ADDI-DATA®
PARTNER FÜR PRÄZISION

Instruction Manual

APCI-8001 and APCI-8008

Look-ahead mode

DIN EN ISO 9001:2015 certified

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Warning!

The following risks result from the improper implementation of the board and from use contrary to the regulations:

Personal injury

Damage to the board, the PC and peripherals

Pollution of the environment.

- Protect yourself, others and the environment!
- Read the safety precautions (yellow leaflet) carefully!

  If this leaflet is not enclosed with the documentation, please contact us and ask for it.
- Observe the instructions of this manual!

  Make sure that you do not forget or skip any step!
  We are not liable for damages resulting from the wrong use of the board.
- Pay attention to the following symbols:

NOTICE!
Designates hints and other useful information.

NOTICE!
Designates a possibly dangerous situation.
If the instructions are ignored, the board, the PC and/or peripherals may be **destroyed**.

WARNING!
Designates a possibly dangerous situation.
If the instructions are ignored, the board, the PC and/or peripherals may be **destroyed** and persons may be **endangered**.

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Chapter overview

In this manual, you will find the following information:

Chapter	Content
1	Information on using and activating Look-ahead mode
2	Definition and limitation of velocity jumps
3	Contact and support address

1 Mode description

1.1 Use

In motion control units, traversing commands are executed consecutively. The command parameters include, for example, the target coordinates, the traversing velocity, the acceleration and the target velocity (velocity in the target coordinate).

The boards **APCI-8001** and **APCI-8008** each have a Look-ahead mode, which allows you to combine multiple commands with one another and thus to optimise both velocity and acceleration, or depending on the axes, to limit drives. Consequently, automated velocity changes between traversing profiles can be adjusted.

Look-ahead mode enables a contour, which includes several interpolation profiles, to be accelerated to the trajectory velocity and decelerated to the target position in a controlled manner. Here, the acceleration and braking ramps may be part of several traversing profiles as well.

If multiple spooled move commands, whose target velocities do not equal 0, are programmed consecutively, the target velocity of the profile entered last in the spooler is set to 0 (by the system software). Afterwards, the target velocities of the profiles entered before are temporarily set in a way so that the programmed trajectory acceleration can be used for deceleration at the end of the whole contour. This means that when a profile is programmed, the target velocities of the previous profiles are automatically adjusted (Look-ahead).

With this mode, it is possible to define a maximum permitted velocity jump (MDVEL) for each axis (see Chapter 2). In case this velocity jump is exceeded with an axis, the target velocity of the corresponding profile (and of the adjacent profiles) will be automatically limited. Hence, the maximum permitted velocity jump is adhered to, and irrespective of the traverse distance of the programmed profiles, all target velocities can be reached with the programmed acceleration.

1.2 Activation

To use Look-ahead mode, you first have to activate it by setting bit 0 in the system constant MODEREG. More information on this can be found in the Programming and Reference Manual PM for the board (see PDF link), especially in Chapter 6.3.1.5 MODEREG.
Please also read Chapter 4.4.162 wrMDVel, and for SAP programming, Chapter 6.3.3 Axis qualifiers as well.

NOTICE!
Only use the documentation from version V2.53f!

2 Velocity jumps

2.1 Definition example

The system traverses with multiple axes with a constant trajectory velocity.
If a new profile with the same trajectory velocity but a different direction (the traversing profile then has a “corner”) is added for running, the traversing velocities of the single axes abruptly change at the profile intersection, whereas the trajectory velocity remains constant. The latter is the geometric addition of the single axis velocities and thus only an absolute value with no directional information.
Using a real system, a velocity jump of an axis causes a position error and an abrupt change in the traversing movement.

2.2 Corner rounding

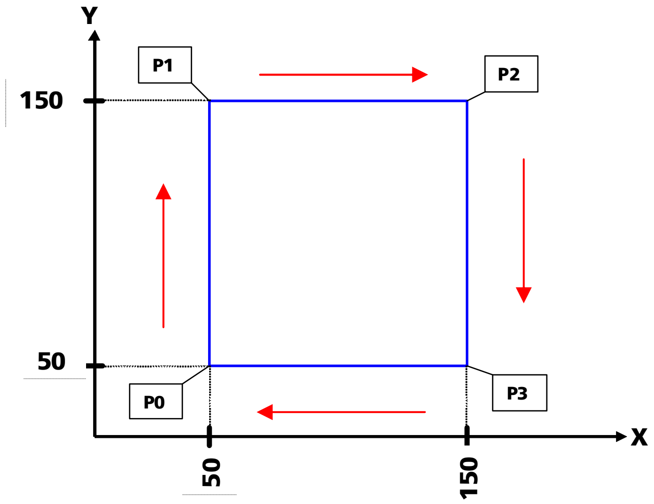
Overrunning a “corner” without stopping induces velocity jumps of the target velocity of the individual axes, although these can never be achieved in reality. At this point, a position error of a large or small extent always builds up. As a result, the system becomes imprecise and oscillations may develop.
From RWMOS.ELF V2.5.3.131 onwards, it is therefore possible to activate a corner rounding for profile intersections between linear movements. For this purpose, a maximum position error (VB_Error) is specified for each axis.
This value is always indicated in the interpolation unit. The transition of the target velocity to the next profile section is therefore no longer abrupt, but instead performed with a linear speed ramp. The specified maximum permitted error (velocity-blending error or 'VB Error' for short) is the maximum positioning error of an axis which has developed right up to the profile intersection. This positioning error is reduced again after the profile intersection.
When selecting axis-specific positioning errors, one must consider that they add geometrically to the real deviation from the programmed path curve.
Corner rounding is only active if Look-ahead mode is activated.

2.3 Limitation of velocity jumps

The following figures show why velocity jumps occur during interpolated axis traversing and how these can be automatically limited by Look-ahead mode.

As a test contour, a square in a two-dimensional coordinate system is run from the start point P0 via P1, P2 and P3 to P0.

Fig. 2-1: Test contour

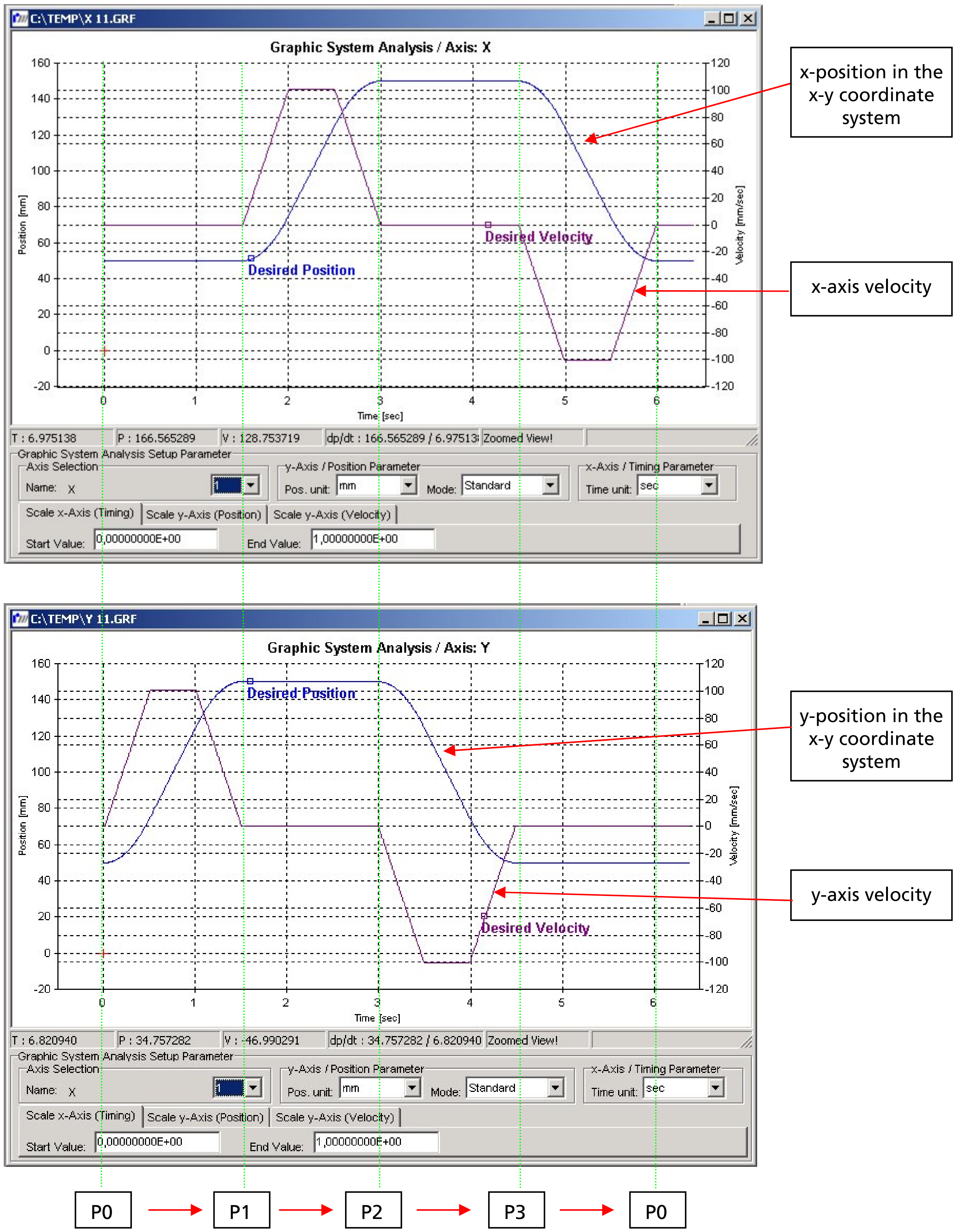


The first traversing profile consists of 4 linear SMLA interpolation commands with the following profile data:

Table 2-1: Profile data (profile 1)

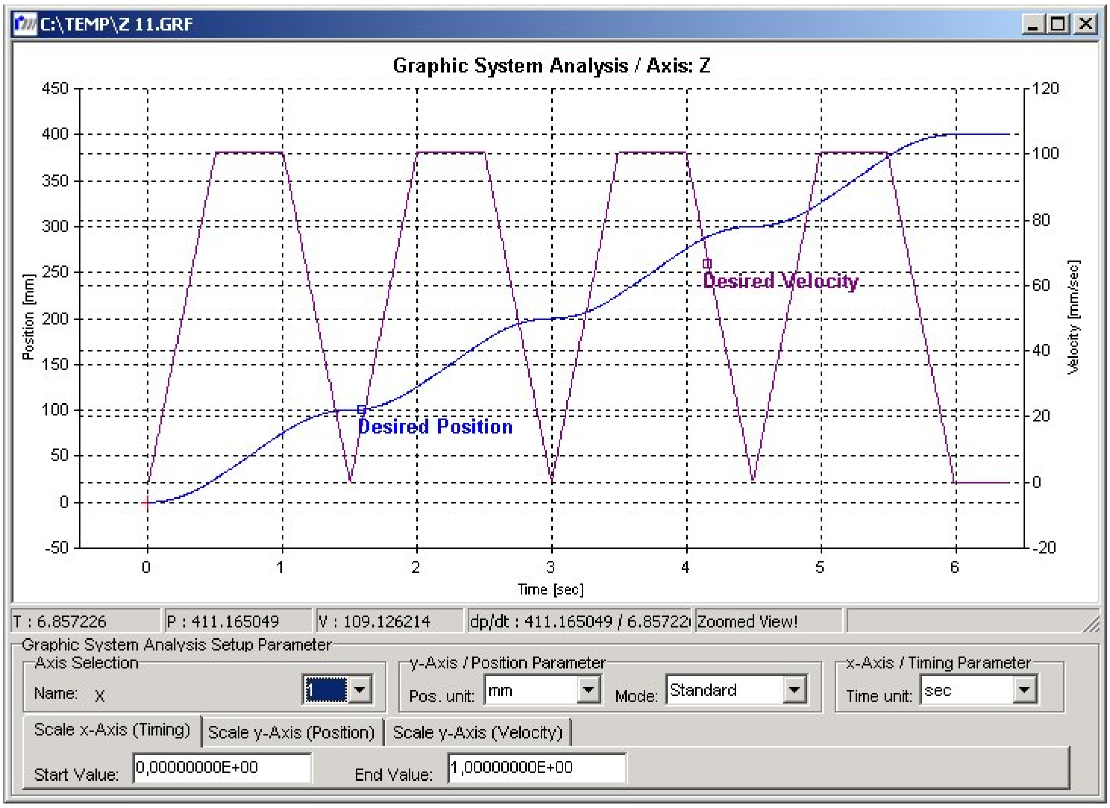
Parameter	Value
Trajectory velocity	100 mm/s
Trajectory acceleration	200 mm/s^2
Trajectory target velocity	0 mm/s

This results in the following velocity and position course of the single axes:



The overall traverse distance and the trajectory velocity course are represented as z-components:

Fig. 2-2: Graphic system analysis: z-axis (profile 1)



In each profile section, the axis to be traversed is accelerated with the programmed trajectory velocity to reach the traversing velocity, and after that, it is decelerated back to 0. During this process, the trajectory velocity is not constant. The entire traversing profile is run within 6 s.

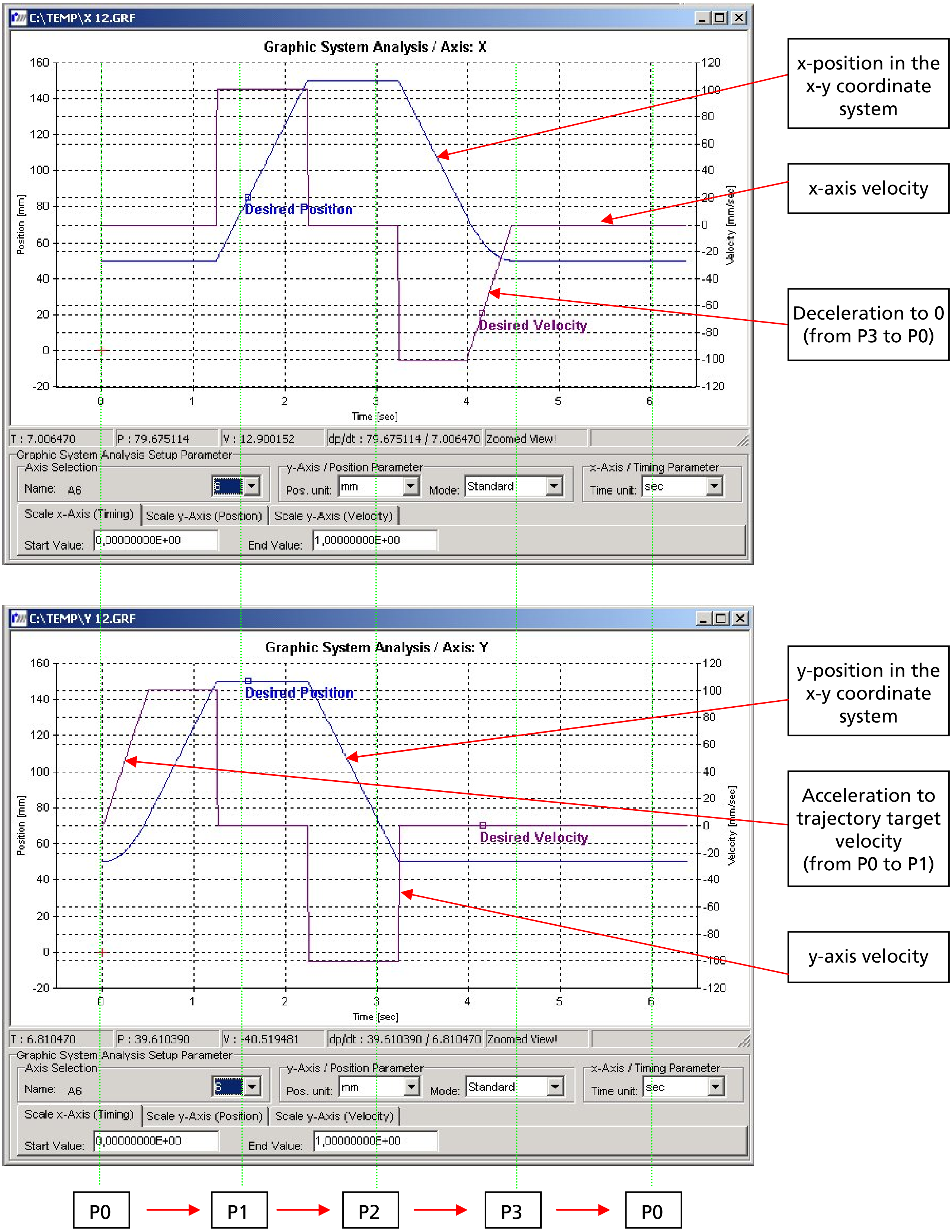
The second traversing profile consists of 4 linear SMLA interpolation commands with the following profile data:

Table 2-2: Profile data (profile 2)

Parameter	Value
Trajectory velocity	100 mm/s
Trajectory acceleration	200 mm/s²
Trajectory target velocity	100 mm/s

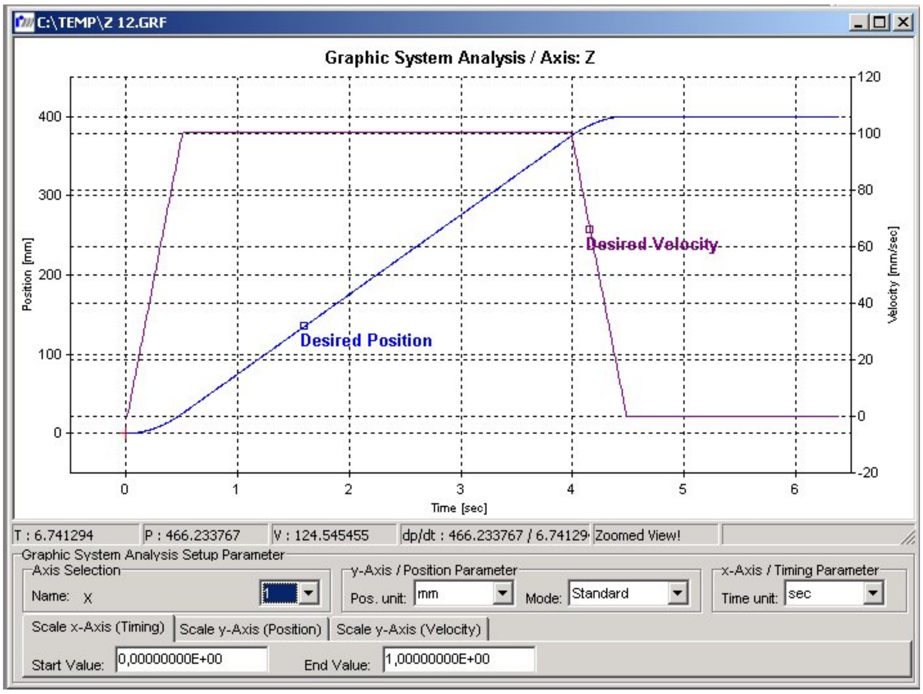
Here, the trajectory target velocity corresponds to the trajectory velocity. Only in the last profile section from P3 to P0, the trajectory velocity is decelerated back to 0.

This results in the following velocity and position course of the single axes:



The overall traverse distance and the trajectory velocity course are represented as z-components:

Fig. 2-3: Graphic system analysis: z-axis (profile 2)



In the first profile section, the system is accelerated with the programmed trajectory acceleration to reach the trajectory velocity, and only in the last profile, it is decelerated back to 0. Between these two sections, the trajectory velocity is constant. The entire traversing profile is run within 4.5 s, because there is no intermediate stop at the profile intersections.
However, the velocities of the single axes abruptly changes at the profile intersections. As a consequence, small or big position errors occur, since real drive systems cannot implement such important velocity jumps.

Look-ahead mode is capable of monitoring and limiting these velocity jumps. For this, the trajectory velocity at the profile intersections is limited in a way so that the predefined velocity jump is adhered to.

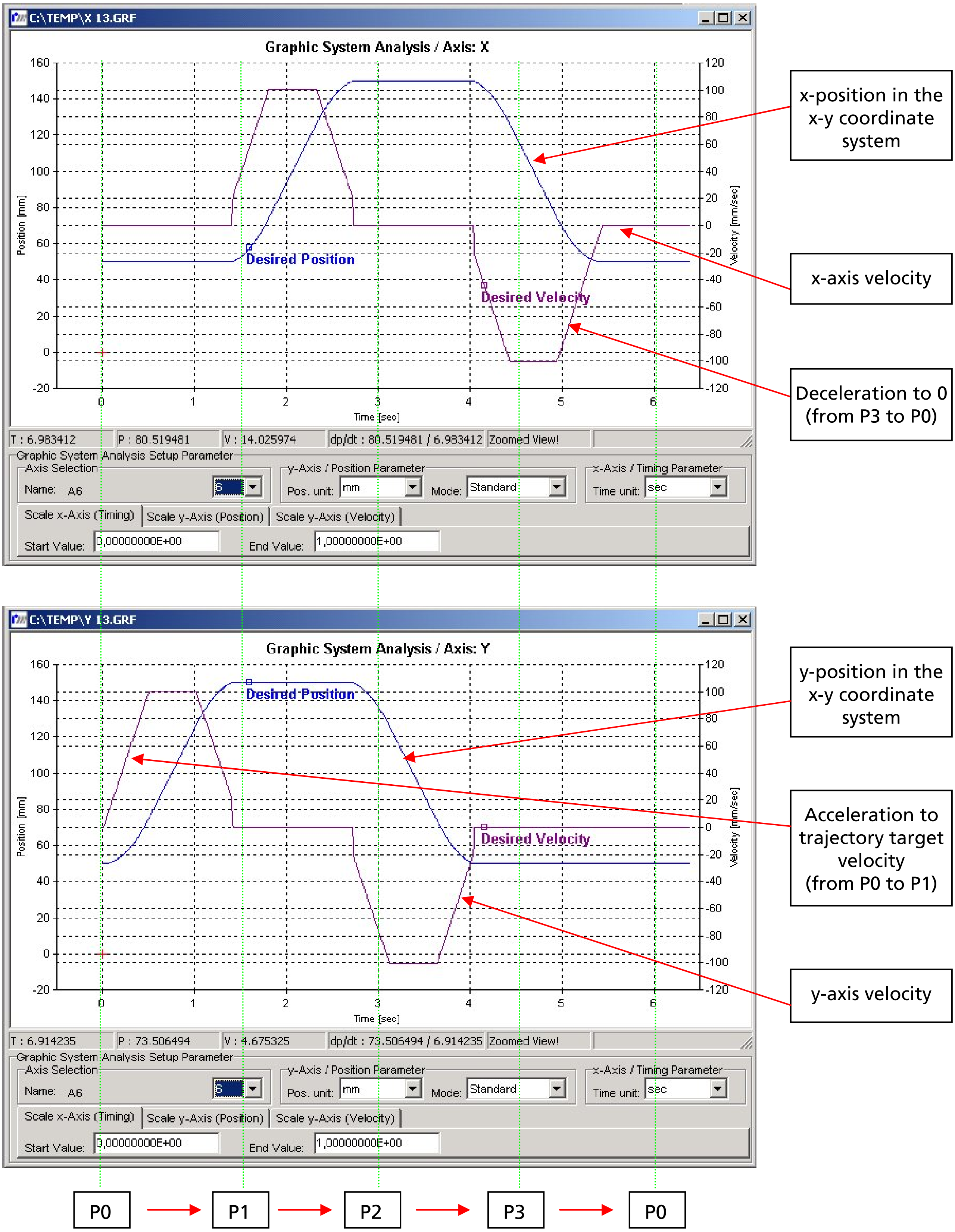
In the following two diagrams, Look-ahead mode is represented with these profile data:

Table 2-3: Profile data (profile 3)

Parameter	Value
Trajectory velocity	100 mm/s
Trajectory acceleration	200 mm/s^2
Trajectory target velocity	100 mm/s
Maximum permitted velocity jump with the x- and y-axis	20 mm/s

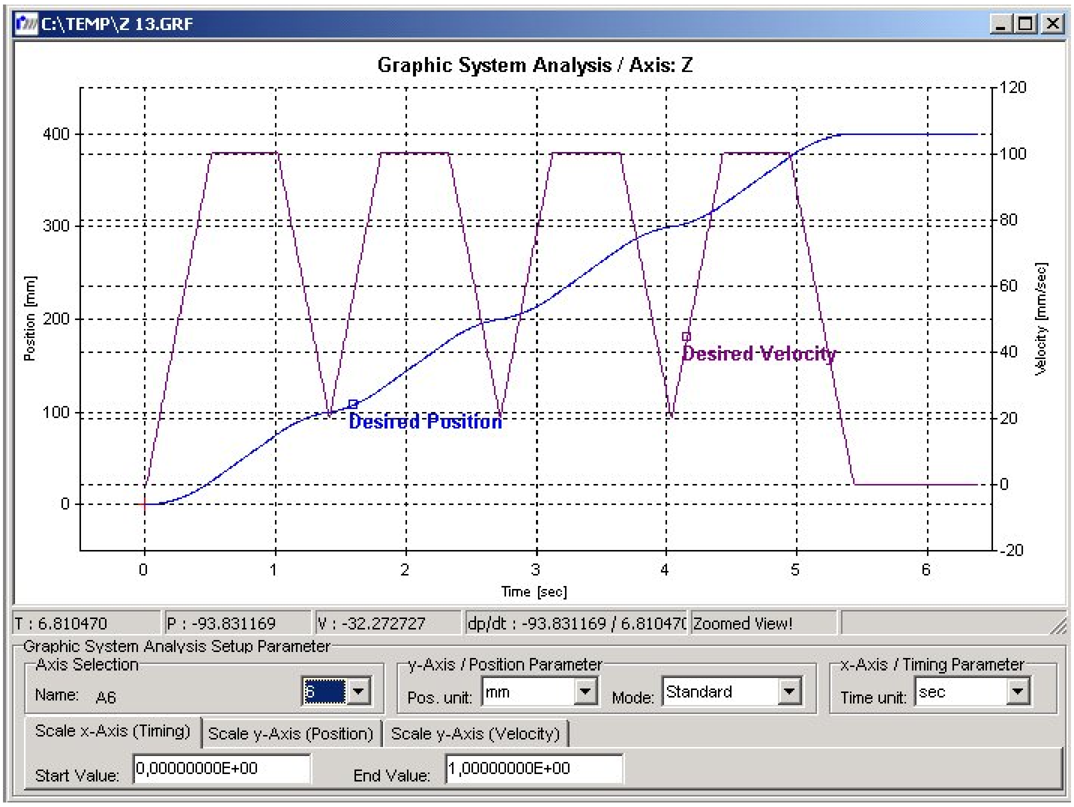
Here, the trajectory target velocity corresponds to the trajectory velocity. Only in the last profile section from P3 to P0, the trajectory velocity is decelerated back to 0.

This results in the following velocity and position course of the single axes:



The overall traverse distance and the trajectory velocity course are represented as z-components:

Fig. 2-4: Graphic system analysis: z-axis (profile 3)



In the first profile section, the system is accelerated with the programmed trajectory acceleration to reach the trajectory velocity, and only in the last profile, it is decelerated back to 0. Between these two sections, the trajectory velocity is consistently reduced so that the velocity jumps of the single axes do not exceed 20 mm/s. The entire traversing profile is run within 5.5 s.
If Look-ahead mode is used, the abrupt changes at the profile intersections are much smaller, which increases path accuracy.

This is an extreme example, though. When real contours are run, curves (such as circular arcs) generally consist of linear interpolation parts. This is represented in the following diagrams in which a circle is approximated by 36 straight interpolation lines, with the traversing direction being changed by 10 degrees with each vector.

Table 2-4: Circular and trajectory data

Parameter	Value
Running a circle in the x-y level with radius	10 mm
Traverse angle	360°
Programmed trajectory velocity	20 mm/s
Programmed trajectory acceleration	10 mm/s^2
Velocity jump limited to	2 mm/s

In the preceding example, the option NoTriangle is activated. This option prevents triangular acceleration and deceleration in a traversing vector. On the one hand, this helps to get smoother traversing, but on the other hand, the trajectory velocity is reduced as well (see the following diagrams).

In the next three diagrams, the function for monitoring velocity jumps is deactivated; in the following three diagrams, the rounding of the velocity steps can be seen.

Fig. 2-5: Trajectory velocity course without velocity jump limitation

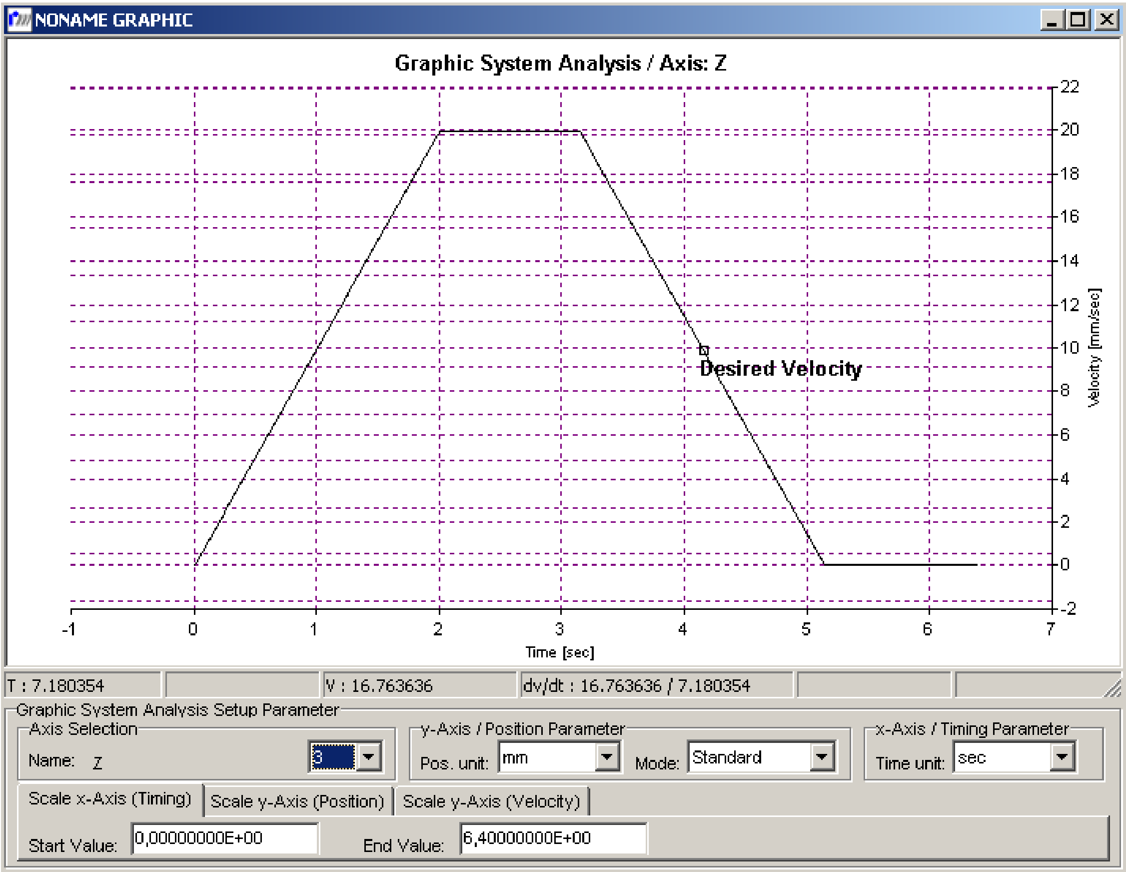


Fig. 2-6: x-axis velocity course without velocity jump limitation

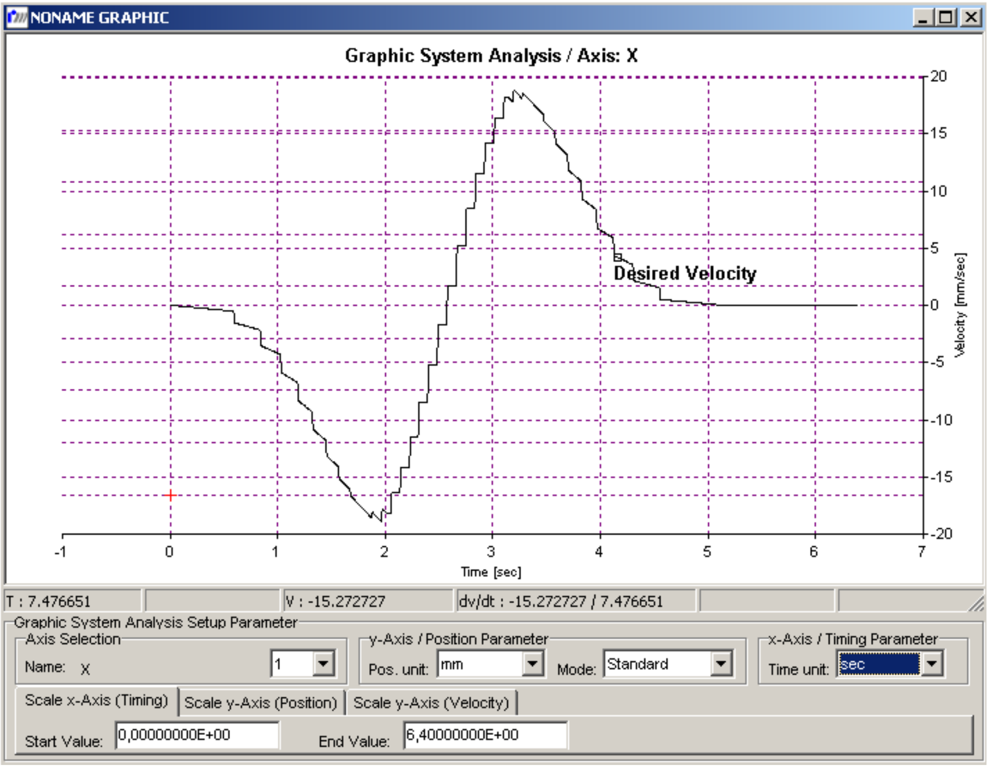


Fig. 2-7: y-axis velocity course without velocity jump limitation

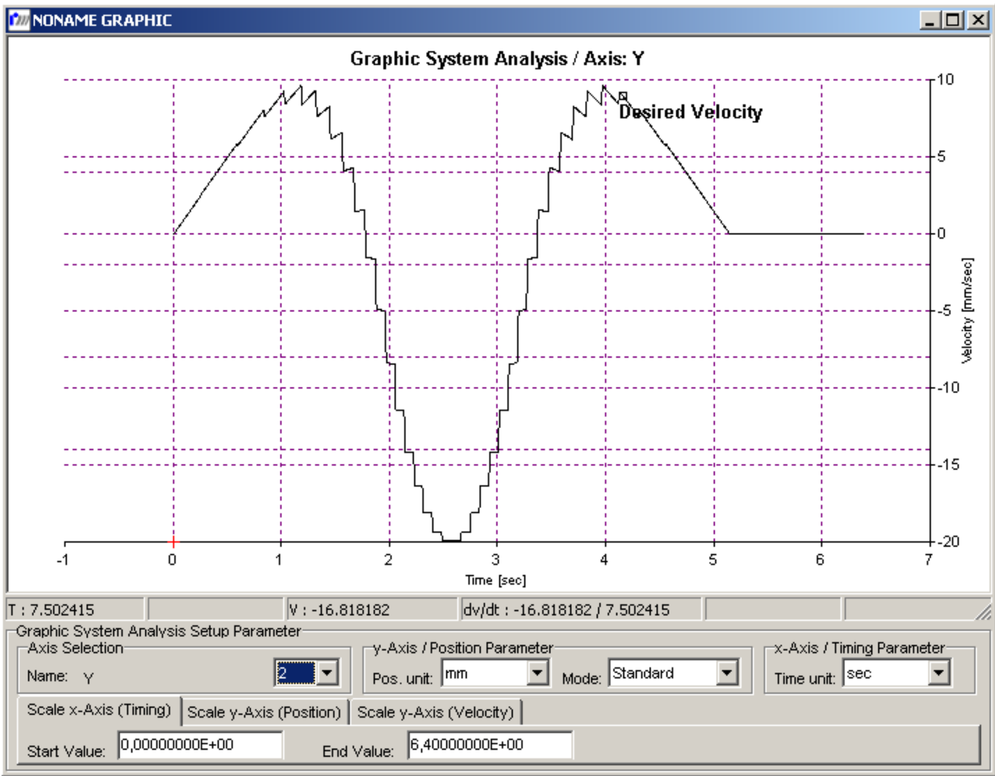


Fig. 2-8: Trajectory velocity course with velocity jump limitation

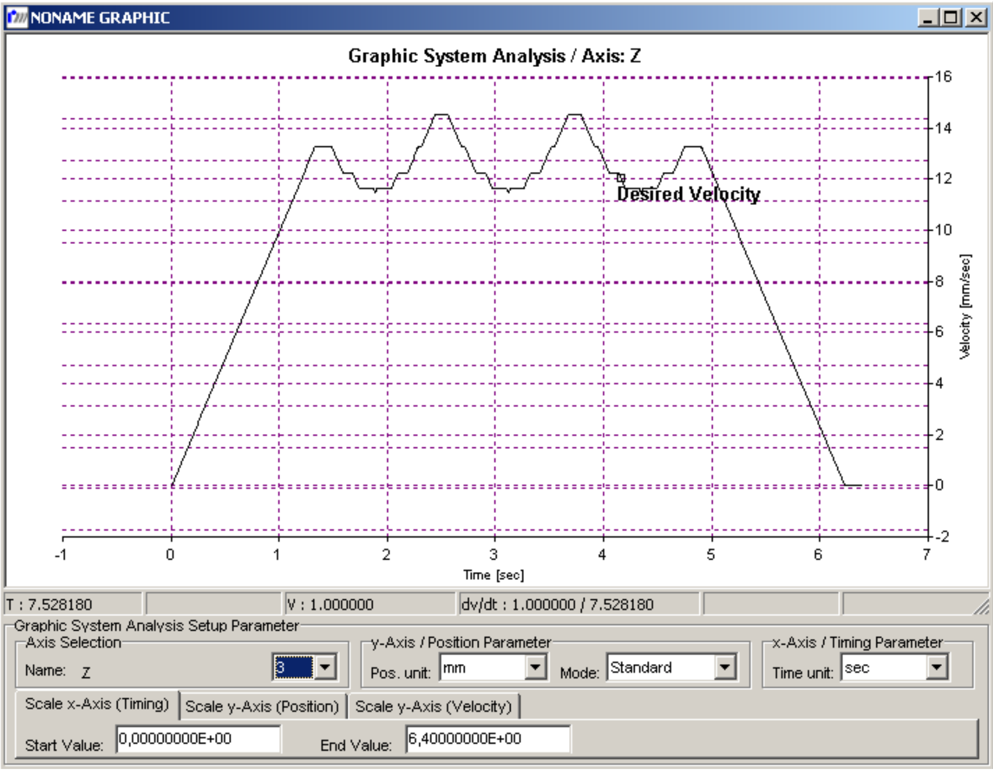


Fig. 2-9: x-axis velocity course with velocity jump limitation

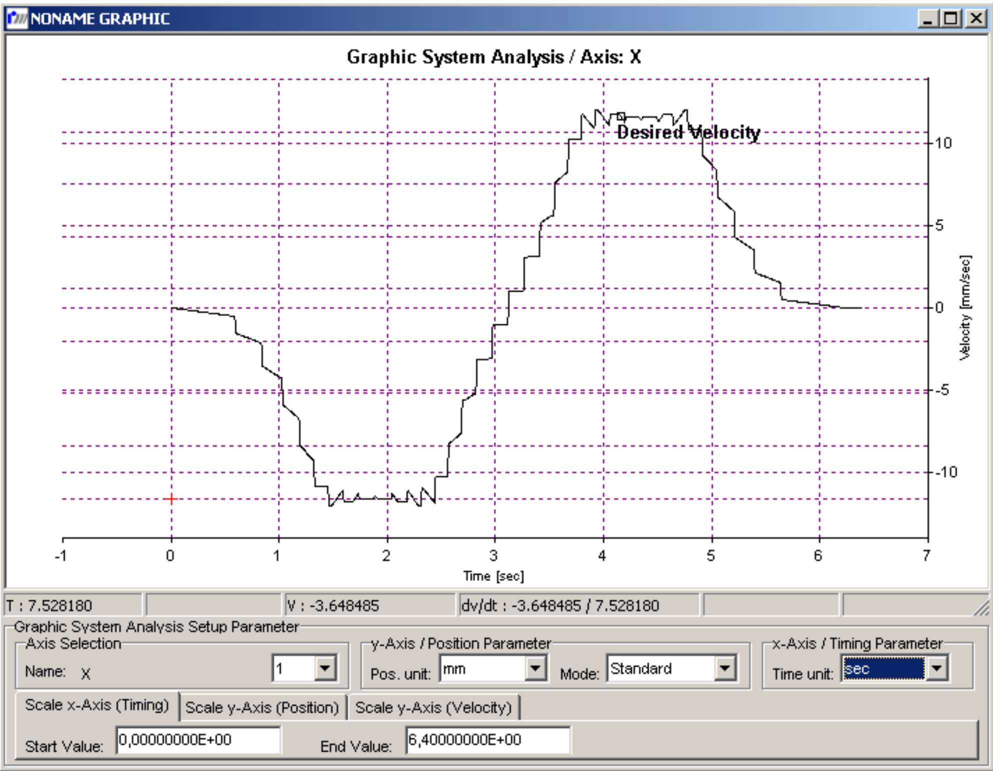
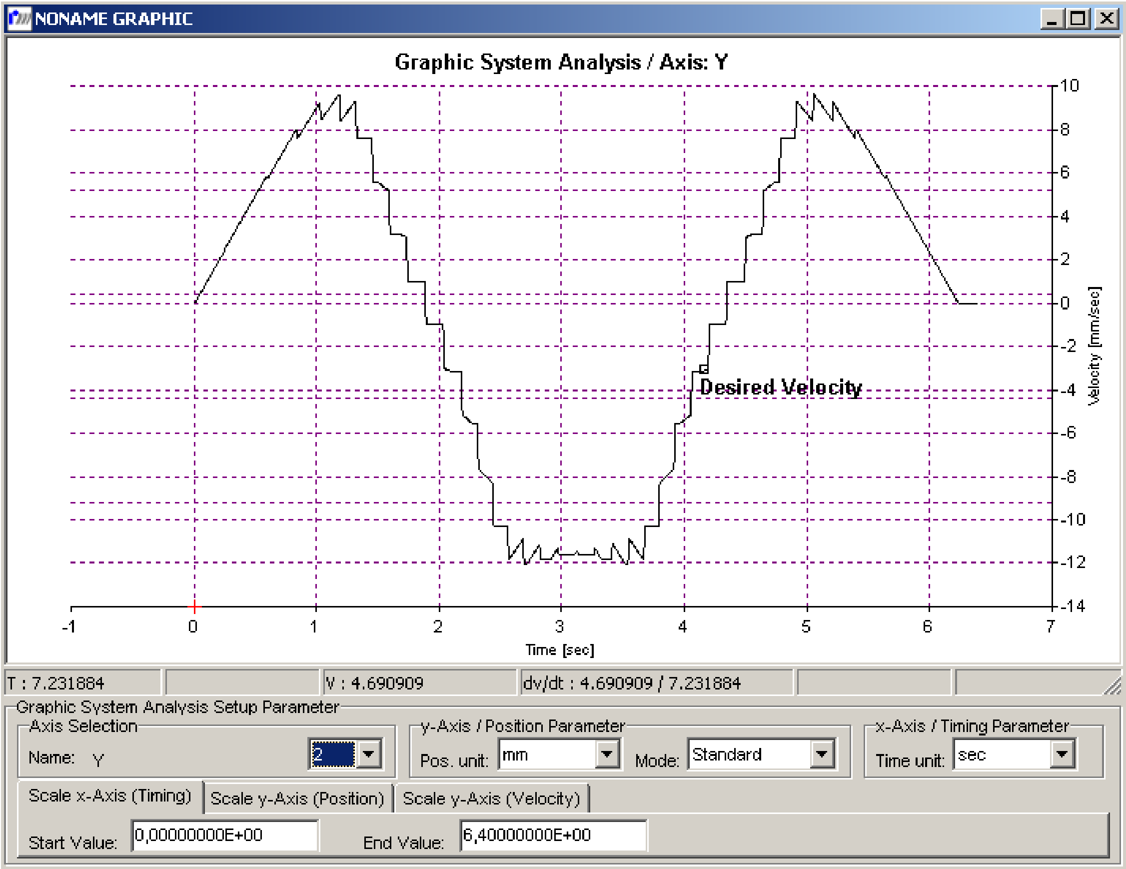


Fig. 2-10: y-axis velocity course with velocity jump limitation



3 Contact and support

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