# For more information

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## Getting started

- o Each product is supplied with a "Quick Start Guide". A paper copy is supplied with the product. In addition, soft copies can be found on Amptek's Installation CD, under "Documentation/Quick Start Guides".

- o For questions related to installation of Amptek's software, refer to the "Amptek DPP Software Installation" guide, found in the installation CD, under "Documentation/Software and Driver Installation"

- o For questions about the detailed specifications and operations of Amptek's products, refer to the specification sheet (found in the installation CD, under "Documentation/Specifications") or to the appropriate user manual (under "Documentation/User Manuals")

- o Much additional information can be found on Amptek's website, www.amptek.com

## Amptek Application Notes

## Troubleshooting Amptek's Products

Amptek has written documents to help user's trying to troubleshoot their systems. These documents work through the most common difficulties. We recommend referring to these before contact Amptek's technical support.

- o *Troubleshooting suggestions for Amptek's Digital Processors*

    This document addresses the most common problems found with Amptek's X-123, DP5, PX5, and GammaRad5 family of products. These include software installation, power problems, incorrect configurations, excess noise, excess counts, etc.

- o *Grounding and Shielding in Amptek Products*

    Once trivial problems are addressed (connections, software installation) and the system is configured appropriately, grounding, shielding, and electromagnetic interference are the most common source of difficulty. This document provides advice on addressing these issues in Amptek's products and include a bibliography of useful references.
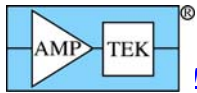
**Understanding Amptek's signal processors**

There are a few topics which generate the most questions and confusion. These are addressed in Help information supplied with the DPPMCA software. In this section, we will point the user to these most commonly needed discussions.

DPPMCA's "Help" contains an FAQ section. This includes discussions on

- o Understanding Gain and Full Scale Energy
- o Understanding Fast and Slow Channels
- o Understanding Thresholds

In Amptek's Installation CD, under "DP5…/DPPMCA/Additional Help Topics", is a discussion on

- o Understanding Acquisition Time, Live Time, and All That.

In Amptek's Installation CD, under "Documentation/Application Notes", is a discussion on

- o Understanding Energy Resolution

The DPPMCA "Help" and the "Additional Help Topics" also include many sections describing how to change many of the configurations parameters and how to carry out many common functions.

On the installation CD, under "Documentation/Application Notes", the *Digital Pulse Processor Theory of Operation* may answer other questions.

**Understanding X-ray Fluorescence Analysis and Analysis Software**

Amptek has written a few notes to help users new to XRF. These are found in Amptek's Installation CD, under "Documentation/Application Notes"

- o *Understanding Characteristic X-rays:* This is a brief introduction of characteristic X-rays, their nomenclature, and use in XRF.
- o *XRF Spectra and Analysis Software:* This illustrates one analysis, of stainless steel, showing the spectrum and the steps required by the software to process the spectrum and yield quantitative results.
- o *EDXRF of light elements in water, of RoHS/WEEE materials, and of used automotive catalysts.* These notes show a few sample EDXRF analyses, with spectra, and a discussion of the examples.

Amptek provides the XRS-FP Analysis software. This is a very powerful and capable piece of software but requires some expertise to use it properly. The latest version is supplied with tutorials, including example files, to illustrate various analysis options and help with the learning curve. Once you have installed the XRS-FP software, there are three folders created, with tutorials:

- o *Basic Setup Tutorial*
- o *Bulk Analysis Tutorial*
- o *SIR-FP Tutorial*

**Amptek Research Papers**

Amptek has published several research papers which describe issues important to many users. We particularly recommend users refer to the following:

Jordanov, V.T., G. F. Knoll, A.C. Huber and J.A. Pantazis, "Digital Techniques for Real Time Pulse Shaping in Radiation Measurements", Nucl. Instr. and Meth., A353, pp. 261-264, 1994.
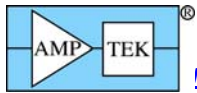
Pantazis, T., J. Pantazis, A. Huber, R. Redus, "The historical development of the thermoelectrically cooled X-ray detector and its impact on the portable and hand-held XRF industries," X-Ray Spectrom, Vol 39, No 2, 2010, p.90-97.

Redus, R.H. and A.C. Huber, Response Function of Silicon Drift Detectors for Low Energy X-rays, submitted to Adv. X-ray Anal, Sept, 2014.

Redus, R.H. and A.C. Huber, Figure of merit for spectrometers for EDXRF. X-Ray Spectrom, 41, pp 401-409, Sept, 2012.

Redus, R.H., Huber, A., Pantazis, T., Pantazis, J. and Cross, B., Combining CdTe and Si detectors for Energy-Dispersive X-Ray Fluorescence. X-Ray Spectrom. 41, pp 393-400, Sept 2012.

Redus, R.H., A. Huber, J. Pantazis, T. Pantazis, "Enhanced Energy Range Thermoelectrically Cooled Silicon X-ray Detectors", Conf. Rec., IEEE Nucl. Sci. Symp, Nov 2011.

Redus, R.H., J.A. Pantazis, T.J. Pantazis, A.C. Huber, and B.J. Cross, "Characterization of CdTe detectors for quantitative X-ray spectroscopy", IEEE Trans. Nucl. Sci., Vol 56, No. 4, pp 2524 – 2532, Aug. 2009

## Textbooks

### Radiation detection in general

Glenn Knoll, *Radiation Detection and Measurement*, 4th edition, John Wiley & Sons, 2010.

This is the classic introductory textbook on radiation detection. Chapter 3 provides a very clear introduction to the fundamental issues of counting statistics, resolution, dead time losses which affect all radiation measurements. Other chapters describe the basics of the different types of radiation detectors and of the signal processing electronics.

### Detectors and electronics

B.G. Lowe, R.A. Sareen, *Semiconductor X-ray Detectors*, CRC Press, 2014.

This new book focuses on semiconductor detectors and their use in X-ray spectroscopy, applying to Amptek's XR100 SiPIN, SDD, and CdTe detectors. This book provides an informative discussion of the details of the operation and performance of such detectors.

Helmut Spieler, *Semiconductor Detector Systems*, Oxford University Press, 2005.

This classic book provides very clear discussion of semiconductor detectors and the signal processing electronics, with very nice derivations of the performance from the signal processors.

Chapter 9 of Spieler's textbook, entitled "Why things don't work", has the clearest discussion of grounding and shielding in the specific context of radiation detectors and is an excellent reference for users dealing with grounding and shielding.

Henry Ott, *Noise Reduction Techniques in Electronic Systems*, 2nd edition, John Wiley & Sons, 1988.

This is a classic textbook on grounding, shielding, and electromagnetic interference for electronics in general. The principles here apply to our systems.

### X-ray Spectroscopy

These textbooks focus less on the detectors and electronics supplied by Amptek and more on the applications within the field of X-ray spectroscopy. These describe how Amptek's X-ray detectors and components are often applied.
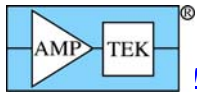
R. Jenkins, R.W. Gould, D. Gedcke, *Quantitative X-ray Spectrometry*, Marcel Dekker, 1995

This is a classic textbook on X-ray spectrometry. The book is rather old, so details of the electronics and software have changed, but the basic principles still apply and the derivations and discussions are very clear.

B. Beckhoff, B. Kanngiesser, et. al. (eds), *Handbook of Practical X-Ray Fluorescence Analysis*, Springer, 2006.

This is a recent book describing the current state of the art in XRF.

R. Van Grieken, A. Markowicz, (eds), *Handbook of X-ray Spectrometry*, Marcel Dekker, 2002

This is another classic book on X-ray spectrometry, much longer and more in-depth than the Jenkins, Gould, and Gedcke textbook.

M. Haschke, *Laboratory Micro-X-Ray Fluorescence Spectroscopy: Instrumentation and Applications*, Springer, 2014

This is a very new book on applications in Micro-XRF.

P.J. Potts, M. West (eds), *Portable X-ray Fluorescence Capabilities for In Situ Analysis*,

This book focuses on portable XRF and its applications.

**Gamma-ray Spectroscopy**

G. Gilmore, J.D. Hemingway, *Practical Gamma-Ray Spectrometry*, John Wiley & Sons, 1995.

This book is a fairly complete introductory textbook to gamma-ray spectroscopy with scintillator/PMT instruments and with high purity germanium (HPGe) systems. Though it is a little dated, the basic principles are still quite applicable.

**Web Sites**

Complete database for information on X-ray spectroscopy (X-ray data booklet)

http://xdb.lbl.gov/

Introduction to radiation safety

https://www.osha.gov/SLTC/radiationionizing/index.html

http://www.epa.gov/radiation/understand/protection_basics.html

X-ray attenuation calculator

http://physics.nist.gov/PhysRefData/FFast/html/form.html

Basic Fundamental Parameters in X-ray Fluorescence

http://www.tau.ac.il/~lab3/XRF/XRF5.pdf

Quantification in X-ray Fluorescence Spectrometry

http://cdn.intechopen.com/pdfs-wm/27342.pdf

Standardless X-ray Fluorescence Spectrometry
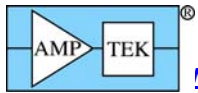
http://rigaku.com/downloads/journal/Vol6.1.1989/kataoka.pdf

Table of the Isotopes

http://ie.lbl.gov/education/isotopes.htm

Periodic table for X-rays

http://www.csrri.iit.edu/periodic-table.html

Signal processing electronics for radiation detection

http://www-physics.lbl.gov/~spieler/NSS_short_course_2007/Front-End_Electronics.pdf

http://www-physics.lbl.gov/~spieler/NSS_short-course/NSS02_Pulse_Processing.pdf

http://www-physics.lbl.gov/~spieler/Heidelberg_Notes_2005/pdf/VIII_Why_Things_don't_Work.pdf