Application Note 007e

AED / FIT®

AED_Panel for time and frequency analysis of the dynamical behavior

I1701-1.1 en

HBM

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1 Introduction

The *AED_Panel32* program supports all AED and FIT® types. As well as setting up communication, the program can be used to set up parameters, to adjust the measurement chain (load cell and electronics) as well as to analyze dynamic processes in the time and frequency range. The results of these analyses make it far easier to optimize the weighing system with regard to weighing speed and accuracy. It is also possible to save the parameters in a file (*.par) and print them out; the dynamic measurements are stored in graphics files (*.grf).

This application document describes the graphic function options for analyzing dynamic processes in weighing systems.

Please note that after the connection has been set up, **all the** panel functions are set to the particular type of electronics (enable or invisible).

In the text below, the electronics are referred to as AED. The description also applies to the FIT, of course and to other supported electronics types (see HELP, About).

2 Basic settings

A fast data transfer rate is a requirement of dynamic measurement. So communication should always be set up at a baud rate of 38400 Bd. The sampling rate (**ICR**) should also be set to the maximum value. The panel program usually works with the 4-byte data format (**COF**8). This also transfers the measurement status, that contains various information for the special graphic display.

Before starting measurement, you must set the scaling and the decimal point ("MEASUREMENT" menu or **NOV** parameter in the "ADJUSTMENT" menu). If required, enter the unit of measurement in the "PARAMETERS" menu (**ENU**).

Figure 1 shows the graphic menu before starting a measurement.

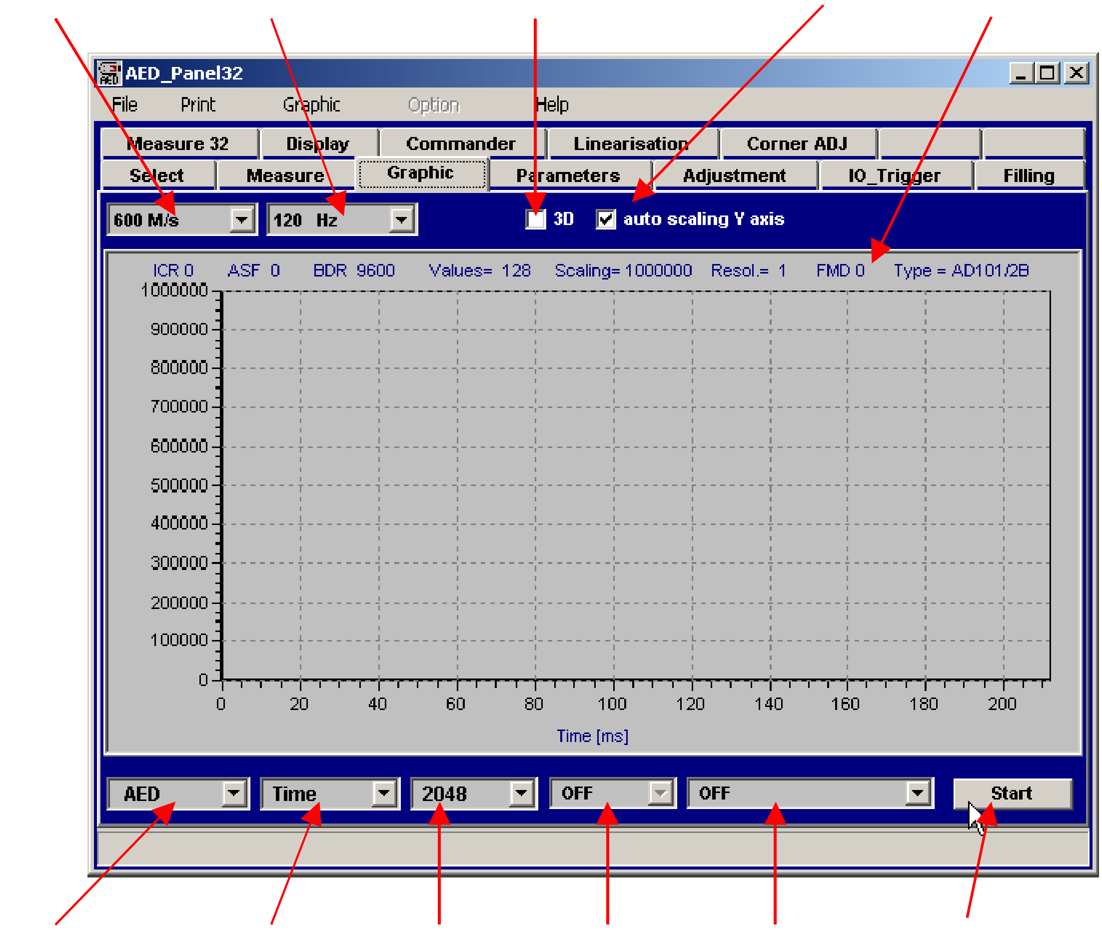


Fig. 1: Settings in the time measurement graphic menu (AED_Panel32 V1.xx)

The panel program has the following measurement modes:

- Block measurement (128…4096 measured values, without loss of data)
- Logger (slow ‚oscillograph' display)
- Trigger special mode, only active if the trigger function is activated)

Block mode has to be used for the timing analysis. Recording time calculation

Time [s] = Number of values / ICR setting [M/s]

The signal source is set to ‚AED'.

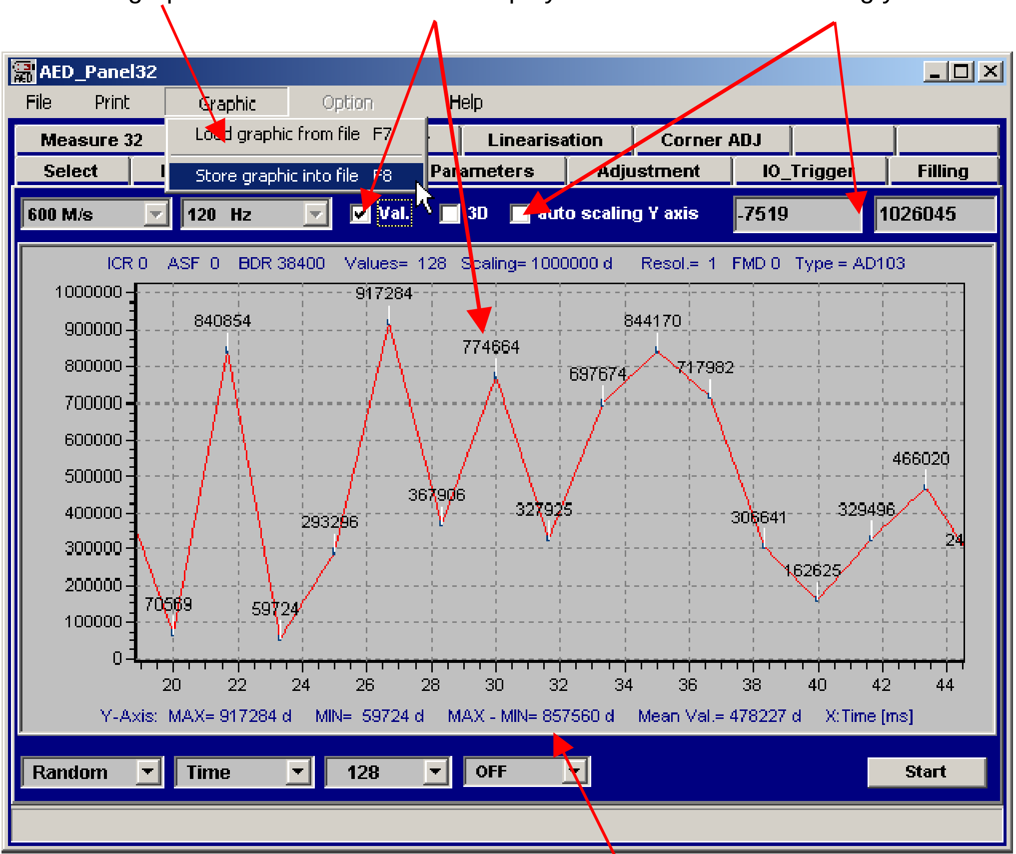
The settings **ICR** and **ASF** are output directly to the AED.

Figures 2 and 3 show the additional functions in the Graphic menu.

Data point value display for Zoom display

Store/Load graphic file

Autoscaling off: Scaling y-axis



Special display MAX, MIN, MAX-MIN, mean value (in display range)

Fig. 2: Zoom display with measurement display

The MAX/MIN values and the mean value always relate to the current display range.

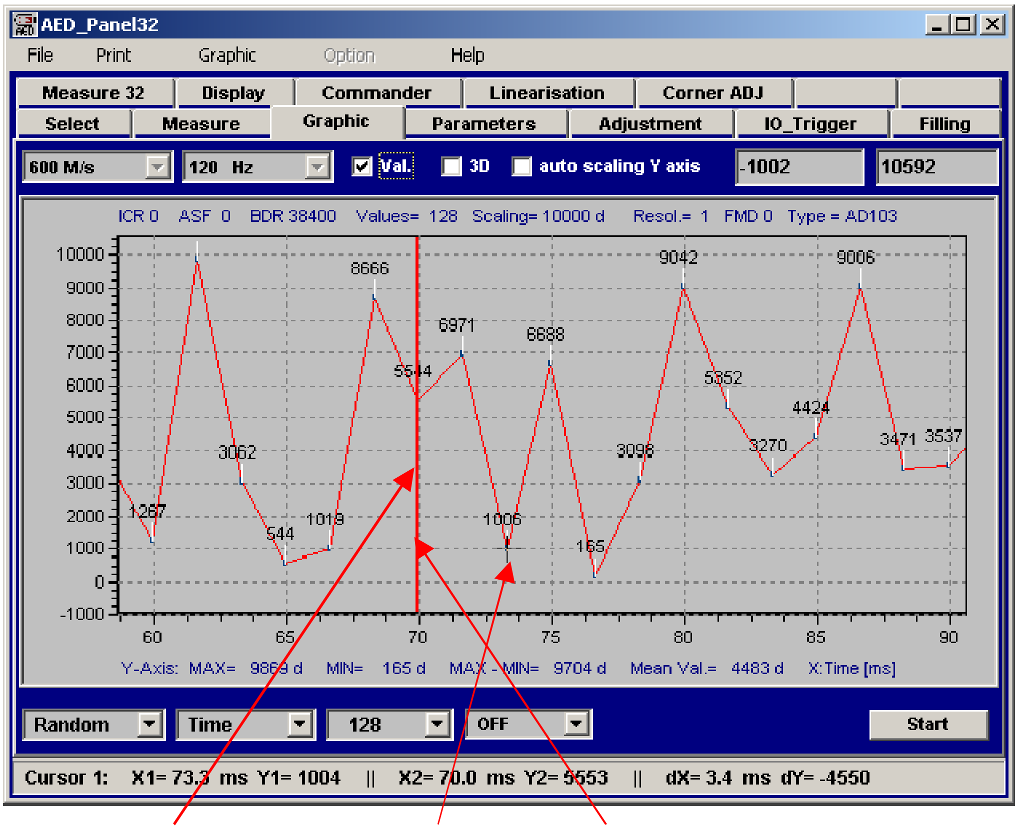


Fig. 3: Cursor display with cursor X1/Y1 und X2/Y2

Some notes on the graphic file *.grf :

The graphic file is created as an ASCII file and as well as the measured values, it contains all the requisite settings and AED parameters for the graphic. Which means that it is also possible to evaluate a graphic file even if there is no AED connected (subsequent evaluation).

It is also possible to run a frequency analysis (see Frequency analysis for dynamic measurements) or to use ‘Post’ filters (see Timing analysis for dynamic measurements) at a later time.

The graphic file can also be read into *EXCEL* and evaluated (set a blank space and a semicolon as the separators).

The graphic file must not be edited, as the line content and the sequence are fixed.

Graphic files from the ‚old’ panel program (*AED_Demo V30...37*) cannot be read in.

Zoom function (Figure 2) :

If autoscaling is deactivated, you can use the mouse to select a rectangular zoom area (1: Move mouse cursor to the interesting initial area, 2: keeping the right-hand mouse button pressed, open up the rectangular area and release the button again).

The MAX/MIN and mean value display in the lower part of the graphic is always related to the area displayed in the graphic.

If you move the mouse cursor to the left-hand or right-hand area of the graphic, the graphic will scroll to the left or to the right.

Deactivating autoscaling deactivates the zoom function.

Cursor measurement (Figure 3) :

First use the right-hand mouse button to define the cursor (red vertical line, e.g. X2/Y2). Then move the mouse cursor to the second interesting measurement point (X1/Y1), without pressing any mouse buttons. The values for cursor 1 and 2 and the difference are displayed in the lower status display.

Special graphic display (Figure 1) :

The special display is only available for the AD103 and second generation FIT types and it is a requirement for the relevant functions to have been activated (trigger function, limit value switches and dosing function).

The status information of all the recorded measured values can be evaluated and displayed using this display (output format **COF**8, depending on the input mode **IMD**):

- Trigger start, trigger end, settling time
- Limit value level, limit value status,
- Status of the outputs during dosing

(This function is not accessible to AD104 and first generation FIT, as these electronics do not transfer the requisite status information)

3 Timing analysis for dynamic measurements

The following points describe the general procedures for measurements with a graphic display:

- Setting the maximum baud rate and setting up communication
- Static adjustment of the measurement chain (**LDW/LWT** in the “ADJUST” menu) and setting the desired resolution (**NOV**)
- Setting the required output rate (**ICR**) and setting filters (**ASF**, **FMD**) in the “PARAMETERS” menu
- Selecting the number of measured values (measurement mode = 256...4096)
- Starting (“GRAPHIC” menu)
- Storing the measurement in the *.grf file and evaluating (Cursor, Zoom,... see Introduction, Figure 2)

If the recording is made with the setting (**FMD**0, **ASF**0, **ICR**0), after the measurements have been recorded, you can choose the best filter for the application, without having to keep re-measuring.

The panel program contains digital filters (= ‚post’ filters), that can be activated after a measurement recording has been made. The panel post-filters are identical to the digital filters incorporated in the AED / FIT. Even the filter mode (**FMD**) is taken into consideration.

The best filter effect is now selected (without re-measuring) using panel post filter **ASF**1...9, **FMD**(0)/1. The original signal (unfiltered, gray) and the filtered signal (blue/red) are displayed simultaneously (Figure 4). The filter mode (**FMD**) can be changed in the “PARAMETERS” menu (do not forget to press *“Write”*).

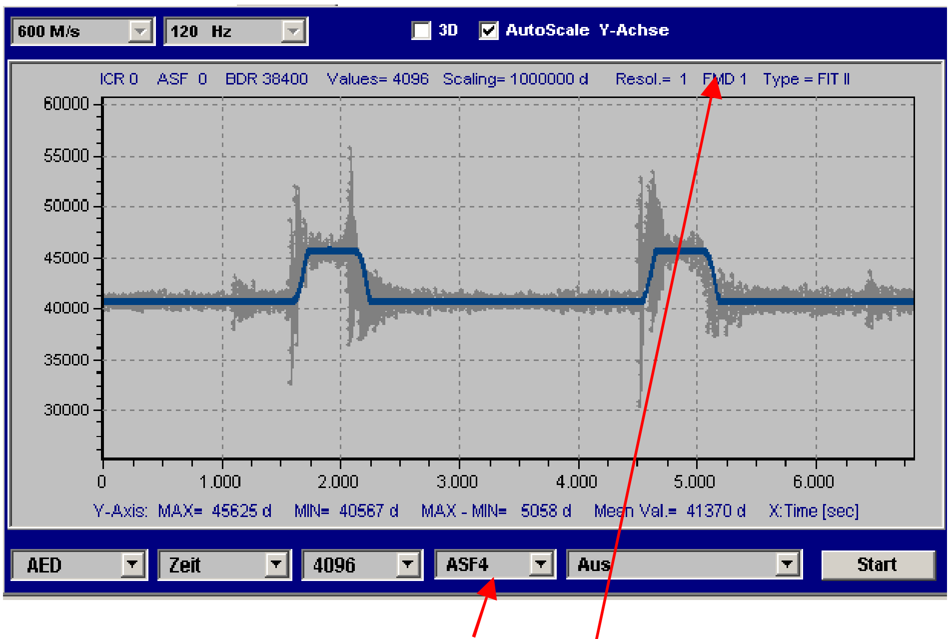


Fig. 4: Measurement display with ‘post’ filter (ASF4, FMD1

4 Frequency analysis of dynamic measurements

The program gives you the opportunity to use FFT (Fast Fourier Transform) to analyze possible disturbance frequencies (for example the drive of a conveyor belt in a checkweigher or other disturbing mechanical vibrations) and to determine which components are to blame. In ‚Frequency' display mode, the amplitude spectrum of the current time series is displayed.

Enter the amplitude in a logarithmic scale on the Y axis. The logarithmic scale is calculated as follows

Y = 20∗log10 (signal/nominal signal) [dB]

The following table provides an overview of the scales of this logarithmic display :

Display in dB	Signal ratio
-3	1/sqrt(2)
-20	1/10
-40	1/100
-60	1/1000
-80	1/10000
-100	1/100000

The nominal signal relates to the selected panel or **NOV** resolution.

Example 1: a frequency line at –60 db amplitude corresponds to 1/1000 of the nominal resolution.

Example 2: a frequency line at –40 db amplitude corresponds to 1/100 of the nominal resolution.

The x-axis is the frequency axis. The spectrum is always displayed at up to half the output rate, depending on the output rate selected
(for example: output rate = 600 Hz → frequency axis = 0...300 Hz).

The following points describe the general procedures for measurements:

- Setting the maximum baud rate and setting up communication
- Static adjustment of the measurement chain (**LDW/LWT** in the “ADJUST” menu) and setting the desired resolution (**NOV**)
- Setting the maximum output rate (**ICR**0) and setting filters (**ASF**0, **FMD**0) in the “PARAMETERS” menu
- Selecting the number of measured values (measurement mode = 256...4096)
- Starting (“GRAPHIC” menu)
- Storing the measurement in the *.grf file and evaluating (Cursor, Zoom,... see Introduction, Figure 1)
- Changing the display mode (see Figure 1) to *“Frequency”*

The maximum output rate and greatest filter bandwidth were therefore selected initially to display all the frequencies unfiltered. To try out the effect of the digital filters (selecting the best filter for an application), you can again use the ‘post’ filter function (Figure 5). The spectrum display then returns the spectrum of the unfiltered values (gray), as well as the spectrum of the filtered values (red), for comparison. This makes it possible to analyze how efficient the digital filters are at suppressing disturbance frequencies (Figure 6).

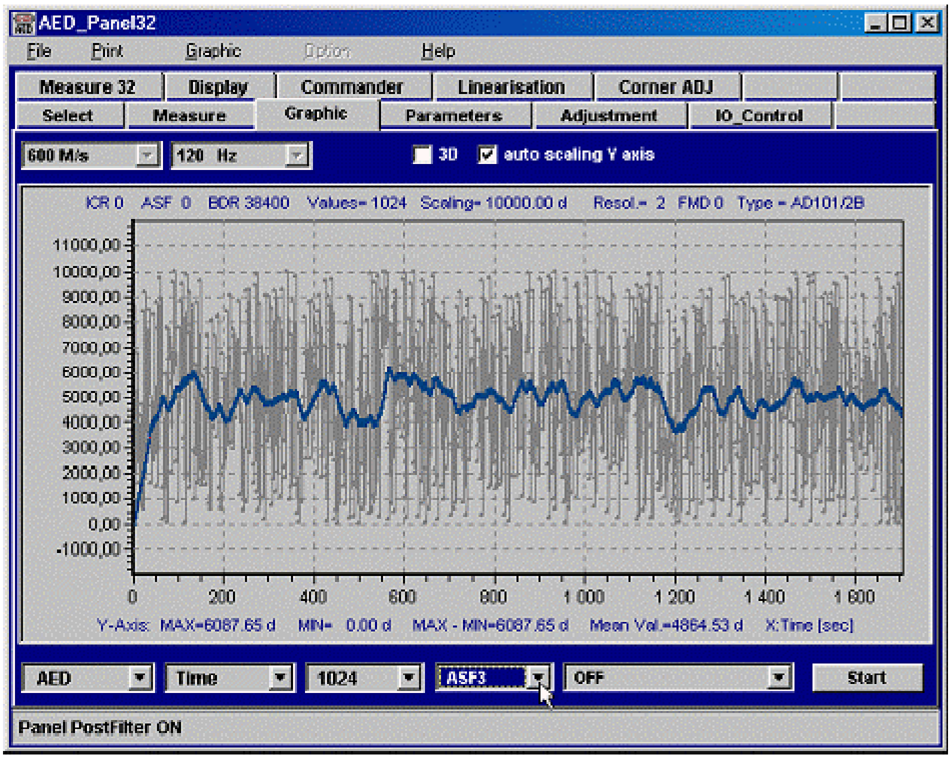


Fig. 5: Measurement display with ‘post’ filter (ASF3, FMD0)

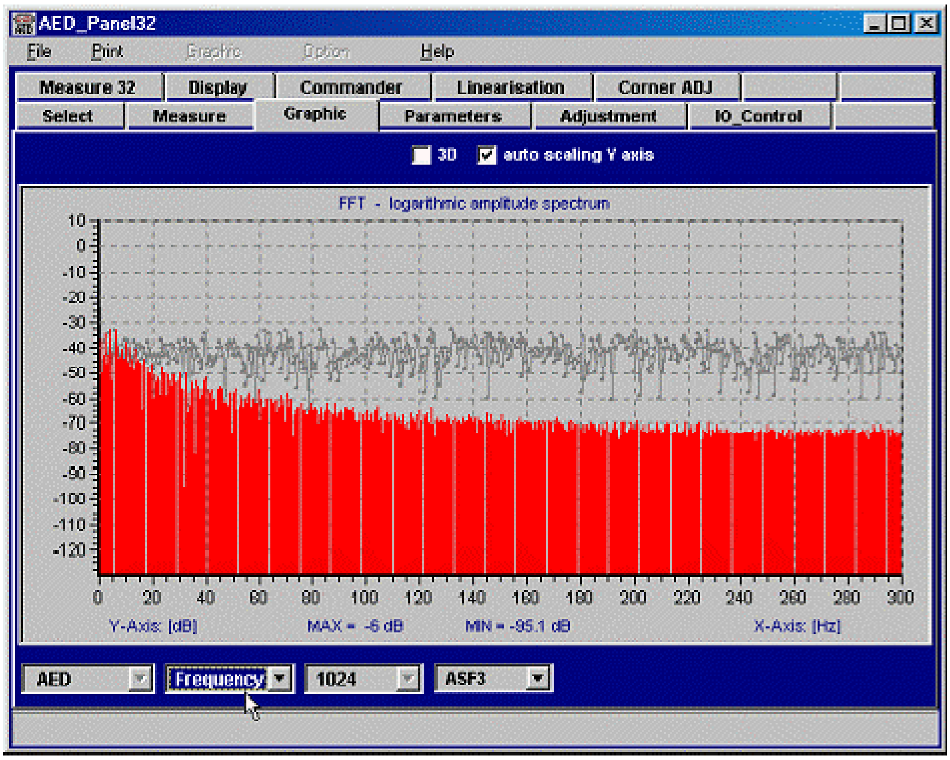


Fig. 6: Spectrum display with ‘post’ filter (ASF3, FMD0) from Fig. 5

5 Displaying the dynamic panel ‘post’ filter properties

The panel program contains digital filters (= ‚post’ filters), that can be activated after a measurement recording has been made. The panel post-filters are identical to the digital filters incorporated in the AED / FIT. Even the filter mode (**FMD**) is taken into consideration.

As well as the table describing the AED / FIT digital filters in the operating manual, the panel program also gives you the opportunity to display the settling time and damping behavior properties of the filters.

The AED signal source is deactivated and either the step function or a dirac pulse is selected.

- Measuring the transient response during a stepped input signal:
  - Setting **ASF**0 and **ICR**0 as well as the required filter mode **FMD**
  - The signal source is switched to ‚Step’ (step function as input signal).
  - Measurement mode to be set to at least 1024 values.
  - Start measurement
  - The input step is displayed.
  - Now the required ‚post’ filter is selected and the display shows the input step (gray) and the filtered signal (blue/red = filter step response of the filter).
  - The settling time can now be gauged with the cursor (Figure 7)

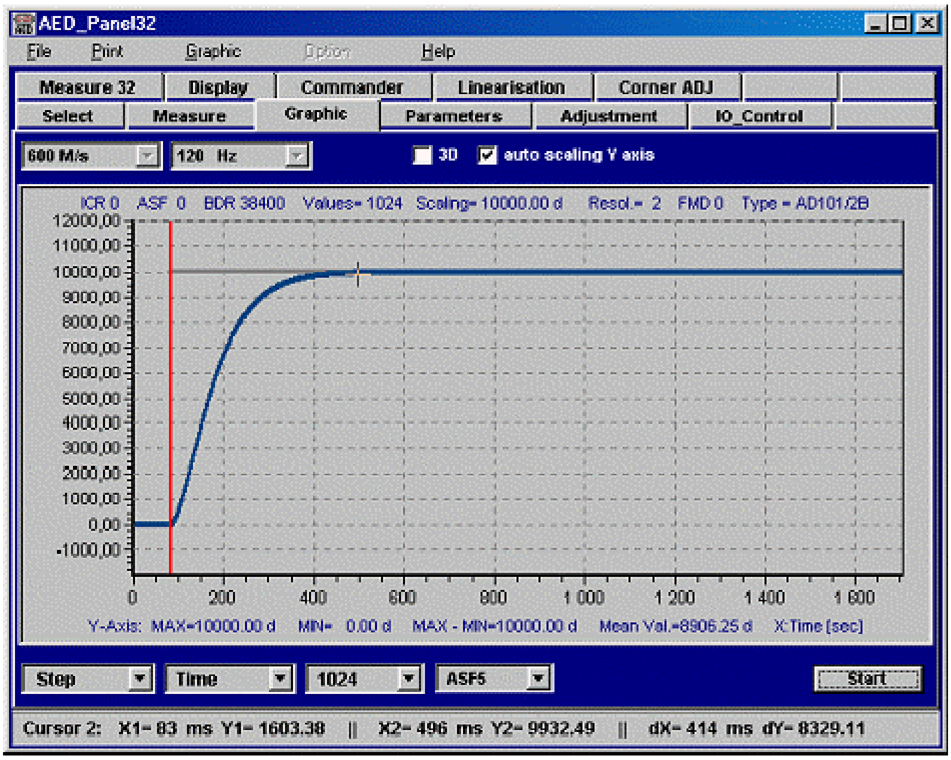


Fig. 7: Input step function and step response of the ‚post’ filter (ASF5, FMD0)

- Measuring the damping behavior of a ‚post’ filter:
  - Setting **ASF**0 and **ICR**0 as well as the required filter mode **FMD**
  - The signal source is switched to ‘dirac’ (dirac pulse as input signal).
  - Measurement mode to be set to at least 1024 values
  - Start measurement
  - The dirac pulse is displayed.
  - Now the required ‘post’ filter is selected and the display shows the input signal (gray) and the filtered signal (blue/red = pulse response of the filter) in Figure 8.
  - The display mode is now changed to ‘frequency’ and you see the damping behavior of the digital filter (Figure 9, Frequency response)

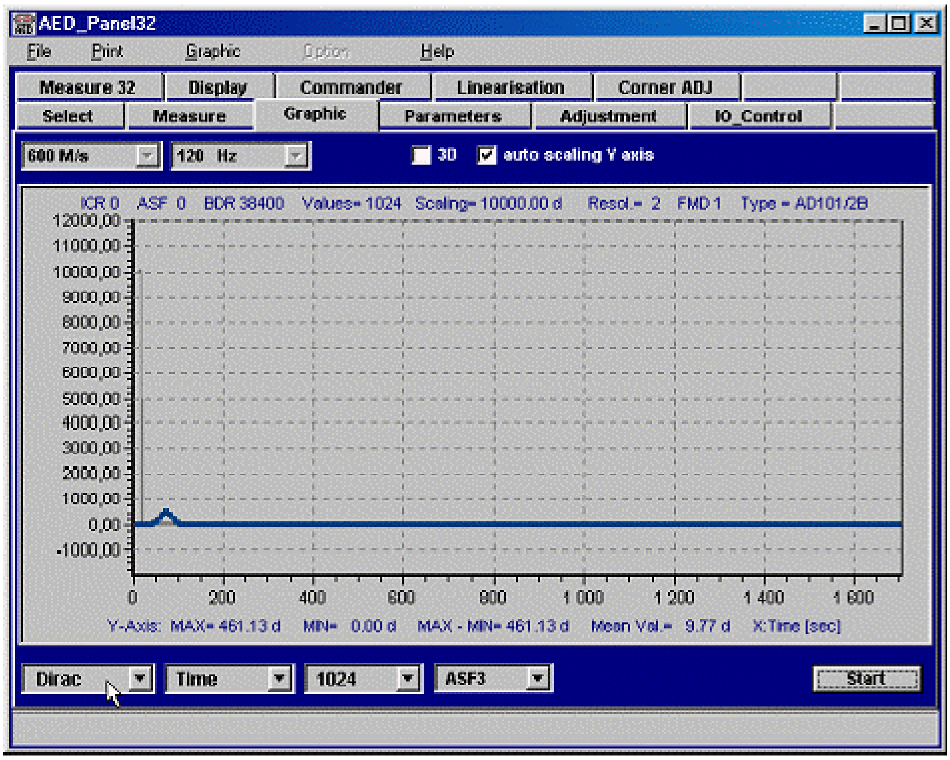


Fig. 8: Dirac pulse and pulse response of the ‚post’ filter (ASF3, FMD1)

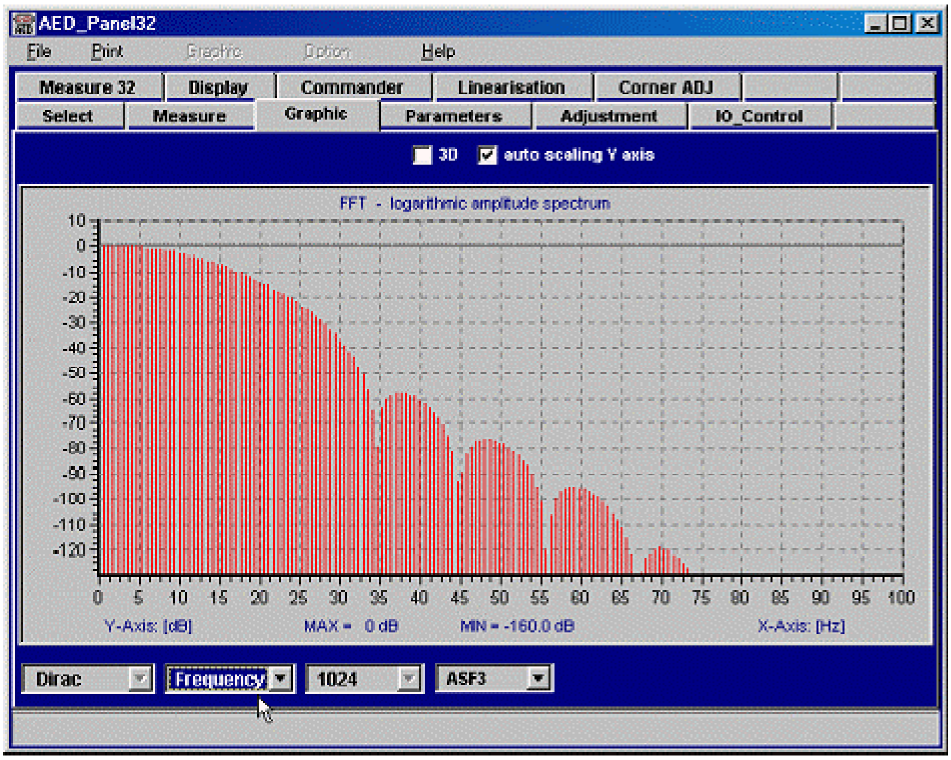


Fig. 9: Damping behavior (frequency response) of the ‚post’ filter (ASF3, FMD1)

The frequency axis is only displayed up to 100 Hz, as the filters (**ASF**3, **FMD**1) in the AED reduce the sampling rate to 200 Hz (see second generation FIT manuals).

As soon as **ASF** > 0 and **ICR** > 0 is set in the FIT, the panel post filters can no longer be used, as the result does not then match the filters in the AED (AED and panel filters active simultaneously).
There are two aspects to consider in the panel post filters display:

- at the start of the graphics display, a software-driven post filter transient state can be seen, which can always be ignored
- there is a delay between the unfiltered and filtered measured values (in accordance with **ASF** for **FMD**1). This is the filter runtime (= length). This runtime also occurs with filtering in the AED.
  The runtime of a filter in the AED (**FMD**1) is the same as the settling time of the filter (see the Manual, command **ASF**).

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APPN005en	Measurement query via the serial link (RS232/RS485)
APPN006en	Dosing and filling with AD103 / FIT®
APPN007en	Using *AED_Panel32* program for time and frequency analysis
APPN010en	Legal for trade applications and parameter checking
APPN011en	Trigger results query
APPN012en	Commissioning CANOpen
APPN013en	Commissioning DeviceNET

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