**cādence**®

# inspectAR Augmented Reality Electronics Platform

The Cadence® inspectAR™ Augmented Reality Electronics Platform is an augmented reality (AR) tool highly specialized for electronics lab bench work. By using the inspectAR tool to separate a circuit board layout into an AR object consisting of nets and components, anyone who works on a circuit board physically with their hands can gain instant connection back to the wealth of knowledge and expertise that was available to the PCB designer.

## inspectAR AR Technology

Whether for tele-engineering, remote design collaboration, co-debugging, inner layer visualization, instant component lookup and net searching while in the lab, or easier-than-ever work instruction diagrams. The inspectAR tool helps the modern, cross-functional hardware teams of today turn their PCB into a live and interactive, model-based piece of documentation once it comes back from the factory.

As continued semiconductor scaling drives increased reliance on small form-factor and fine pitch components, with a rising number of passives and a broad range of advanced-process technology required to implement designs. In addition, compact and cost-effective sensors, microcontrollers, and memory have turned the appliances, infrastructure, and devices of today's world into networks of PCBs working together simultaneously. Electronic design automation (EDA) design software has significantly scaled and innovated to meet these demands. This industry trend has caused a reactionary bottleneck in testing, debugging, and reworking when hardware products are manufactured; both in prototype and mass-manufacturing scenarios. The PCB design software industry has thus far been unable to pivot towards this trend due to the technological inability to interpret a

physical object like a PCB with the same accuracy that a human would. Countless errors and inefficiencies occur among both trained R&D engineers as well as factory floor technicians when they need to access documentation to do any kind of work on a manufactured PCB.

The inspectAR tool overcomes the technological barrier of using software to interpret a design in the real-world by using nothing more than a camera and some EDA manufacturing outputs (AR glasses neither required nor supported). It is not much harder than depositing a check to your bank account using a smartphone app was five or ten years ago. Now, just by clicking on a component, you are brought to its datasheet, supplier information, and a design-specific pinout. A complex net, such as "GND" on a 12-layer board can be reduced to a set of probeable points, even if a test point was not configured in the design.

## Specifications

▸ Desktop support with external web camera for Windows and MacOS

▸ Android and iOS smartphones and tablets

▸ Cloud-native for easy sharing

  – On-premises version available for a "private" cloud

- EDA-agnostic project creation, standard IPC-2581B manufacturing export is taken. Select PCB design products from vendors such as:
    - Cadence (native file coming soon)
    - Altium
    - Siemens EDA
    - Zuken
        - CR-5000/8000 only
    - Autodesk Eagle (native file)
    - KiCAD (native file)

## Benefits

- Easy-to-use AR technology requires only basic experience with smartphones and cameras

- Any PCB shape will work, size depends on your camera

- Simple calibration process can account for changes of assembly completion and lighting

- Easy color selection for overlays, nets can also be colored individually and not by layer

- Desktop camera control has video microscope-inspired control

- Built-in component search automates finding datasheets and parametric part information

- AR probing by clicking on components to view attached nets and other components
    - Explore a board intuitively based solely on the topology between nets and components

- Built-in work instruction and documentation tool

- Team-wide commenting system

- Share entire subsystem to other collaborators by creating a "Save State" (e.g., I2C Bus #1)

- Interactive search can bring a full BOM line item to life on a real PCB

- File attachments can associate data with a physical PCB, making it an interactive document repository

## Coming Soon

- Procedure design
- Simulation integration
- Measurement capture
- Multi-board system support

## Features

### Easy-to-Use AR Technology

The inspectAR tool uses off-the-shelf devices with a hybrid of in-house and custom AR technology. Repeat a two-step calibration process for the front and back side of the board to get a project up and working in minutes. No fiducials are required, and any color combination of silkscreen, solder mask, and work surface background will work.

Once tracking has been attained, you can zoom in either through software or by moving the camera physically until as little as 20% of the board is in view. If you lose tracking, you only have place 80% of the board back in view to regain tracking and start viewing overlays again.
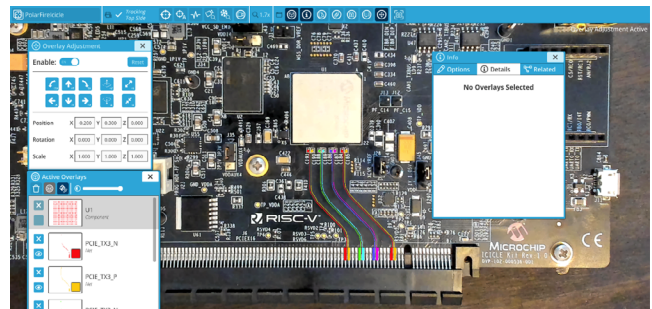


*Figure 1: AR overlays active on a PCB*

### Any PCB Shape Will Work

From simple rectangles to circular boards, irregular shapes with internal cutouts, and custom profiles made to fit form-factor cases, the inspectAR tool will still work. The custom calibration matches the profile of your board exactly, accounting for overhanging, side-mounted components, and any internal cutouts or slots your design may have.

There is no limit on the size of the board that you can use, as everything in the inspectAR tool's videos is filmed using circuit boards that are 30cm or smaller in their largest dimension. Boards larger than 30cm will work, just initially position your camera far enough back to get 80% of the board in view. Mobile devices make this easy, and you can move the camera forward and zoom in further after that.

You also may not need the fine detail of being able to view tiny and fine pitch components on a larger board. You can easily exceed the 30cm dimension limit if you do not need this level of detail. The following is an example of larger components such as header pins and connectors with a two-foot measure for scale of what you can do.
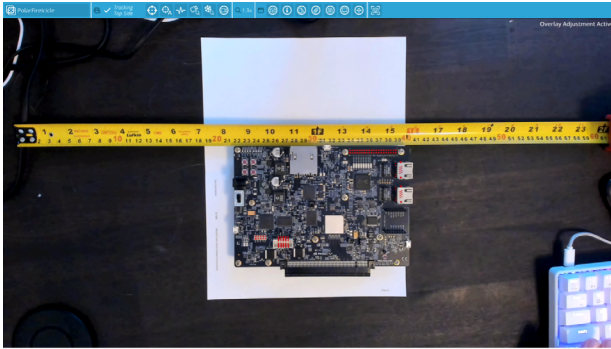
*Figure 2: The inspectAR platform can handle even large sized PCBs*

## Simple Calibration Process

The inspectAR tool's calibration process really is like depositing a check at a bank from your smartphone, albeit a bit more manual since it is dealing with a circuit board and not a check of known dimensions. The PCB must be on a flat surface, and you should make sure that the camera above is also level. From there, you just need to confirm where you see the board outline in the image that the inspectAR tool shows you.

The inspectAR tool uses this board outline to calculate the approximate location of your AR overlays and compute the location the board in real-time once you enter the AR scene. You can make small adjustments to your overlays after calibration.
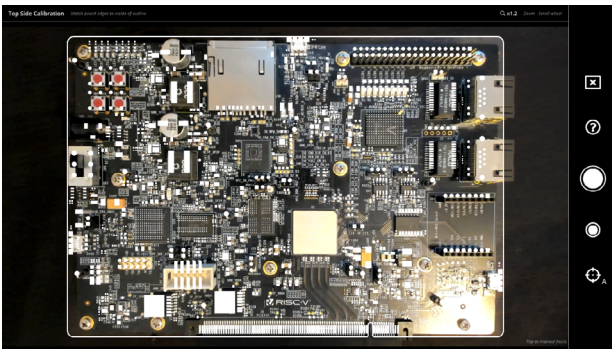


*Figure 3: Initial calibration window. Users align the PCB to the overlay.*



*Figure 4: 2nd calibration window. Users fine-tune the calibration.*

## AR Probing

You can directly interact with a board in the real world by clicking or tapping on components from within the inspectAR tool. Hover over a component and it will give you its reference designator. Click a component and you can view the design-specific pinout natively from the inspectAR tool. If you flip the board over, all the overlays that you are looking at will be reversed and mirrored to match the design.
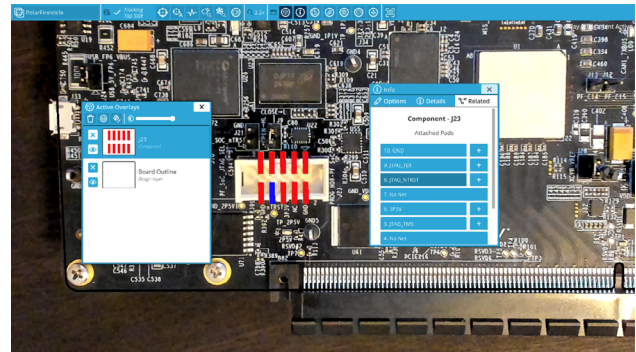


*Figure 5: Active overlay of a component with related nets displayed in the information pane.*

## Topology-Based Menu System

Every overlay in the inspectAR tool understands its topology in relation to others. For example, a component knows which net each pin is connected to and a net knows which components are connected to. Therefore, you can use engineering intuition rather than specific knowledge of a design to navigate around the board. Once you activate a component, you'll then see which net each pin is connected to. You can keep following the flow of power or move on to different functional and logical nets to explore communications, sensor behavior, etc.
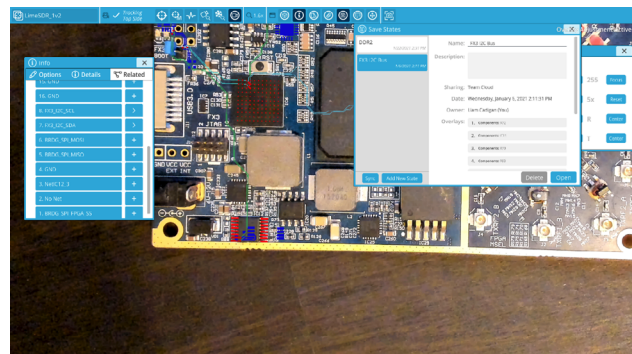


*Figure 6: Easily follow connections between components and nets*

## Built-in Work Instruction and Documentation Tool

Engineers spend countless hours preparing in-lab documentation using tools such as Microsoft Paint or PowerPoint. Step one is painstakingly lining up shapes and symbols to match the image you have taken. The inspectAR tool does this automatically and, from its screenshot markup tool, you can add your own custom drawings and instructions to the image. Instructions can then be attached to any net or component and viewed natively alongside the components in the AR scene.
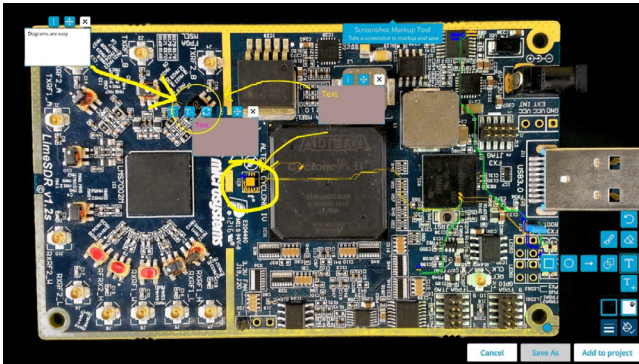


*Figure 7: The screenshot markup tool replaces the need for Paint programs for easy referencing and presentation of issues*

## Team-Wide Commenting

Comments can be attached to any net or component in order to streamline discussions and solve issues faster. Comments can be tagged and coded according to priority or function.
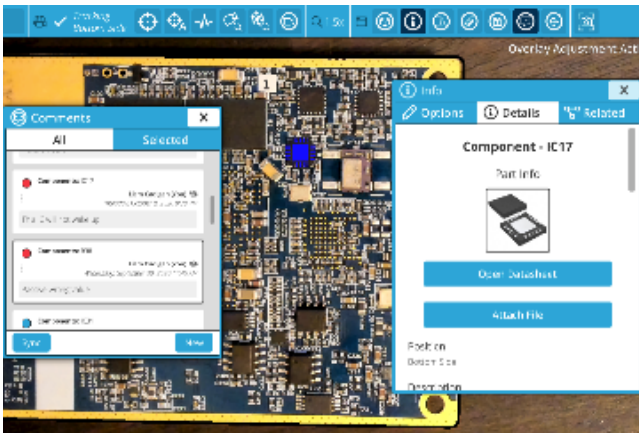


*Figure 8: Comments to nets and components are saved to project files and can be shared with team members for quick communication.*

## Share Subsystems with Save States

Save states allows you to group together various nets and components to create an entire subsystem. You can share this directly to a team member in order to give them confidence of the area of the board they need to work on, eliminating confusion caused from looking at the wrong area of the board.
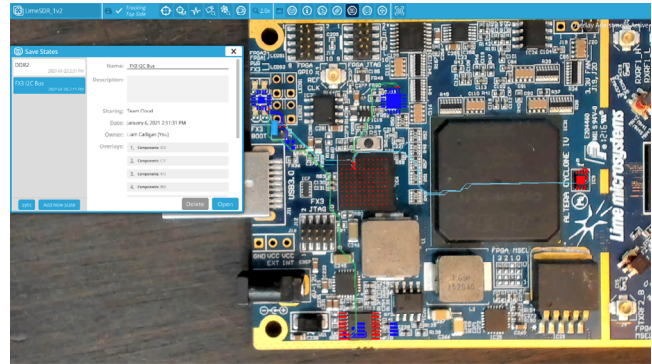


*Figure 9: Saved States instantly highlight where users need to work.*

## Easy Color Selection

By default, overlays within inspectAR are colored by layer just like you would see in an EDA. You can also color them by net if you like to maximize contrast once you are viewing the board in AR. When viewing similar, nearby signals with color-by-net you can minimize your pin swapping errors and stop yourself from confusing signals with each other when they overlap across different layers of layout.
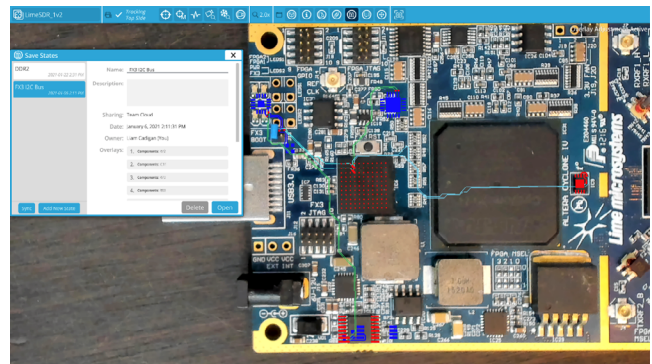


*Figure 10: Color-by-Net allows users to differentiate between nets to minimize mistakes.*
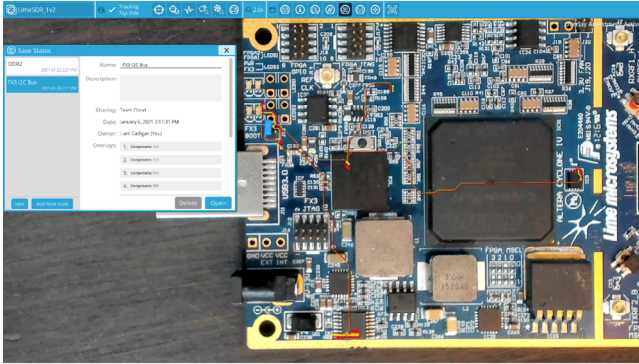
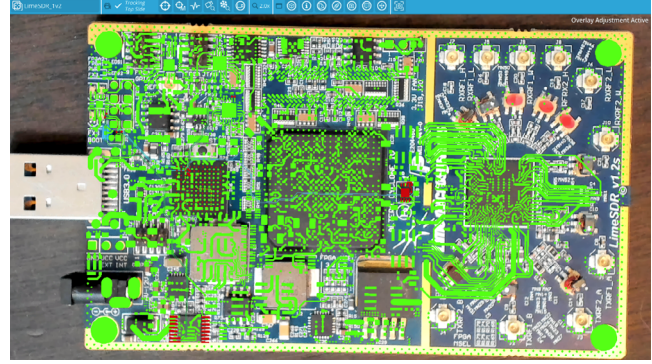*Figure 11: The color wheel gives users the freedom to represent nets and layers with any color they wish.*



*Figure 13: Camera controls in app to give users the precision comparable with optical microscopes.*
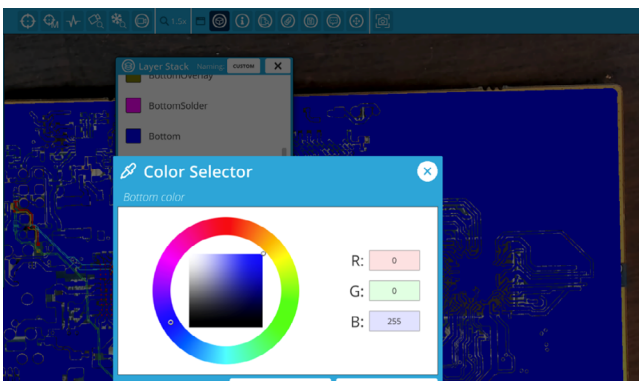


*Figure 12: The color of layers like the top copper can also by customized.*

## Built-in Component Search

Finding a data sheet to look up component pin mapping before probing is a difficult, problematic task when you must guess which orientation that part was placed on the board by the designer. Finding a particular temperature curve or the expected packets within the datasheet for a given signal can be similarly difficult.

The inspectAR tool's built-in part search leverages Cadence's Unified Component search to bring datasheets and parametric part information right into the lab. PDFs can be viewed natively from withint the inspectAR tool right alongside your overlays and board.

## Desktop Camera Has Video Microscope-Inspired Control

Many inspectAR users are already familiar with putting a board underneath a microscope in the electronics lab. While a video feed will never truly replace the resolution and zero-latency feedback of an optical microscope, the inspectAR tool gives you as much of that control and precision as possible.

A full camera control panel allows you to adjust your focus and zoom completely manually if needed. You can also switch over to automatic control, which will give you an experience more similar to a smartphone camera.
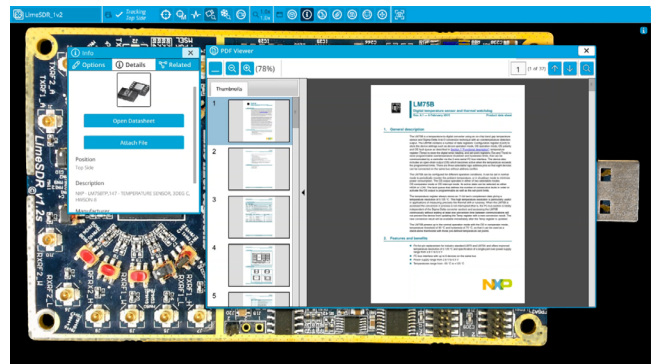


*Figure 14: Unified component search gives users access to datasheets of components to reduce contact-switching.*

## Interactive Part Search

The inspectAR tool allows you to select overlays based on a keyword search of your entire BOM. For example, searching for "10k" can pull up all 10k resistors on your board. Searching the part number of a single 10k resistor will pull up that entire line item from the BOM. You can directly search any net or component from this interface, plus you can combine searches to create custom groups of components.
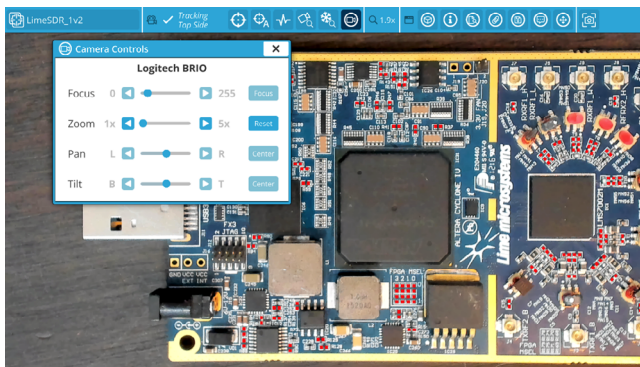


*Figure 15: Interactive part search can accept parameters such as value, MPN, and more.*

## File Attachments

You can turn your board into a live and interactive piece of documentation by attaching files to nets and components. This way you can share custom data sheets, simulations, and measurements while specific integrations are being developed.
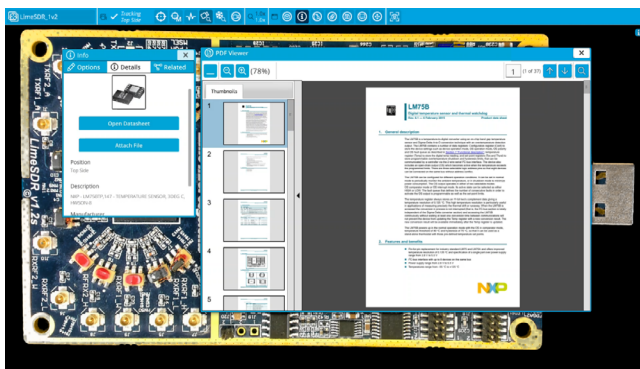


*Figure 16: File attachments allow users to upload custom PDF's and images.*

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