

## RoHS compliance of PCBs

### Fast screening of restricted substances

The directive on the restriction of the use of hazardous substances (RoHS) in electrical and electronic equipment in Europe has been in effect since 2006. This legislation is an initiative to solve the problem of the huge amounts of toxic waste produced nowadays. The directive is focused on the restriction of six substances: lead, mercury, cadmium, hexavalent chromium ( $\text{Cr}^{6+}$ ), polybromated biphenyls (PBB) and polybromated diphenyl ethers (PBDE). Philips Innovation Services provides a fast and non destructive chemical analysis technique with high spatial resolution to screen printed circuit boards (PCBs), namely by using micro X-ray fluorescence spectroscopy ( $\mu$ -XRF).



Fig. 1: the red circle shows a 30 µm measuring spot on the component of the PCB with the red rectangle in figure 2.

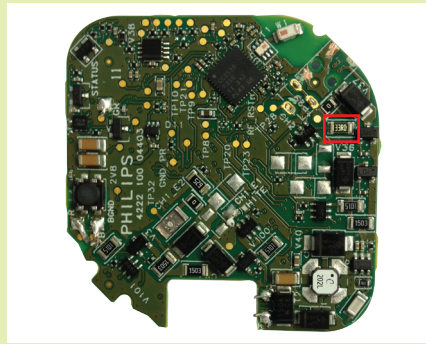


Fig. 2: photo montage of a PCB

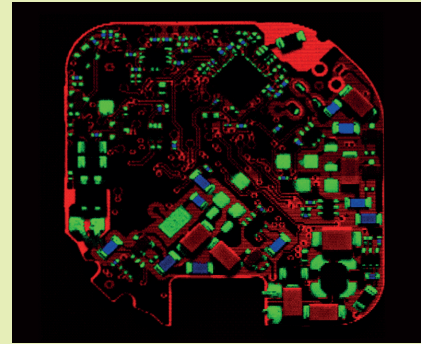


Fig. 3: element map (Br=red, Sn=green, Cr=blue).

### Principles of XRF

XRF is a well-established analytical technique for quantitative determination of the elemental composition of solid materials. By exposing a sample to X-rays, the inner electrons in the atoms are ejected. Subsequently, electrons from higher orbitals 'fall' into the lower orbital, thereby filling the hole that was left behind. As a result, characteristic photons are created and detected. The energy of each characteristic photon is directly linked to the element present in the sample.

### µ-XRF

The micro XRF system enables fast analysis, in just seconds for a single point analysis or several minutes for a 2-dimensional mapping of a 10 by 10 cm<sup>2</sup> surface. By using different types of measuring spots as small as 30 micrometer, samples can be analyzed in great detail. Micro XRF is a non destructive analysis technique that will not change the chemical composition of the samples during measurement. Little to no sample preparation is needed.

### PCB analysis

The RoHS directive will eventually lead to products that are free of the listed hazardous substances. In the meantime, there is a strong need for checking existing products and/or purchased half-products and components for the presence of RoHS-restricted substances. Such a component is the PCB that has always contained hazardous substances (see figure 2). The components present on a PCB, such as resistors and capacitors,

### Philips Innovation Services Materials Analysis

offers a full range of analytical methods and expertise to support both research and manufacturing, serving customers by taking an integral, solution-oriented approach.

World-class expertise – working for you

For more information:

Tel: +31 - 040-2748044

E-mail: [innovationservices@philips.com](mailto:innovationservices@philips.com)

[www.innovationservices.philips.com](http://www.innovationservices.philips.com)

Application Note 32

July 2013

are progressively diminishing in size and can have dimensions of 0.2 x 0.1 mm. To be able to screen a PCB on the level of individual components, a 2-dimensional mapping is performed (figure 3). The mappings of the different elements have been combined into a single image and can subsequently be displayed on top of the photo to have a direct correlation between the element distribution and the PCB lay-out.

### Additional analysis

After the fast micro XRF measurements, additional analysis may be required to identify the chemical state of the elements detected. The broad portfolio of analytical techniques at Philips Innovation Services facilitates this second step in the RoHS analysis. For example, a Cr<sup>6+</sup> spot test (fast, qualitative coloring reaction) or X-ray Photoelectron Spectroscopy (XPS) analysis can distinguish Cr<sup>3+</sup> from Cr<sup>6+</sup>, and High Performance Liquid Chromatography (HPLC) can confirm if Br is present as PBB or PBDE.



©2013 Koninklijke Philips Electronics N.V.  
All rights reserved.