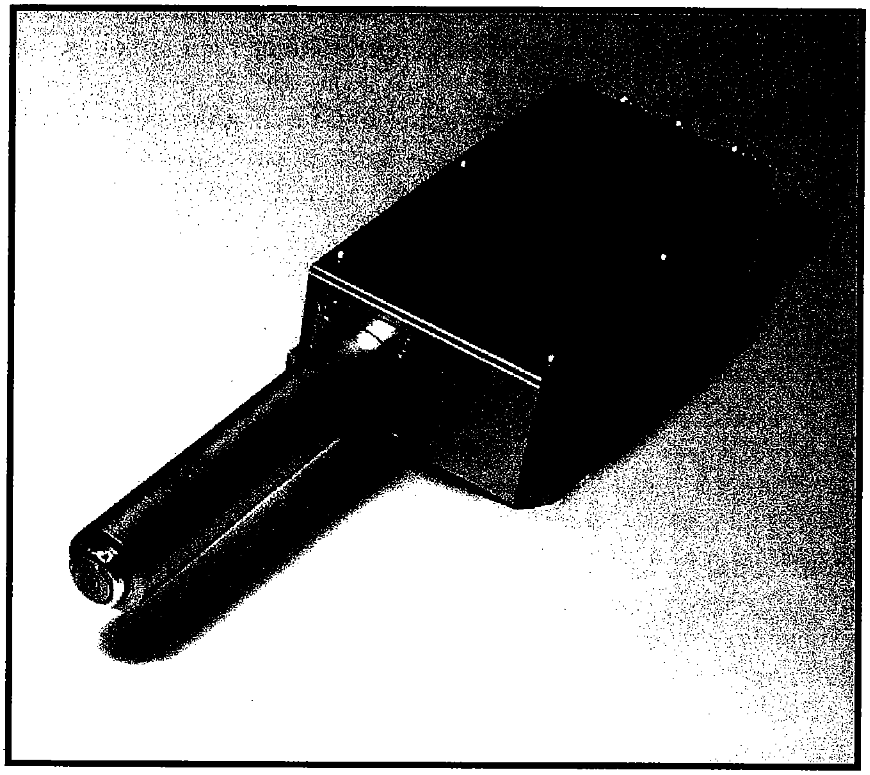
DP00150

AXAS

(Analog X-ray Acquisition System)



Operating Manual

KETEK

Creative Detector Solutions

Caution

- This document contains data valid only for the AXAS system you purchased it with. Please do not use it as a reference to operate any other devices you purchased earlier or later on from our company.
- Do not drop or cause mechanical shock to the AXAS, especially if you purchased a system equipped with an AP3.3 radiation entrance window.
- Avoid any kind of high forces and/or torques during mounting of the AXAS, especially if you purchased a system equipped with an AP3.3 radiation entrance window.
- Do not operate the AXAS at a temperature (measured at the steel electronics case) above 35 °C. Apply additional cooling to the steel case if necessary (contact to heat sink, gills, PC air cooler etc.). The performance of the system will noticeably worsen above this temperature.
- Never change the setting of any potentiometer inside the electronics case. Every system is adjusted carefully before delivery. We will not take any warranty for systems damaged by manipulation of these potentiometers or adjust the system a second time for free, if you did not contact us first.
- If you purchased a system and an ADC/MCA it is possible to adjust some detector parameters (voltages) via software. Do not change these settings without advice of KETEK. You may damage the system seriously by changing these settings. No warranty will be taken by KETEK in this case.
- Do not touch or apply any mechanical force or shock to the radiation entrance window (Beryllium or Ap3.3) integrated at the front end of the AXAS. The integrity of each window is checked carefully before delivery and no warranty will be taken if it is damaged by the customer. Moreover breaking the window during operation of the system will most probably destroy the whole detector.
- Take care to connect the output contacts and the test input properly as it is described in this manual later on.
- Take care to follow the instructions regarding the power input to the system given in this manual. Otherwise the system may be destroyed. We strongly recommend our own power supply.
- Do not expose the detector to a high particle flux (such as ions or electrons). Damages done by incident particles will not be covered under warranty.
- Concerning radiation damage done by photons a maximal dose is guaranteed for each detector. In case of malfunction it is due to the customer to bring evidence that this dose has not been applied.

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* The picture on the title page shows the AXAS detector system

KETEK GmbH
Halbleiter- und
Reinraumtechnik

AXAS Datasheet

Every detector system produced by KETEK GmbH is tested electrically and spectroscopically. Testing parameters and results achieved in the final qualification are reported below.
A leackage test (MIL-STD-883, Method 1014.10) was performed and passed.

AXAS-Serial-NO:	00150
AXAS-Batch-NO:	24-05
TO8-Serial-NO:	X0061
Class:	SDD7-1403000

Spectroscopic results

FWHM: 163 eV @ 0.25 μs @ -20 °C (chip temperature)

P/B ratio: 3732

Count rate [cps]: 1201

Specifications

Snout length [mm]:	100
Shaping time [μs]:	0,25
Vacuum tightness:	NO
Upper energy limit [keV]:	20
Power supply:	YES

The spectroscopic results can be achieved, when the temperature of the AXAS housing is +20°C.

TO8 housing

Cap Type:	VITUS	Entrance window:	MOXTEK DuraBeryllium 8 um
Collimator:	Zr On-chip	Window diameter:	3.0 mm (7mm²)
Collimator support:		Auxiliary Colli. dia.:	

WARNING:

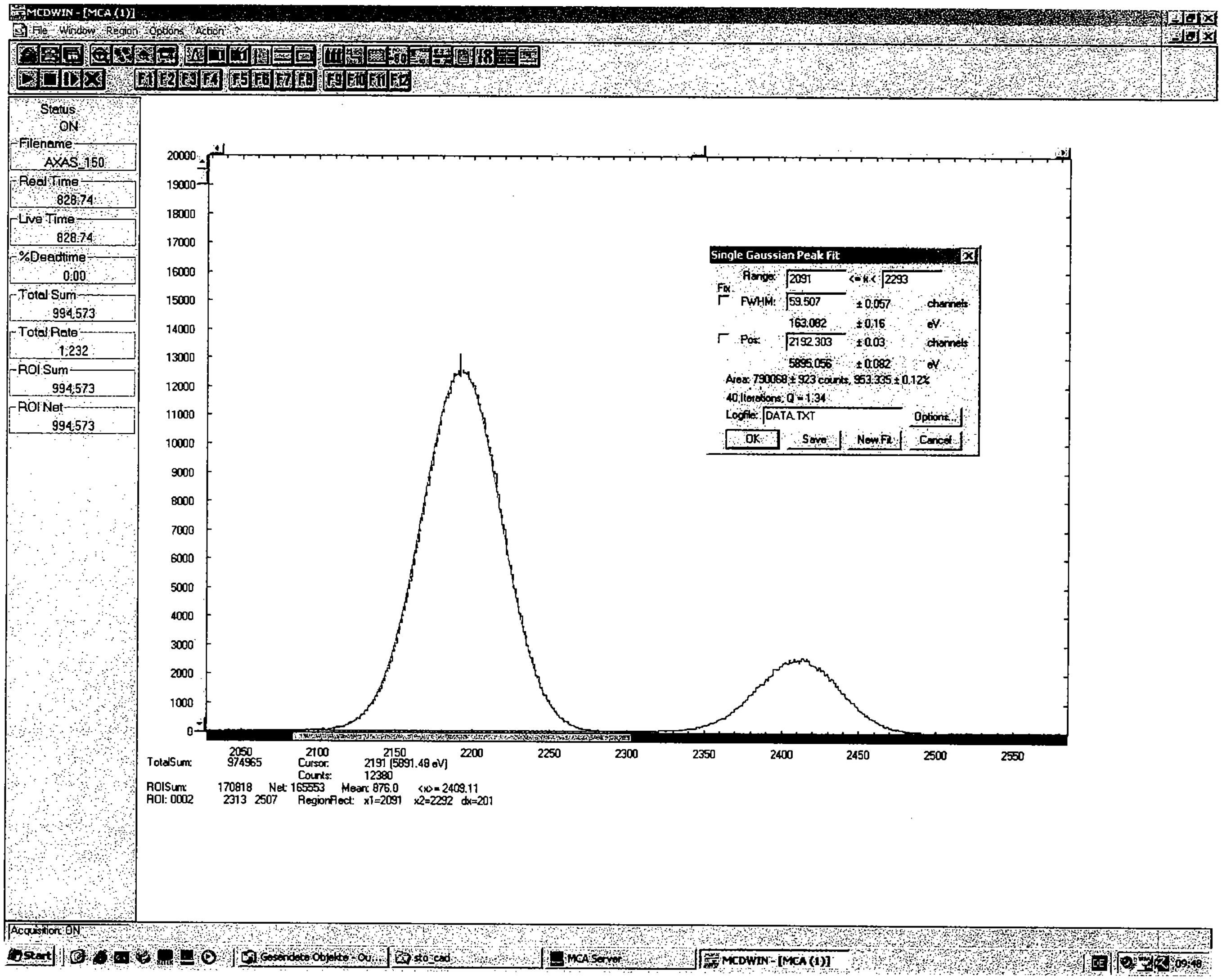
1. Sealing
The TO8-housing is closed hermetically. A leakage test MIL-STD-883 was performed. However every mechanical stress on the detector module can damage the module entrance window or the PIN s introducing a leakage in the housing.

2 Radiation hardness
Radiation hardness of the silicon drift detector has been investigated using synchrotron radiation.
With a total dose of 1012 absorbed photons on the SDD active area, typical variation of the energy resolution in terms of FWHM are less than 2% and peak/background ratio variation are less than 10%.
Radiation hardness is energy dependent. The analyses made represents the worst case, assuming incoming x-rays in an energy range between 10 and 15 keV, where the damage on the integrated electronics is maximized. Outside this energy range is the detector radiation harder.

Our technical staff is at your disposal for any kind of questions
mail to: support@ketek.net
http://www.ketek.net

DP00150

AXAS # 00150
SDD # X0061 @ 0,25µs



Operating instructions

The AXAS-detector system should be kind of plug and play. That means you should not have to change anything on the system itself. If this though is necessary contact us first in any case! After you unpacked the different components please connect them to each other and the components you supply by yourself regarding to the connection diagram inside this manual.

Packing list:
You should have received the following components:

- AXAS detector system, including detector, preamplifier, shaping amplifier (removed on customers demand), temperature control and internal power supply
- External ± 12 V power supply if purchased.
- Additional shaping time boards if purchased.
- This manual.
- ADC/MCA incl. set of connection cables and manual if purchased

Dimensions and HD-15 connector:
A technical drawing inside this manual gives the dimensions of the AXAS system, the pin definition of the integrated male HD-15 connector, and the definitions of the other input and output connectors in detail. Please never connect any pin, input or output in a different way or you may destroy the detector. Please note that the drawing corresponds to an AXAS system with a 100 mm snout. So this dimension may vary if you purchased a system with a different snout length.

Shaped output / radiation entrance window:
The BNC / Shaper OUT output provides an amplified, shaped signal (see example inside this manual / typical rise and fall time curves are attached too) within a voltage range from 0 to about 6 V (input impedance 1 mega ohm). It can be used as input signal to any standard ADC, although we recommend our own ADC/MCA ($AXAS^{MCA}$). The detector is calibrated in a way that the mentioned voltage spread covers a spread of x-ray energies from 0 to the upper energy limit you specified. The theoretical lower limit of the detector is about 200 eV but due to the entrance window you purchased the practical lower limit may be higher (e.g. for Beryllium about 1 keV). For more detailed information on the transmission of your entrance window please have a look at the attached transmission curves.

Pre-amplified output / test pulse input:
If you did not purchase our shaper the BNC / Shaper OUT does not provide any signal. In any case a pre-amplified signal is provided by BNC / Preamp. OUT. BNC / Test Input allows the user to connect a pulse generator to the system and test the output by applying different test pulses.

Pile-up rejection:
The pins 1 and 2 of the HD-15 connector each provide a TTL signal as input for an ADC with integrated pile-up rejection (not_PUR is inverted with respect to PUR / see attached oscilloscope screen shot). If you purchased a power supply these signals can be taken also at the side of the connection plug (PUR = yellow, not_PUR = green)

Ambient temperature:
Please note that the detector performance depends on the ambient temperature you provide. The metal housing of the AXAS system acts as a heat sink for the cooling mechanism of the detector. The housing should not have a temperature above 35 °C during operation. Anyway it is optimal if the housing stays at room temperature or somewhat below. So if possible attach an additional heat sink or apply active cooling to the housing.

Detector temperature:
The current temperature of the SDD detector integrated into your AXAS system can be monitored by reading the voltage given at the two temperature monitor output connectors (see technical drawing). This option is for service purposes mainly. More details are available on request.

Resolution (at high count rates) / shaping time:
Each detector has been tested carefully at the KETEK laboratory at Munich/Germany to redeem the guaranteed specifications. The guaranteed energy resolution was checked with reference to a measurement using the Mn K_α line of a Fe55 x-ray source and a shaping time of 1 μs. Please note that the best resolution you will observe depends on the shaping time and the count rate you use. For more detail have a look at the attached diagram giving the resolution of an example AXAS system in dependence of count rate and shaping time.

Peak shift at high count rates:
For high count rates a peak shift in the recorded spectra may occur depending on the applied count rate. The attached "AXAS – Peak Shift" diagram gives an example of this peak shift. Please note that the example we attached represents a kind of worst case scenario. The actual peak shift is different for every detector and should not exceed the given example by much.

Check the connection diagram:
If your system does not operate properly, please check all the connections referring to the connection diagram. Please also check by the two LEDs if the system is operational. If everything is connected the right way, please contact us before you open the AXAS and change any internal settings. YOU MAY DESTROY THE DETECTOR!!!

KETEK ADC/MCA
If you purchased an AXAS^{MCA} also several AXAS settings can be manipulated via the ADC software. This feature facilitates the service by far and may make a (re-)calibration of the detector system at your site possible. However, please do not change the settings without advice of KETEK or you may damage the detector.

In case of questions or warranty please contact:

Ketek GmbH
Gustav-Heinemann-Ring 125
D-81739 Munich

Mail: support@ketek.net
Tel.: ++498967346770
Fax.: ++498967346777

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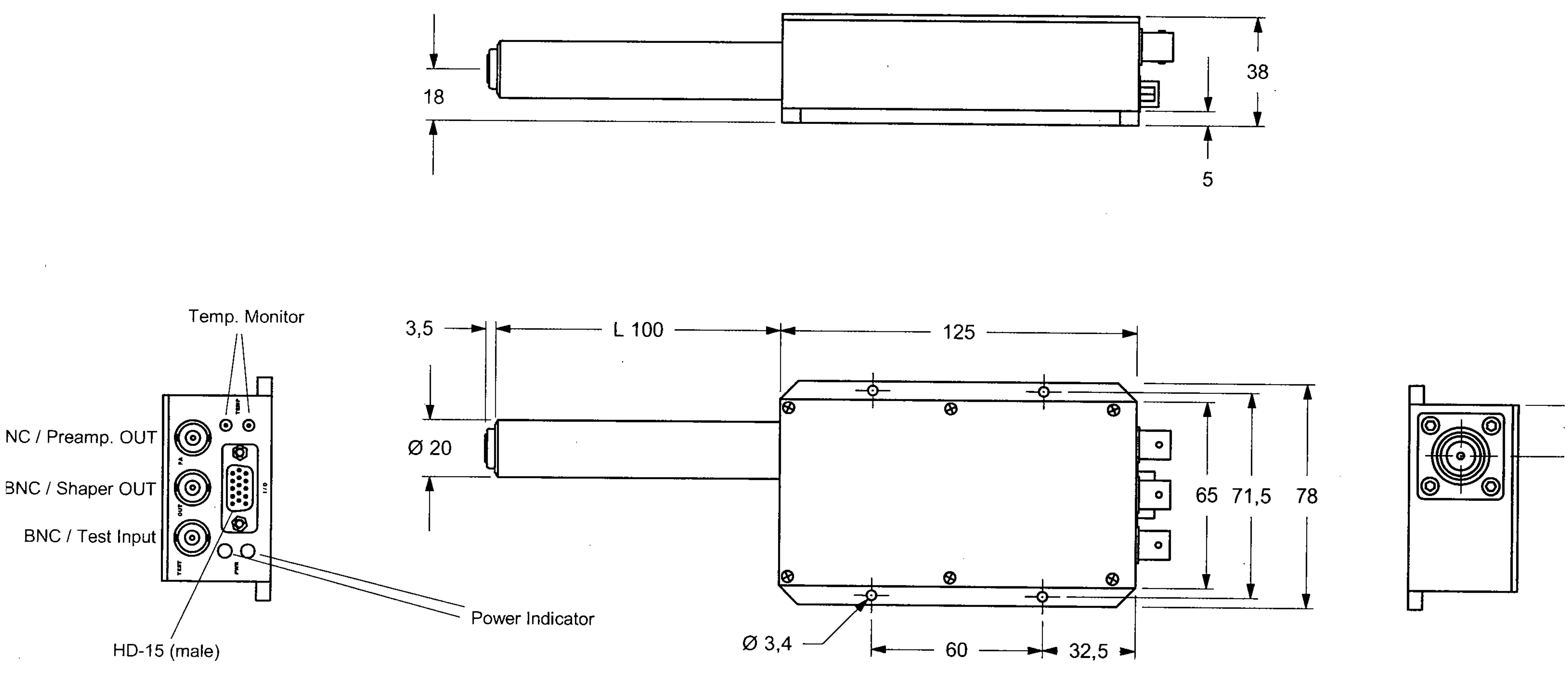
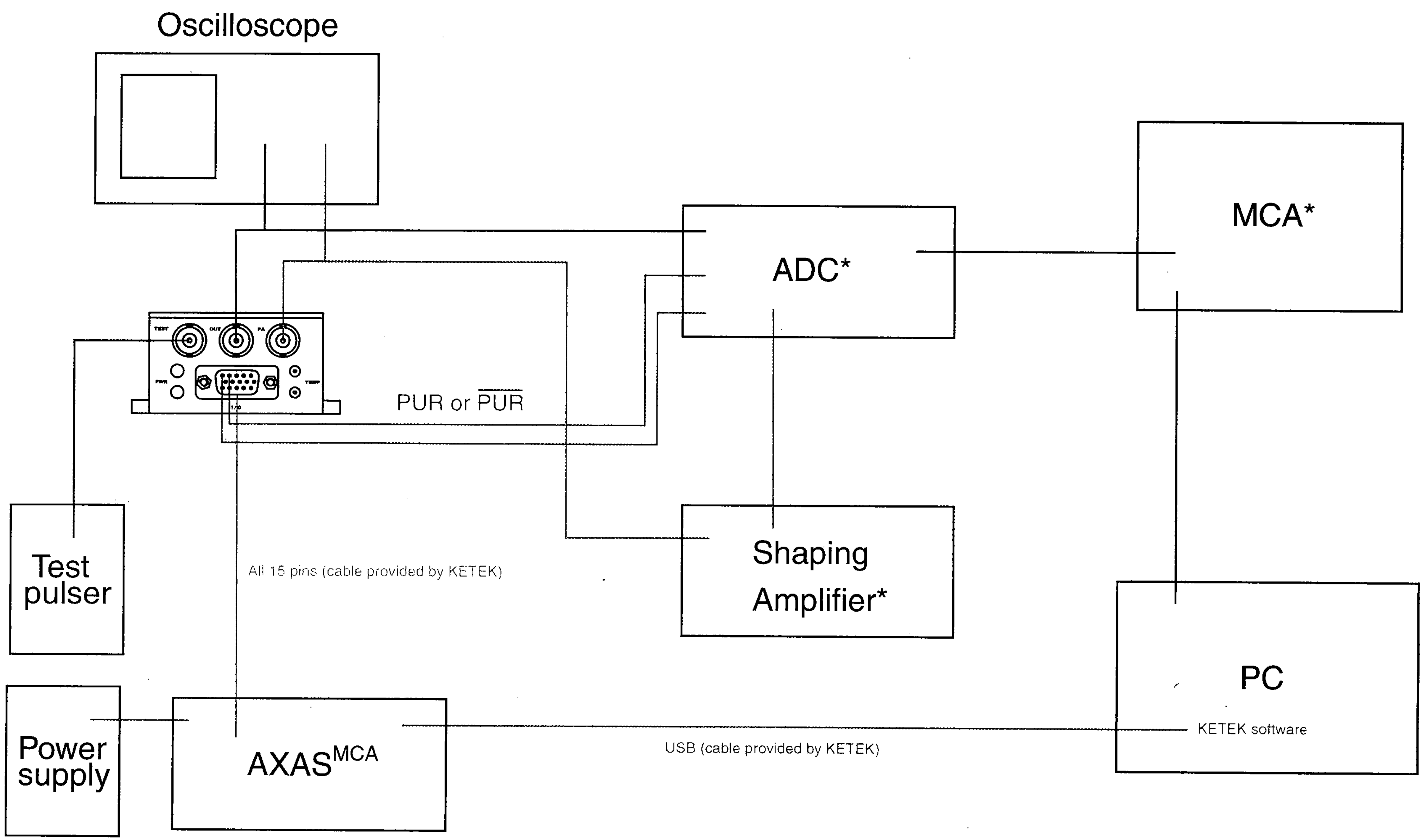
Technical drawing of an AXAS system with a 100 mm snout



	2	3	4	5	6	7	8	9	10	11	12	13	14	15
IR	$\overline{\text{PUR}}$	GND	GND	AMON*	+12V	GND	GND	GND	-12V	SCK*	SDO*	SOT*	ALD*	L5318*

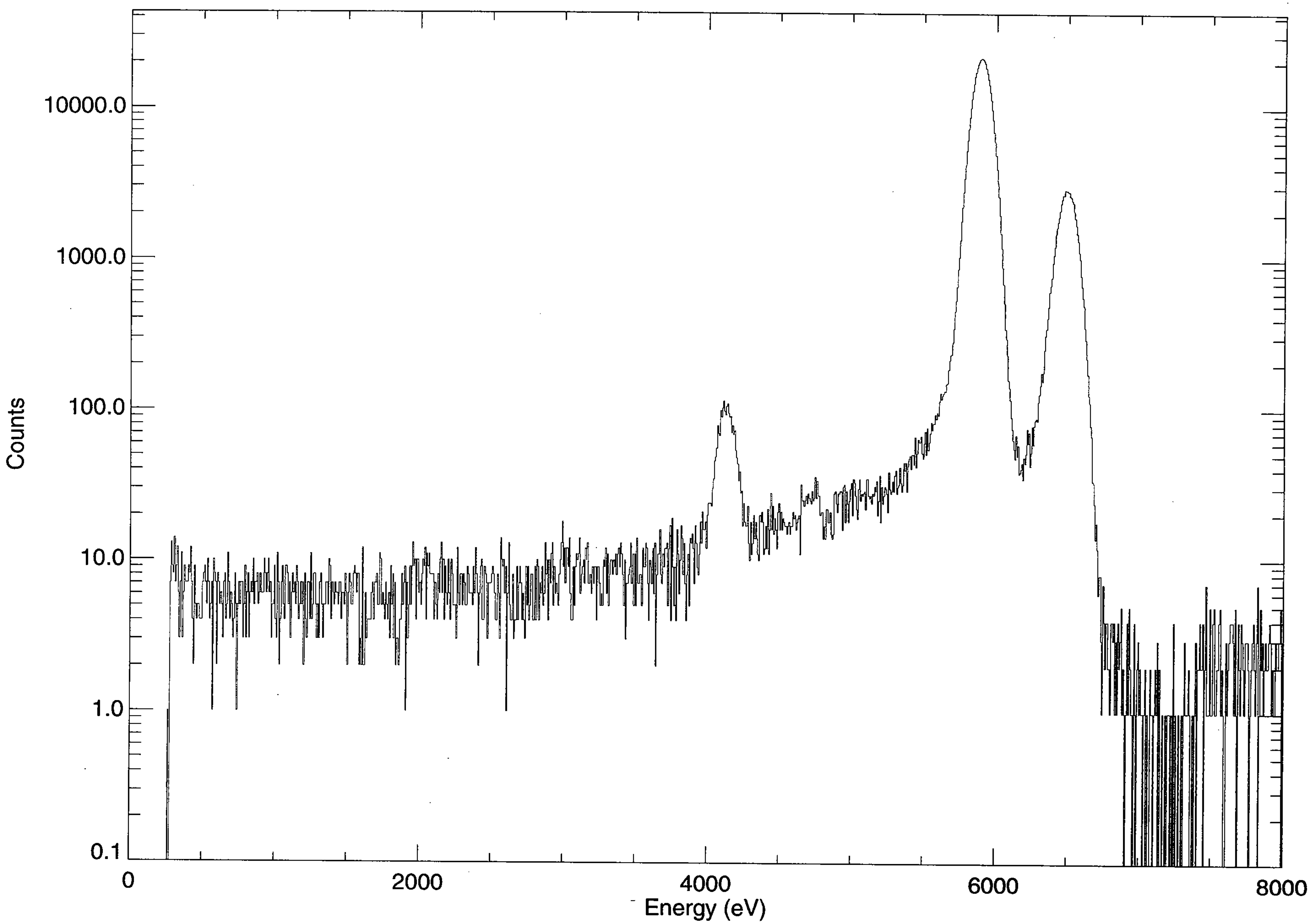
ɔr KETEK ADC/MCA handshaking.

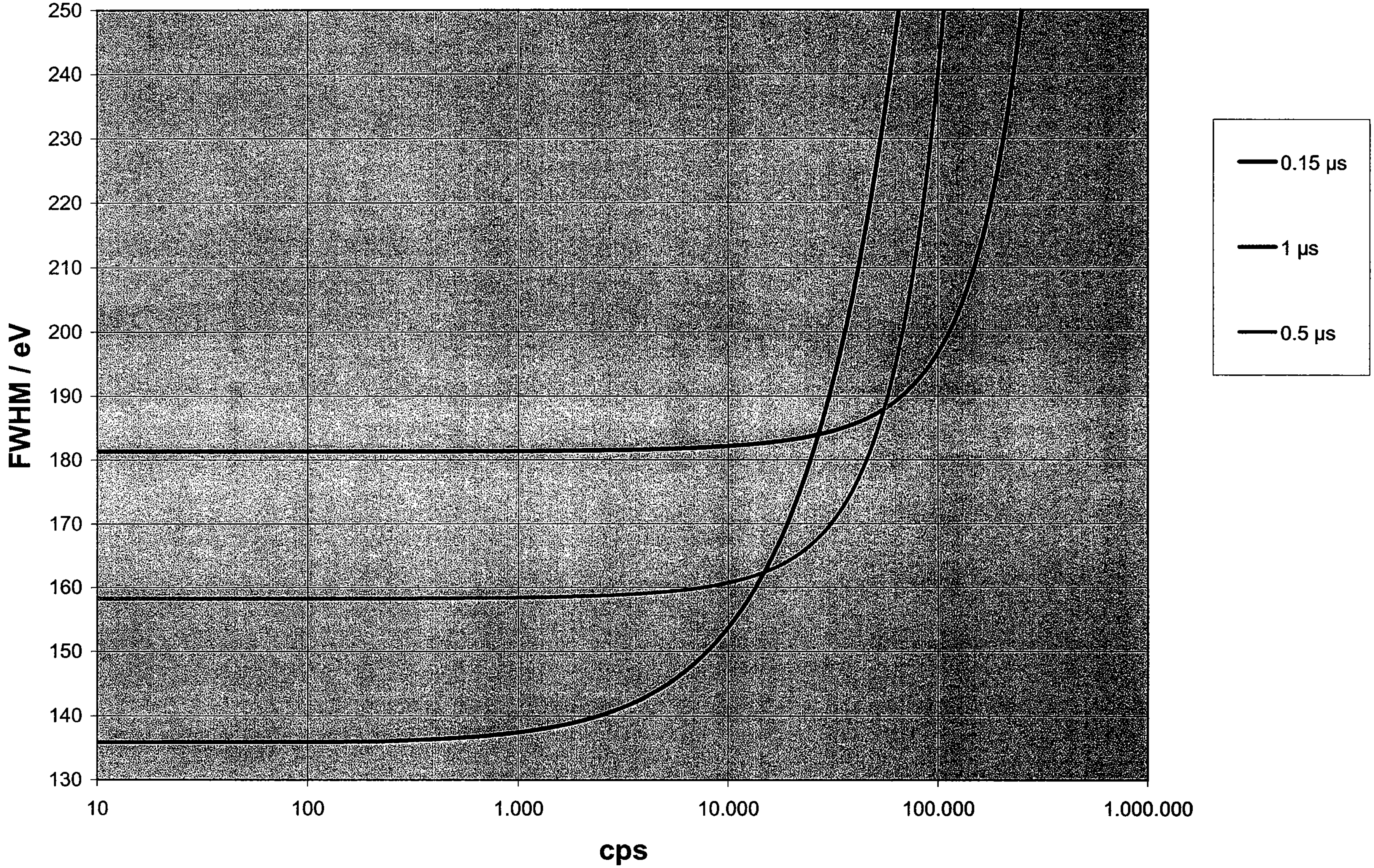
Connection diagram



*It is recommended to use Keteks shaping amplifier, which integrated in the AXAS system and KETEKs ADC/MCA AXAS^{MCA}

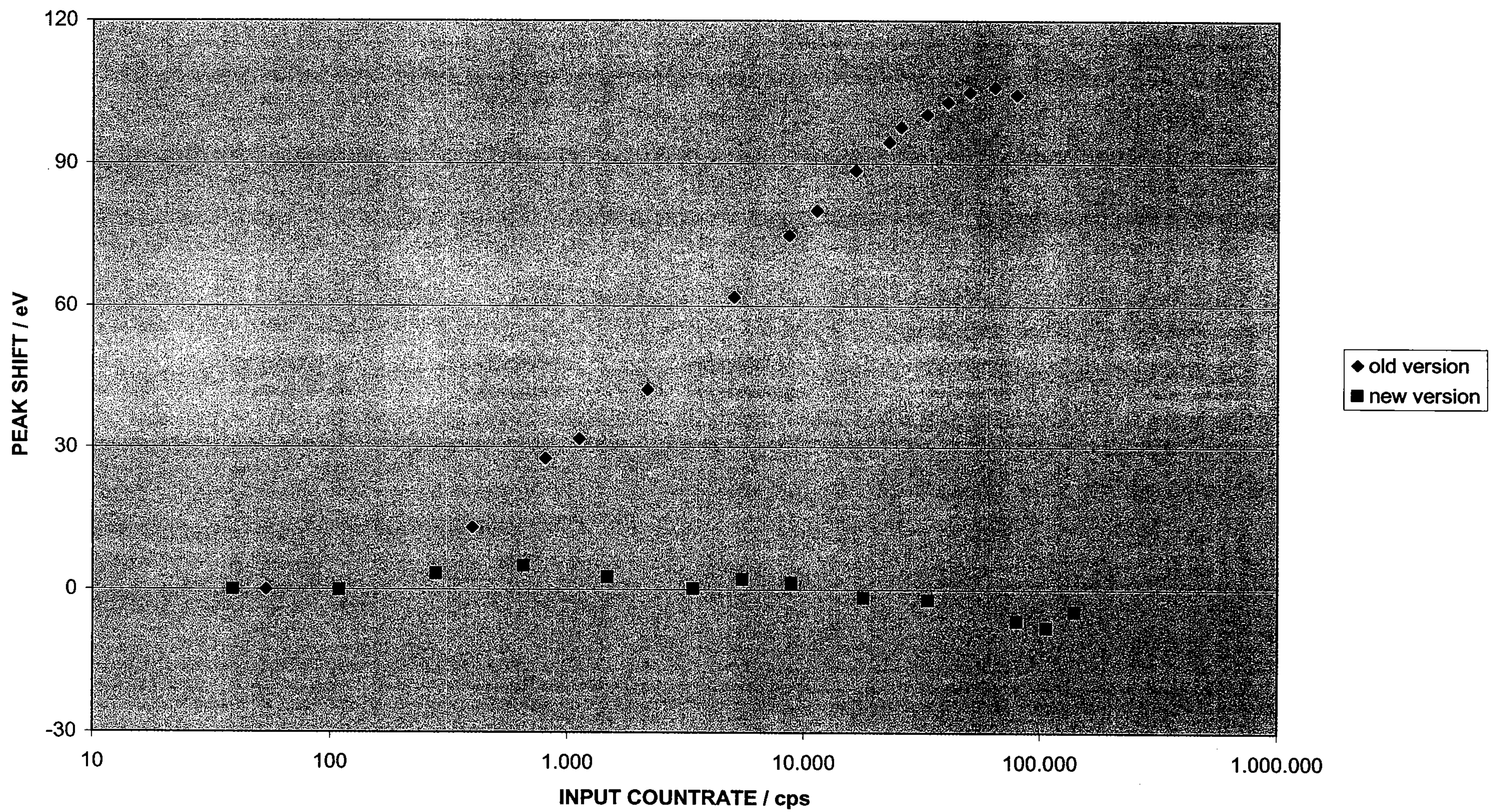
Example spectrum of a Fe55 radiation source $\sigma(Mn\ K_\alpha) = 141$ eV FWHM





FWHM / eV
250
240
230
220
210
200
190
180
170
160
150
140
130
10
100
1.000
10.000
100.000
1.000.000
cps
0.15 µs
1 µs
0.5 µs

Peak Shift with AXAS 1 μs



typical AXAS output characteristics

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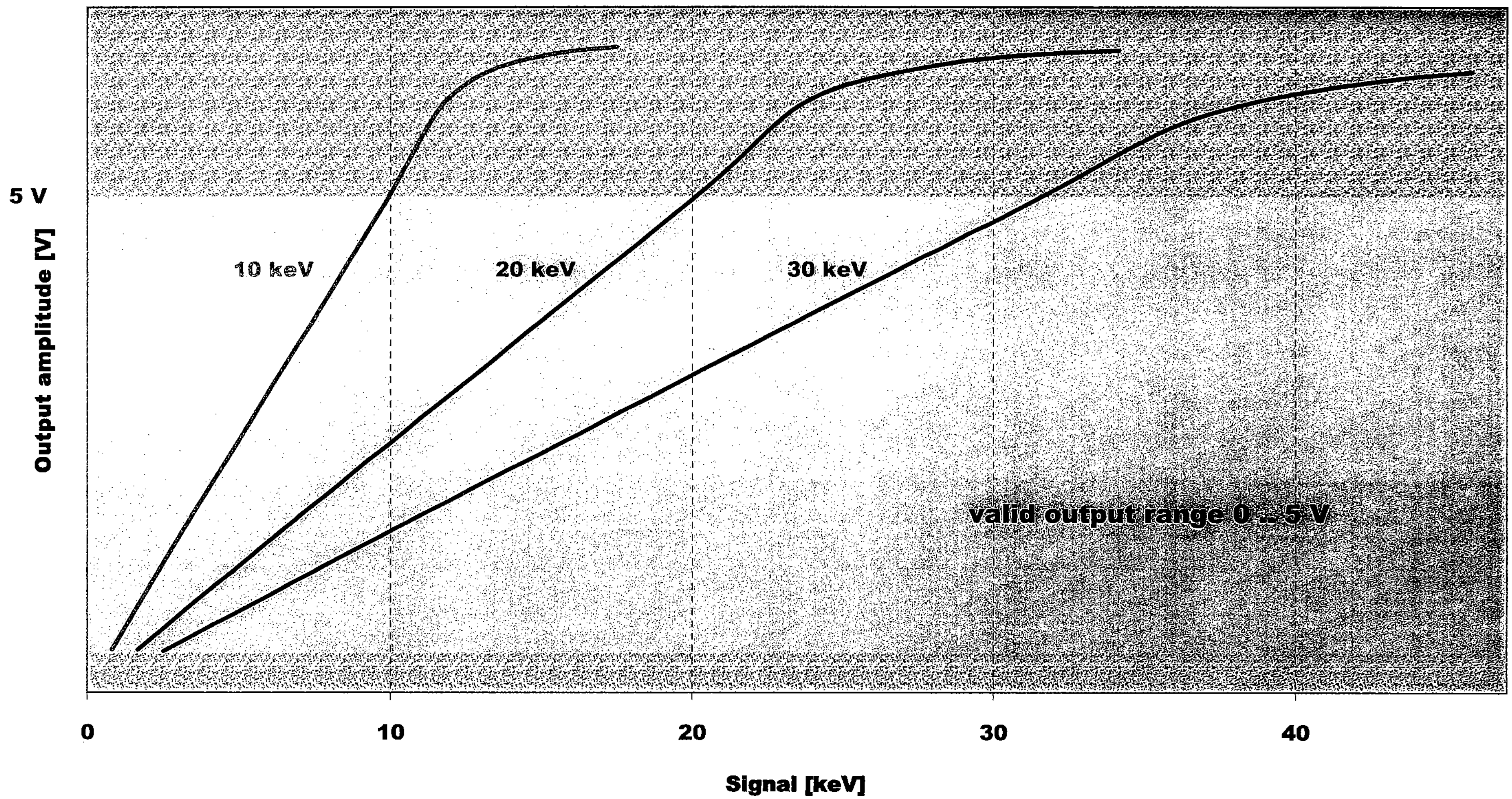
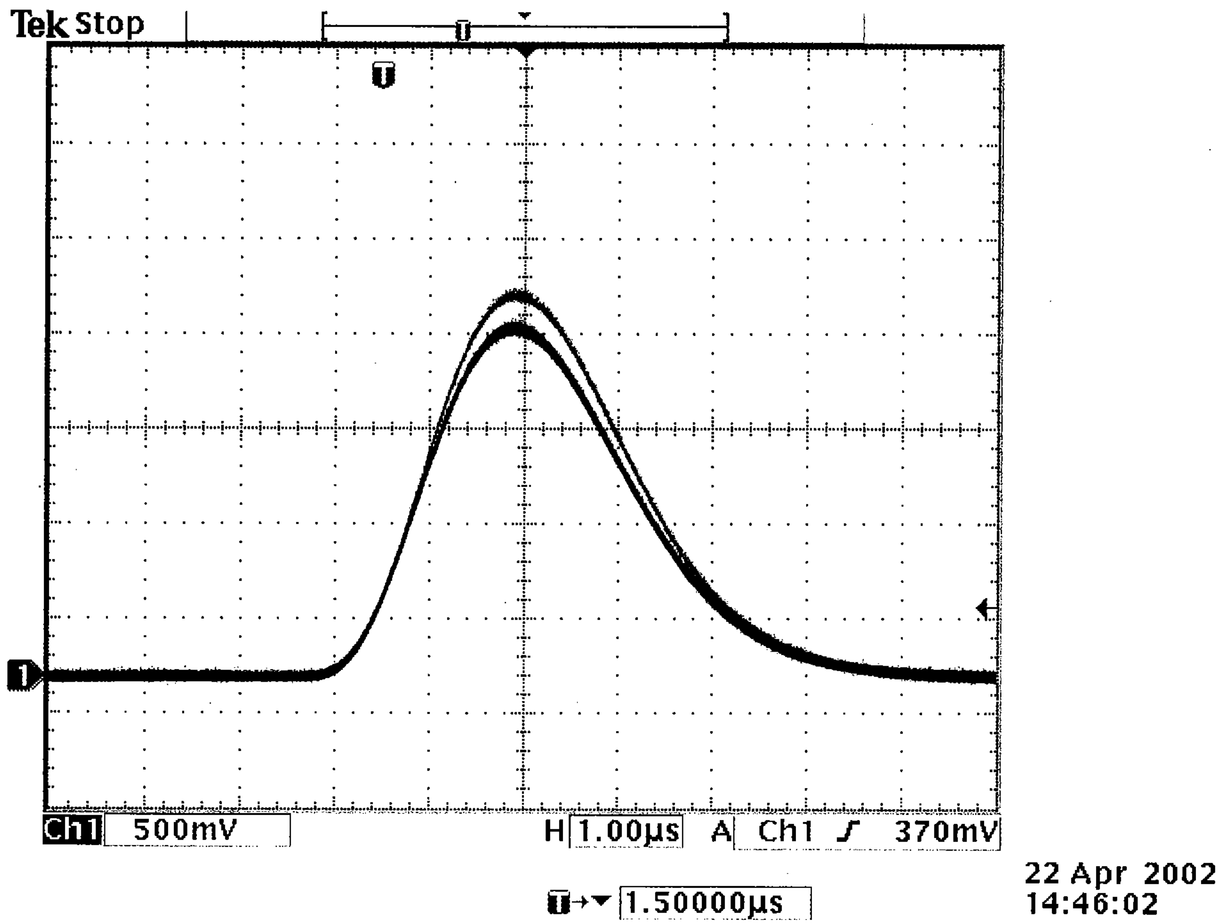
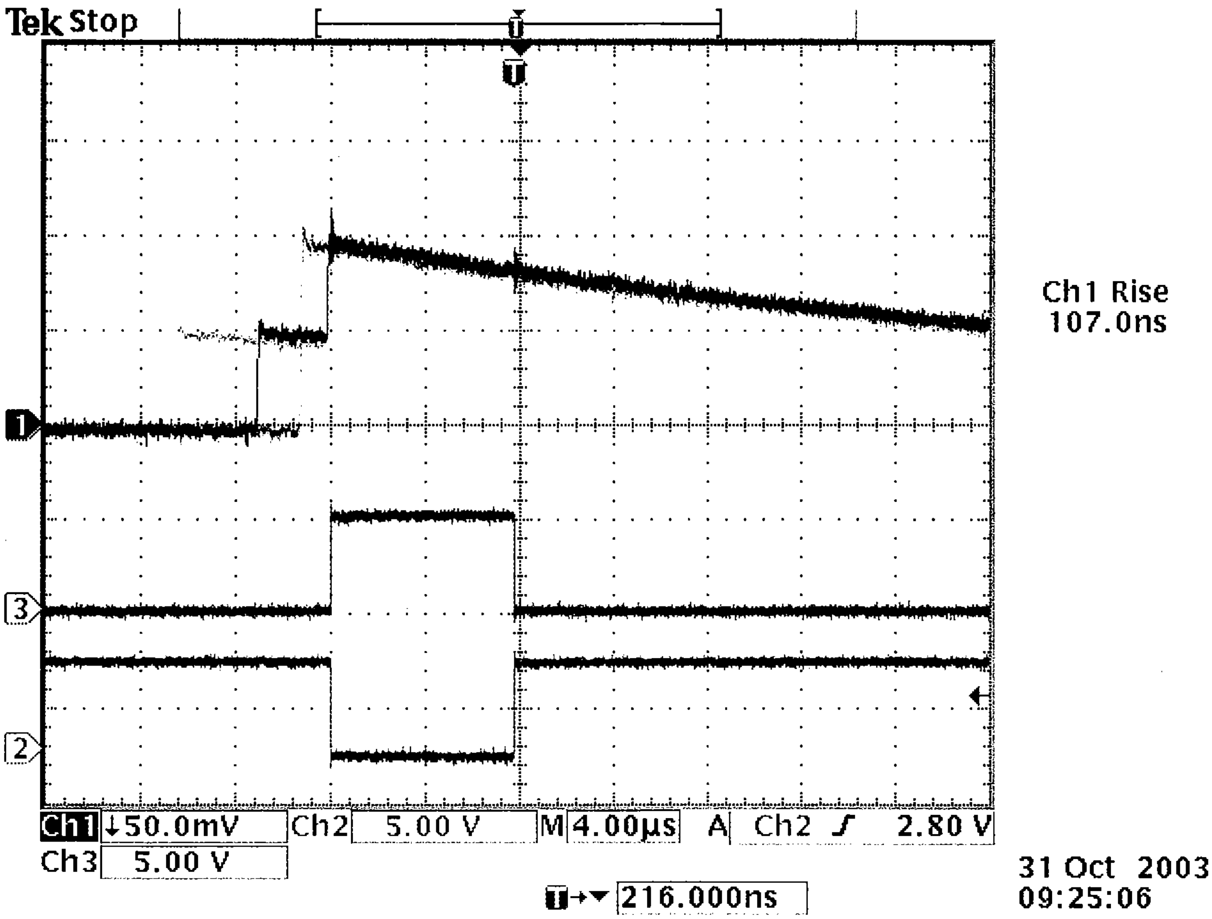


Amplified, shaped output of the AXAS system



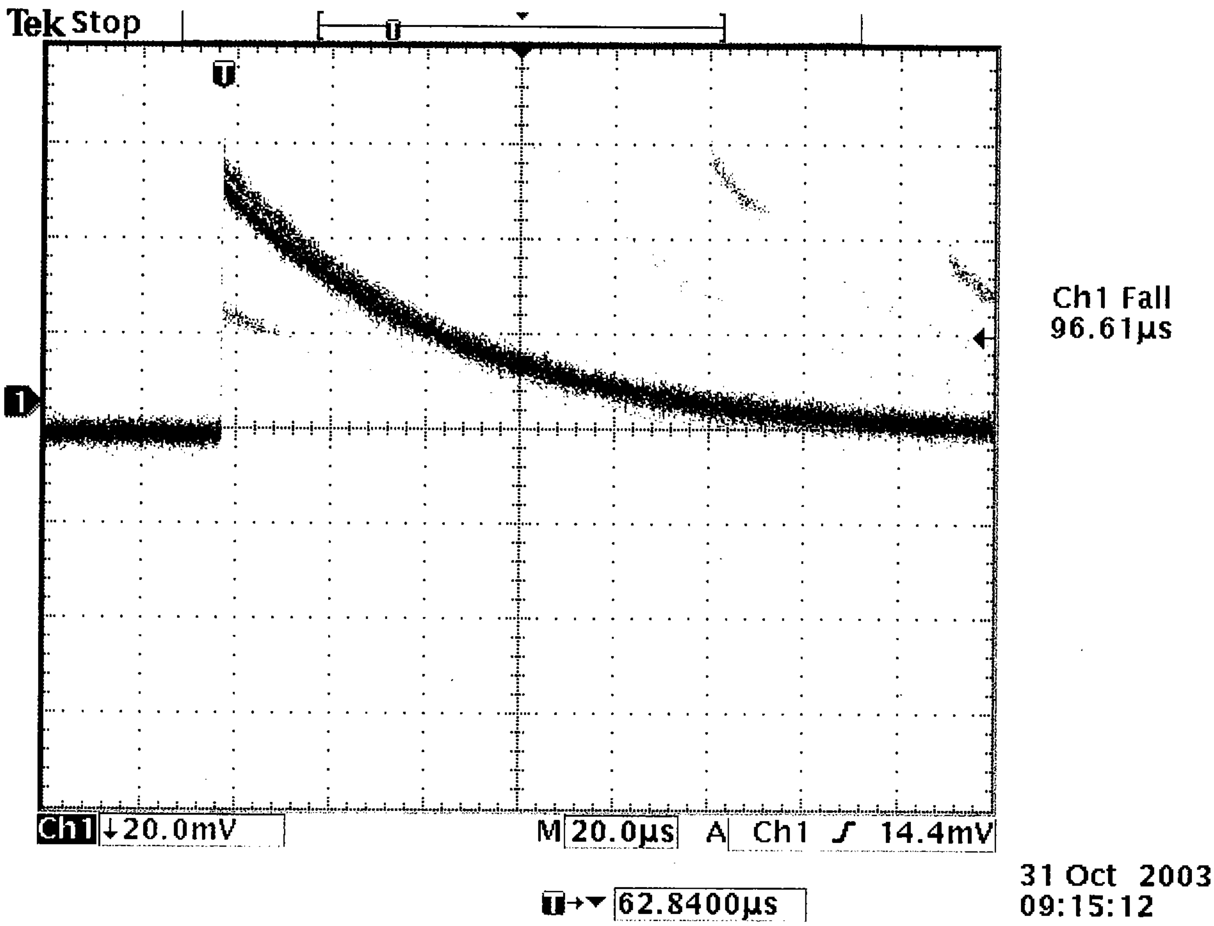
This oscilloscope screen shot shows a typical shaped and amplified output signal of the AXAS system (BNC / Shaper OUT). A Fe^{55} x-ray source was used for irradiation of the detector. The Mn K_{α} and K_{β} lines are clearly separated. Please note that the amplitude of the signal depends on the adjusted gain voltage range and the x-ray energy.

Double pulse and PUR TTL pulse



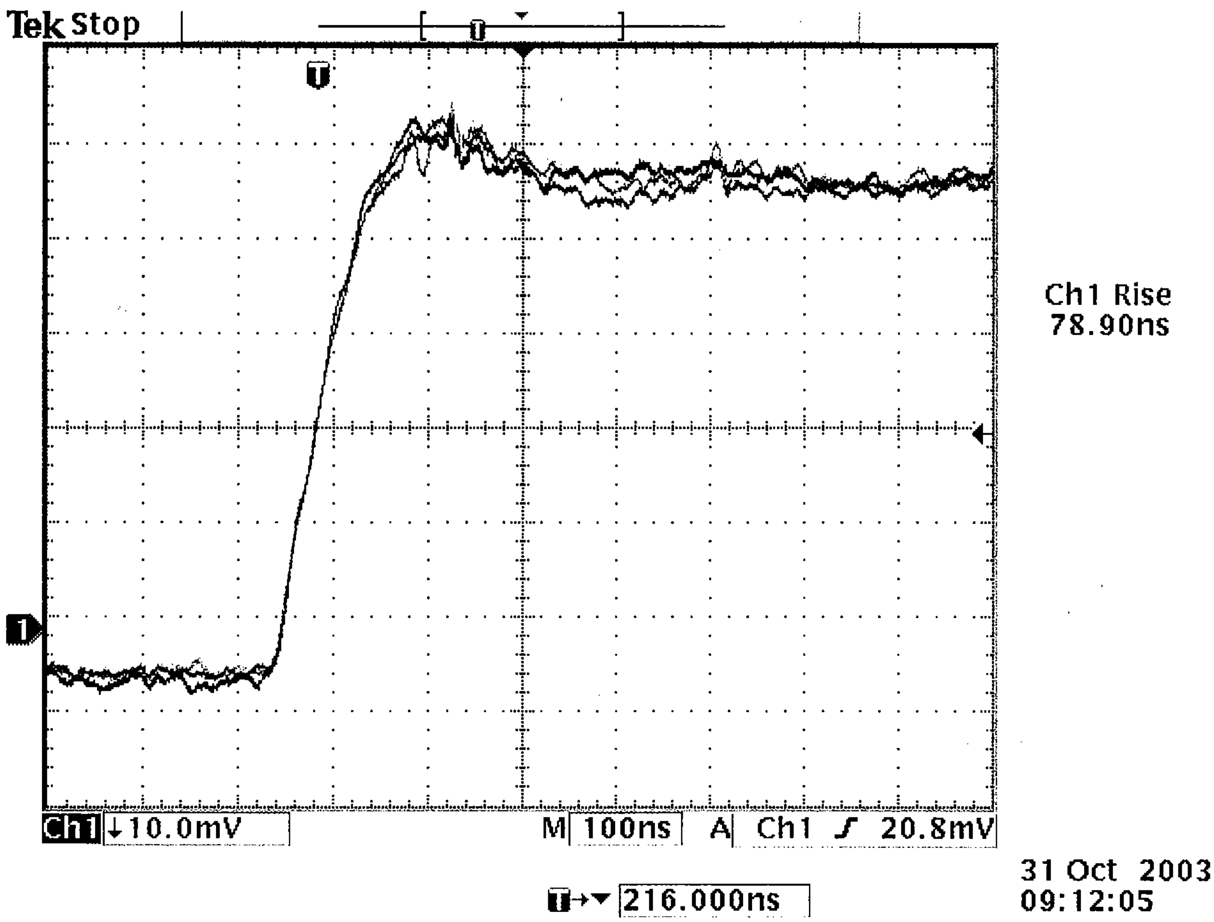
This screen shot shows a typical double (pile up) pulse (upper curve) and the subsequent TTL pulses produced by the AXAS system (lower curves) as input to an optional pile up rejection feature of your ADC. The pink curve shows the PUR, the blue curve the respective inverse PUR (the contact is denoted as PUR with a line above the letters) signal. Please note, that the original output is inverted with respect to this picture.

Fall time of the pre-amplified signal



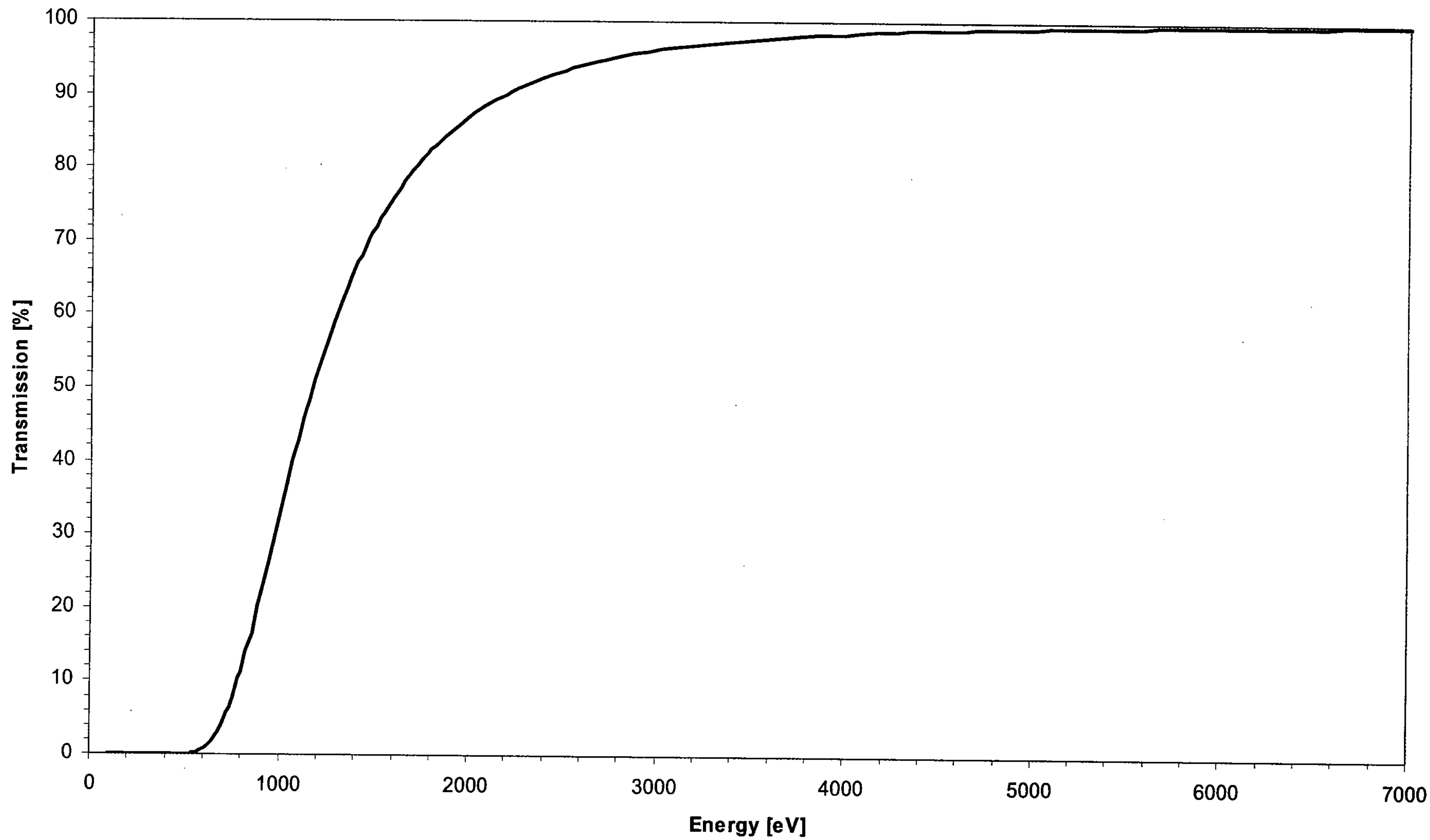
This picture shows the typical fall time (96.61 µs in this case) of a pre-amplified signal (BNC / Preamp. OUT). Again a Fe^{55} x-ray source was used to irradiate the detector. Please note that the amplitude and the total fall time of the signal depend on the x-ray energy and that the original output is inverted with respect to this picture.

Rise time of the pre-amplified signal

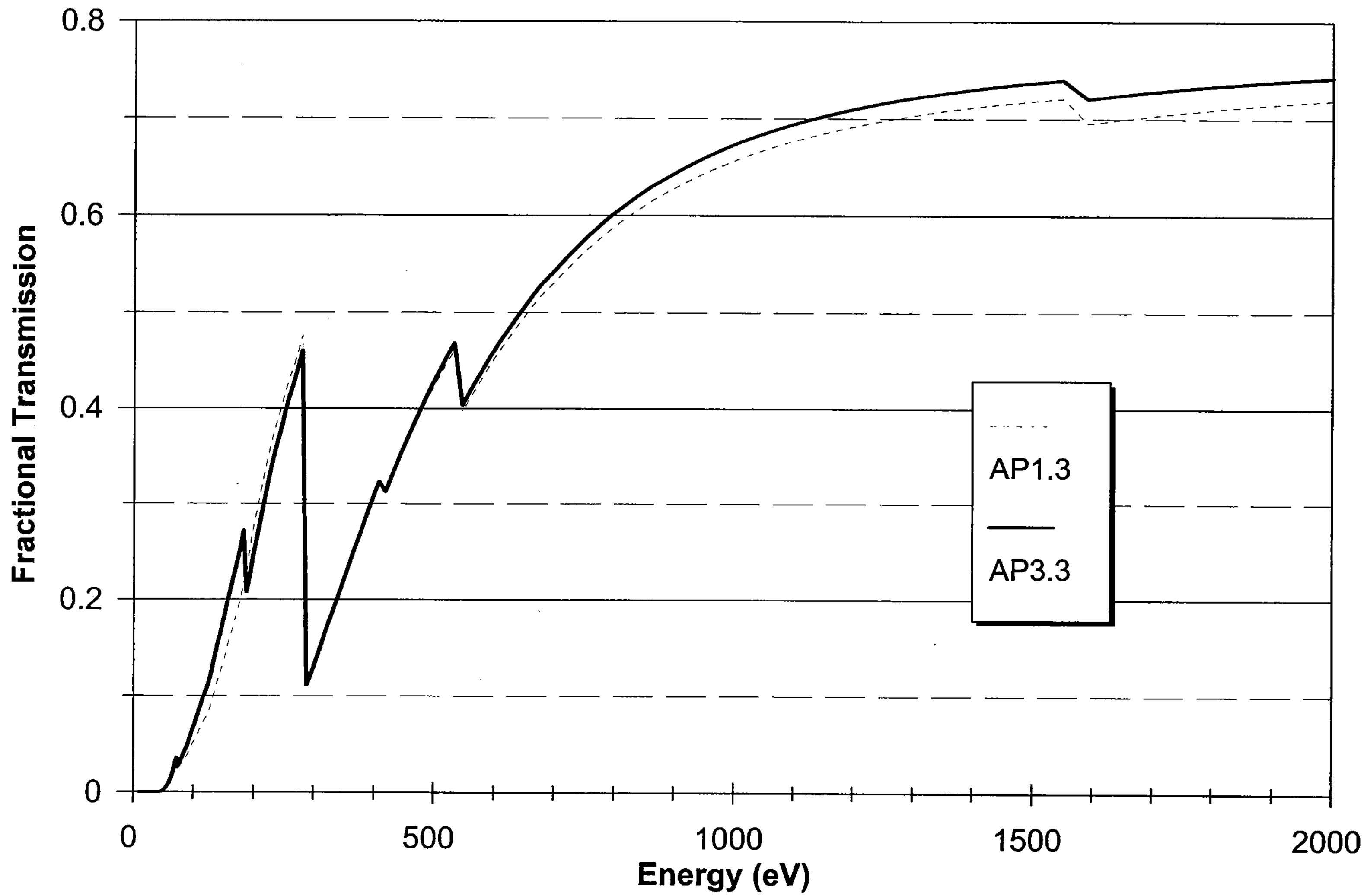


This picture shows the typical rise time (78.90 ns in this case) of a pre-amplified signal (BNC / Preamp. OUT). Again a Fe^{55} x-ray source was used to irradiate the detector. Please note that the amplitude and the total rise time of the signal depend on the x-ray energy and that the original output is inverted with respect to this picture.

Transmission of a duraberyllium window



Transmission of a AP3.3 window



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Legend: Atomic Number → 21; Element → Sc; Atomic Mass → 44.96; Line*, Energy (keV) → Kα 4.091, Kβ 4.461, Lα 0.395

1.008 H																	2 4.0 He
6.941 i 0.054	4 9.012 Be Kα 0.109											5 10.81 B Kα 0.183	6 12.01 C Kα 0.277	7 14.01 N Kα 0.392	8 16.00 O Kα 0.525	9 19.00 F Kα 0.677	10 20. Ne Kα 0.849
22.99 la 1.041	12 24.31 Mg Kα 1.254											13 26.98 Al Kα 1.487	14 28.09 Si Kα 1.740 Kβ 1.836	15 30.97 P Kα 2.014 Kβ 2.139	16 32.07 S Kα 2.308 Kβ 2.464	17 35.45 Cl Kα 2.622 Kβ 2.816	18 39. Ar Kα 2.958 Kβ 3.191
39.10 K 3.314 3.590	20 40.08 Ca Kα 3.692 Kβ 4.013 Lα 0.341	21 44.96 Sc Kα 4.091 Kβ 4.461 Lα 0.395	22 47.87 Ti Kα 4.511 Kβ 4.932 Lα 0.452	23 50.94 V Kα 4.952 Kβ 5.427 Lα 0.511	24 52.00 Cr Kα 5.415 Kβ 5.947 Lα 0.573	25 54.94 Mn Kα 5.899 Kβ 6.490 Lα 0.637	26 55.85 Fe Kα 6.404 Kβ 7.058 Lα 0.705	27 58.93 Co Kα 6.930 Kβ 7.649 Lα 0.776	28 58.69 Ni Kα 7.478 Kβ 8.265 Lα 0.852	29 63.55 Cu Kα 8.048 Kβ 8.905 Lα 0.930	30 65.41 Zn Kα 8.639 Kβ 9.572 Lα 1.012	31 69.72 Ga Kα 9.252 Kβ 10.26 Lα 1.098	32 72.64 Ge Kα 9.886 Kβ 10.98 Lα 1.188	33 74.92 As Kα 10.54 Kβ 11.73 Lα 1.282	34 78.96 Se Kα 11.22 Kβ 12.50 Lα 1.379	35 79.90 Br Kα 11.92 Kβ 13.29 Lα 1.480	36 83. Kr Kα 12.65 Kβ 14.11 Lα 1.586
85.47 Rb 13.40 14.96 1.694	38 87.62 Sr Kα 14.17 Kβ 15.84 Lα 1.807	39 88.91 Y Kα 14.96 Kβ 16.74 Lα 1.923	40 91.22 Zr Kα 15.78 Kβ 17.67 Lα 2.042 Lβ 2.124	41 92.91 Nb Kα 16.62 Kβ 18.62 Lα 2.166 Lβ 2.257	42 95.94 Mo Kα 17.48 Kβ 19.61 Lα 2.293 Lβ 2.395	43 (98) Tc Kα 18.37 Kβ 20.62 Lα 2.424 Lβ 2.538	44 101.1 Ru Kα 19.28 Kβ 21.66 Lα 2.559 Lβ 2.683	45 102.9 Rh Kα 20.22 Kβ 22.72 Lα 2.697 Lβ 2.834	46 106.4 Pd Kα 21.18 Kβ 23.82 Lα 2.839 Lβ 2.990	47 107.9 Ag Kα 22.16 Kβ 24.94 Lα 2.984 Lβ 3.151	48 112.4 Cd Kα 23.17 Kβ 26.10 Lα 3.134 Lβ 3.317	49 114.8 In Kα 24.21 Kβ 27.28 Lα 3.287 Lβ 3.487	50 118.7 Sn Kα 25.27 Kβ 28.47 Lα 3.444 Lβ 3.663	51 121.8 Sb Kα 26.36 Kβ 29.73 Lα 3.605 Lβ 3.844	52 127.6 Te Kα 27.47 Kβ 31.00 Lα 3.769 Lβ 4.030	53 126.9 I Kα 28.61 Kβ 32.29 Lα 3.938 Lβ 4.221	54 131 Xe Kα 29.78 Kβ 33.62 Lα 4.110 Lβ 4.423
132.9 Cs 30.97 34.97 4.287 4.620	56 137.3 Ba Kα 32.19 Kβ 36.38 Lα 4.466 Lβ 4.828	57 138.9 La Kα 33.44 Kβ 37.80 Lα 4.651 Lβ 5.042	72 178.5 Hf Lα 7.899 Lβ 9.023 Mα 1.645	73 180.9 Ta Lα 8.146 Lβ 9.343 Mα 1.710	74 183.8 W Lα 8.398 Lβ 9.672 Mα 1.775	75 186.2 Re Lα 8.653 Lβ 10.01 Mα 1.843	76 190.2 Os Lα 8.912 Lβ 10.36 Mα 1.910	77 192.2 Ir Lα 9.175 Lβ 10.71 Mα 1.980	78 195.1 Pt Lα 9.442 Lβ 11.07 Mα 2.051	79 197.0 Au Lα 9.713 Lβ 11.44 Mα 2.123	80 200.6 Hg Lα 9.989 Lβ 11.82 Mα 2.195	81 204.4 Tl Lα 10.27 Lβ 12.21 Mα 2.271	82 207.2 Pb Lα 10.55 Lβ 12.61 Mα 2.346	83 209.0 Bi Lα 10.84 Lβ 13.02 Mα 2.423	84 (209) Po Lα 11.13 Lβ 13.45 Mα 2.502	85 (210) At Lα 11.43 Lβ 13.88 Mα 2.581	86 (22 Rn Lα 11.73 Lβ 14.32 Mα 2.662
(223) Fr 12.03 14.77 2.743	88 (226) Ra Lα 12.34 Lβ 15.24 Mα 2.825	89 (227) Ac Lα 12.65 Lβ 15.71 Mα 2.910	104 (261) Rf	105 (262) Db	106 (266) Sg	107 (264) Bh	108 (269) Hs	109 (268) Mt									

Actinides	58 140.1 Ce Lα 4.840 Lβ 5.262 Mα 0.883	59 140.9 Pr Lα 5.034 Lβ 5.489 Mα 0.929	60 144.2 Nd Lα 5.230 Lβ 5.722 Mα 0.978	61 (145) Pm Lα 5.433 Lβ 5.961 Mα 1.029	62 150.4 Sm Lα 5.636 Lβ 6.205 Mα 1.081	63 152.0 Eu Lα 5.846 Lβ 6.456 Mα 1.131	64 157.3 Gd Lα 6.057 Lβ 6.713 Mα 1.185	65 158.9 Tb Lα 6.273 Lβ 6.978 Mα 1.240	66 162.5 Dy Lα 6.495 Lβ 7.248 Mα 1.293	67 164.9 Ho Lα 6.720 Lβ 7.525 Mα 1.348	68 167.3 Er Lα 6.949 Lβ 7.811 Mα 1.406	69 168.9 Tm Lα 7.180 Lβ 8.101 Mα 1.462	70 173.0 Yb Lα 7.416 Lβ 8.402 Mα 1.521	71 175 Lu Lα 7.656 Lβ 8.709 Mα 1.581
Lanthanides	90 232.0 Th Lα 12.97 Lβ 16.20 Mα 2.996	91 231.0 Pa Lα 13.29 Lβ 16.70 Mα 3.082	92 238.0 U Lα 13.61 Lβ 17.22 Mα 3.171	93 (237) Np Lα 13.94 Lβ 17.75 Mα 3.260	94 (244) Pu Lα 14.62 Lβ 18.85 Mα 3.351	95 (243) Am Lα 14.62 Lβ 18.85 Mα 3.443	96 (247) Cm Lα 14.96 Lβ 19.43 Mα 3.537	97 (247) Bk Lα 15.31 Lβ 20.02 Mα 3.632	98 (251) Cf Lα 15.66 Lβ 20.56 Mα 3.727	99 (252) Es Lα 16.02 Lβ 21.17 Mα 3.824	100 (257) Fm Lα 16.38 Lβ 21.78 Mα 3.923	101 (258) Md	102 (259) No	103 (26 Lr

ed are the Kα1, Kβ1, Lα1, etc. energies. The observed energies may/will slightly vary because of (not resolved) α2, β2, etc. contributions.