QUASAR
Core PCB

Product brief

v1.0

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1 Introduction

1.1 Objectives

Surface Mount Technology (SMT) has brought about a paradigm shift in high-density design, opening new horizons. However, with its widespread adoption, ensuring the quality of SMT soldering has emerged as a significant challenge. To tackle this, a range of inspection technologies, including X-Ray, optical, and thermal imaging, have been integrated to scrutinize soldering flaws. Yet, traditional human inspection methods for solderability testing and void detection suffer from drawbacks such as being time-consuming, error-prone, and inconsistent, largely influenced by the inspector's experience level.

Some existing X-Ray inspection systems rely on void detection algorithms that demand meticulous fine-tuning to adapt across different devices and production batches. In response to these challenges, 7 Sensing Software presents Quasar Core PCB: an AI-powered optical inspection solution tailored for solder voids detection.

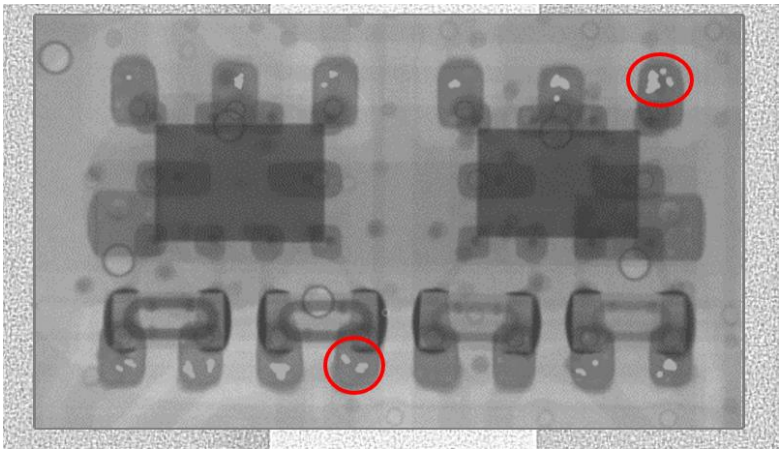


Figure 1 Example of solder voids in an X-Ray image of a PCB

1.2 Overview

Quasar Core PCB revolutionizes soldering inspection for Printed Circuit Boards (PCB). It excels in pixel-level solder voids areas detection, ensuring meticulous quality control.

Quasar Core PCB makes manual intervention obsolete, significantly cutting down on non-quality issues and labor costs. Quasar Core PCB offers rapid inspection, processes an image almost instantaneously and generates comprehensive technical reports compliant with IPC standard.

Moreover, Quasar Core PCB accurately analyzes images of any PCBs, seamlessly integrating with various X-Ray machines. Its intuitive graphical user interface is accessible from anywhere, catering to users of all expertise levels. Quasar Core PCB also offers REST-API interfaces,

facilitating its integration to any automated process. Additionally, the batch-level analysis provided in the reports expedites root cause diagnosis, enhancing overall efficiency.

1.3 Product Offer description

A poor-quality solder joint can significantly impact the reliability and proper functioning of a PCB.
Using X-Ray imaging, Quasar Core PCB can detect each solder joint on the PCB, along with any solder voids present. This includes solder joints of components like BGA and QFN. The percentage of the surface area occupied by the voids compared to the total surface area of the solder joint is then calculated. Based on a threshold set according to the user's preferred standard, the solder joint is classified as either good or defective. Quasar Core PCB provides metrics at the solder joint, PCB, and PCB batch levels.

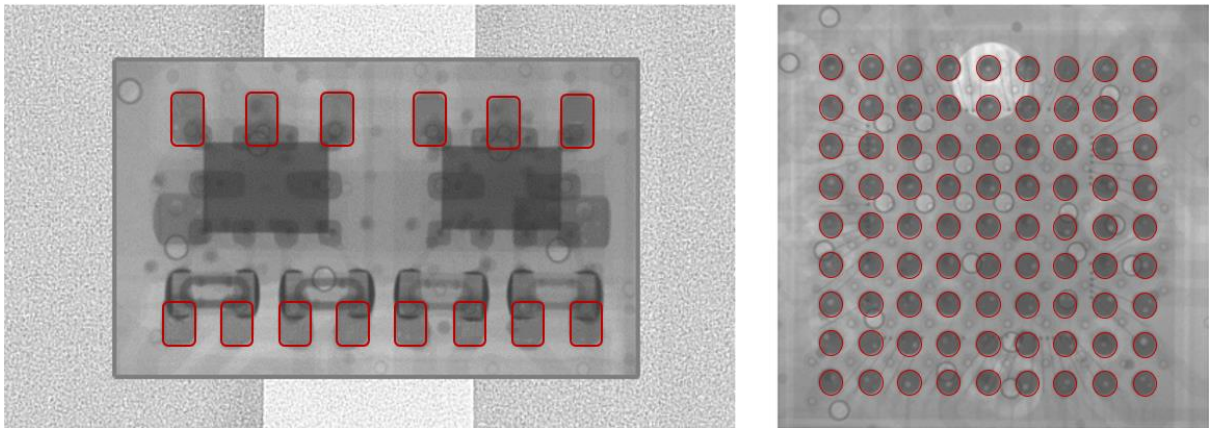


Figure 2 - Example of X-Ray image of a full PCB (left) and a specific location of a PCB corresponding to a BGA (right), for solder void analysis. Examples of solder joints are circled in red

1.4 Key Points

This documentation will present in detail:

- The main features and functionalities of Quasar Core PCB
- The key technical specifications and requirements
- A user guide of the web application
- Inspection results analysis

2 Product overview

2.1 Description

Quasar Core PCB allows users to inspect soldering quality through a web application accessible from any web browser, or via REST-API requests, from any device connected to the internet.

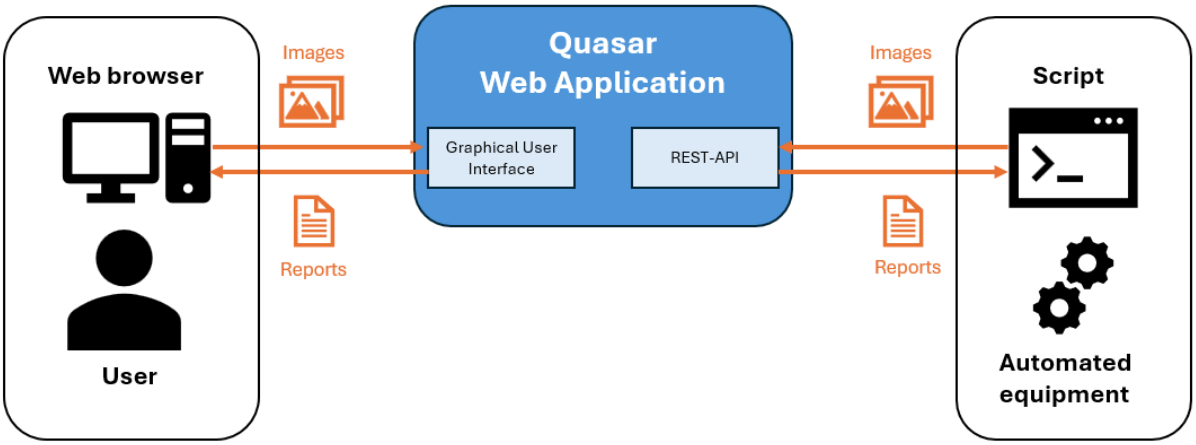


Figure 3 Illustration of soldering quality inspection report generation flow with Quasar Core PCB

Table 1 summarizes the key features of Quasar Core PCB.

Table 1 Key features of Quasar Core PCB

Feature Name	Feature Description
User authentication and service access	The user shall log in via its distributed account to access the service landing page.
Solder void analysis	The user uploads a batch of X-Ray images of a PCB. The results include various soldering quality metrics, derived from the detection of solder voids in each solder joint. These metrics can be provided at the solder joint, PCB, and batch levels, indicating compliance with the selected quality standard. Once completed, the user can download both a PDF and an Excel report.

2.2 Technical overview

Interface	- Graphical User Interface: web-based accessible from browsers such as Safari, Chrome, Firefox and Edge - REST-API: to access Quasar Core PCB from automated process or equipment
Languages	English
Version	1.0.0

3 Getting started

3.1 Prerequisite

Before running the first analysis, an administrator must provide the following information to Quasar Core PCB:

- The name of the PCB to be inspected
- A reference X-Ray image of the PCB
- The corresponding solder joint stencil image, which will be used by Quasar Core PCB to identify the solder joints of interest

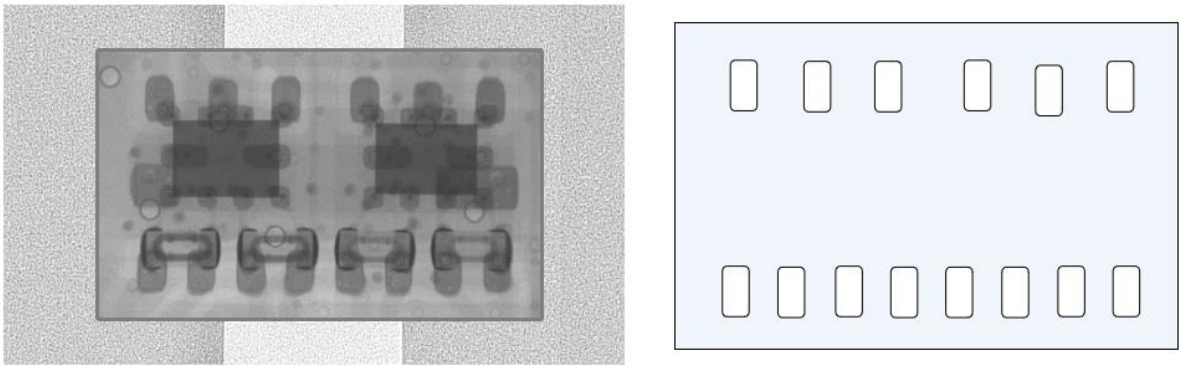


Figure 4 - Example of reference image (left) and solder joint stencil (right)

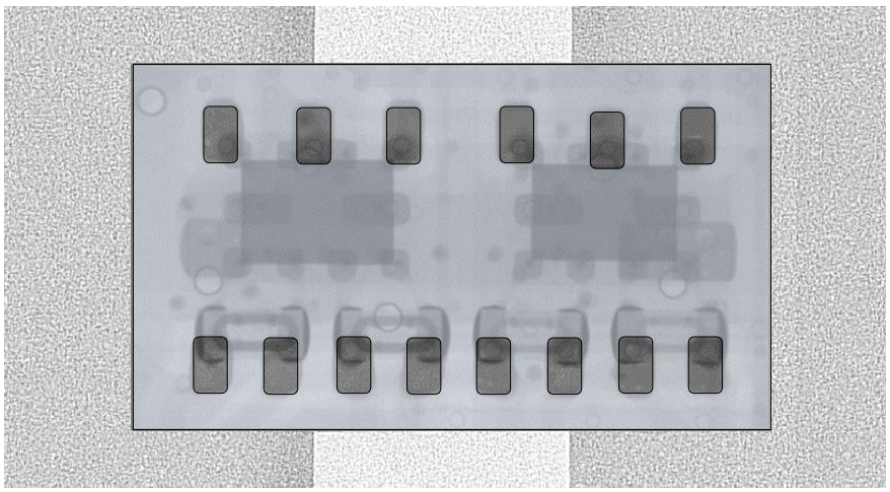


Figure 5 – Reference image overlaid with the solder joint stencil

3.2 Landing Page overview

3.2.1 Login

Before accessing the service, users must authenticate. Quasar Core PCB can interact with existing SSOs or handle authentication with a login/password by itself. This section details the user authentication feature and provides instructions on how to access the service.

When entering the Quasar Core PCB URL in the browser, the user will be directed to a login page if they are not authenticated.

The user must click the "Login" button, prompting a pop-up window to appear, asking them to sign in with their account. Upon successful authentication, the user will be redirected to the landing page shown in the next section.

The username will be included in all analysis reports initiated by the user.

3.2.2 Landing page

When logged in, Quasar Core PCB displays the following page

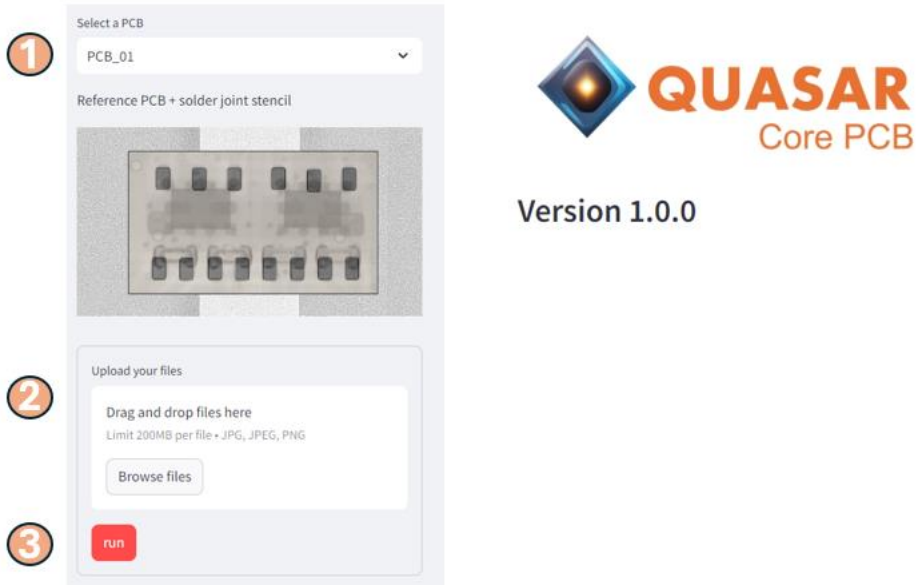


Figure 6 - Quasar Core PCB landing page

3.2.3 PCB name selection

The user must select the name of the PCB to be analyzed by Quasar Core PCB, among all the PCBs he provided, as explained in section 3.1.

Once the PCB has been chosen, the corresponding reference X-Ray image and solder-joint stencil are displayed below, as shown in Figure 6 (step 1).

3.2.4 Upload files

The user can upload a batch of images for inspection by either browsing in his folders by clicking on “Browse files” button or using drag and drop, as shown in Figure 6 (step 2).

Each of the images of the batch must contain a single PCB, corresponding to the selected PCB.

The accepted image formats are JPEG, PNG or TIF and the maximal size is 200MB per file.

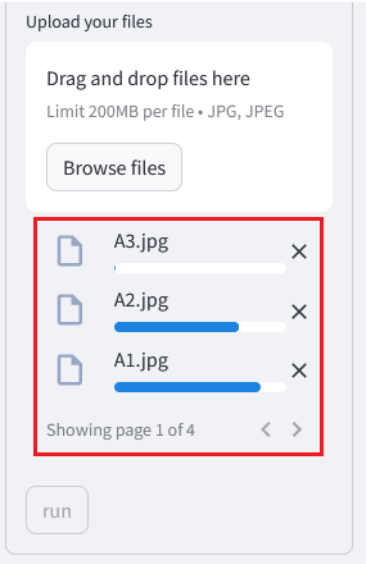


Figure 7 - Example of images being uploaded for the PCB X-Ray soldering analysis

3.2.5 Run

Once all the images have been successfully uploaded, the user can click the "Run" button, as shown in Figure 6 (step 3), to start the inspection.

A progress bar will then display the number of images processed.

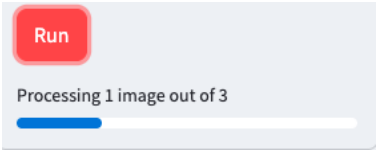


Figure 8 - Illustration of progress bar when running the inspection on uploaded images

4 Results

4.1 Solder joints and image-level analysis

After an image is processed by Quasar Core PCB, the results are displayed in the right frame and contains:

- The image name.
- The original image.
- The image with the mask identifying the solder-joints and the solder voids.
- The solder void percentage for each solder joint, as well as the status PASS/FAILL of each solder joint. The status depends on the threshold of the solder void percentage that the user wants to use. This threshold is set to 25% by default.
- A PCB status: PASS/FAIL of the PCB. The status is FAIL if at least one of the solder joints has been classified as FAIL.

The results for each image are displayed one after the other as seen in the figure below:

Figure 9 – Example of results displayed for a given image

4.2 Batch-level analysis

Once all the images of a batch had been analyzed, Quasar Core PCB computes batch-level metrics and a heatmap showing the occurrence of solder void in the device.

4.2.1 Batch-level metrics

The batch-level metrics are gathered in the batch summary table, at the end of the results page, and include:

- **Rate of defective PCBs [%]:** number of PCBs where at least one solder joint is classified as FAIL, over the total number of PCBs in the batch.
- **Rate of defective solder joints [%]**: number of solder joints classified as FAIL, over the total number of solder joints in the batch.
- **Maximum solder void rate [%]**: the maximum solder voids rate among all the solder joints in the batch
- **Average solder void rate [%]**: average solder voids percentage of all the solder joints in the batch

Batch summary :

	Overview
Date	2024-09-16
User	John Smith
PCB name	PCB_01
Number of PCBs	3
Number of solder joints per PCB	14
Solder void rate threshold [%]	25
Rate of defective PCBs [%]	33.33
Rate of defective solder joints [%]	2.38
Maximum solder void [%]	28
Average solder void [%]	5.2

Figure 10 - Example of batch summary including batch-level metrics

4.2.2 Heatmap

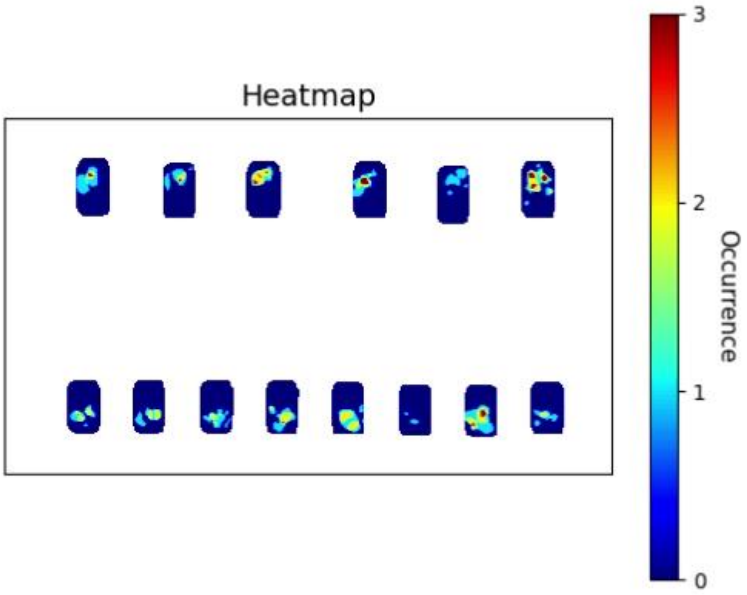


Figure 11 - Example of solder void heatmap

Figure 11 shows an example of solder void heatmap. It is built by counting the occurrence of each pixel of a solder void in a solder joint area, in all the batch images.

Such heatmap can highlight repeated solder voids at precise positions, giving potential hints to the user to the root cause of the defect.

4.3 Graphical and statistical reports

Below the analysis summary, a link allows downloading a PDF report as shown in the figure below.

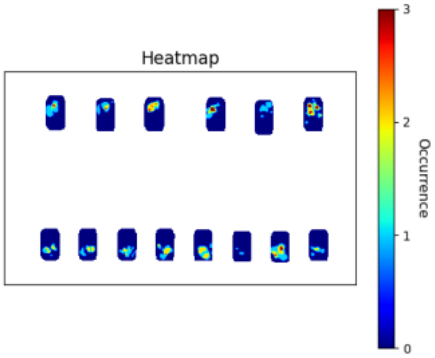
4.3.1 PDF report description

The PDF contains the following information:

- Batch level analysis: a heatmap explained in section 4.2.2 and an analysis summary shown in section 4.2.1 are summarized on the cover page of the report.
- Image level analysis: a dedicated page for each image in the batch is generated. It contains the original image, the result image where the solder-joints are highlighted in blue, and the voids in red, tables giving metrics at the image-level and at the solder joint-level table.

QUASAR

Automatic Report for PCB_01



Date	2024-09-17
Quasar version	1.1.0
User	John Smith
PCB name	PCB_01
Reference image	default

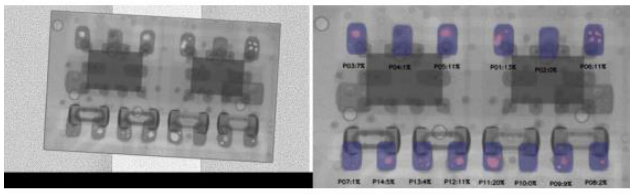
Number of PCBs	3
Rate of defective PCBs [%]	33.33
Number of solder joints per PCB [%]	14
Rate of defective solder joints [%]	2.38
Maximum solder void [%]	28
Average solder void [%]	6.8

solder joint id	01	02	03	04	05	06	07	08	09	10	11	12	13	14
Solder void threshold [%]	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Average solder void [%]	11.3	6.3	7.3	2.7	5.3	10.3	5.3	3.3	16.3	3.0	11.3	6.3	3.7	3.0
Number of defective solder joints	0	0	0	0	0	0	0	0	1	0	0	0	0	0

Figure 12 - PDF report: batch summary page

Report for pcb_img_01.png

Average Void [%]	Max Void [%]	Status
6.79	20.0	PASS



Pad ID	Solder Void [%]	Status
01	13.0	PASS
02	0.0	PASS
03	7.0	PASS
04	1.0	PASS
05	11.0	PASS
06	11.0	PASS
07	1.0	PASS
08	2.0	PASS
09	9.0	PASS
10	0.0	PASS
11	20.0	PASS
12	11.0	PASS
13	4.0	PASS
14	5.0	PASS

Figure 13 - PCB report: image-level analysis

4.3.2 Excel report description

Will be released soon!