
Backsonil buller liver.	Dweathe delay: 0 milliocondi
F" Beep there lines when connecting or disconnecting	ASCII Receiving
	F Append line leads to incoming line ands
in the second se	Force incoming date to 7 bit ASCI State incoming date to 7 bit ASCII

7. Ask scaling factor of your electronic unit ???

Command	Comment
lGS1	Check communication
#R	OK
1PIA	Request resolution of position
#19531250	19,0735 um
1VIA	Request resolution of velocity
#190735	0,190735 um/s
!AIA	Request resolution of acceleration
#238419	0.238 m/s ²
lCI1	Request resolution of current
#23438	23,438 mA

8. Scale the values

Position 20 n	nm	\rightarrow	1049
Position 80 mm			4194
Position incre	ement 10 mm	\rightarrow	524
Velocity Acceleration	1.6 m/s 50 m/s2	$\rightarrow \delta \\ \rightarrow 2$	3400 210
Current 15% current	2 A	$\rightarrow $ \rightarrow	35 13

9. Send commands to electronic unit

LSI-1Switch electronic from 'Wait' (disabled) to "Enable". This procedure is onlyLSI-1necessary if you are not in the 'auto start' mode (selectable by LinMot® talk)LSI+1InitiateLSR+1Select Run mode#

ISV8400A Set max velocity # ISA250A Set max. acceleration # ISC85A Set Current (force) 100% (2A) #

!SP4049A #	Move to position 80 mm
lgpa #4049	Check position $ ightarrow$ ok

!sc13a #	Reduce force to 15%
!IP524A #	Increment position by 10 mm
13P1049A #	Move back to 80 mm
1sc85a #	Increase force to 100 %

Note:

If you have problems with switching between LinMot® talk and RS-232 communication just switch off and re-start the electronic.

16. Stop situations Go to special stop position

Task description

In a machine it is required that the linear motor for safety reasons withdraws itself to a so-called emergency stop position (14mm), as soon as an external stop signal is created.



1. Enable ', Go to Position' inside of the Error handling mask of the Drive

Туре	Þ	Error Mask 🛛 🕨	>	Emergency Stop Mode	Γ	O Off
Initialization	Þ.	Warn Mask 🛛 🗼	۶ľ	Emergency Configuration	1	O Freeze
Set Value Generation	▶	Emergency Stop 🛛 🔋	≽		Ľ	Goto Position
Position Monitoring	Þ∥				IF	
Control Switches	Þ∥				1	
Control Parameters	Þ∥				1	
Commutation	Þ∥				1	
Error Handling	Þ					

2. Set the ,Stop Position' value

Туре	₽	Error Mask	Þ	Emergency Stop Mode	₽	Stop Position:	14.003 mm
Initialization	⊳	Warn Mask	⊳	Emergency Configuration	Þ		
Set Value Generation	⊳	Emergency Stop	۲				
Position Monitoring	⊳						
Control Switches	⊳						
Control Parameters	⊳						
Commutation	⊳						
Error Handling	Þ						

17. Check whether movement space is free Check if any blocked package are in front of the motor

Task description

When starting the machine it is to be checked whether the movement space in front of the motor is free. Often it occurs the fact that a package in the machine blocked itself or that someone left an object such as a screw driver inside of the machine. In this case an error message is to be generated, so that the machine fails to start.

Room of movement in front of the motor: 80 mm Check room with max. velocity of 25 mm/s Reduce force to 75% during checking Afterwards go to initial position 10 mm



Additional question: What is the parameter ,Home Position' for?

1. During the initialization (homing) it's possible to check the room in front of the motor \rightarrow set the parameters

	Parameter Inspector: E400-MT on COM	1			_ 🗆 ×
•	▶ ✓ 🛓				
	Drive A	Туре 👂	Init Mode 🛛 🔊	Init Velocity:	24.414 mm/s
	Drive B 🔊 👂	Initialization 🛛 🔊	Init Switches 👂	Maximal Init Current:	75 %
	Drive C 👂	Set Value Generation 🛛 🔋 🕨	Init Config 🛛 🕑 🕨	Home Position:	0 mm
1	Drive D 👂	Position Monitoring 🛛 🔋 🕨		Check Init Position:	79.995 mm
-		Control Switches		Initial Position:	9.999 mm
		Control Parameters 🛛 🔋 🕨			
		Commutation 👂			
		Error Handling 🛛 🔋 🕨			
_			1	I	I

Answer to the additional question:

After the homing procedure the 'home position' can be moved as it is convenient for the application. In particular, if the max stroke is longer than 630 mm, the homing position must often be shifted to be able to run between -630mm and +630mm.

18. Application 'Jog' Remote control of LinMot® with buttons

Task description

People would like to operate a LinMot® linear motor by remote control using three buttons. One button is used to move the slider 'out', a second button to move it 'in' and third button for fast movement.

Button B: Slider move 'in' with v=0.01 m/s

Button C: Change speed to 0.2 m/s instead of 0.01 m/s if operated simultaneously with button A or B

LinMot® Multitrigger electronic unit Exxx-MT: The buttons A, B and C are directly connected to the trigger inputs A, B and C. Set Jitter filter to about 10 ms to get an immediate answer if buttons are pressed.



19. Positioning with 10 μ m repeatability Configuration with external position sensing

On a printing machine a film is to be positioned with a repeat accuracy of 10 μ m.

With LinMot P linear motors the repeatability of the internal position sensing is 100 μ m. To raise this to 10 μ m therefore, external sensing is employed.

Available are only an E200-AT, an external sensor system (consisting of measuring head, tape with 1 mm pole distance and amplifier adapter) and a linear motor P01–23x160/0x140. The target position is given via RS232.



On motor channel A there is the external sensing for configuration, and on motor channel B the linear motor.

1. Adjust for RS232 interface.

The target position is given on channel B via RS232 protocol.

System 🕨	Info 👂	O AT
Drives 👂	Passwords 👂	OMT
	Error Handling 🛛 👂	© ASCII RS232
	Startup Mode 🛛 👂	O ASCII RS485
	10 Configuration 🛛 🔋	O Application
1	Command Interface 🛛 🗎	

2. Set position sensor to motor channel A.

System 👂	Drive A	🕨 Туре 🔅	O No Drive
Drives 🕨	Drive B	Sensor Configuration 🛛 🔋 🕨	O LinMot P0x-23
	Drive C	Master / Booster 🛛 👂	O LinMot P1x-23
	Drive D	Error Handling 🛛 🔋 🕨	O LinMot P0x-37
			O LinMot P1x-37
			O Stepper
			O Magnet
			Sin/Cos Position Sensor
	II		I

3. Adjust sensor period to 1 mm.

Drive A	🕨 Туре 🔰 👔	Sensor Period 🛛 🔋	© 1 mm
Drive B	Sensor Configuration	Sensor Direction	O 5 mm
Drive C	Master / Booster 🛛 🕴		
Drive D	▶∥Error Handling ♪	·	

4. Set sensor direction to "positive"; master/booster must be at "master".

Drive A 🛛 🔋	Туре 👂	Sensor Period 👂	Positive
Drive B 🛛 👂	Sensor Configuration	Sensor Direction	O Negative
Drive C 🛛 👂	Master / Booster 🛛 👂		
Drive D 👂	Error Handling 🛛 🔋 🕨		

5. Set linear motor P0x23 to motor channel B and configure as master.

Drive A 🛛 👂	Туре 👂	O Internal Sensor
Drive B 🔊	Master / Booster 🛛 👂	O External 20 um
Drive C 👂	Position Sensor 🛛 🕑	O External 10 um
Drive D 👂	Initialization 👂	O External 5 um
	Set Value Generation 🛛 🔋 👂	O External 2.5 um
	Position Monitoring 🛛 🔋 🕨	© External 1.25 um
	Control Switches 👂	

6. Adjust external sensor resolution to 1.25 $\mu m.$

7. All parameters defining a position are given another scaling factor on account of the external sensing. For 1.25 μm resolution, all position values must be entered 16 times bigger than is wanted, i.e. 480 mm must be entered if the maximum position is to be fixed at 30 mm. The same applies to position targeting via RS232.

Drive A	👌 Type 🛛 🔹	Run Mode 🛛 🕨	🖪 Minimal Position: 0 m
Drive B	Master / Booster 🛛 🕨 🕨	Set Value Configuration	🖪 Maximal Position: 🛛 480.008 m
Drive C	Position Sensor 🛛 🔊 🕨	Filter Parameter 👂	
Drive D	Initialization		
1			

Note: With external sensing the values of the PID controller parameters may be raised on the strength of the higher resolution.

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20. Improved linearity with external position sensing Configuring the external position sensing

On a handling machine any position must be moved into with an absolute accuracy of 0.05 mm. Maximum travel is 920 mm. The target position is to be set via the serial interface RS232.

Owing to the restricted linearity, the internal position sensing of the linear motor is inadequate for attaining an absolute accuracy of 0.05 mm. Consequently external position sensing is employed.

Available are an E200-AT, a sensor system (consisting of measuring head, magnetic tape with 5 mm pole distance and amplifier adapter) and a linear motor P01-37x240/860x1060.



1. Set position sensor to motor channel A.

System 👂	Drive A 🛛 🗎	Туре 🔉	O No Drive
Drives 🔊	Drive B 🔊	Sensor Configuration 🛛 👂	O LinMot P0x-23
	Drive C 🔊 🔊	Master / Booster 🛛 👂	O LinMot P1x-23
	Drive D 🔊	Error Handling 🛛 🕨 🕨	O LinMot P0x-37
			O LinMot P1x-37
			O Stepper
			O Magnet
			Sin/Cos Position Sensor

2. Adjust sensor period to 5 mm.

. []	Type 🗦	Sensor Period 🛛 🕑	0 1 mm
	Sensor Configuration	Sensor Direction	⊛ 5 mm
: 1	Master / Booster	>	
)]	Error Handling	>	

3. Set sensor direction to "positive"; master/booster must be at "master".

Drive A	Туре 👂	Sensor Period	Positive
Drive B 🔊	Sensor Configuration	Sensor Direction	O Negative
Drive C 🛛 👂	Master / Booster 🛛 👂		
Drive D 👂	Error Handling 🛛 👂		

4. Set linear motor P0x37 as master onto motor channel B.

Drive A	⊳	Туре	Þ][«	Master
Drive B		Master / Booster	Þ		🔾 Booster parallel
Drive C	⊳	Position Sensor	Þ		O Booster reverse
Drive D	⊳	Initialization	⊳		
1		Set Value Generation	Þ		

5. Adjust external sensor resolution 20 µm.

System 👂	Drive A	Туре	₽	O Internal Sensor
Drives 🔊	Drive B	Master / Booster	▶	🔘 External 20 um
	Drive C	Position Sensor		O External 10 um
	Drive D	Initialization	▶	OExternal 5 um
		Set Value Generation	▶	O External 2.5 um
		Position Monitoring	▶	O External 1.25 um
1	11			I

21. Operating 2 motors in parallel Force multiplication to raise the dynamics

A load mass of 0.5 kg is to be raised vertically by 480 mm within 210 ms.

The peak force of a single P01-37x120 linear motor is not enough to perform such a dynamic motion. Though one linear motor P01-37x240 can deliver this peak force, it cannot reach the maximum speed. Therefore two linear drives of type P01-37x120 are connected in series.

Available are an E2000-AT, two P01-37x120 and one PL01-20x1000/920 .

Note: The two motors move a common slider and are placed in opposite directions. A common flange assures mechanical parallelism.



The target position is entered on the master (in this case motor channel A). The second motor operates in booster mode as amplifier doubling the force. The target position is given using ,two-point mode'.

- Adjust maximum speed to 3.5 m/s, acceleration to 50 m/s². With equation F =m*a (where m = load mass + slider mass) the theoretical dynamic force amounts to 135 N. Holding force is 27 N.
- 2. Set motor type for motor channel A as Lin Mot P0x-37

Drive A		Гуре		O No Drive
Drive B	► N	Master / Booster	₽	O LinMot P0x-23
	F	Position Sensor	▶	O LinMot P1x-23
	I	nitialization	▶	LinMot P0x-37
	9	Set Value Generation	▶	O LinMot P1x-37
	F	Position Monitoring	▶	O Stepper
	lla	Control Parameters	Þ	O Magnet

3. Set motor on motor channel as master.

Drive A 🔊	Туре 👂	Master
Drive B 🔊	Master / Booster 🛛 🔋 🕨	O Booster parallel
	Position Sensor 👂	O Booster reverse
	Initialization 🗦	
	Set Value Generation 🛛 🔋 🕨	
	Position Monitoring	
	Control Parameters	
1	le	

4. Set motor type for motor channel B as LinMot P0x-37.

Drive A	Туре 👂	O No Drive
Drive B	Master / Booster 🛛 👂	O LinMot P0x-23
	Commutation 👂	O LinMot P1x-23
	Error Handling 🛛 🔋 🕨	LinMot P0x-37
		O LinMot P1x-37
		O Stepper
		O Magnet

5. Set linear motor on motor channel B as "booster reverse".

Drive A 🔊	Туре 👂	O Master
Drive B 🔊	Master / Booster 🛛 👔 🕅 🕨	O Booster parallel
	Commutation 👂	Booster reverse
	Error Handling 🛛 🔋 🕨	

6. Adjust controller.

Drive A	▶	Туре	⊳	Ī	Maximal Current:	5.99 A
Drive B	⊳	Master / Booster	⊳	·II	Current Offset:	-0.749 A
		Position Sensor	⊳	·I	🖪 P:	0.8 A/mm
		Initialization	⊳	·II	🖬 D:	4.995 A*s/mm
		Set Value Generation	⊳	·II	🖪 l:	0 A/(mm*s)
		Position Monitoring	⊳	·II	FF Friction:	0.211 A
		Control Parameters	Þ		FF Acceleration:	100 mA/(m/s^2)
		Commutation	⊳	Ī	FF Deceleration:	80 mA/(m/s^2)

22. Operating 4 motors in parallel Paralleling to raise the peak force

On an assembling facility a workpiece weighing 10 kg is to be moved 120 mm in 120 ms. Cycle time is 1 second.

The peak force of one P01-37x240 linear drive is insufficient for the acceleration needed. Several linear drives must therefore be operated in parallel.

Available are an E4000-AT, four P01-37x240/60x260.



The task can be performed by the parallel operation of four P01-37x240/60x260, generating a total peak force of 800 N. To enable the motion to be performed, a maximum speed of 1.5 m/s and a maximum acceleration of 38 m/s² are needed.

1. Set motor type for chennels A, B, C and D as LinMot P0x-37.

System 👂	Drive A 🛛 🕨	Туре	🔘 🔿 No Drive
Drives 🕨	Drive B 🔊	Master / Booster	▶ O LinMot P0x-23
	Drive C 👂	Position Sensor	▶ O LinMot P1x-23
	Drive D 👂	Initialization I	🛛 🕲 LinMot P0x-37
		Set Value Generation	▶ O LinMot P1x-37
		Position Monitoring	Stepper
1	1	Control Curitohoo	Magnat

2. Set motor type on channel A as master.

System 👂	Drive A 🛛 🕅	Туре	Þ	Master
Drives 🔊	Drive B 🔊 🔊 👂	Master / Booster		O Booster parallel
	Drive C 🔊	Position Sensor	Þ	O Booster reverse
	Drive D 🔊	Initialization	⊳∥	
		Set Value Generation	⊳∥	
		Position Monitoring	Þ	

3. Set motor types on channels B, C, and D as paralleled boosters.

System 👂	Drive A 🛛 👂	Туре 👂	O Master
Drives 🕨	Drive B 🔊 🔊	Master / Booster 🛛 🔋 🕨	🔘 Booster parallel
	Drive C 🛛 👂	Commutation 👂	O Booster reverse
	Drive D 🕨	Error Handling 🛛 🔋 🕨	

Note: The target position is given typically in two-point mode via motor channel A.

23. PLC/PC with PROFIBUS-DP master selection Moving into any position

The task involved

A freely adjustable linear motion is needed for a laboratory facility. The movement is calculated on-line by a PC or a PLC and ranges between 20 mm and 70 mm. It must be possible to move into any position within this range. For safety reasons the acceleration must never exceed 75 m/s^2 nor the speed 1.6 m/s.

Supplementary requirement

It must be possible to move into many freely selectable positions at will. Maximum speed must not exceed 0.2 m/s.



Position targeted via PROFIBUS-DP with speed and acceleration limited via LinTalk.

1. Speed and acceleration limited with LinTalk.



- 2. Read the GSD data file into the configuration software for the PLC. The file is entitled "linm00b6.gsd" and is located in the subdirectory ..\GSD of LinTalk.
- 3. Tie the LinMot electronic unit into the bus system and configure the data to be exchanged, here taking as example a Siemens Simatic S7-315-2DP under STEP7.



- 4. After loading the configuration into the PLCI and linking this with the LinMot electronic unit according to standard, communication is taken up.
- 5. Initializing the motors is triggered by setting the "INIT-request" bit in the control word. After the "WARNING pending" bit (INIT not done) has changed to zero, the "INIT-request" bit can be reset and the "RUN-request" bit set. The LinMot electronic unit now changes into the RUN state and evaluate the values given in the "Set position" module. The actual position of the LinMot may be read out in the "Get position" module.

🔚 Variablentabelle1							
Ope	erand	Symbol	Statusformat	Statuswert	Steuerwert		
AU	20	"Control"	BIN	2#0000 0010 0000 0000	2#0000 0010 0000 0000		
EW	20	"Status"	BIN	2#0000_0010_0011_0000			
AU	22	"Set Position"	DEZ	1024	1024		
EW	22	"Get Position"	DEZ	1024			

The unit of the position is 19.53125 μm (in the above example 1024 is equivalent to exactly 20mm).

24. Control through force Interface to a Delta Tau PMAC motion control board

The task involved

The motion of a linear motor is to be controlled from an outside axis control board. The output of this is an analog control signal proportional to the force to be exerted (comparable to the torque setpoint with rotary motors). Used here as an example is a PMAC board of Delta Tau Data Systems Inc. .



An E1xxx-AT or E1xxx-MT-electronics with installed force control software is used. The force of the connected linear motor is adjusted by an analog signal (0-10V) at the "TRIG IN 1" input. The diagram belows shows the U/F characteristic.



-/+10V control signals

The control signal from many motion control boards ranges within -/+10V. If the board cannot be adjisted for 0-10V operation, the signals may be conditioned with the LinMot ,Breakout Module' and presented between 0-10V.

Voltages below 0.25 V or above 9.75 V cause the motor to cut out. This will prevent any uncontrolled motor movements if there is a cable break between the motion control board and the LinMot electronics.

To enable the position to be controlled, an external length measuring system must be attached to the linear motor. Its position signal is led straight to the motion control board. The position control is thus performed entirely by this board.

The diagram that follows shows the typical design of such a system with Delta Tau, which is reproduced here in slightly abbreviated form.



For further information the reader is referred to the application note of Delta Tau, which is reproduced here in slightly abbreviated form.





NOTE

Using PMAC with *LinMot*[®] Linear Motors and Drive Units

LinMot[®] Force Control Unit (E100-AT and E1000-AT)

Introduction

This application note describes how to connect and configure the Delta Tau PMAC (Programmable Multi Axis Controller) to control single or multiple *LinMot*[®] linear motor/drive systems. The PMAC will interface with *LinMot*[®] *E100-AT* and *E1000-AT Force Control Units*. The PMAC will require position feedback from an external sensor such as an encoder.

Overview

The *LinMot*[®] *Force Control Unit* utilizes a current/force loop which is commanded externally by an analog 0-10V reference signal from the PMAC. 0.25-5V input signals result in a negative force. 5-9.75V input signals result in a positive force. Zero force is at 5V. The *Force Control Unit* implements a safety zone which is $\pm 0.25V$ about zero force input. The drive will not operate unless the input voltage is within the safety zone when the enable signal becomes true. This prevents unintentional ejection of the slider

System Requirements (PMAC1)

A typical single axis linear motor system will require the following hardware:

- 1. One of the following Delta Tau Data Systems control boards:
 - a) Mini-PMAC (2 axis)
 - b) PMAC-PC(4 or 8 axix)
 - c) PMAC-Lite (4 axis)
 - d) PMAC 1.5 STD (4 or 8 axis)
 - e) PMAC-VME (4 or 8 axis)

Note: All PMAC control boards may be used in a standalone configuration if an external +5VDC power supply is provided.

- 2. One of the following Delta Tau Data Systems break-out boards per 4-axes:
 - a) Accessory 8D (Phoenix terminal block with options)
 - b) Accessory 8P (Phoenix terminal block)
 - c) Accessory 8DP (D-sub connectors)
 - d) Accessory 8DCE (CE Certified board, terminal block or D-sub)
- 3. LinMot[®] E100-AT or E1000-AT with Force Control Software
- 4. *LinMot[®] P Linear Motor*
- 5. F eedback Device (encoder)
- 6. 24..48VDC Power supply for LinMot[®] Force Control Unit
- 7. 10 VDC Power supply (*LinMot*[®] drive input select)
- 8. ±15VDC Power supply for PMAC

System Requirements (PMAC2)

A typical single axis linear motor system will require the following hardware:

- 1. One of the following Delta Tau Data Systems control boards:
- a) Mini-PMAC2 (2 axis)
- b) PMAC2-PC (4 or 8 axis)
- c) PMAC2-Lite (4 axis)
- d) PMAC2-VME (4 or 8 axis)
 - Notes: 1. All PMAC control boards may be used in a standalone configuration if an external +5VDC power supply is provided.
 - 2. PMAC2 Ultralite may be used with *LinMot*[®] motors and drives, contact Delta Tau Data Systems for more information.
- 2. Delta Tau Accessory 8E break-out board
- 3. E100-AT or E1000-AT with Force Control Software
- 4. LinMot[®] P Linear Motor
- 5. Feedback Device (encoder)
- 6. 24..48VDC Power supply for LinMot[®] Electronic Unit
- 7. 10 VDC Power supply (*LinMot*[®] drive input select)
- 8. ±15VDC Power supply for Accessory 8E

PMAC Setup

In addition to normal setup and motor tuning (discussed in your PMAC User's Manual), some preliminary configuration will be required in order to setup PMAC to control the *LinMot*[®] drive unit.

I-Variables Settings

Ix29 Motor x Output – DAC Bias

Ix29 is PMAC's digital equivalent to an offset potentiometer. In conventional servo control applications the analog control signal is $\pm 10V$, 0V being zero force. The *LinMot*[®] Force Control Unit utilizes a unique control signal of 0-10V, 5V being zero force. With Ix29 we can easily shift PMAC's zero force output to 5V by setting it to 16,383 (units are DAC bits, 32,767 = 10V).

Ix69 Motor x Output Command (DAC) Limit

Ix69 defines the magnitude of the largest output that can be sent from the control loop. In compliance with Figure1, the maximum voltage output should be set to 4.75V. Voltages above this will cause the *LinMot*[®] *Force Control Unit* to set it's outputs equal to zero force when PMAC commands maximum force. Ix69 should be set to 15,564 (units are DAC bits, 32,767 = 10V).

Encoder Setup

Once you have completed wiring and preliminary setup as discussed above it will be necessary to verify proper feedback of the encoder. To do this we issue an open loop command for the appropriate motor and watch the position window. If a positive open loop command yields a positive position change, the encoder decode sense is correct. If however a positive open loop command yields a negative change in position, the encoder decode settings will need to be modified. Please refer to your PMAC Software manual for details. (I900, I905..I975 for PMAC1, I9n0 for PMAC2).

Example of open loop command for motor 1: *In the terminal window:* #1O2 <CR>

This would result in a positive output of 2 percent of the maximum allowable output set by 1169 for motor 1.

CAUTION: Damage to the equipment or personal injury may result from improper use of the open loop command. The user should gradually increase the value until motion is detected and then immediately kill the motor with a CTRL "K". Starting with a value of 1% is not unrealistic.

PMAC User's Manual for instructions on how to tune a motor using PMAC.

Optional Outputs

The *LinMot*[®] *Force Control Unit* includes three outputs which the user may wish to incorporate into their application. These outputs are specific to the *Force Control Unit*, but may be monitored by the PMAC or other external devices. The three outputs are as follows:

- 1. Warning-Output
- 2. Error-Output
- 3. Drive-Enabled Output

The user may bring these signals into the PMAC via JOPTO (PMAC1) , JI/O (PMAC2), or any of the other Accessory 34 I/O devices. These signals may be used in PLC's to monitor conditions of the application.

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