MicroLinks



ViTiny USB Microscope for Android

Complete User Manual | Human Operation and AI Retrieval Reference

Software version 1.1 (version code 286)

Manual edition 2026-09-08

Microlinks Technology Co., Ltd. | ViTiny

Software	ViTiny USB Microscope Android v1.1 / version code 286
Android package	com.vitiny.usbmicroscope
Manual	2026-09-08 / public user functions

How to use this manual

Every function is described by a stable command ID, the exact English UI label, prerequisites, steps, result, output, limits, and recovery. Search by ID (for example CAM.URST) or by the visible label (for example URST).

Note This manual describes the public user interface, built-in HELP, operating behavior, and device workflows of ViTiny USB Microscope Android v1.1. Available choices still depend on the microscope model, firmware, Android device, and USB power.

Important The native USB-microscope UVC components are supplied for 32-bit and 64-bit ARM. Android emulators are commonly x86/x86_64 and cannot reliably reproduce OTG, UVC, and CP2102 dual USB authorization. Validate with a physical Android device. Successful installation does not prove USB Host/OTG support.

Note The public Android permission requested by v1.1 is Camera. It does not request network, microphone, location, or broad storage permissions. Camera permission is still required to start the image pipeline when a USB UVC microscope is used. Video recordings contain no audio.

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Chapter 1 Product identity, architecture, and reading conventions

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

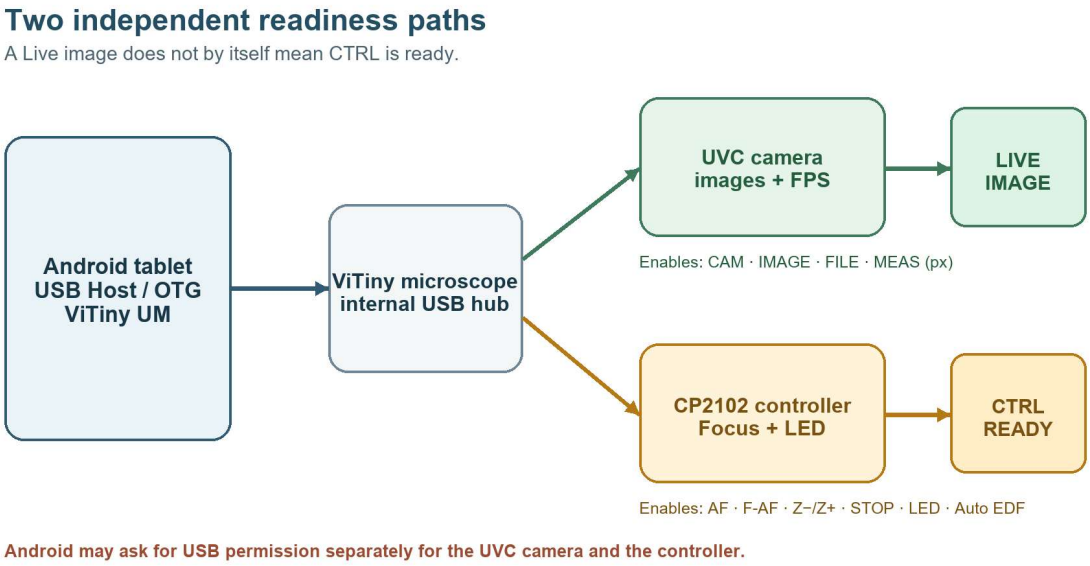


Figure 1 The UVC image path and CP2102 control path are independent readiness conditions.

0.1 Product identification

- Public product name: **ViTiny USB Microscope**.
- Abbreviated name visible in the UI/HELP: **ViTiny UM**; UM = USB Microscope.
- Android package ID: `com.vitiny.usbmicroscope`.
- Software version covered by this manual: 1.1; version code 286.
- Minimum Android version: API 26, Android 8.0.
- Target API: 36. This is not the minimum OS and does not guarantee hardware compatibility.
- Native UVC library ABIs: `arm64-v8a`, `armeabi-v7a`. Do not claim support for x86/x86_64 Android emulators.
- Recommended environment: an Android tablet in landscape orientation, USB Host/OTG, stable power, and a short, reliable USB-C/OTG cable. Use a high-quality externally powered USB hub when necessary.

0.4 Shared prerequisite codes

- `P-APP`: The app is installed and Android Camera permission is allowed. The main screen cannot operate normally if permission is denied.
- `P-UVC`: EXT/UVC has Android USB permission and continuously updating Live frames.
- `P-CTRL`: The CP2102 controller has USB permission, and UART/heartbeat is ready.
- `P-LIVE`: The current state is Live streaming, not a locked, loaded still image.
- `P-STILL`: A Freeze, loaded, or completed processed still working image is available.
- `P-CAL`: A calibration applicable to the current optical configuration has been ACCEPTed.
- `P-STORAGE`: The device has sufficient free space and the Android media/document storage workflow is available.
- `P-IDLE`: No F-AF, Auto EDF, AUTO CAL, AIP composition, recording, or other mutually exclusive task is running.
- `P-REF`: A usable Compare Reference has been loaded.
- `P-VIX`: A readable, validated VIX `.vix` case or compatible legacy profile `.json`/case `.zip` is available.

0.5 Fixed output paths

- Images and EDF: `Pictures/UM Viewer`.
- Silent recordings: `Movies/UM Viewer`.
- Measurement CSV/DXF and OCR TXT: `Download/UM Viewer`.
- VIX: `Download/UM Viewer/VIX/Cases`.
- Calibration patterns: `Download/UM Viewer/Calibration Pattern`.
- Depending on the Android version and file manager, these may appear in Photos/Videos/Downloads collections. The manual provides both the logical path and media type but cannot guarantee identical names in every vendor file manager.

0.6 Core architecture: understand UVC and CP2102 separately

Component	What it provides	Evidence of success	What must not be inferred
UVC camera	Live image, camera format/resolution/FPS, and some hardware IQ	The image updates continuously and Inspection shows UVC information	Seeing an image does not mean the motor/LED can be controlled
CP2102 controller	Heartbeat, Focus Position, AF/F-AF, Z motor, STOP, LED Level/Mode	UART/Focus/LED/Model status is ready in Inspection	CTRL being ready does not guarantee that the current UVC mode will stream stably

- One motorized ViTiny microscope may enumerate as two USB functions behind an internal hub, so two Android USB permission prompts may appear on first connection.
- An early unit without CP2102 may still show an image and resolutions but cannot use motor focus, Auto EDF, or LED control.
- `URST` is a complete UVC + CP2102 **software reconnect**. An Android app cannot physically power-cycle the USB hub.

Chapter 2 Installation, permissions, and sessions

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

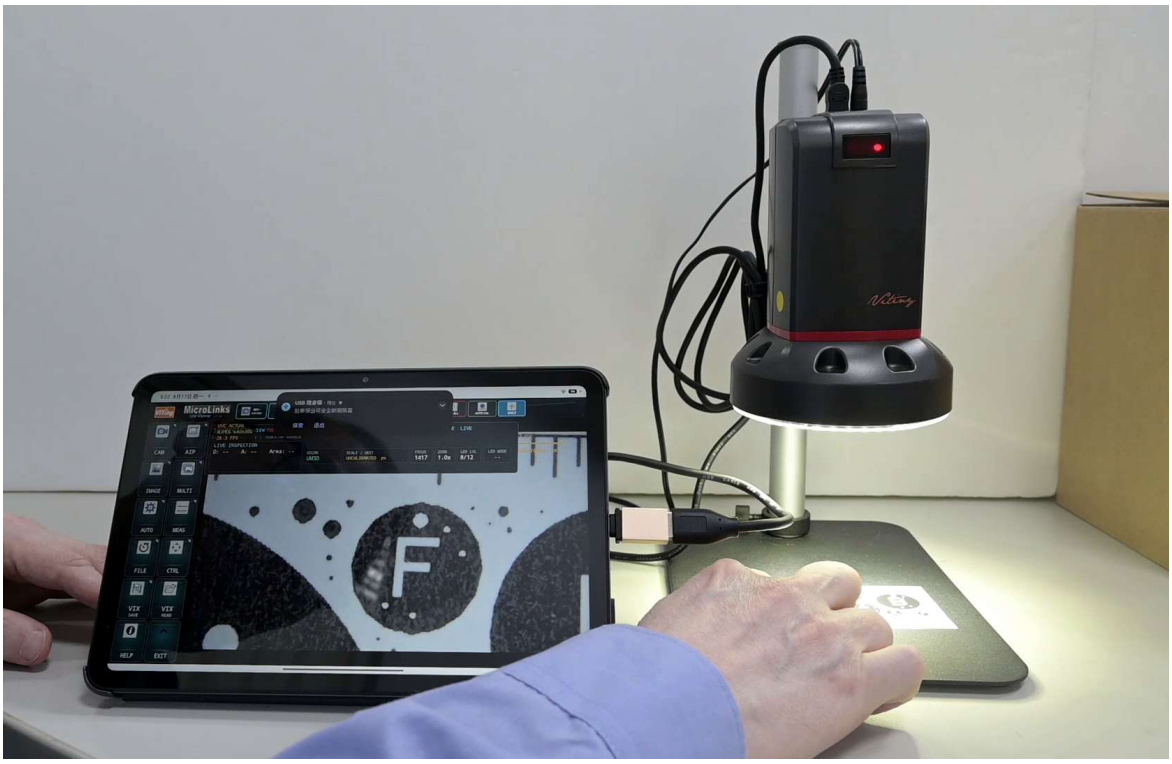


Figure 2 Typical connection: Android tablet in landscape orientation, OTG/USB link, and a ViTiny USB microscope.

APP.INSTALL — Install and start

Screen label	Android installation screen, `ViTiny USB Microscope`.
Purpose	Install the v1.1 app on a supported Android device.
Prerequisites	Android 8.0 or later, 32/64-bit ARM, and sufficient storage. Actual USB use also requires USB Host/OTG.
Procedure	Install from the official distribution source designated by Microlinks, then open the app.
Result	The app starts, enters the Camera permission flow, and then allows selection of a camera source.
Output/path	App installation data; no user output file is created.
Limitations	Installability does not mean USB microscope compatibility. Do not use the old com.vitiny.UMViewer store page as the v1.1 download page. x86 emulators are outside the supported claim.
Recovery/troubleshooting	If installation fails, check the Android version, CPU ABI, package integrity, and device security settings. Hardware compatibility must be tested on a physical device.

APP.PERMISSION.CAMERA — Camera permission

Screen label	Android `Camera` permission prompt.
Purpose	Allow the app to create its camera/UVC display workflow; this is required even with a USB microscope.
Prerequisites	`APP.INSTALL` is complete.
Procedure	Choose Allow on first launch. If previously denied, open Android Settings → Apps → ViTiny USB Microscope → Permissions, allow Camera, and reopen the app.
Result	The main screen can create camera sources and the image pipeline.
Output/path	Android permission state; no file.
Limitations	The app's public Android permissions do not include microphone, network, location, or broad storage permission. Wording varies by Android version.
Recovery/troubleshooting	If `Camera permission denied` appears or the main UI is unavailable, allow the permission in system settings. If it still fails, force-stop and reopen the app.

APP.PERMISSION.USB — UVC/CP2102 USB permission

Screen label	Android USB device authorization dialog; it may appear twice in succession.
Purpose	Allow the app to access the UVC camera and CP2102 controller.
Prerequisites	USB Host/OTG is available, and the microscope is correctly powered and connected.
Procedure	Allow every prompt that belongs to the microscope. Wait for enumeration; do not repeatedly unplug the cable while a prompt is active.
Result	UVC Live may appear first; CP2102 later makes UART/Focus/LED status ready.
Output/path	Android authorization state for that USB device; no file.
Limitations	The “open by default” option varies by Android vendor. Authorization may be requested again after unplugging, rebooting, or clearing system defaults.
Recovery/troubleshooting	After denial, disconnect once, reconnect, and authorize again. If Live works but CTRL does not, look for a second CP2102 prompt and wait for UART heartbeat.

SESSION.BACK — Android system Back

Screen label	Android system Back.
Purpose	Send the app to the background and return to the desktop without ending the session.
Prerequisites	The app is in the main workspace.
Procedure	Press the system Back control. Later reopen the app from Recents or its icon.
Result	The same session resumes, retaining measurements, Draw/Text annotations, Zoom/Pan, and workspace state.
Output/path	No file; only foreground/background state changes.
Limitations	Android may still terminate a background app under memory pressure. Do not rely on background retention for important data.
Recovery/troubleshooting	If state is gone after reopening, recover from saved CSV/images/VIX. Use `APP.EXIT` to close completely.

APP.EXIT — EXIT

Screen label	`EXIT` on the main icon row.
Purpose	Close ViTiny UM completely instead of merely sending it to the background.
Prerequisites	Stop recording, F-AF, Auto EDF, or any save operation first.
Procedure	Tap `EXIT` and complete the confirmation dialog.
Result	Camera/controller work stops and the app session ends.
Output/path	Unsaved data is not saved automatically.
Limitations	Unsaved measurements, temporary results, or annotations may be lost.
Recovery/troubleshooting	Save with FILE, MEAS SAVE, or VIX SAVE first. After accidental closure, only files already written can be recovered.

Chapter 3 Main screen, header, and shared interaction

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

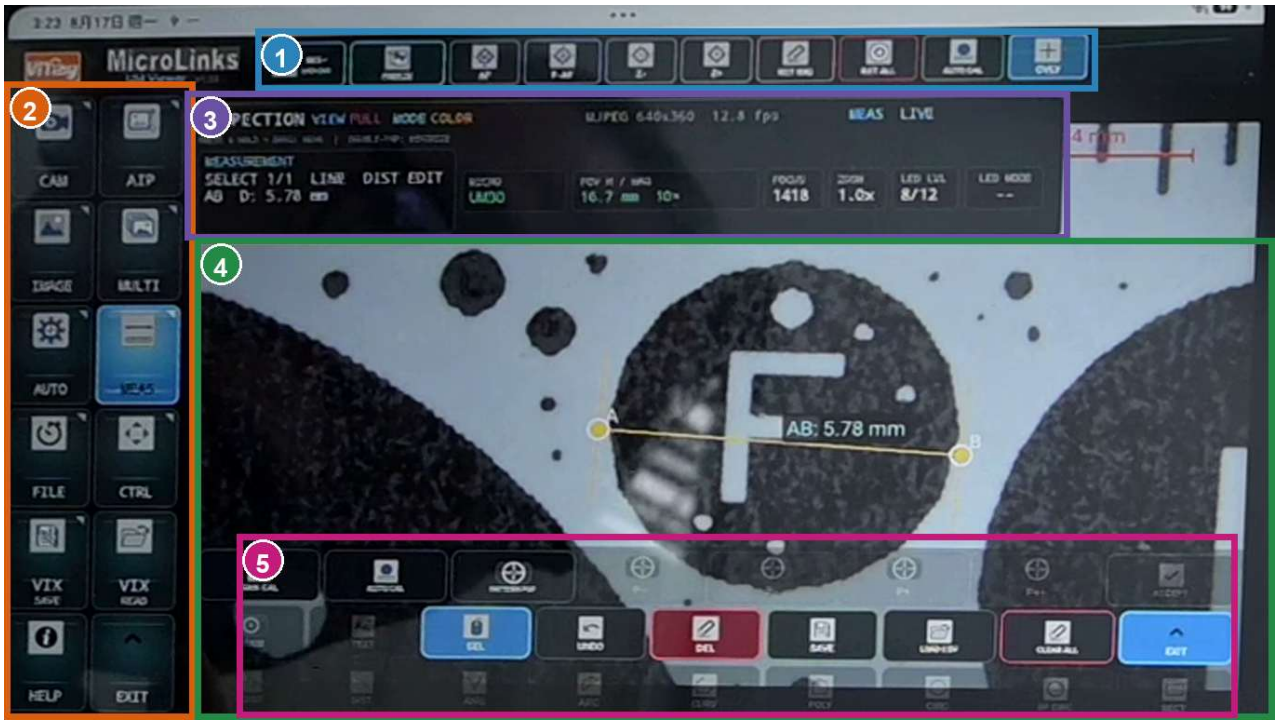


Figure 3 Main screen regions: 1 header, 2 main toolbar, 3 Inspection, 4 working image, and 5 options panel.

Top header controls

RES	FREEZE	LIVE	AF
F-AF	Z−	Z+	RST IMG
RST ALL	AUTO CAL	OVLY	Inspection I

Figure 4 Header controls. AF, F-AF, Z−/Z+, and reset functions remain available across workspaces when their prerequisites are met.

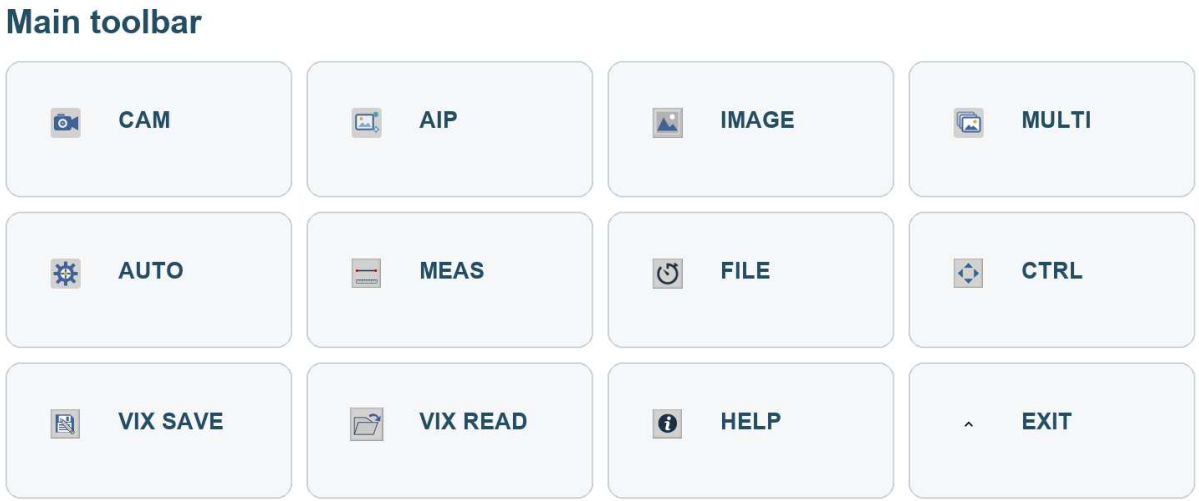


Figure 5 The 12 main entries. Availability depends on image state, controller state, and the current operation.

UI.MAIN_TOOL — CAM/IMAGE/AIP/MULTI/AUTO/MEAS/FILE/CTRL/VIX/HELP

Screen label	Each main icon on the left/main toolbar.
Purpose	Switch functional workspaces; the selected tool expands its child controls.
Prerequisites	`P-APP`; tools requiring images also need `P-UVC`, `P-LIVE`, or `P-STILL`.
Procedure	Tap a main icon. Long-press CAM, IMAGE, AIP, MULTI, AUTO, or CTRL to perform the workspace reset/cancel action described by the public hint.
Result	The corresponding child panel appears. Top-header Live/Focus controls remain shared.
Output/path	No file. Workspace state remains in memory and some parts can enter VIX.
Limitations	Some computations are mutually exclusive; other tools pause or become unavailable while they run. On narrow displays, rows may wrap or require horizontal scrolling.
Recovery/troubleshooting	Wait for or stop the current task. If a temporary state is unclear, long-press the relevant main tool as instructed, or use `HDR.RESET_IMAGE`/`HDR.RESET_ALL`.

UI.TOUCH_ZOOM_PAN — Pinch/Wheel/Drag

Screen label	`TOUCH`; there is no fixed button on the image.
Purpose	Apply Digital Zoom and, where allowed, Pan; drag an ROI, selection handle, or Compare Reference.
Prerequisites	The current tool permits Zoom/Pan and no workflow such as AUTO CAL has locked the view.
Procedure	Use a two-finger pinch or mouse wheel for Digital Zoom. Drag the image to pan when allowed. Drag an ROI or control point directly.
Result	Only display scale, visible area, or the specified object's position changes. Digital Zoom does not alter the calibrated source Pixel Size.
Output/path	No file. SCREEN flattens the currently visible view.
Limitations	While a measurement tool is placing points, drag may belong to measurement rather than Pan. AUTO CAL and ANALYZE lock the view to centered 1.0×.
Recovery/troubleshooting	Close the current drawing tool before Zoom/Pan. Use the applicable Reset or 1.0X control to restore the initial view.

UI.INSPECTION.MOVE — Move Inspection

Screen label	`Inspection` window.
Purpose	Move the microscope status panel to view MICRO, UVC, UART, Focus Position, LED Level, LED Mode, FOV, and related fields.
Prerequisites	Inspection is expanded.
Procedure	Hold an empty area of the panel and drag it away from important image content.
Result	The panel position changes and remains stored when collapsed/restored.
Output/path	No file. SCREEN includes the visible panel.
Limitations	Blank/N/A means no data is currently available, not necessarily a fixed hardware fault. FOV and displayed magnification require `P-CAL`.
Recovery/troubleshooting	Drag the panel back inside the screen if it obstructs controls. Collapse it on a narrow display.

UI.INSPECTION.COLLAPSE_RESTORE — Double-tap Inspection/I

Screen label	`Inspection`; information icon `I` at the far right of the top header.
Purpose	Collapse or expand Inspection.
Prerequisites	`P-APP`.
Procedure	Double-tap Inspection to collapse it. Then double-tap the fixed `I` at the far right of the top header to restore it.
Result	The movable panel disappears or returns at its previous position.
Output/path	No file.
Limitations	`I` is fixed in the header; it is not a movable minimized window. On narrow screens, scroll the header horizontally to reach it.
Recovery/troubleshooting	Scroll to the far right to find `I`. If it remains hidden, check system display scaling and orientation.

HDR.RES — RES

Screen label	The first top-header `RES` button and current dimensions.
Purpose	Quickly select an image size allowed by the current UVC microscope.
Prerequisites	`P-UVC`, `P-IDLE`.
Procedure	Tap `RES` and choose a size. The current size is checked. MJPEG/YUYV entries with the same dimensions appear only once here.
Result	The app safely closes/reopens UVC and considers the change successful only after receiving real new frames. Calibration stays valid with unchanged optics and horizontal FOV.
Output/path	No file; the UVC working mode changes.
Limitations	Blocked during F-AF, Auto EDF, AUTO CAL, or a conflicting task. This menu selects size only; CAM provides full format/FPS/bandwidth details.
Recovery/troubleshooting	For a black or unstable image, return to a smaller MJPEG mode. Wait for switching to complete; do not tap repeatedly. Use `CAM.URST` if necessary.

HDR.FREEZE_LIVE — FREEZE/LIVE

Screen label	FREEZE, LIVE.
Purpose	Hold the current working image or return to camera streaming.
Prerequisites	Freeze requires P-UVC; Live requires an available camera source or a loaded-media workspace.
Procedure	Tap FREEZE to hold; tap LIVE to resume streaming.
Result	IMAGE, AUTO, MEAS, and MULTI share this single image state. A loaded, locked still remains usable until LIVE is selected.
Output/path	No automatic file; save through FILE when needed.
Limitations	Freeze is not Save. It may disappear after app exit or workspace reset.
Recovery/troubleshooting	If Live cannot resume, check FILE.LIVE, UVC permission, and CAM SRC. Use CAM.URST if frames do not arrive.

HDR.AF — AF

Screen label	AF.
Purpose	Run the microscope controller's normal single autofocus.
Prerequisites	P-UVC, P-CTRL, P-IDLE; the subject is within the useful image area.
Procedure	Keep the microscope and subject stable, tap AF, and wait for completion.
Result	The controller moves focus and stops. Focus Position changes, invalidating physical-size calibration.
Output/path	No file; hardware focus and status change.
Limitations	Unavailable on devices without CP2102. Low contrast, glare, or a moving subject can give poor focus.
Recovery/troubleshooting	Press CTRL.STOP if needed. After CTRL recovers, retry or make short adjustments with HDR.Z_MINUS_PLUS, then recalibrate.

HDR.F_AF — F-AF

Screen label	F-AF, yellow Focus ROI, START, STOP, phases 1/5–5/5, POS.
Purpose	Scan the usable travel with the app's Focus Score and find the best focus in a chosen ROI.
Prerequisites	P-UVC, P-CTRL, P-IDLE; Focus Position is valid.
Procedure	Tap F-AF. Drag/resize the default 360 × 360 yellow ROI over high-contrast detail, avoiding blank, reflective, or moving areas. Tap START; tap STOP if needed.
Result	The app stores the original UVC mode, switches to validated 640 × 360 (or the smallest reported mode if unavailable), performs a 100-Position coarse scan and 10-Position fine scan, waits for settling at each station, rejects stale frames, and uses the median of three distinct new Focus values. It returns to the strongest position, stops the motor, restores the original resolution, and verifies real frames. Any focus change invalidates calibration.
Output/path	No file. ROI, curve, final Position, and failure phase may remain for inspection.
Limitations	Slower than continuous scanning and mutually exclusive with Auto EDF. Do not change source/resolution, operate Z, or unplug USB while scanning.
Recovery/troubleshooting	Tap STOP to cancel safely. After motion/reply/sampling/connection failure, wait for CTRL recovery, place the ROI over detailed content, and retry. A real cable disconnect cancels the scan.

HDR.Z_MINUS_PLUS — Z−/Z＋

Screen label	Z−, Z＋.
Purpose	Drive the focus motor manually.
Prerequisites	P-UVC, P-CTRL, P-IDLE.
Procedure	Press and hold either key to move; release to stop. Use short presses near focus.
Result	Focus Position and image sharpness change, invalidating physical-size calibration.
Output/path	No file; hardware focus position changes.
Limitations	Nearer/farther motion on screen depends on the optical configuration; do not infer direction from +/− alone.
Recovery/troubleshooting	Judge by Live and Focus Position. If motion is uncontrolled, tap CTRL.STOP, wait for UART readiness, and retry.

HDR.RESET_IMAGE — Reset Image

Screen label	Reset Image/corresponding icon.
Purpose	Clear image processing, analysis overlays, QR/OCR boxes, and temporary IMAGE results while retaining ACCEPTed calibration.
Prerequisites	P-APP; confirmation may appear.
Procedure	Tap Reset Image and confirm.
Result	The image returns to the base view and IMAGE-related layers are cleared; calibration remains.
Output/path	No file; previously written files are not deleted.
Limitations	This is not a full workspace reset. Confirm on screen whether measurement or other module state remains.
Recovery/troubleshooting	Save with SCREEN/SAVE first. Accidentally cleared temporary processing normally cannot be undone; configure it again.

HDR.RESET_ALL — Reset All/RESET WORKSPACE

Screen label	Reset All, HOME VIEW RESET, RESET WORKSPACE.
Purpose	Return the complete user workspace to a safe initial state.
Prerequisites	Stop tasks and save important data first; confirmation is required.
Procedure	Tap Reset All, or long-press CAM to open HOME VIEW RESET and confirm RESET WORKSPACE.
Result	Measurements and overlays are removed, calibration is cleared, TIP returns to TIP 1S, and safe camera defaults and the initial workspace are restored.
Output/path	No file; saved files are not deleted.
Limitations	Unsaved work is irrecoverable. This is not a physical USB power cycle.
Recovery/troubleshooting	Save VIX/CSV/SCREEN first. After accidental reset, rebuild only from saved files.

HDR.AUTO_CAL — AUTO CAL shortcut

Screen label	Top-header `AUTO CAL`.
Purpose	Open the same automatic-calibration workflow as MEAS.
Prerequisites	`P-UVC`, `P-IDLE`, and a clear, correctly printed calibration marker.
Procedure	Tap AUTO CAL, then complete scan, Review, and ACCEPT/CANCEL according to `MEAS.CAL.AUTO`.
Result	The view returns to centered 1.0× and stays locked until the workflow ends. ACCEPT creates physical-unit calibration.
Output/path	Calibration state; no calibration-pattern file is created automatically.
Limitations	This is an entry shortcut, not another algorithm. Do not confuse it with `MEAS.CAL.PATTERN_PDF` or `FILE.CAL_PATTERN`.
Recovery/troubleshooting	Judge the Review letter, size, confidence, and result. If blurred or ambiguous, CANCEL, improve focus/lighting/printing, and retry.

HDR.OVERLAY — OVERLAY

Screen label	`OVERLAY`.
Purpose	Cycle combinations of center crosshair, upper-right scale/ruler, grid, and OFF.
Prerequisites	`P-APP`; physical scale units require `P-CAL`.
Procedure	Repeatedly tap OVERLAY to cycle ALL, Center + Scale, Center + Grid, Scale + Grid, Center, Scale, Grid, and Off (as displayed by the actual UI).
Result	The visible overlay combination changes. The complete-image center is (0,0): X is negative left/positive right, and Y is positive up/negative down.
Output/path	SCREEN, including the SCREEN member of SAVE ALL, flattens visible overlays. RAW does not include them.
Limitations	An overlay is a visual aid, not a measurement object. Without calibration, do not treat the scale as physical size.
Recovery/troubleshooting	Cycle to OFF. Use Reset Image if another analysis layer remains.

Chapter 4 CAM: source, UVC mode, IQ, and information

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

CAM.SRC — SRC (BACK/FRONT/EXT / UVC)

Screen label	`SRC`, `BACK`, `FRONT`, `EXT / UVC`.
Purpose	Select the device rear camera, front camera, or USB UVC microscope as image source.
Prerequisites	`P-APP`; EXT/UVC also requires USB Host, cable, and USB permission.
Procedure	Open CAM and repeatedly tap `SRC` or choose a source option. Select `EXT / UVC` for a USB microscope.
Result	The app creates the selected source. Source change invalidates calibration. Device-camera mode displays its limitation hint.
Output/path	No file; subsequent RAW/PHOTO use the current source.
Limitations	ViTiny UM is designed primarily for USB microscopes. Many UVC, motor, LED, and Auto EDF functions are unavailable under BACK/FRONT. Recalibration is required.
Recovery/troubleshooting	If EXT does not appear, check OTG, USB permission, and cable. Wait for hub enumeration, then reconnect only once or use `CAM.URST`.

CAM.R_MINUS_PLUS — R−/R＋

Screen label	`R-`, `R+`, and candidate UVC mode text.
Purpose	Select the previous/next candidate format, resolution, FPS, and bandwidth mode.
Prerequisites	`P-UVC`, `P-IDLE`.
Procedure	Tap R− or R＋ to browse. Check format, dimensions, FPS/bandwidth, then use `CAM.APLY`.
Result	Only the pending mode changes until APLY. If the UI previews immediately, success still requires real frames.
Output/path	No file.
Limitations	A camera-advertised mode may not stream stably with the current cable, hub, power, or tablet. YUYV generally uses more bandwidth than MJPEG.
Recovery/troubleshooting	Return to a smaller MJPEG mode. Avoid rapid taps. If apply fails, wait for recovery or use `CAM.URST`.

CAM.APLY — APLY

Screen label	APLY.
Purpose	Apply the detailed UVC mode selected in CAM.
Prerequisites	P-UVC, P-IDLE; a candidate was selected with R−/R＋.
Procedure	Tap APLY once and wait for safe close/open and real-frame verification.
Result	On success, format, resolution, FPS/bandwidth status update. With the same optics and horizontal FOV, calibration is retained.
Output/path	No file; the UVC mode changes.
Limitations	Native acceptance does not mean streaming success. Higher resolution increases bandwidth, memory, and processing time.
Recovery/troubleshooting	Do not tap repeatedly. For black/flickering video, choose lower MJPEG, check power/cable, and use URST if needed.

CAM.AUTO — AUTO

Screen label	AUTO inside CAM.
Purpose	Automatically select and apply a safe/suitable mode for the current UVC device.
Prerequisites	P-UVC, P-IDLE.
Procedure	Tap AUTO and wait for the mode change and real frames.
Result	The app selects an available mode and restores Live. Same optics/FOV: calibration retained.
Output/path	No file.
Limitations	“Best” is a compatibility/safety software choice, not a promise of highest resolution or FPS, and does not replace task-specific manual selection.
Recovery/troubleshooting	If unstable, manually choose smaller MJPEG and check the USB path and power.

CAM.URST — URST

Screen label	URST.
Purpose	Retire and rebuild the complete microscope USB session: UVC camera/preview plus CP2102 serial port, initialization, and heartbeat.
Prerequisites	The microscope remains physically connected; stop recording and computations first.
Procedure	Tap URST once, allow any repeated USB prompts, and wait for both UVC and UART to recover.
Result	Camera, controller, and preview resources perform a complete software reconnect.
Output/path	No file; current temporary work may stop.
Limitations	Android cannot physically remove power from the USB hub. URST is not a power cycle; cable, power, or hardware issues still require physical correction.
Recovery/troubleshooting	If reconnect fails, stop tapping, disconnect once, check a short cable/OTG/powered hub/power, reconnect, and reauthorize both USB functions.

CAM.IQ.OPEN_CLOSE — IQ/X

Screen label	`IQ`, panel `UVC IMAGE QUALITY HW` or `N/A`, `X`.
Purpose	Open/close hardware image-quality controls exposed by the current camera.
Prerequisites	EXT UVC and its firmware expose the corresponding UVC controls. Device cameras show N/A.
Procedure	Tap IQ to open; after adjustment, tap X to close.
Result	Available buttons and a 3 × 3 parameter-slider layout appear. Closing does not reset values.
Output/path	No file; supported items may be saved/restored by a compatible VIX.
Limitations	N/A means the hardware/firmware does not provide the control. Ranges/defaults differ by camera and must not be hard-coded in the manual.
Recovery/troubleshooting	Tap SHOW to reread. If unresponsive, confirm EXT/UVC Live. Use RESET to restore defaults.

CAM.IQ.SHOW_RESET — SHOW/RESET

Screen label	`SHOW`, `RESET` in the IQ panel.
Purpose	SHOW reads and displays current hardware values; RESET restores available UVC IQ defaults.
Prerequisites	`P-UVC`; the IQ panel is open.
Procedure	Tap SHOW to synchronize. To discard adjustments, tap RESET and wait for hardware feedback.
Result	Panel values update or supported IQ controls return to safe defaults.
Output/path	No file; UVC hardware state changes.
Limitations	Applies only to controls exposed by the current camera. IQ RESET has a different scope from Reset Image and Reset All.
Recovery/troubleshooting	Do not retry writing an N/A field. If hardware replies slowly, wait and tap SHOW again rather than repeatedly tapping.

CAM.IQ.AUTO_TOGGLES — AE/AWB/BLC/50/60 Hz

Screen label	`AE`, `AWB`, `BLC`, and mains-frequency display (for example 50/60 Hz, as shown by the UI).
Purpose	Toggle auto exposure, auto white balance, backlight compensation, and anti-flicker mains frequency.
Prerequisites	`P-UVC`; the camera advertises support for that control.
Procedure	Tap each button to toggle. With AE on, manual Exposure/Gain sliders are disabled; with AWB on, White Balance is disabled.
Result	Camera hardware controls update; Live brightness/color/flicker may change.
Output/path	No file; subsequent RAW/PHOTO reflect hardware capture state.
Limitations	Availability/reporting depends on firmware. BLC or mains-frequency control may be unavailable on some cameras.
Recovery/troubleshooting	For flicker, choose local mains frequency or RESET. If a control is N/A, adjust physical lighting and available IQ instead.

CAM.IQ.SLIDERS — Brightness/Contrast/Sharpness/Saturation/Hue/Gamma/Exposure/Gain/White Balance

Screen label	The nine listed sliders and values.
Purpose	Adjust UVC hardware IQ parameters exposed by the camera.
Prerequisites	`P-UVC`; the control is available. Exposure/Gain require AE off; White Balance requires AWB off.
Procedure	Drag a slider and release to apply. Confirm with the Live image and read-back value.
Result	The UVC source image changes directly. RAW reflects hardware IQ, unlike IMAGE software processing.
Output/path	No separate file; a supported VIX may record the state.
Limitations	Range/step/default are determined entirely by hardware. Do not confuse hardware Gamma with IMAGE software Gamma.
Recovery/troubleshooting	Use IQ RESET after clipped detail or color cast. Use SHOW/check N/A if unresponsive. In low light, improve LED/exposure before raising Gain and noise.

CAM.INFO — INFO

Screen label	`INFO` and the camera/USB information dialog.
Purpose	View current camera, USB, resolution, and measured/requested FPS information.
Prerequisites	`P-APP`; information is more complete with UVC connected.
Procedure	Tap INFO, read source/mode/connection data, and close the dialog.
Result	Status is displayed without changing the image.
Output/path	No file; SCREEN can preserve visible evidence.
Limitations	Descriptor-advertised FPS does not equal measured FPS on the current USB path. Do not fill blank fields by assumption.
Recovery/troubleshooting	If information does not refresh, wait for real frames or reopen. Cross-check Inspection and CTRL status.

CAM.TIP — TIP 1S/TIP OFF/TIP H/TIP 3S

Screen label	`TIP 1S`, `TIP OFF`, `TIP H`, `TIP 3S`.
Purpose	Set how long the main Guidance Card remains visible.
Prerequisites	`P-APP`.
Procedure	Repeatedly tap TIP to cycle 1 second (default), Off, Hold, and 3 seconds.
Result	Main-tool and short HINT text use the HELP-selected language and current duration. TIP H stays until the user closes/switches it.
Output/path	No file; Reset All returns to TIP 1S.
Limitations	Disabling hints does not change functions or hide status/error messages.
Recovery/troubleshooting	If tutorial cards are absent, cycle to TIP 1S or TIP 3S. Leave TIP H if it obstructs the screen.

Chapter 5 IMAGE: processing, recognition, effects, and analysis

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

IMG.ROI_FULL — ROI 200/400/800/FULL

Screen label	`ROI / FULL`; states cycle through 200, 400, 800, FULL.
Purpose	Select a centered/movable software-processing area or the full image.
Prerequisites	`P-UVC` or `P-STILL`.
Procedure	Repeatedly tap ROI/FULL to choose a size. When a processing frame appears, drag it over the target.
Result	Subsequent IMAGE effects apply only inside the selected area; FULL processes the whole image.
Output/path	PHOTO reflects the processed result; RAW is unaffected.
Limitations	Available ROI sizes depend on source resolution. FULL may reduce speed substantially.
Recovery/troubleshooting	Choose a smaller ROI to improve FPS. Long-press IMAGE to return to Color and clear IMAGE overlays.

IMG.PIP.OPEN — PIP

Screen label	`PIP`, yellow sample frame, magnified window.
Purpose	Inspect local detail at 2X/4X/8X.
Prerequisites	`P-UVC` or `P-STILL`.
Procedure	Tap PIP. Move the yellow frame/cursor to choose the area. Tap again or use the panel to leave.
Result	A local magnified view appears without changing original image resolution.
Output/path	SCREEN may include PIP; RAW does not.
Limitations	PIP is digital magnification; it adds no optical detail and does not change calibrated Pixel Size.
Recovery/troubleshooting	If the magnified area is missing, move the yellow frame inside the image, reduce Digital Zoom, or close and reopen PIP.

IMG.PIP.CONTROLS — PIP−/PIP xX/PIP＋/LOCK/UNLOCK

Screen label	`PIP-`, `PIP xX`, `PIP+`, `LOCK`, `UNLOCK`.
Purpose	Decrease/show/increase PIP magnification and lock the sample position or let PIP follow the cursor.
Prerequisites	`IMG.PIP.OPEN` is enabled.
Procedure	Use PIP−/PIP＋ or the mouse wheel to cycle 2X/4X/8X. Tap LOCK to fix the sample, UNLOCK to resume following. A double-tap on the yellow frame also toggles the public interaction.
Result	Magnification and tracking mode update.
Output/path	No separate file; SCREEN saves the visible state.
Limitations	LOCK fixes only the PIP sample position; it does not lock the whole image or loaded media.
Recovery/troubleshooting	If PIP does not follow the cursor, check for LOCKED. Return to 2X if the view is too magnified to interpret.

IMG.PIP.DISPLAY_MODE — S→L/L→S

Screen label	`S→L`, `L→S`.
Purpose	S→L magnifies a small sample into PIP; L→S shows a full-camera overview in PIP while a green frame navigates the main view.
Prerequisites	PIP is open.
Procedure	Tap S→L/L→S to switch. S→L uses the yellow sample frame, 2X/4X/8X, and LOCK. In L→S, Zoom/Pan continue to control the main image.
Result	PIP input/display roles change; switching cancels PIP lock.
Output/path	No file; SCREEN can save the current mode.
Limitations	S→L locks Digital Zoom/Pan so the yellow source frame remains unambiguous. The L→S PIP itself does not accept pointer input.
Recovery/troubleshooting	If Zoom/Pan is unavailable, switch to L→S or close PIP. Return to S→L for local magnification.

IMG.QR — QR/Barcode

Screen label	`QR`, `QR / Barcode ON/OFF`, recognition box/content.
Purpose	Recognize a QR code or supported barcode in the current image.
Prerequisites	A clear, complete, high-contrast Live or Still image.
Procedure	Tap QR, place the entire code in view, and wait. Tap QR again to turn it off.
Result	A recognition box and content appear. Leaving QR, Reset Image, or Reset All clears the box.
Output/path	No automatic save is claimed. Use SCREEN or manually copy visible content if retention is needed.
Limitations	Resolution, glare, rotation, blur, code type, and ML Kit support affect results. Manually verify critical content.
Recovery/troubleshooting	Improve focus/lighting, enlarge the code while retaining its full border, and use clean Color/Gray. Do not use a suspected misread in a safety-critical workflow.

IMG.OCR.OPEN_ROI — TEXT (OCR)

Screen label	IMAGE `TEXT`, `TEXT OCR ON/OFF`, OCR rectangle.
Purpose	Enable text recognition and define an area.
Prerequisites	Clear, upright, high-contrast text.
Procedure	Tap TEXT and draw a rectangle. If no box is drawn, READ scans the full image.
Result	The OCR panel opens. Leaving, Reset Image, or Reset All clears the OCR box.
Output/path	Nothing is saved yet; `IMG.OCR.READ_SAVE` creates TXT.
Limitations	This TEXT is OCR, distinct from the MEAS text annotation `MEAS.TEXT`.
Recovery/troubleshooting	If a box cannot be drawn, close any tool intercepting drag, or use full-image READ. Improve contrast and focus.

IMG.OCR.READ_SAVE — READ/CLEAR/SAVE TXT/EXIT

Screen label	`READ`, `CLEAR`, `SAVE TXT`, `EXIT OCR`.
Purpose	Run OCR, clear a result, save plain text, or leave OCR.
Prerequisites	`IMG.OCR.OPEN_ROI` is open; SAVE additionally requires recognized text and `P-STORAGE`.
Procedure	Draw a box and tap READ; inspect the text. Use CLEAR to retry, SAVE TXT to save, and EXIT to leave.
Result	READ shows recognized text; SAVE TXT writes to `Download/UM Viewer`; EXIT clears the OCR workspace box.
Output/path	`UMV_Text_yyyyMMdd_HHmmss.txt` → `Download/UM Viewer`.
Limitations	OCR does not guarantee every character. Formatting, tables, and layout are not guaranteed to be retained.
Recovery/troubleshooting	If no result appears, use the whole image or a smaller clean ROI, correct orientation, and reduce glare. Open the saved TXT and verify it.

IMG.COLOR_MODES — COLOR/RED/GREEN/BLUE/HSV/LAB

Screen label	`COLOR` and its Color, Red, Green, Blue, HSV, LAB modes.
Purpose	Show original color, individual channels, or color spaces. HSV helps with colored objects/PCB/LED/markers; LAB separates luminance and color difference.
Prerequisites	`P-UVC` or `P-STILL`.
Procedure	Open the COLOR child row and choose a mode. Some effects return to Color when selected again.
Result	PHOTO and display use the selected software processing; RAW remains the UVC source.
Output/path	PHOTO → `Pictures/UM Viewer`; no separate settings file.
Limitations	HSV/LAB visualization is not a colorimeter measurement. Lighting, white balance, and camera color response affect results.
Recovery/troubleshooting	Choose Color or long-press IMAGE. For color cast, check IQ AWB/White Balance and lighting.

IMG.GRAY_MODES — GRAY/BIN/ADB/CLAHE

Screen label	`GRAY`, Gray, `BIN`, `ADB`, `CLAHE`.
Purpose	Grayscale, global binary, adaptive binary, and local contrast enhancement. CLAHE helps uneven illumination, shadow detail, and OCR/AUTO CAL preprocessing.
Prerequisites	`P-UVC` or `P-STILL`.
Procedure	Choose a mode in the GRAY child row. Select Gray/Color to return.
Result	Display/PHOTO use the processing. Whether AUTO/OCR consumes it depends on the active UI/workflow; not every module is guaranteed to use the processed view.
Output/path	PHOTO → `Pictures/UM Viewer`.
Limitations	BIN/ADB can remove detail; CLAHE can amplify noise.
Recovery/troubleshooting	Return to Gray/Color and adjust lighting/ROI. Do not mistake a binary image for RAW.

IMG.EDGE_MODES — EDGE/SHRP/SOBX/SOBY/CANNY

Screen label	EDGE, SHRP, SOBX, SOBY, CANNY.
Purpose	Outline enhancement, sharpening, horizontal/vertical gradients, and Canny edge display.
Prerequisites	P-UVC or P-STILL.
Procedure	Open the EDGE child row and choose an effect. Sobel X emphasizes vertical edges; Sobel Y emphasizes horizontal edges.
Result	Processing appears in ROI/FULL and can be saved with PHOTO.
Output/path	PHOTO → Pictures/UM Viewer.
Limitations	An edge map is a visual/preprocessing aid, not an automatic dimension. Sharpening may create halos; Canny is sensitive to noise/thresholds.
Recovery/troubleshooting	Return to Color/Gray, reduce ROI, denoise, or improve lighting. AUTO results still require Review.

IMG.MAP_MODES — JET/HOT/TURBO

Screen label	MAP, JET, HOT, TURBO.
Purpose	Map brightness differences to false color. HOT is approximately black→red→yellow→white; TURBO provides a smooth high-resolution color scale.
Prerequisites	P-UVC or P-STILL.
Procedure	Open MAP and choose a color map. Select again or return to Color to end.
Result	Display and PHOTO show false color.
Output/path	PHOTO → Pictures/UM Viewer.
Limitations	This is not temperature measurement or thermal data. Colors represent image brightness and have no physical temperature scale.
Recovery/troubleshooting	Return to Color/Gray; inspect RAW alongside any critical interpretation.

IMG.FX_MODES — EMB/INV/GAMMA

Screen label	FX, EMB, INV, Gamma state.
Purpose	Emboss surface direction, invert subtle contrast, or cycle software Gamma.
Prerequisites	P-UVC or P-STILL.
Procedure	Open FX and choose an effect. Repeatedly tap Gamma to cycle available levels/OFF as displayed.
Result	The processed view appears; PHOTO reflects it, RAW does not reflect software FX.
Output/path	PHOTO → Pictures/UM Viewer.
Limitations	IMAGE Gamma is software processing, distinct from hardware Gamma in CAM.IQ.SLIDERS; it is not a fixed calibration basis.
Recovery/troubleshooting	Choose Color or Gamma OFF. If tones clip, compare with RAW.

IMG.ANALYZE.OPEN — ANALYZE

Screen label	`ANALYZE`.
Purpose	Enter Histogram, Color Analysis, Focus Curve, and FIELD tools.
Prerequisites	An image is available.
Procedure	Tap ANALYZE, choose a child tool, and close each analysis when done.
Result	Analysis uses the original centered 1.0× image and locks Digital Zoom/Pan while active. Each tool has an independent movable/resizable ROI.
Output/path	No data file by default; SCREEN saves visible analysis.
Limitations	Values depend on image, lighting, and ROI and are not readings from a calibrated laboratory instrument.
Recovery/troubleshooting	Close all analyses to restore normal interaction. If the view remains locked, long-press IMAGE or use Reset Image.

IMG.ANALYZE.HIST — HIST 200/400/FULL/OFF

Screen label	`HIST`, Histogram ROI/graph.
Purpose	View pixel distribution in a selected area.
Prerequisites	`IMG.ANALYZE.OPEN`; an image is available.
Procedure	Repeatedly tap HIST to cycle 200, 400, Full Area, Off. Drag the ROI when not Full.
Result	A histogram for the current image area appears.
Output/path	No analysis file; SCREEN saves the graph.
Limitations	It is not proof of exposure calibration. Processing, color mode, and source state may affect the display.
Recovery/troubleshooting	Cycle to Off. If abnormal, return to Color and ensure the ROI is within valid image content.

IMG.ANALYZE.COLOR — COLOR inside ANALYZE

Screen label	`COLOR`, sample box, Color Analysis ON/OFF.
Purpose	Inspect a local color sample.
Prerequisites	`IMG.ANALYZE.OPEN`; a color/analyzable image.
Procedure	Tap COLOR, drag the sample box, single-tap to change size, double-tap to reset, and tap again to close.
Result	ROI color-analysis values appear.
Output/path	No data file; SCREEN can save the visible result.
Limitations	Does not replace color calibration/colorimetry. Camera AWB, lighting, and display affect interpretation.
Recovery/troubleshooting	Double-tap to reset the ROI and retest under fixed IQ/lighting. Use an appropriate instrument for traceable data.

IMG.ANALYZE.FOCUS — FOCUS 200/400/FULL/OFF

Screen label	`FOCUS`, Focus Curve/Score.
Purpose	Use the ROI sharpness trend to assist manual focusing or comparison.
Prerequisites	`IMG.ANALYZE.OPEN`; an image is available.
Procedure	Cycle 200, 400, Full Area, Off. Place the ROI on a fixed textured target and observe curve/score.
Result	An image-focus score trend appears; the motor does not move automatically.
Output/path	No data file; SCREEN can save it.
Limitations	Scores are relative to content/ROI and cannot be used as an absolute optical metric across different targets, lighting, or resolutions.
Recovery/troubleshooting	Avoid blank/reflected areas; fix lighting and ROI. Use F-AF for an automatic scan.

IMG.ANALYZE.FIELD — FIELD/LIVE/TEST/GRID/MAP/CURVE

Screen label	`FIELD`, `LIVE`, `TEST`, 7 × 5/13 × 9/27 × 19/55 × 39, `MAP`, `CURVE`, OFF/EXIT as displayed.
Purpose	Analyze full-field brightness uniformity as percentages relative to image center.
Prerequisites	`IMG.ANALYZE.OPEN`; stable lighting and image.
Procedure	Open FIELD, use LIVE to adjust lighting, choose a grid, and tap TEST. The app discards settling frames and averages 30 frames. Switch MAP/CURVE afterward without recapture.
Result	The app discards 5 settling frames and averages the next 30 full-view frames, showing 1/30–30/30. It holds RESULT with grid size, uniformity, corner/center ratio, and maximum deviation. Each cell is a percentage of geometric-center brightness normalized to 100. CURVE shows horizontal column-average and vertical row-average profiles, center-normalized to 100, with min/max and X/Y grid positions.
Output/path	No structured data file is claimed; SCREEN can save the result.
Limitations	High grids and high resolutions are computationally expensive. The center is not an externally calibrated photometric standard. Subject/lighting motion invalidates the result.
Recovery/troubleshooting	Reduce resolution/grid and close other heavy processing. Use RETEST. Changing grid, RETEST, or leaving FIELD replaces/clears the held result.

IMG.HOLD_RESET — HOLD IMAGE

Screen label	Long-press main `IMAGE`.
Purpose	Return to Color and clear every IMAGE overlay layer.
Prerequisites	The IMAGE workspace has temporary processing/overlays.
Procedure	Long-press IMAGE until the hinted action completes.
Result	IMAGE processing and layers return to the public initial state.
Output/path	No file; saved output is not deleted.
Limitations	Not Reset All and does not clear hardware IQ.
Recovery/troubleshooting	Save SCREEN first if the view is needed. Accidentally cleared effects must be configured again.

Chapter 6 AIP: STABILIZE, DENOISE, and HDR

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

AIP.OPEN_BACK_RESET — AIP/← AIP/HOLD AIP

Screen label	`AIP`, `← AIP`, long-press AIP.
Purpose	Enter the three AIP tools, return to the AIP home, or cancel temporary AIP workspace state.
Prerequisites	A Live/Still image; save any result before canceling.
Procedure	Tap AIP and choose a tool; tap ← AIP on a child page; long-press AIP to cancel temporary state.
Result	The AIP workspace switches or resets. Global AF/Z controls normally remain, but automated processing may disable them temporarily.
Output/path	No automatic file.
Limitations	Let AIP finish before switching source, resolution, or workspace. Long-press does not delete saved files.
Recovery/troubleshooting	If processing stalls, use its STOP/LIVE/CLEAR first, then long-press AIP. Use CAM URST for a USB fault.

AIP.STAB.ON_OFF_PRESET — STAB ON/OFF/SOFT/STD/STRONG

Screen label	`STAB ON/OFF`, `SOFT`, `STD`, `STRONG`.
Purpose	Stabilize the Live display with low, balanced, or stronger correction presets.
Prerequisites	`P-UVC`, `P-LIVE`.
Procedure	Tap STAB ON, select SOFT/STD/STRONG for the motion level, and tap OFF when done.
Result	Motion in the Live display is reduced.
Output/path	None; **only the Live display changes. RAW, PHOTO, Capture, and measurement coordinates do not change**.
Limitations	Display crop/latency may occur; stronger is not always better. A stable display does not prove the physical position has not moved.
Recovery/troubleshooting	For drift/edge motion, reduce the preset or use `AIP.STAB.RESET`. Turn OFF when unnecessary.

AIP.STAB.PARAMS — GAIN/RANGE/LIM/RESP/RATE

Screen label	`GAIN`, `RANGE`, `LIM`, `RESP`, `RATE`.
Purpose	Cycle correction strength, maximum search distance, maximum applied displacement, response, and sampling rate.
Prerequisites	STAB page; preferably a stable Live view with STAB ON.
Procedure	Tap one parameter repeatedly to cycle values. Change one item at a time and observe for several seconds.
Result	Stabilization tracking behavior updates.
Output/path	No file; whether workspace/VIX preserves a supported setting must be verified with the actual case.
Limitations	Values are algorithm settings, not motor or camera hardware parameters. Excessive RANGE/GAIN can cause false tracking.
Recovery/troubleshooting	Use STD or RESET for a baseline. Reduce RATE/resolution if CPU load is high.

AIP.STAB.RESET — RESET

Screen label	`RESET` inside STABILIZE.
Purpose	Clear the current stabilization reference image/displacement baseline.
Prerequisites	STAB page.
Procedure	Stabilize the subject, tap RESET, and wait for a new reference.
Result	Displacement estimation restarts from the current image.
Output/path	No file.
Limitations	This is not IMAGE Reset or IQ RESET.
Recovery/troubleshooting	If the new reference remains unstable, improve physical mounting, light, and image texture, or turn STAB off.

AIP.DENOISE.MODE_LEVEL — STILL/LIVE; LOW/MID/HIGH

Screen label	`STILL / LIVE`, `LOW / MID / HIGH`.
Purpose	Choose one-time or continuous denoising and increase temporal averaging through 3/5/8 frames.
Prerequisites	`P-UVC`, `P-IDLE`; stable subject and lighting.
Procedure	Select STILL or LIVE, then LOW(3), MID(5), or HIGH(8).
Result	Sets the frame count used by the next Capture or continuous denoising.
Output/path	Not saved yet; use PHOTO/SCREEN to save the result.
Limitations	More frames increase motion trails and processing time. Bright monitor-style fields are information, not buttons.
Recovery/troubleshooting	For motion artifacts, choose LOW, secure the sample, increase light, or shorten exposure.

AIP.DENOISE.RUN — CAPTURE/START/STOP/LIVE/CLEAR

Screen label	`CAPTURE`, `START / STOP`, `STATUS`, `LIVE / CLEAR`.
Purpose	Capture one STILL denoise stack, start/stop continuous LIVE denoise, or leave a result for normal Live.
Prerequisites	Denoise mode/level selected; `P-UVC`, `P-IDLE`.
Procedure	For STILL, tap CAPTURE and keep still. For LIVE, tap START and later STOP. Wait for `DENOISE READY`; tap LIVE/CLEAR to leave.
Result	A held denoised result or continuous denoised view is produced.
Output/path	No automatic file; PHOTO saves the processed image and SCREEN saves the UI.
Limitations	Do not switch source/resolution while running. A moving subject produces ghosting.
Recovery/troubleshooting	Use STOP or LIVE/CLEAR. If progress stalls, reduce resolution/level, close background apps, and if necessary long-press AIP.

AIP.HDR.MODE_STEP — STILL/LIVE/STEP/LOW·MID·HIGH

Screen label	`STILL / LIVE`, `STEP`, bright `LOW · MID · HIGH` display.
Purpose	Select one-time or continuous HDR, set exposure-bracket spacing, and view the three exposure levels.
Prerequisites	`P-UVC`; camera exposure control cooperates; `P-IDLE`.
Procedure	Select STILL/LIVE, repeatedly tap STEP for bracket spacing, confirm LOW/MID/HIGH, then run.
Result	The three-exposure composition workflow is configured. Bright fields show information only and are not buttons.
Output/path	Not saved yet.
Limitations	If HDR is unavailable at 4K, lower UVC resolution. Moving objects or unstable exposure cause artifacts.
Recovery/troubleshooting	Reduce resolution/STEP, secure the sample/lighting, and check AE/Exposure behavior.

AIP.HDR.RUN — CAPTURE/START/STOP/LIVE/CLEAR

Screen label	`CAPTURE`, `START / STOP`, `STATUS`, `HDR READY`, `LIVE / CLEAR`.
Purpose	Capture/merge one STILL bracket, start/stop continuous HDR, or return to normal Live.
Prerequisites	`AIP.HDR.MODE_STEP` configured; `P-UVC`, `P-IDLE`.
Procedure	Tap CAPTURE for STILL or START for LIVE. Keep the subject still until READY. Use STOP if needed and LIVE/CLEAR to leave.
Result	A composed HDR result or continuous HDR appears.
Output/path	No automatic file; PHOTO saves the processed result, SCREEN saves the UI.
Limitations	Do not switch source/resolution during processing. HDR does not increase true sensor resolution, and dynamic scenes ghost.
Recovery/troubleshooting	Use STOP/LIVE/CLEAR, reduce resolution/STEP, avoid glare/motion, and preserve RAW alongside an important result.

Chapter 7 MULTI: EDF and COMPARE

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

MULTI.OPEN_BACK_RESET — MULTI/← MULTI/HOLD MULTI

Screen label	`MULTI`, `← MULTI`, long-press MULTI.
Purpose	Enter multi-image tools, return to the tool home, or cancel temporary multi-image state.
Prerequisites	An image is available; save any EDF/Reference result before canceling.
Procedure	Tap MULTI and choose EDF/COMPARE; tap ← MULTI on a child page; long-press MULTI to clear temporary state.
Result	The workspace switches or resets. Top-header AF/Z can be used before collection.
Output/path	No automatic file.
Limitations	STOP or finish an active Auto EDF/build/compare analysis before leaving.
Recovery/troubleshooting	Use the tool's STOP/CLEAR/EXIT first, then long-press MULTI.

MULTI.EDF.MODE — MANUAL/AUTO

Screen label	`MANUAL / AUTO`.
Purpose	Choose manual focus-plane collection or motorized scanning.
Prerequisites	Manual requires `P-UVC`; Auto additionally requires `P-CTRL`, valid Focus Position, `P-IDLE`.
Procedure	Choose MANUAL or AUTO on the EDF page.
Result	START/ADD/BUILD or SET A/B/FR/RUN controls appear.
Output/path	No file.
Limitations	Both modes require the sample and microscope to remain motionless through the frame set. F-AF and Auto EDF are mutually exclusive.
Recovery/troubleshooting	Use Manual if CTRL is unavailable. CLEAR the old session before switching modes.

MULTI.EDF.MANUAL — START/ADD/BUILD

Screen label	`START`, `ADD`, `BUILD`.
Purpose	Manually collect focus planes and compose an Extended Depth of Focus image.
Prerequisites	Manual mode, `P-UVC`, `P-IDLE`; at least two different focus planes can be captured.
Procedure	Tap START. Focus the first plane with top-header Z/physical adjustment and tap ADD. Repeat focus + ADD for each plane. Tap BUILD after at least two images.
Result	The chosen planes merge into one extended-depth image.
Output/path	BUILD creates held EDF; `MULTI.EDF.SAVE` writes to `Pictures/UM Viewer`.
Limitations	Scene motion, lighting changes, or missing planes create seams/halos/blur. EDF is a composite, not a new optical capture.
Recovery/troubleshooting	CLEAR and recollect before BUILD. Secure motion/light and add frames covering missing focus layers.

MULTI.EDF.AUTO_ENDPOINTS — SET A/SET B/GO A/GO B

Screen label	`SET A`, `SET B`; when available, `GO A`, `GO B`.
Purpose	Store and verify the two Focus Position endpoints for Auto EDF.
Prerequisites	Auto mode, `P-UVC`, `P-CTRL`, valid Position.
Procedure	Move with Z to one end and SET A; move to the other and SET B. Use GO A/GO B to verify the range and focused planes.
Result	Two distinct valid endpoints are stored for even focus-plane distribution.
Output/path	No file; endpoints belong only to the current EDF session.
Limitations	Equal/invalid A and B cannot start. Re-enter endpoints after a real disconnect. Endpoint order does not imply physical up/down direction.
Recovery/troubleshooting	Wait for CTRL ready, set two distinct positions again, and reduce the range if it exceeds valid travel.

MULTI.EDF.AUTO_RUN — FR−/FR＋/RUN (AUTO)/STOP

Screen label	`FR-`, `FR+`, `RUN` or `AUTO`, `STOP`.
Purpose	Select equally spaced focus-plane count between A/B, start, or stop Auto EDF.
Prerequisites	Valid `MULTI.EDF.AUTO_ENDPOINTS`; `P-UVC`, `P-CTRL`, `P-IDLE`.
Procedure	Choose frame count with FR−/FR＋, secure the sample, and tap RUN/AUTO. The app moves, settles, captures, and builds at each point. Use STOP if necessary.
Result	A held EDF result appears. Motor and camera sampling are reserved during the operation.
Output/path	Nothing is written until `MULTI.EDF.SAVE`.
Limitations	Do not operate Z/F-AF, switch modes, unplug USB, or move the sample while running. More frames take longer.
Recovery/troubleshooting	STOP safely, wait for CTRL/UVC recovery, reset endpoints, and rerun. Reduce resolution or frame count on a slow device.

MULTI.EDF.SAVE_CLEAR_EXIT — SAVE/CLEAR/EXIT

Screen label	`SAVE`, `CLEAR`, `EXIT`.
Purpose	Save EDF, clear its session/result, or leave EDF.
Prerequisites	SAVE requires a completed build and `P-STORAGE`; decide whether to retain the result before CLEAR/EXIT.
Procedure	Inspect for artifacts and tap SAVE. Use CLEAR to redo and EXIT when finished.
Result	SAVE writes the fused image; CLEAR removes current frames/result; EXIT returns to MULTI.
Output/path	`ViTiny_EDF_WIDTHxHEIGHT_yyyyMMdd_HHmmss.png` → `Pictures/UM Viewer`.
Limitations	The saved composite is not guaranteed to contain a recoverable stack of every focus plane. Preserve sources for important evidence.
Recovery/troubleshooting	Open the saved image in a file manager. If CLEAR/EXIT was used before save, the set must be captured again.

MULTI.CMP.LOAD_REF — LOAD REF

Screen label	`LOAD REF`.
Purpose	Load a JPEG Reference for comparison with Live without replacing Live or RAW.
Prerequisites	A readable JPEG and file picker; Compare workspace.
Procedure	Tap LOAD REF and select a JPEG.
Result	The Reference enters Compare; Live and RAW remain unchanged.
Output/path	No new file; reads the selected Reference.
Limitations	Public guidance explicitly identifies JPEG. Do not claim all image formats work as Reference.
Recovery/troubleshooting	If loading fails, confirm the JPEG opens, permission, and space. Re-save as a standard JPEG if needed.

MULTI.CMP.MATCH_POS — MATCH REF/CONFIRM POS

Screen label	`MATCH REF`, `CONFIRM POS`.
Purpose	Begin matching the Reference position/lighting and confirm the prepared reference position.
Prerequisites	`P-REF`; compatible controller state if hardware positioning is involved.
Procedure	Tap MATCH REF and adjust as indicated. After matching position/light, tap CONFIRM POS.
Result	A position baseline is established for split/overlay/compare.
Output/path	No file; Compare session only.
Limitations	Mechanical, optical, and lighting reproduction is not guaranteed. Do not apply hardware state when saved/current models differ.
Recovery/troubleshooting	If matching fails, nudge manually, recapture the Reference, or secure the sample again.

MULTI.CMP.VIEW_MODES — LIVE L/R/OVERLAY/BLINK

Screen label	`LIVE L / R`, `OVERLAY`, `BLINK`.
Purpose	Place Live on the split left/right, overlay a full-size Reference at 50% opacity, or alternate full-screen Live/Reference every 0.5 second.
Prerequisites	`P-REF`; usually `P-LIVE`.
Procedure	Choose split direction, OVERLAY, or BLINK.
Result	Differences appear in the selected viewing mode.
Output/path	No comparison data file; SCREEN saves an instant, but BLINK captures only one phase.
Limitations	50% and 0.5 second describe current public behavior, not freely entered opacity/frequency.
Recovery/troubleshooting	Return to split if unclear, correct Reference zoom/alignment, and turn BLINK off to avoid visual fatigue.

MULTI.CMP.REF_NAV — REF x.xX/STEP/← ↑ ↓ →/DRAG/PINCH

Screen label	`REF x.xX`, `STEP`, four arrows, Reference pane.
Purpose	Reset Reference zoom/pan to 1.0X, set pixel nudge step, nudge with arrows, or drag/pinch directly.
Prerequisites	`P-REF`.
Procedure	Tap REF x.xX to reset; cycle nudge pixels with STEP; use arrows; drag or pinch on the Reference pane/overlay.
Result	Reference display position/scale changes; Live does not move.
Output/path	No file; Compare-session state.
Limitations	2D display alignment cannot correct perspective, rotation, scale difference, or deformation. Automatic ALIGN requires matching VIEW zoom.
Recovery/troubleshooting	If alignment worsens, reset REF to 1.0X, match scale first, then use small nudges.

MULTI.CMP.ROI_ALIGN — ROI VIS/CTR/ALIGN

Screen label	`ROI VIS / CTR`, `ALIGN`.
Purpose	Analyze the visible view or center 60%, then apply automatic X/Y translation when VIEW zoom matches.
Prerequisites	`P-REF`; shared detail in Live/Reference; matching zoom.
Procedure	Choose VIS or CTR, align roughly, and tap ALIGN.
Result	The algorithm estimates and applies translation without changing source files.
Output/path	No file.
Limitations	Only X/Y translation is claimed; it does not automatically correct rotation, perspective, scale, or non-rigid deformation.
Recovery/troubleshooting	Manually match zoom/pan, change ROI, or choose textured detail, then refine with nudge.

MULTI.CMP.ANALYZE — COMPARE/SIM/STR/LUM/HEAT ON/OFF

Screen label	`COMPARE`, results `SIM`, `STR`, `LUM`, `HEAT ON/OFF`.
Purpose	Calculate similarity/structure/luminance indicators at the current position and show/hide a difference heat map.
Prerequisites	`P-REF`; reasonable alignment and ROI selection.
Procedure	Tap COMPARE, read SIM/STR/LUM, and tap HEAT ON/OFF.
Result	Current indicators and optional heat map appear.
Output/path	No structured report file is claimed; SCREEN can save visible results.
Limitations	Indicators are relative image comparisons, not a product acceptance rule or statistical guarantee. Lighting, focus, scaling, and compression affect them.
Recovery/troubleshooting	Realign, fix light/focus, and use the same ROI; verify with visual inspection and external specifications.

MULTI.CMP.CLEAR — CLEAR

Screen label	`CLEAR` inside Compare.
Purpose	Remove the loaded Reference and end its comparison state.
Prerequisites	`P-REF`.
Procedure	Tap CLEAR. Clear/close Compare before returning to ordinary Live.
Result	Reference and current comparison results are removed; Live remains.
Output/path	The source JPEG is not deleted.
Limitations	Unsaved SCREEN/numeric displays cannot be recovered.
Recovery/troubleshooting	LOAD REF again after accidental clearing.

Chapter 8 AUTO: automatic detection and result review

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

AUTO.SEARCH_ROI — ROI 120/180/240/300

Screen label	`ROI 120` (then 180/240/300 on repeated taps).
Purpose	Set the circular click-search diameter for AUTO tools; the guide ring matches the actual search area.
Prerequisites	AUTO workspace and an image.
Procedure	Repeatedly tap ROI to cycle 120 → 180 → 240 → 300 pixels. Choose a size covering the target edge without excessive clutter.
Result	The guide ring and next detection area update together.
Output/path	No file.
Limitations	Pixel diameter is a search area, not physical size or the result ROI. The same pixel circle covers a different physical field at another resolution.
Recovery/troubleshooting	Increase size if nothing is found; reduce it if the wrong object is captured. Ensure the target edge lies inside the ring.

AUTO.RECT — RECT

Screen label	`RECT`, `AUTO RECTANGLE`.
Purpose	Detect an object's bounding rectangle/external extent.
Prerequisites	Clear image and sufficient target/background separation; physical units require `P-CAL`.
Procedure	Tap RECT, place the crosshair inside the physical target, tap the image, wait for processing, and Review contour/dimensions.
Result	A candidate rectangle appears. It enters measurement history only after ACCEPT in `AUTO.REVIEW_ACCEPT_CANCEL`.
Output/path	After ACCEPT, MEAS SAVE exports CSV/DXF; nothing is written before ACCEPT.
Limitations	Glare, shadow, touching boundaries, nonrectangular targets, and low contrast can misdetect. A bounding rectangle is not geometric-tolerance inspection.
Recovery/troubleshooting	CANCEL, improve lighting/background or ROI, and retry. Use manual RECT when unreliable.

AUTO.CIRCLE — CIRCLE

Screen label	`CIRCLE`, `AUTO CIRCLE`.
Purpose	Detect one circle and create a circular measurement candidate.
Prerequisites	Most of the complete circumference lies within the search ring with clear contrast; physical units require `P-CAL`.
Procedure	Tap CIRCLE, place the first circumference edge inside the ring and tap, then Review center/circumference/dimensions.
Result	A successful candidate awaits ACCEPT; ACCEPT adds a circle measurement.
Output/path	MEAS SAVE → CSV/DXF.
Limitations	Ellipse, perspective, gaps, burrs, and glare affect fit. Verify manually.
Recovery/troubleshooting	CANCEL and adjust focus/light/ROI. Use manual CIRC or 3P CIRC if needed.

AUTO.TWO_CIRCLE — 2 CIRCLE

Screen label	`2 CIRCLE` (guidance may abbreviate `2-CIRC`), `2-CIRCLE`.
Purpose	Detect two circles and their center distance.
Prerequisites	Both circles are distinguishable; image and calibration conditions are stable.
Procedure	Tap 2 CIRCLE, follow prompts to place each circumference within the ring and tap, then Review both circles and center distance.
Result	A successful candidate awaits ACCEPT; ACCEPT adds editable measurements.
Output/path	MEAS SAVE → CSV/DXF.
Limitations	The two clicks must correspond to the correct circles. Overlap, extreme size difference, or perspective reduces stability.
Recovery/troubleshooting	CANCEL and retry with smaller ROI, or verify using two manual CIRC/3P CIRC objects plus DIST.

AUTO.SHAPE — SHAPE

Screen label	`SHAPE`, `AUTO SHAPE`.
Purpose	Find and Review an object's outer contour.
Prerequisites	Sufficient outer-edge/background contrast; target edge lies inside the ring.
Procedure	Tap SHAPE, place the expected edge within the ring, tap the image, wait, and inspect the contour.
Result	A successful candidate becomes a Polygon measurement after ACCEPT.
Output/path	MEAS SAVE → CSV/DXF.
Limitations	Texture, holes, shadows, and joined objects alter contours. The automatic contour is not CAD truth.
Recovery/troubleshooting	CANCEL, improve background/light or ROI, and verify with manual POLY.

AUTO.NUT — NUT

Screen label	`NUT`, `AUTO NUT`.
Purpose	Find a nut-like outer contour and center-hole candidate.
Prerequisites	Clear hexagonal edge/center hole with outer edge in the ring; physical dimensions require `P-CAL`.
Procedure	Tap NUT, place the hexagonal edge within the ring, tap, wait for outer-contour/hole analysis, and Review.
Result	ACCEPT adds Polygon + Circle. Messages such as `LIKELY` identify a candidate only.
Output/path	MEAS SAVE → CSV/DXF.
Limitations	Does not identify thread specification, material, or conformance. Dirt, washers, perspective, chamfers, and occlusion affect results.
Recovery/troubleshooting	CANCEL, place the part flat/front-facing, improve edge contrast, and verify by manual measurement or an external gauge.

AUTO.TOOTH — TOOTHS

Screen label	Actual toolbar `TOOTHS`; guidance/status may show `TOOTH`, `AUTO TOOTH`.
Purpose	Analyze an external spur gear's outer contour, shaft bore, and candidate tooth count.
Prerequisites	Complete visible outer teeth and bore, approximately front-facing, with a tooth edge in the ring; physical dimensions require `P-CAL`.
Procedure	Tap TOOTHS, place one outer-tooth edge in the ring, tap, wait for teeth + bore analysis, and Review tooth count/dimensions.
Result	ACCEPT adds outline + bore measurements and displays candidate tooth count `Z`.
Output/path	MEAS SAVE → CSV/DXF.
Limitations	Only a candidate for visibly distinguishable external gears. It does not guarantee module, pressure angle, profile tolerance, or gear conformance.
Recovery/troubleshooting	CANCEL, correct the front view, improve silhouette contrast, and include the full tooth ring. Verify tooth count/dimensions manually or with gauges.

AUTO.TWO_EDGE — 2-EDGE

Screen label	`2-EDGE`, `2-EDGE DIST`.
Purpose	Detect two black/white boundaries and measure their separation.
Prerequisites	Two distinguishable, approximately defined boundaries with clear contrast; physical units require `P-CAL`.
Procedure	Tap 2-EDGE and follow prompts to tap the first black/white boundary/search position; Review both edges and DIST.
Result	ACCEPT adds a Distance measurement.
Output/path	MEAS SAVE → CSV/DXF.
Limitations	Gradients, burrs, oblique edges, glare, and texture can create multiple boundaries. Distance is an image-plane projection.
Recovery/troubleshooting	CANCEL, reduce ROI/improve light, and verify with manual DIST across the same points.

AUTO.P_LINE — P-LINE

Screen label	Toolbar `P-LINE`; prompts/results may show `AUTO LINE`, `WIDTH`.
Purpose	Find a boundary pair within a line/gap and obtain width.
Prerequisites	The line/gap and clear boundaries lie inside the search circle; physical units require `P-CAL`.
Procedure	Tap P-LINE, tap inside the line/gap, and Review the detected line pair and width.
Result	ACCEPT adds it to measurement history as a DIST type.
Output/path	MEAS SAVE → CSV/DXF.
Limitations	Public HELP “Line” and toolbar `P-LINE` are the same user tool; do not invent a second LINE button. Detected width is not process-conformance judgment.
Recovery/troubleshooting	CANCEL, tap the stable gap center, adjust ROI/contrast, and verify with manual DIST.

AUTO.REVIEW_ACCEPT_CANCEL — ACCEPT/CANCEL

Screen label	`ACCEPT`, `CANCEL` during Review.
Purpose	Convert an inspected AUTO candidate into a MEAS record or discard only that candidate.
Prerequisites	Detection has completed; ACCEPT is available only for a successful candidate.
Procedure	Check overlay, control points, values, and target one by one. ACCEPT only when correct; otherwise CANCEL.
Result	ACCEPT adds the corresponding measurement; CANCEL clears this Review without deleting existing measurements.
Output/path	Nothing is written immediately; later use MEAS SAVE for CSV/DXF.
Limitations	ACCEPT is not a specification pass or accuracy guarantee. Without calibration, units remain px/px².
Recovery/troubleshooting	After mistaken ACCEPT, use MEAS SEL + DEL or UNDO. After mistaken CANCEL, run detection again.

AUTO.HOLD_RESET — HOLD AUTO

Screen label	Long-press main `AUTO`.
Purpose	Clear the current un-ACCEPTed Auto result and return to ready.
Prerequisites	AUTO has a temporary candidate/Review.
Procedure	Long-press AUTO.
Result	Only the unaccepted result is cleared; accepted measurements should remain.
Output/path	No file.
Limitations	Not CLEAR ALL or Reset All.
Recovery/troubleshooting	Run detection again after accidental clear; save SCREEN first if visual evidence is needed.

Chapter 9 MEAS: measurement, annotation, editing, and export

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

9.1 Coordinates and units (shared by all MEAS commands)

- The complete source-image center is `(0,0)`: X is negative left/positive right; Y is positive up/negative down.
- Without an ACCEPTed calibration, coordinates/length use `px` and area uses `px²`.
- With an ACCEPTed, still-valid calibration, the UI shows physical units (guidance specifies mm), and CSV/DXF contains corresponding calibration information.
- Microscope model, lens name, Focus Position, or UVC mode **never estimates scale automatically**.
- Digital Zoom correctly maps image coordinates and does not change calibrated source Pixel Size. Recalibrate after changing source, lens, focus, working distance, or any optical/mechanical condition that changes scale.
- All results are reference values. Independently verify important measurements with an appropriate traceable standard, instrument, and procedure.

MEAS.POINT — POINT

Screen label	`POINT`.
Purpose	Mark one center coordinate in the image.
Prerequisites	An image; physical units require `P-CAL`.
Procedure	Tap POINT, then tap the image. Repeat for more points.
Result	Each tap creates a Point measurement showing X/Y.
Output/path	MEAS SAVE → CSV/DXF (`Download/UM Viewer`).
Limitations	Touch precision, Digital Zoom, edge interpretation, and calibration affect results.
Recovery/troubleshooting	Select with SEL and drag/DEL, or UNDO the last step. Zoom before placement for precision.

MEAS.DIST — DIST

Screen label	`DIST`, A/B.
Purpose	Measure straight-line distance between two points.
Prerequisites	An image; physical length requires `P-CAL`.
Procedure	Tap DIST and place A. To Zoom/Pan, tap DIST again to close it, adjust view, then tap DIST and continue with B. The second point completes the distance.
Result	A Distance measurement with A/B and length is created.
Output/path	MEAS SAVE → CSV/DXF.
Limitations	It is projected image-plane distance without height/perspective correction.
Recovery/troubleshooting	Select and drag A/B, UNDO/DEL, and recalibrate after focal-plane or working-distance change.

MEAS.ANG — ANG

Screen label	ANG, three control points.
Purpose	Measure an angle from three points.
Prerequisites	An image.
Procedure	Tap ANG and place three points in order. Close ANG before Zoom/Pan, then reopen to continue.
Result	The third point creates an Angle measurement in degrees.
Output/path	MEAS SAVE → CSV/DXF.
Limitations	Point order determines vertex/direction. Perspective projection affects geometric angle.
Recovery/troubleshooting	If unexpected, select and drag A/B/C or redo. Keep the measured plane approximately perpendicular to the optical axis.

MEAS.ARC — ARC

Screen label	ARC, three control points.
Purpose	Create a circular arc from three points and measure arc length/angle.
Prerequisites	An image; physical arc length requires P-CAL.
Procedure	Tap ARC and place three points defining the arc. Pause the tool for Zoom/Pan if needed, then continue.
Result	An Arc measurement appears with available arc length/angle values.
Output/path	MEAS SAVE → CSV/DXF.
Limitations	Nearly collinear points are unstable; fitting a noncircular curve does not represent its true path.
Recovery/troubleshooting	Spread the three points, select/drag them, or use CURV for a noncircular path.

MEAS.CURV — CURV

Screen label	CURV, multiple control points.
Purpose	Measure a multipoint curve length.
Prerequisites	An image; physical length requires P-CAL.
Procedure	Tap CURV and place points along the curve. After at least two points, tap CURV again to close and save the complete item. When closed, Zoom/Pan and then begin/continue the public flow as appropriate.
Result	A multipoint Curve measurement computes length from its controls.
Output/path	MEAS SAVE → CSV/DXF.
Limitations	Sampling density affects approximation: too few points underestimate; excessive jitter can overestimate.
Recovery/troubleshooting	UNDO the last point/object, select and drag a control point, or redraw with consistent spacing.

MEAS.POLY — POLY

Screen label	`POLY`, multiple vertices.
Purpose	Measure closed-polygon area and perimeter.
Prerequisites	An image; physical length/area requires `P-CAL`.
Procedure	Tap POLY, place at least three points in boundary order, then tap POLY again to close/save the complete item.
Result	A closed Polygon measurement shows area/perimeter.
Output/path	MEAS SAVE → CSV/DXF.
Limitations	Self-intersection, incorrect order, and perspective produce incorrect area; only the projection is measured.
Recovery/troubleshooting	Select and drag vertices. For self-intersection, DEL/redraw in one consistent direction.

MEAS.CIRC — CIRC

Screen label	`CIRC`, center/circumference controls.
Purpose	Create a circle from center + edge and measure diameter/area.
Prerequisites	An image; physical size requires `P-CAL`.
Procedure	Tap CIRC, place the center, then the circumference. Pause for Zoom/Pan if needed.
Result	A Circle measurement is created.
Output/path	MEAS SAVE → CSV/DXF.
Limitations	The user must judge the center. A perspective circle appears elliptical, so the result is not true diameter.
Recovery/troubleshooting	Select/drag center or edge. Use 3P CIRC or AUTO CIRCLE to cross-check when center is difficult.

MEAS.CIRC3 — 3P CIRC

Screen label	`3P CIRC`, three circumference points.
Purpose	Create a circle from three circumference points.
Prerequisites	A full/partial arc is visible; physical size requires `P-CAL`.
Procedure	Tap 3P CIRC and place three points on the circumference; the third completes it.
Result	A three-point Circle measurement is created.
Output/path	MEAS SAVE → CSV/DXF.
Limitations	Closely spaced or nearly collinear points are extremely unstable; burrs/perspective affect fit.
Recovery/troubleshooting	Spread points evenly over the visible circumference, then select/drag or redraw.

MEAS.RECT — RECT

Screen label	MEAS `RECT`, two corner points.
Purpose	Measure rectangle width, height, and area from diagonal corners.
Prerequisites	An image; physical size requires `P-CAL`.
Procedure	Tap RECT and place two diagonal corners. Pause for Zoom/Pan if needed.
Result	A Rectangle measurement is created.
Output/path	MEAS SAVE → CSV/DXF.
Limitations	This is an image-axis-aligned projected rectangle. A rotated object's bounding box is not its edge length.
Recovery/troubleshooting	Select/drag corners. For a rotated rectangle, measure edges separately with DIST or another suitable method.

MEAS.DRAW — DRAW

Screen label	`DRAW`.
Purpose	Draw freehand annotations directly in image coordinates.
Prerequisites	An image; not in a SEL edit session.
Procedure	Tap DRAW and drag with finger/stylus; tap again to close.
Result	A freehand Draw path follows Pan and scales with Digital Zoom.
Output/path	MEAS SAVE writes CSV/DXF; LOAD CSV restores it; SCREEN flattens its appearance.
Limitations	There is **no Free/Line/Arrow child menu**. Draw has **no restorable object history in VIX**, although a flattened preview may visibly contain it. It is not a measurement value.
Recovery/troubleshooting	Select and DEL or UNDO. Use DIST for straight dimensions; do not treat freehand as a dimension line.

MEAS.TEXT — TEXT/ACCEPT/CANCEL

Screen label	MEAS `TEXT`, positioning crosshair, first-stage `ACCEPT/CANCEL`, text-dialog second-stage `ACCEPT/CANCEL`.
Purpose	Place a text annotation of up to 200 characters at size 12–96 in image coordinates, or modify selected Text.
Prerequisites	An image; no other SEL when adding, or select Text first when editing.
Procedure	Tap TEXT, tap/drag the center crosshair to the anchor, first ACCEPT the position, enter text/size, and second ACCEPT to place. CANCEL at either stage adds nothing. To edit: SEL existing Text → TEXT → edit → ACCEPT.
Result	Text is anchored in image coordinates, follows Pan, and scales with Zoom.
Output/path	MEAS SAVE → CSV/DXF; LOAD CSV restores it; SCREEN flattens it.
Limitations	Text has **no restorable object history in VIX**, although a flattened preview may visibly contain it. It differs from IMAGE OCR TEXT. Limits are 200 characters and size 12–96.
Recovery/troubleshooting	Use SEL + TEXT to modify, or DEL/UNDO. CANCEL at the first stage to replace a mistaken anchor.

MEAS.SEL_QUICK_SELECT — SEL/long-press about 2 seconds

Screen label	SEL; controls/line of the selected object.
Purpose	Cycle saved Measurements, Draw, and Text, or long-press an object for precise edit.
Prerequisites	MEAS is open with at least one object.
Procedure	Tap SEL to cycle objects; or long-press about 2 seconds on a completed measurement control/visible line, curve, arc, circle, rectangle, or polygon boundary, release, then drag a handle. Text/Draw share the same object order.
Result	Drawing tools are disabled and the object enters an edit session.
Output/path	Changes remain in memory until SAVE CSV/DXF.
Limitations	A short tap places points only while a drawing tool is active. Moving noticeably before the long-press completes cancels quick select. Empty-space taps in MEAS idle select/place nothing.
Recovery/troubleshooting	Tap SEL again or EXIT if the wrong item is selected. Zoom and long-press a line/control if difficult to hit.

MEAS.UNDO — UNDO

Screen label	UNDO.
Purpose	Undo the latest point addition, creation, edit, or deletion as applicable.
Prerequisites	Undo history exists.
Procedure	Tap once and inspect; repeat step by step if needed.
Result	The latest step is restored according to the edit/selection undo stack.
Output/path	No file; overwritten external files are not restored.
Limitations	Undo may not survive Reset All, CLEAR ALL, or app exit.
Recovery/troubleshooting	No action means no available undo. Save before important edits; note that Draw/Text object history is not restored by VIX.

MEAS.DEL — DEL

Screen label	DEL.
Purpose	Delete the currently selected Measurement/Draw/Text.
Prerequisites	An object is selected.
Procedure	Confirm the highlight/controls belong to the intended object, then tap DEL.
Result	The object is removed from current history.
Output/path	No file; old CSV/DXF remains.
Limitations	Do not assume a deletion target if nothing is selected.
Recovery/troubleshooting	Immediately UNDO. If undo is gone, LOAD CSV or recreate it.

MEAS.SAVE — SAVE

Screen label	MEAS `SAVE`.
Purpose	Export Measurements + Draw + Text together as CSV and DXF.
Prerequisites	At least one savable object and `P-STORAGE`; close incomplete point sets so they become complete objects.
Procedure	Tap SAVE, wait for success, and open both files in a file manager.
Result	Matching CSV and DXF use the same center-origin coordinate system and include physical units when calibration is valid.
Output/path	`MeasureReport_yyyyMMdd_HHmmss.csv` + same-timestamp `MeasureReport_yyyyMMdd_HHmmss.dxf` → `Download/UM Viewer`.
Limitations	No raster screenshot is created. Use FILE SCREEN/SAVE ALL to preserve the exact visible appearance.
Recovery/troubleshooting	Check space/document access, retry, and confirm nonzero files that can be reloaded with LOAD CSV.

MEAS.LOAD_CSV — LOAD CSV

Screen label	`LOAD CSV`.
Purpose	Load app-saved Measurements, Draw, Text, and available calibration information.
Prerequisites	A compatible readable CSV; save current work first.
Procedure	Tap LOAD CSV, select a file, and read the success/error message.
Result	File objects replace current measurement history; Draw paths, Text content/anchor/size, and valid Pixel Size in the file are restored.
Output/path	Reads the selected CSV; does not necessarily create a file.
Limitations	Arbitrary third-party CSV is not guaranteed compatible. A loaded calibration is trustworthy only when it matches current image/optics.
Recovery/troubleshooting	Back up current work first. Do not modify the source CSV after failure; use the original app export. Recalibrate immediately if conditions differ.

MEAS.CLEAR_ALL — CLEAR ALL (double confirmation)

Screen label	`CLEAR ALL`; prompt `Press again within 3.5 seconds`.
Purpose	Clear every measurement/annotation.
Prerequisites	SAVE important objects first.
Procedure	After the first tap, tap again within 3.5 seconds.
Result	A completion message reports all measurements cleared.
Output/path	Saved CSV/DXF/images are not deleted.
Limitations	Bulk-deletes the current workspace. After 3.5 seconds the confirmation must restart.
Recovery/troubleshooting	Immediately UNDO if available; otherwise LOAD CSV. Do not describe CLEAR ALL as Reset All.

MEAS.EXIT_EDIT — EXIT

Screen label	`EXIT` in the MEAS row.
Purpose	Leave the selected-measurement edit session while retaining confirmed edits.
Prerequisites	Active SEL/edit session.
Procedure	After dragging, tap EXIT.
Result	Editing ends, drawing tools return, and edit-saved/exited status appears.
Output/path	No external file yet; use SAVE.
Limitations	This is not main App EXIT and does not clear measurements.
Recovery/troubleshooting	UNDO the last edit if needed. Use `APP.EXIT` to close the app.

Chapter 10 Calibration, FOV, and two calibration patterns

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

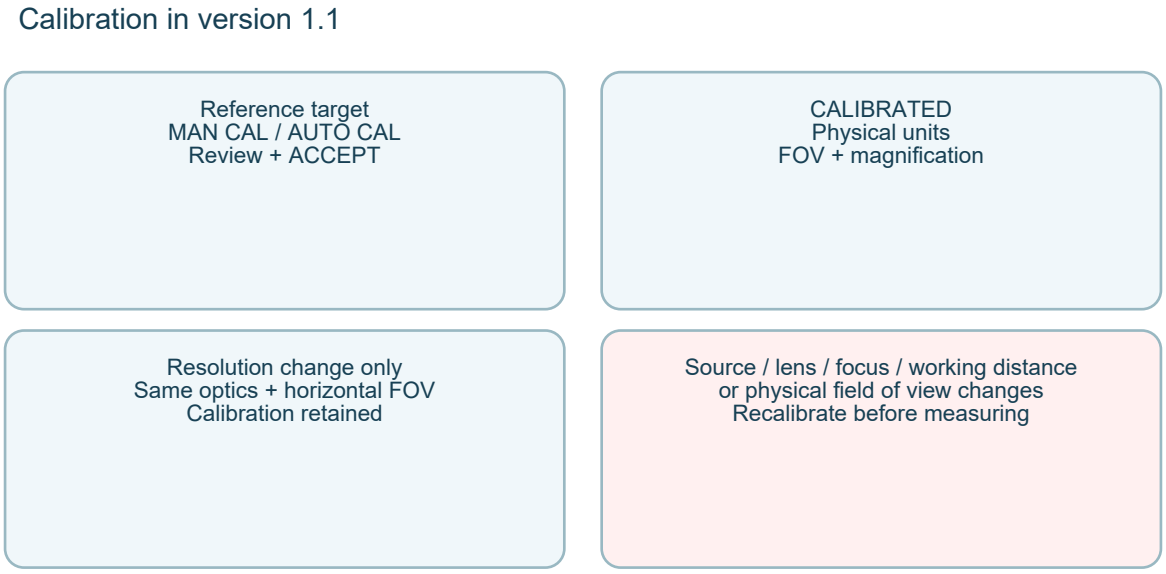


Figure 6 Calibration validity decision. Recalibrate after any optical or geometric configuration change.

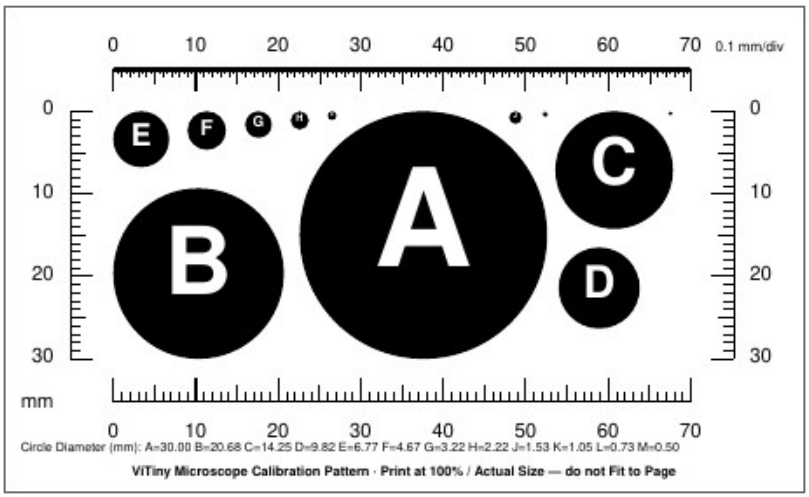


Figure 7 Preview of the MEAS A4 12-marker calibration pattern. Open the PDF exported by the App, print at 100% original size, and verify the edge ruler.

MEAS.CAL.MANUAL — MAN CAL/CANCEL

Screen label	`MAN CAL`; at draft stage the same position becomes `CANCEL`, with A/B.
Purpose	Create Pixel Size from a known traceable length.
Prerequisites	A clear, stable, minimally processed image; standard and sample share the same focal plane, lens, working distance, and resolution.
Procedure	Tap MAN CAL, place A/B at the known-length endpoints, use P controls to refine pixel length, enter/confirm the physical value, and ACCEPT. Tap CANCEL to abandon.
Result	ACCEPT creates valid calibration and enables physical units/FOV/scale. CANCEL restores the previous valid calibration.
Output/path	Calibration remains in workspace state and can enter CSV/VIX; no calibration certificate is generated.
Limitations	Do not claim accuracy without a traceable standard, shared focal plane, and identical optical conditions.
Recovery/troubleshooting	ACCEPT is unavailable before A/B completion. CANCEL restores prior state. Recalibrate after focus/source or physical FOV changes.

MEAS.CAL.P_ADJUST — P--/P-/P+/P++

Screen label	`P--`, `P-`, `P+`, `P++`.
Purpose	Coarsely/fine-adjust manual-calibration pixel length/endpoint distance.
Prerequisites	MAN CAL draft contains A/B and ACCEPT is enabled.
Procedure	Tap or hold the corresponding negative/positive key while watching the value and staying within a reasonable range.
Result	Draft pixel length updates but is not yet applied.
Output/path	No file.
Limitations	Symbols adjust a number, not the Z motor or physical direction. P--/P++ are larger steps and P-/P+ smaller; use actual UI behavior rather than inventing unpublished step sizes.
Recovery/troubleshooting	Use the opposite direction or CANCEL and replace A/B.

MEAS.CAL.ACCEPT — ACCEPT

Screen label	Calibration-row `ACCEPT`.
Purpose	Apply a prepared manual or automatic calibration Review.
Prerequisites	Valid A/B + known length, or a valid AUTO CAL marker result.
Procedure	Check unit, standard length/letter, marker size, confidence, and result, then tap ACCEPT.
Result	The new calibration becomes the active workspace Pixel Size and replaces the old value.
Output/path	Workspace state; may be saved with CSV/VIX.
Limitations	ACCEPT is not an accuracy guarantee; the operator must validate the standard/environment.
Recovery/troubleshooting	Recalibrate immediately if unreasonable. Use CANCEL during Review rather than accepting doubt.

MEAS.CAL.AUTO — AUTO CAL/ACCEPT/CANCEL

Screen label	`AUTO CAL`, orange guide, scan/Review, `ACCEPT`, `CANCEL`.
Purpose	Recognize the app's valid calibration marker and center letter and calculate Pixel Size.
Prerequisites	`P-UVC` or a suitable clear image, `P-IDLE`; correctly printed 100%, undamaged marker; even illumination.
Procedure	Tap AUTO CAL and scan a clear, complete circle at centered 1.0x. If OCR cannot read the center letter, tap A-Z and choose the letter on the 20-circle pattern. Verify circle, letter and size, then ACCEPT. CANCEL keeps prior calibration. See Appendix 1.1.
Result	ACCEPT creates calibration; CANCEL does not apply it. Detection may use the local area or full image when necessary, and does not guess ambiguous letters.
Output/path	Workspace calibration; no automatic PDF/SVG/GBR.
Limitations	Scaling, Fit to Page, curl, perspective, damage, glare, blur, or unsupported letters cause failure. Manually verify OCR result.
Recovery/troubleshooting	Use clean Color/Gray, centered 1.0×, better focus/light, and upright paper. Reprint at Actual Size. CANCEL or use MAN CAL when uncertain.

MEAS.CAL.PATTERN_PDF — PATTERN PDF (A4, 12 markers)

Screen label	MEAS `PATTERN PDF`.
Purpose	Save the built-in A4 **12-marker** calibration sheet for AUTO CAL/verification after printing.
Prerequisites	`P-STORAGE`; no camera/UVC connection required.
Procedure	Tap PATTERN PDF. Print from a PDF app that preserves dimensions at `100%/Actual Size`; **do not use Fit to Page**. Check the paper edge ruler with a physical ruler.
Result	One A4 12-marker PDF is created.
Output/path	`ViTiny_Calibration_Pattern_A4_12_Markers.pdf` → `Download/UM Viewer/Calibration Pattern`.
Limitations	Printer scaling, paper deformation/curl, perspective, or damage invalidates calibration.
Recovery/troubleshooting	If the edge ruler is wrong, correct print scaling/paper and reprint. A screen display cannot replace a physical dimensional standard.

FILE.CAL_PATTERN — CAL PATTERN (A4 single-up SVG + GBR)

Screen label	FILE `CAL PATTERN`.
Purpose	Generate an A4 **single-up vector master** as matching SVG and GBR.
Prerequisites	`P-STORAGE`; **no camera connection required**.
Procedure	Open FILE, tap CAL PATTERN, wait for `Generating A4 CAL PATTERN...` and success, and record both actual filenames.
Result	A matched vector SVG/Gerber GBR master pair is created.
Output/path	`UMViewer_Calibration_Pattern_A4_1up_20level_30mm_to_0p05mm_yyyyMMdd_HHmmss_SSS.svg` plus the same-stem `.gbr` → `Download/UM Viewer/Calibration Pattern`.
Limitations	This is not the MEAS 12-marker PDF or an ordinary screenshot. Verify physical size and downstream production/printing compatibility.
Recovery/troubleshooting	Check space/document path after failure. Regenerate and confirm that both files exist. Distinguish this command from `MEAS.CAL.PATTERN_PDF` by its FILE entry, single-up purpose, and SVG + GBR formats.

CAL.FOV_RECAL — FOV/display magnification/recalibration rules

Screen label	Inspection horizontal FOV, approximate display magnification, Pixel Size/Need Calibration.
Purpose	Understand calibration-derived values and invalidation.
Prerequisites	FOV/display magnification require `P-CAL`.
Procedure	Inspect these fields after ACCEPT. Recalibrate after changing source, lens, Focus Position, working distance, or any optical/mechanical scale condition.
Result	Valid state shows derived FOV/approximate display magnification; invalid state shows px or Need Calibration.
Output/path	No separate file; CSV/VIX or SCREEN may preserve it.
Limitations	Display magnification is an estimate from calibration/display, not an optical-magnification certificate. Digital Zoom only changes visible FOV/mapping.
Recovery/troubleshooting	On any scale concern, recalibrate with a standard and check a known dimension.

Chapter 11 FILE: images, recording, loading, and media state

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

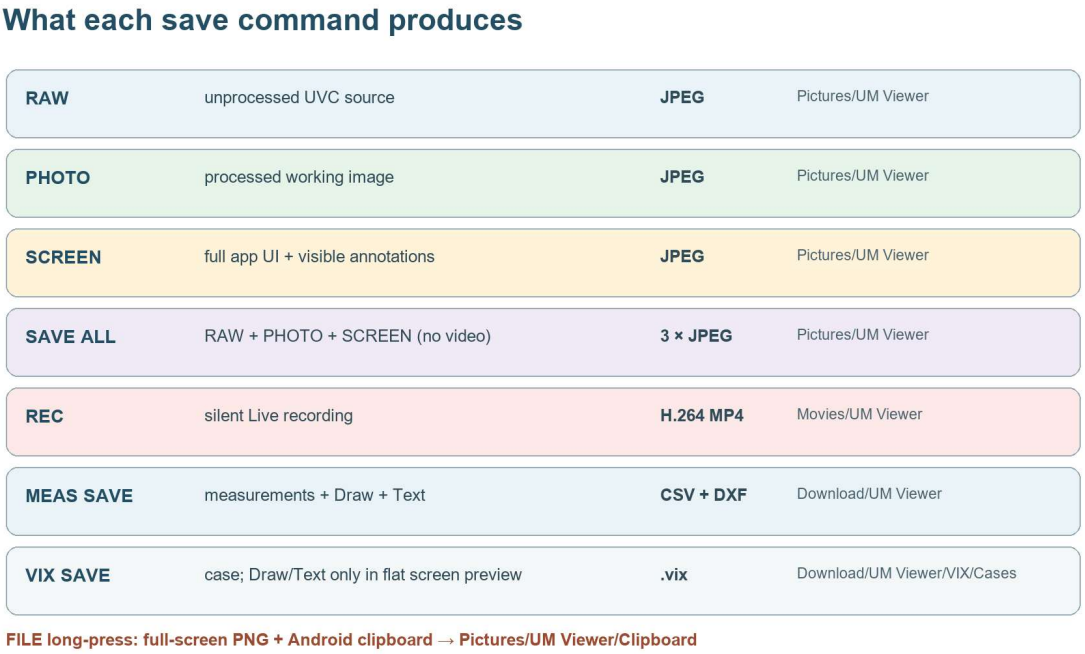


Figure 8 Save functions, file formats, and Android logical paths.

Verified output names, formats, and paths

> **Note** WIDTHxHEIGHT is the actual pixel size and yyyyMMdd_HHmmss is the creation time. `[ModelTag_]` in RAW/PHOTO/SCREEN appears only when the app has an available model label. An Android file manager may present collections differently, but the logical paths below do not change.

Function	Format / actual name	Path	Content / note
FILE RAW	ViTiny_UVC_RAW_[ModelTag_]WIDTHxHEIGHT_yyyyMMdd_HHmmss.jpg	Pictures/UM Viewer	UVC source frame; JPEG quality 95, not Bayer/DNG
FILE PHOTO	ViTiny_PHOTO_[ModelTag_]WIDTHxHEIGHT_yyyyMMdd_HHmmss.jpg	Pictures/UM Viewer	Current processed image; JPEG quality 95
FILE SCREEN	ViTiny_SCREEN_[ModelTag_]WIDTHxHEIGHT_yyyyMMdd_HHmmss.jpg	Pictures/UM Viewer	Full UI and visible annotations; JPEG quality 95
HOLD FILE	ViTiny_CLIP_WIDTHxHEIGHT_yyyyMMdd_HHmmss.png	Pictures/UM Viewer/Clipboard	Full-screen PNG; URI is also placed on the Android clipboard
REC	VID_WIDTHxHEIGHT_yyyyMMdd_HHmmss.mp4	Movies/UM Viewer	H.264 MP4; silent; UVC is normally 15 fps
EDF SAVE	ViTiny_EDF_WIDTHxHEIGHT_yyyyMMdd_HHmmss.png	Pictures/UM Viewer	Extended-depth fusion PNG
OCR SAVE TXT	UMV_Text_yyyyMMdd_HHmmss.txt	Download/UM Viewer	OCR plain text
MEAS SAVE	MeasureReport_yyyyMMdd_HHmmss.csv	Download/UM Viewer	Measurements, Draw, Text, calibration, and center coordinates
MEAS SAVE	MeasureReport_yyyyMMdd_HHmmss.dxf	Download/UM Viewer	CAD geometry, Draw layer, and Text
PATTERN PDF	ViTiny_Calibration_Pattern_A4_12_Markers.pdf	Download/UM Viewer/Calibration Pattern	A4 12-marker pattern; print at 100% / Actual Size
CAL PATTERN	UMViewer_Calibration_Pattern_A4_1up_20level_30mm_to_0p05mm_yyyyMMdd_HHmmss_SSS.svg	Download/UM Viewer/Calibration Pattern	A4 single-up vector master

Function	Format / actual name	Path	Content / note
CAL PATTERN	same stem .gbr	Download/UM Viewer/Calibration Pattern	Gerber master with the same stem as the SVG
VIX SAVE	VIX_yyyyMMdd_HHmmss.vix	Download/UM Viewer/VIX/Cases	Case container with PNG thumbnail envelope and ZIP payload

FILE.RAW — RAW

Screen label	First FILE `RAW`.
Purpose	Save the current UVC source frame before IMAGE software processing at the active UVC resolution.
Prerequisites	`P-UVC`, `P-STORAGE`; a real source frame is present.
Procedure	Tap RAW, wait for success, and open the file to check dimensions.
Result	A source-frame image is created.
Output/path	`ViTiny_UVC_RAW_[ModelTag_]WIDTHxHEIGHT_yyyyMMdd_HHmmss.jpg` (optional `[ModelTag_]`, JPEG quality 95) → `Pictures/UM Viewer`.
Limitations	RAW means “unprocessed UVC frame,” not sensor Bayer RAW/DNG. It still reflects UVC firmware, hardware IQ, encoding, and color conversion.
Recovery/troubleshooting	Return to LIVE/check UVC if no frame. If dimensions differ, check active mode and whether non-Live media is loaded.

FILE.PHOTO — PHOTO

Screen label	`PHOTO`.
Purpose	Save the current software-processed working image.
Prerequisites	A Live/Still/processed result and `P-STORAGE`.
Procedure	Confirm the IMAGE/AIP/EDF result, tap PHOTO, and open the output.
Result	A processed image is created.
Output/path	`ViTiny_PHOTO_[ModelTag_]WIDTHxHEIGHT_yyyyMMdd_HHmmss.jpg` (optional `[ModelTag_]`, JPEG quality 95) → `Pictures/UM Viewer`.
Limitations	It is not guaranteed to include full app chrome or every UI/Draw/Text layer. Use SCREEN for an exact full-screen view.
Recovery/troubleshooting	If the effect is wrong, check ROI/processing mode and save RAW for comparison.

FILE.SCREEN — SCREEN

Screen label	SCREEN.
Purpose	Save the complete app screen, including visible controls, Inspection, overlays, Measurements, Draw/Text, and other visible elements.
Prerequisites	P-STORAGE; arrange/hide panels first.
Procedure	Set the UI as desired, tap SCREEN, and open the file.
Result	The whole application screen becomes a raster image; visible annotations are flattened.
Output/path	ViTiny_SCREEN_[ModelTag_]WIDTHxHEIGHT_yyyyMMdd_HHmmss.jpg (optional [ModelTag_], JPEG quality 95) → Pictures/UM Viewer.
Limitations	Flattened objects are no longer editable in MEAS. SCREEN dimensions are app-screen dimensions, not active UVC resolution.
Recovery/troubleshooting	Move/collapse Inspection and close hints if they obstruct the target, then resave. Also save CSV/DXF for editable measurements.

FILE.CLIPBOARD_COPY — HOLD FILE/COPY IN 3-2-1

Screen label	Long-press main FILE; countdown COPY IN 3, COPY IN 2, COPY IN 1.
Purpose	Save the full app screen as a PNG and place its Android content URI on the clipboard for pasting/sharing in another app.
Prerequisites	P-APP, P-STORAGE; arrange the visible screen before starting.
Procedure	Press and hold the main FILE icon for about 2.5 seconds and keep holding through the 3-2-1 countdown. Releasing before completion cancels. After success, switch to a compatible app and paste/use the clipboard item.
Result	A full-screen PNG is written and its Android URI is placed on the system clipboard.
Output/path	ViTiny_CLIP_WIDTHxHEIGHT_yyyyMMdd_HHmmss.png → Pictures/UM Viewer/Clipboard; clipboard stores the Android URI.
Limitations	This differs from tapping SCREEN: it produces PNG in the Clipboard subfolder and also updates the clipboard. The receiving app must support the URI/image. Releasing early creates nothing.
Recovery/troubleshooting	Hold steadily for the full countdown. If paste is unavailable, open the PNG in Pictures/UM Viewer/Clipboard and share it through Android. Check free space if no file appears.

FILE.SAVE_ALL — SAVE ALL

Screen label	SAVE ALL.
Purpose	Save RAW, PHOTO, and SCREEN once in a fixed sequence.
Prerequisites	P-STORAGE, usable source/working image, and space for three images.
Procedure	Tap once, wait for all success messages, and verify three files.
Result	Three images are created in RAW → PHOTO → SCREEN order.
Output/path	Three JPEG images → Pictures/UM Viewer.
Limitations	**Does not include REC/video** and does not replace MEAS CSV/DXF, OCR TXT, or VIX.
Recovery/troubleshooting	Low space can give partial completion. Verify all three types, free space, and repeat; do not rely on one success toast.

FILE.REC — REC/STOP

Screen label	`REC`; changes to `STOP`/status while recording.
Purpose	Start or stop Live video recording.
Prerequisites	`P-UVC`, `P-LIVE`, `P-STORAGE`; sufficient sustained write space.
Procedure	Tap REC, watch recording state/time, and tap STOP before source/mode changes, disconnect, or EXIT.
Result	A **silent** video is created.
Output/path	`VID_WIDTHxHEIGHT_yyyyMMdd_HHmmss.mp4` (H.264, no audio; UVC recording normally 15 fps) → `Movies/UM Viewer`.
Limitations	The app requests no microphone permission and records no audio. UVC recording is normally 15 fps; actual sustained performance still depends on CPU, USB bandwidth, and storage throughput.
Recovery/troubleshooting	After interruption, verify playback. Lower resolution, prefer MJPEG, close heavy processing, and free space.

FILE.LOAD — LOAD

Screen label	`LOAD`, Android document picker.
Purpose	Open an image or video for inspection.
Prerequisites	Readable user media; save temporary work first.
Procedure	Tap LOAD, choose media in the Android picker, and wait for preview.
Result	Loaded-media state begins; still images support LOCK/MEAS, and video is viewed according to player capability.
Output/path	No new file; reads the selected media URI.
Limitations	Not every codec/container is guaranteed. Do not trust physical measurements on an image without matching calibration.
Recovery/troubleshooting	Verify format/permission in a system app. Use `FILE.LIVE` to return to Live.

FILE.LOCK_UNLOCK — LOCK/UNLOCK

Screen label	`LOCK`, `UNLOCK`.
Purpose	Keep a loaded still active or allow an image tap to return to Live.
Prerequisites	A still image is loaded.
Procedure	Tap LOCK to hold. Tap UNLOCK; then, as hinted, tap the loaded image to return to Live.
Result	LOCK permits VIEW/MEAS on the still; UNLOCK removes return protection.
Output/path	No file; source image is unchanged.
Limitations	This loaded-media LOCK differs from PIP LOCK and VIX READ IMAGE + LOCK, although concepts are related.
Recovery/troubleshooting	Reload after accidentally leaving. If Live cannot return, UNLOCK or tap FILE LIVE.

FILE.LIVE — LIVE

Screen label	FILE `LIVE`.
Purpose	Leave loaded media/original preview and return to the camera stream.
Prerequisites	Loaded media/preview is active; camera source is available.
Procedure	Tap LIVE.
Result	Loaded-media display is released and streaming resumes.
Output/path	No file; loaded source is not deleted.
Limitations	LIVE cannot create an image when UVC is disconnected.
Recovery/troubleshooting	Use CAM SRC → EXT/UVC, check permission/cable, or URST if no image appears.

Note Fixed FILE button order: RAW, PHOTO, SCREEN, SAVE ALL, REC, LOAD, LOCK/UNLOCK, LIVE, CAL PATTERN. Rows may wrap on narrow screens, but the order does not change. FILE.CLIPBOARD_COPY is a long-press gesture on the main FILE icon, not an additional row button.

Chapter 12 CTRL: CP2102 motor and LED control

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

CTRL.STOP — STOP

Screen label	CTRL `STOP`; F-AF/Auto EDF also have STOP.
Purpose	Immediately request that the focus motor/current controller action stop.
Prerequisites	`P-CTRL`; if disconnected, the app still enters safe cleanup.
Procedure	Tap STOP for unwanted movement or to cancel a scan; wait for stopped/ready status.
Result	The motor is released. F-AF/Auto EDF perform fuller session cleanup through their own STOP flows.
Output/path	No file.
Limitations	With complete USB/UART loss, delivery cannot be guaranteed. Disconnect power only under the hardware safety procedure; do not invent an emergency-stop rating.
Recovery/troubleshooting	Wait for heartbeat. If still busy, reconnect the complete microscope/use URST and confirm movement has stopped.

CTRL.LED_PLUS_MINUS — LED＋/LED−

Screen label	`LED+`, `LED-`.
Purpose	Raise/lower illumination Level on a compatible microscope.
Prerequisites	`P-CTRL`; LED-level hardware support.
Procedure	Hold LED＋/LED− for continuous adjustment and release to stop. Make small changes while observing Live/Inspection.
Result	LED Level and image brightness change.
Output/path	No file; a compatible VIX hardware restore may optionally restore it.
Limitations	Unavailable on UVC devices without CP2102/LED support. Brightness affects exposure, AUTO, FIELD, Compare, and image results.
Recovery/troubleshooting	Check UART/LED Level if unresponsive. Avoid repeated commands, wait for heartbeat, then use URST/reconnect if needed.

CTRL.MODE — MODE (M0–M5/AUTO)

Screen label	`MODE`, states M0–M5, AUTO/LED Mode symbol as model reports.
Purpose	Cycle compatible microscope LED layout modes.
Prerequisites	`P-CTRL`; the microscope supports modes.
Procedure	Each tap cycles M0 → M1 → … → M5 → AUTO according to hardware feedback; observe Inspection.
Result	LED illumination pattern changes.
Output/path	No file; compatible VIX may record/optionally restore it.
Limitations	Behavior differs by model. Only UM-22-specific status-display logic maps Mode 1–5 to symbols and Mode 0/AUTO to All. **This does not establish official Android compatibility for UM-22 on its public product page.**
Recovery/troubleshooting	If symbol/mode differs, trust physical illumination and controller feedback. Return to AUTO/M0 or reconnect.

CTRL.STATUS — STATUS/Inspection controller fields

Screen label	CTRL status bar, MICRO, UART, Focus Position, LED Level, LED Mode, Model.
Purpose	Determine whether the controller can accept AF, F-AF, Z, Auto EDF, and LED commands.
Prerequisites	Microscope connected and USB permission flow complete.
Procedure	Check UART/heartbeat and model/position fields. Wait while busy/blank; do not send repeated commands.
Result	Controller/focus/LED/model status appears; these are information fields, not buttons.
Output/path	No file; SCREEN preserves evidence.
Limitations	Slow Android TV boxes may receive CP2102 replies later; one delayed reply is not a disconnect.
Recovery/troubleshooting	If Live works but CTRL does not, wait for UART recovery. If persistent, reconnect the whole microscope, not only preview.

CTRL.HOLD_RESET — HOLD CTRL

Screen label	Long-press main `CTRL`.
Purpose	Cancel temporary CTRL workspace state.
Prerequisites	Temporary CTRL state exists; STOP important hardware action first.
Procedure	Long-press CTRL.
Result	Public CTRL child-workspace state is cleaned up.
Output/path	No file.
Limitations	Not a USB reconnect/hub power cycle and deletes no file.
Recovery/troubleshooting	Use STOP, URST, or physical reconnection for persistent hardware problems.

Chapter 13 VIX: reproducible case save and restore

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

VIX.SAVE — VIX SAVE/HOLD 3-2-1

Screen label	`VIX SAVE`, `HOLD`, countdown 3-2-1, `CASE`.
Purpose	Save a reproducible workspace as a VIX case.
Prerequisites	`P-STORAGE`; arrange the workspace, stabilize the source, and verify important state.
Procedure	Press and hold VIX SAVE through the complete 3-2-1 countdown, wait for success, and inspect the case in the folder.
Result	v1.1 writes one VIX_yyyyMMdd_HHmmss.vix case. It uses a PNG original-image thumbnail envelope with an embedded ZIP payload containing `00_Report.txt`, `01_Screen.png`, `02_Original.png`, `03_Parameters.json`, and `04_System.json`. The case records the full screen, UVC original frame, supported image settings, measurements, calibration, workspace, UVC settings, and defined microscope state.
Output/path	`VIX_yyyyMMdd_HHmmss.vix` → `Download/UM Viewer/VIX/Cases`.
Limitations	Draw/Text do not enter restorable VIX object history, although flattened `01_Screen.png` may visibly contain them. Hardware/camera restore depends on saved content, current model, and compatibility. VIX is not the only backup.
Recovery/troubleshooting	If hold is released/canceled, repeat. Verify immediately with VIX READ and also save RAW/SCREEN/CSV/DXF.

VIX.READ.OPEN — VIX READ/OPEN

Screen label	`VIX READ`, `OPEN`.
Purpose	Select and validate a v1.1 .vix case or supported legacy/profile .json/case .zip.
Prerequisites	A readable supported case; save current work first.
Procedure	Tap VIX READ/OPEN, select a case from `Download/UM Viewer/VIX/Cases`, and wait for validation and the options dialog.
Result	After validation, IMAGE/STATE/HARDWARE restore options appear; inspect before ACCEPT.
Output/path	Reads the selected case; does not overwrite the original.
Limitations	Damaged, different-version/field, or asset-incomplete cases may be partially usable or rejected. .vix is the primary v1.1 save output; .json/.zip support is for validated compatible inputs.
Recovery/troubleshooting	Use the unmodified original/backup. Do not edit JSON and claim compatibility after a read failure.

VIX.READ.IMAGE — IMAGE (saved image + LOCK/keep current Live/image)

Screen label	`IMAGE` option, saved image + `LOCK`, keep current Live/image.
Purpose	Load and lock the case Original image, or keep the current Live/image.
Prerequisites	Validated case containing a usable image.
Procedure	Choose saved image + LOCK for reproducibility; choose keep current Live/image to apply only state to the current sample.
Result	The case Original appears or current source remains. Saved image enters loaded-still lock.
Output/path	No new file.
Limitations	Case calibration applies only to the saved optical conditions. Keeping current Live does not prove scale matches.
Recovery/troubleshooting	Use FILE LIVE or reread VIX after a wrong choice. Recalibrate whenever scale is uncertain.

VIX.READ.STATE — STATE

Screen label	`STATE`.
Purpose	Restore workspace settings, calibration, and measurements.
Prerequisites	Valid case; review differences and save current work.
Procedure	Enable STATE with the chosen IMAGE strategy, accept, then inspect workspace/calibration/measurements.
Result	Supported software workspace state is restored.
Output/path	No new file; a new case/CSV may be saved afterward.
Limitations	Draw/Text are not restored as editable history. Version/source/image-size differences may make state inapplicable.
Recovery/troubleshooting	Use Reset Image/Reset All or reread with the option disabled. Validate calibration.

VIX.READ.HARDWARE — HARDWARE (default OFF)

Screen label	Optional `HARDWARE` restore.
Purpose	Optionally restore compatible Focus, LED, UVC IQ/mode, and defined hardware state when saved/current microscope models match.
Prerequisites	`P-CTRL`, `P-UVC`; case/current model match; operator confirms focus motion/lighting change is safe.
Procedure	Leave OFF by default. Enable only for the same model when needed; inspect source, calibration, Focus, LED, and UVC options before ACCEPT.
Result	The app attempts supported hardware-state application according to compatibility.
Output/path	No file; physical focus/lighting and UVC controls change.
Limitations	Same model does not guarantee identical firmware/environment. Never force restore to another model; read back and verify.
Recovery/troubleshooting	STOP, disable HARDWARE/reread the case, and use IQ RESET/AUTO, LED mode, AF, or manual Z to return safely, then recalibrate.

Chapter 14 HELP, language, and support

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

HELP.OPEN_LANGUAGE_CLOSE — HELP/繁中/English/日本語/한국어/CLOSE

Screen label	`HELP`, four language choices, `CLOSE`.
Purpose	Read production help and set the language for HELP/Guidance/short HINT.
Prerequisites	`P-APP`.
Procedure	Tap HELP; choose Traditional Chinese, English, Japanese, or Korean; browse sections; tap upper-right CLOSE.
Result	Hint language changes. CLOSE does not alter image, calibration, measurement, or connection state.
Output/path	No file.
Limitations	Visible button abbreviations generally remain English for UI consistency. Follow the exact English labels shown by the app when performing an operation.
Recovery/troubleshooting	Reenter HELP to change language. If Guidance is absent, check CAM TIP.

SUPPORT.CONTACT — Contact and support

Screen label	Company/contact information in HELP About/Privacy.
Purpose	Obtain assistance for model/device combinations, software issues, and formal policies.
Prerequisites	Prepare app version, Android version, microscope model, USB path, CAM INFO/Inspection screenshot, and reproducible steps; do not send unnecessary sensitive data.
Procedure	Email `mltc@vitiny.com`; phone `+886-7-657-9551`; the official contact page is subject to the content currently available on the live site.
Result	Microlinks support handles the request.
Output/path	User-selected Email/Browser app handles communication.
Limitations	Official web pages are subject to the content currently available on the live site. External sites have their own policies.
Recovery/troubleshooting	If a link fails, use Contact/Download on `www.vitiny.com`; retain evidence and original-file backups.

Chapter 15 Standard operating procedures (SOP)

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

SOP.QUICK_START — Obtain the first Live image

1. Use an ARM Android 8.0+ tablet in landscape and confirm USB Host/OTG. Keep tablet and microscope powered.
2. Install v1.1 and allow Camera permission at startup.
3. Connect with a short, reliable USB-C/OTG cable; use a powered high-quality hub if needed.
4. Allow every UVC and CP2102 Android USB prompt; two prompts may appear.
5. Open CAM → SRC → `EXT / UVC`. If insertion does not open the app, start it manually and use this path.
6. Wait for Live frames and confirm UVC first. Then inspect MICRO/UART/Focus/LED to confirm CP2102.
7. If unstable, use CAM AUTO or choose a smaller MJPEG and APLY; do not tap repeatedly.
8. Once CTRL is ready, use AF; use F-AF only for a full scan. Recalibrate after any Focus or physical FOV change.

Completion criterion: frames update continuously and CAM INFO/Inspection is reasonable. A hardware-control job additionally requires P-CTRL. Live alone does not mean the complete microscope is ready.

SOP.CALIBRATED_MEASURE — Measurement after traceable calibration

9. Fix microscope, lens, working distance, Focus, source, and horizontal FOV.
10. Use clean Color/Gray with uniform illumination and a clear, stable image.
11. Choose MAN CAL + traceable reference, or AUTO CAL + a correct marker printed at 100% Actual Size.
12. Check A/B, known length/letter, marker size, confidence, and Pixel Size before ACCEPT.
13. Independently check another known dimension; recalibrate if it fails.
14. Use POINT/DIST/ANG/ARC/CURV/POLY/CIRC/3P CIRC/RECT.
15. Refine with SEL and check perspective, burrs, glare, and operator placement.
16. MEAS SAVE creates CSV + DXF; FILE SCREEN preserves visible evidence; also save RAW when source evidence is needed.
17. Open and verify the files, then create a second backup.

SOP.AUTO_MEASURE — Automatic detection with human Review

18. Complete valid calibration and stabilize image/lighting.
19. Choose the appropriate AUTO tool and ROI 120/180/240/300.
20. Place the specified edge/target inside the ring/crosshair, tap once, and wait.
21. Inspect overlay, controls, target association, and values individually.
22. ACCEPT only when correct; otherwise always CANCEL.
23. After ACCEPT, inspect/refine with MEAS SEL and sample-check with a manual tool or external gauge.
24. SAVE CSV/DXF + SCREEN. AUTO ACCEPT must never be treated as product pass/fail.

SOP.EDF — Extended depth-of-focus composition

25. Secure sample, microscope, and lighting; choose a reasonable resolution.
26. Manual: START → focus first plane with Z → ADD → repeat each plane → BUILD.
27. Auto: confirm P-CTRL → set two distinct valid A/B → verify GO A/B → choose FR count → RUN.
28. While running, do not touch the sample, operate Z, unplug USB, or run F-AF.
29. Inspect edge halo, scene motion, lighting change, and missing focus planes.
30. SAVE EDF to Pictures; also save representative RAW/SCREEN and preserve source evidence for important work.

SOP.COMPARE — Live/Reference comparison

31. Create a trustworthy Reference JPEG with the same optics, resolution, focus, lighting, and positioning.
32. LOAD REF; use MATCH REF/CONFIRM POS when position matching is needed.
33. First match scale/large position with REF 1.0X and drag/pinch, then nudge with STEP + arrows.
34. Choose ROI VIS or CTR; use ALIGN only after zoom matches.
35. Inspect visually with SPLIT, OVERLAY, BLINK; use COMPARE for SIM/STR/LUM and HEAT for differences.
36. Interpret results with alignment, light, focus, and compression; never use one score alone.
37. SCREEN saves visible results. CLEAR Reference before ordinary work.

SOP.EVIDENCE_SET — Recommended save set

- Source evidence: FILE RAW.
- Processed result: FILE PHOTO/EDF SAVE.
- Visible-screen evidence: FILE SCREEN.
- Three images at once: SAVE ALL (no video).
- Editable/exchange measurement: MEAS SAVE CSV + DXF.
- OCR: SAVE TXT.
- Workspace case: VIX SAVE; because Draw/Text are not restored as editable VIX history, also use CSV/DXF + SCREEN.
- Dynamic process: silent REC video.
- Quick clipboard handoff: long-press FILE through COPY IN 3-2-1; use the PNG/clipboard URI.
- Open every saved output to verify it, and keep at least one independent second backup.

Chapter 16 Troubleshooting decision tree

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

TS.NO_UVC — No EXT/UVC or no image

38. Confirm ARM Android 8.0+, USB Host/OTG, and microscope/tablet power.
39. Confirm Camera permission and allow the UVC USB prompt.
40. Remove unnecessary USB devices, use a short compliant cable, and use a powered hub if needed.
41. Wait for internal-hub enumeration; reconnect only once.
42. Manually open the app → CAM → SRC → EXT / UVC.
43. If it previously worked, tap URST once and wait; physically reconnect only if it still fails.
44. Installability does not prove USB Host capability or adequate power.

TS.LIVE_NO_CTRL — Live works but AF/Z/LED does not

45. Diagnosis: the UVC image path works; the CP2102 path is not ready or hardware has no controller.
46. Check UART, MICRO/Model, Focus Position, and LED fields in Inspection.
47. Wait for initialization/heartbeat. One delayed reply on a slow TV box is not a disconnect.
48. Check whether the second USB prompt was missed.
49. Do not repeatedly send AF, F-AF, Z, Auto EDF, or LED commands while busy/blank.
50. If persistent, use URST; then reconnect the whole microscope rather than only switching preview.

TS.BLACK_FLICKER — Black, flickering, or unstable image

51. Return to a smaller MJPEG and wait for continuous real frames.
52. Do not repeatedly tap APLY; a brief image does not prove mode stability.
53. Check LED, IQ AE/Exposure/Gain, cable, hub, power, and bandwidth.
54. YUYV needs more bandwidth; prefer MJPEG for USB 2.0/high resolution.
55. URST is only a software reconnect and cannot fix physical power/cable faults.

TS.LOW_FPS — Low FPS or slow processing

56. Lower resolution, prefer MJPEG, and close heavy background apps.
57. Close unnecessary FIELD, OCR, HDR, Denoise, EDF, AUTO, Full ROI, and high-resolution REC.
58. Inspect measured state in CAM INFO; descriptor FPS may exceed actual Live FPS.
59. Use a powered hub, short cable, and stable power.
60. Never promise fixed FPS for a tablet/mode without testing that exact combination.

TS.F_AF_EDF_BLOCKED — F-AF/Auto EDF cannot start

61. Confirm P-UVC, P-CTRL, valid Focus Position, and P-IDLE.
62. F-AF: place its ROI over clear high-contrast detail before START.
63. Auto EDF: A/B must be distinct valid positions and FR selected.
64. Check for another camera/motor task, recording conflict, or resolution switch.
65. After a real disconnect, wait for complete recovery and reset endpoints; do not reuse an old run.

TS.AUTO_CAL_FAIL — AUTO CAL cannot recognize/result is unreliable

66. Confirm the pattern is generated/designated for this version, printed at 100% Actual Size, and its edge ruler is correct.
67. Use centered 1.0×, complete marker, outer edge inside guide, and upright letter.
68. Use sharp focus, even light, low glare, and clean Color/Gray.
69. Keep paper flat and coplanar with the sample; avoid perspective.
70. Rejection of an ambiguous/unsupported letter is a safety behavior; never guess it manually.
71. If still failing, use MAN CAL + traceable reference.

TS.WRONG_SCALE — Incorrect physical scale

72. Check for `Need Calibration` or px/px² results.
73. Determine whether source, lens, Focus, working distance, or optical/mechanical conditions changed.
74. Confirm that calibration loaded from image/CSV/VIX exactly matches the current image.
75. Verify print scaling, known length, and unit.
76. Digital Zoom does not invalidate Pixel Size, but screen magnification is not optical scale.
77. Check a known standard; if wrong, recalibrate and repeat critical measurements.

TS.SAVE_FAIL — File missing/incomplete save

78. Look by type in Pictures, Movies, Download/UM Viewer, VIX/Cases, and Calibration Pattern.
79. Check space, Android document picker/media scanning, and file-manager categories.
80. SAVE ALL must produce RAW/PHOTO/SCREEN images; it has no video.
81. CAL PATTERN must have SVG + GBR; MEAS PATTERN is PDF.
82. MEAS SAVE must have CSV + DXF. Draw/Text depend on these plus SCREEN, not restorable VIX history.
83. For FILE long-press copy, check `Pictures/UM Viewer/Clipboard` for `ViTiny_CLIP_WIDTHxHEIGHT_yyyyMMdd_HHmmss.png`; clipboard content may not be shown as a normal text item.
84. Open every file; a toast alone is not completion evidence.

Chapter 17 Compatibility and functional boundaries

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

17.1 Verified general rules

- A ViTiny-identified device may use all microscope-advertised resolutions permitted by the app; AF/F-AF/Z/LED still require a genuinely compatible CP2102.
- Other UVC devices: only the lowest permitted mode is allowed, and that mode's width must be ≤ 640 pixels. If its lowest mode is wider than 640, the app does not list it as an external camera.
- MJPEG compresses each frame and normally uses less USB bandwidth. YUYV/YUV is uncompressed and normally requires more.
- A camera descriptor advertising a mode does not mean the cable/hub/tablet/power can stream it stably.
- Models whose official public product pages explicitly list Android are compatibility references only. Confirm or physically test the actual microscope model, firmware, Android device/version, cable, and hub combination with Microlinks support.

Chapter 18 Privacy, safety, and responsibility

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

18.1 Permissions and data flow

- The merged manifest's general Android permission is Camera only; no microphone, location, or broad storage permission. Android's USB permission dialog separately manages USB access.
- Images/video, image processing, OCR, QR/barcode, and manual/automatic measurement are primarily processed on-device.
- ViTiny UM does not upload images, recognized text/codes, or measurement results to a Microlinks-operated server.
- Save/export occurs only when the user invokes the corresponding action; files stay on the device or at a user-selected location.
- Opening/copying/backing up/sharing through another app/cloud/email is governed by that provider's policy.
- The app has no user account, ads, Microlinks cloud service, or payment. Microlinks does not sell personal data obtained by the app.
- Google ML Kit is used for OCR/barcode. According to Google's Android data disclosure, it may process app/device information, per-install identifier, and performance/diagnostic telemetry; bundled on-device APIs do not send input images or recognized text/barcode results to Google. Every language must attribute this to Google's explanation and not broaden the guarantee.

18.2 Accuracy and safety

- Measurements are reference values and do not guarantee accuracy.
- Factors include calibration, reference quality, focus, image quality, optics, camera/lens/resolution, installation, operator technique, and environment.
- Independently verify critical results with an appropriate calibrated instrument/procedure.
- The app does not replace professional inspection, regulatory compliance confirmation, medical diagnosis, or safety-critical measurement.
- The user is responsible for risk assessment, original evidence/backups, and rules/procedures for the intended use.

18.3 Open source

- Public About may list saki4510t UVCCamera modules, libuvc, libusb, libjpeg-turbo, RapidJSON, and others.
- Original copyright/license notices are in the distributed source package and `licenses/OPEN_SOURCE_NOTICES.md`; applicable notices must remain on redistribution.
- The end-user manual need not copy every third-party license; provide an accurate location and access method.

Chapter 19 AI retrieval and synonyms

This chapter uses stable IDs for public operations. Visible labels remain exactly as shown by the app.

85. For “image works but AF does not,” separate UVC from CP2102; do not collapse both into “USB is broken.”
86. Before answering any physical dimension, ask whether a valid calibration was ACCEPTed and whether source/lens/focus/working distance changed.
87. For save location, identify RAW/PHOTO/SCREEN/REC/CSV+DXF/OCR/VIX/Pattern first, then give its logical path.
88. For “original image,” explain that RAW is a UVC frame before app processing, not Bayer sensor raw.
89. For “save everything,” SAVE ALL = RAW + PHOTO + SCREEN; video/CSV/VIX are excluded.
90. For “calibration pattern,” distinguish PDF 12-marker from SVG+GBR single-up.
91. For “Text,” distinguish IMAGE OCR TEXT from MEAS annotation TEXT.
92. For “Lock,” distinguish FILE loaded-image LOCK, PIP position LOCK, and VIX IMAGE + LOCK.
93. For “Gamma,” distinguish CAM IQ hardware Gamma from IMAGE FX software Gamma.
94. For compatibility, give a conditional conclusion; installability/Live does not prove every function.
95. For OCR/AUTO/EDF/Compare/measurement, require human review, calibration, and independent verification.
96. When available evidence does not confirm an answer, say “not confirmed by the available evidence,” then recommend physical INFO/Inspection/output-file or Microlinks support verification; never invent.
97. Use command IDs to disambiguate functions across languages, and preserve the exact button labels shown by the app.
98. For “copy/paste the screen,” distinguish SCREEN JPEG from long-press FILE, which creates `ViTiny_CLIP_WIDTHxHEIGHT_yyyyMMdd_HHmmss.png` and copies its Android URI.
99. For “VIX file,” identify .vix as primary v1.1 output; .json/.zip are supported compatible read inputs, not the v1.1 SAVE extension.

19.1 Common synonyms and ambiguity resolution

User term	Correct mapping
original/raw image	Usually FILE.RAW; first say it is not Bayer/DNG
photo/processed image	FILE.PHOTO
screenshot/whole screen	FILE.SCREEN; if clipboard/paste is requested, FILE.CLIPBOARD_COPY
save all	FILE.SAVE_ALL, three images only
autofocus	Quick single HDR.AF or full-range HDR.F_AF; ask which is needed
motor/focus up and down	HDR.Z_MINUS_PLUS, requiring CP2102
calibration PDF	MEAS.CAL.PATTERN_PDF, A4 12-marker
calibration vector/Gerber	FILE.CAL_PATTERN, single-up SVG+GBR
text recognition	IMG.OCR.*
add text	MEAS.TEXT
depth-of-field stacking	MULTI.EDF.*
reference image comparison	MULTI.CMP.*
case/profile	VIX.*; primary v1.1 SAVE is .vix
restart USB	CAM.URST, software reconnect only
clipboard image/quick copy	FILE.CLIPBOARD_COPY, PNG + Android URI

Appendix A Command ID index

IDs are the common location keys for all four language editions and for AI retrieval. If the same visible label appears in more than one workspace, distinguish it by the full ID.

ID	Visible label / topic	Chapter
APP.INSTALL	Install and start	2
APP.PERMISSION.CAMERA	Camera permission	2
APP.PERMISSION.USB	UVC/CP2102 USB permission	2
SESSION.BACK	Android system Back	2
APP.EXIT	EXIT	2
UI.MAIN_TOOL	CAM/IMAGE/AIP/MULTI/AUTO/MEAS/FILE/CTRL/VIX/HELP	3
UI.TOUCH_ZOOM_PAN	Pinch/Wheel/Drag	3
UI.INSPECTION.MOVE	Move Inspection	3
UI.INSPECTION.COLLAPSE_RESTORE	Double-tap Inspection/I	3
HDR.RES	RES	3
HDR.FREEZE_LIVE	FREEZE/LIVE	3
HDR.AF	AF	3
HDR.F_AF	F-AF	3
HDR.Z_MINUS_PLUS	Z−/Z＋	3
HDR.RESET_IMAGE	Reset Image	3
HDR.RESET_ALL	Reset All/RESET WORKSPACE	3
HDR.AUTO_CAL	AUTO CAL shortcut	3
HDR.OVERLAY	OVERLAY	3
CAM.SRC	SRC (BACK/FRONT/EXT / UVC)	4
CAM.R_MINUS_PLUS	R−/R＋	4
CAM.APLY	APLY	4
CAM.AUTO	AUTO	4
CAM.URST	URST	4
CAM.IQ.OPEN_CLOSE	IQ/X	4
CAM.IQ.SHOW_RESET	SHOW/RESET	4
CAM.IQ.AUTO_TOGGLES	AE/AWB/BLC/50/60 Hz	4
CAM.IQ.SLIDERS	Brightness/Contrast/Sharpness/Saturation/Hue/Gamma/Exposure/Gain/White Balance	4
CAM.INFO	INFO	4
CAM.TIP	TIP 1S/TIP OFF/TIP H/TIP 3S	4
IMG.ROI_FULL	ROI 200/400/800/FULL	5
IMG.PIP.OPEN	PIP	5
IMG.PIP.CONTROLS	PIP−/PIP xX/PIP＋/LOCK/UNLOCK	5
IMG.PIP.DISPLAY_MODE	S→L/L→S	5
IMG.QR	QR/Barcode	5
IMG.OCR.OPEN_ROI	TEXT (OCR)	5
IMG.OCR.READ_SAVE	READ/CLEAR/SAVE TXT/EXIT	5

ID	Visible label / topic	Chapter
IMG.COLOR_MODES	COLOR/RED/GREEN/BLUE/HSV/LAB	5
IMG.GRAY_MODES	GRAY/BIN/ADB/CLAHE	5
IMG.EDGE_MODES	EDGE/SHRP/SOBX/SOBY/CANNY	5
IMG.MAP_MODES	JET/HOT/TURBO	5
IMG.FX_MODES	EMB/INV/GAMMA	5
IMG.ANALYZE.OPEN	ANALYZE	5
IMG.ANALYZE.HIST	HIST 200/400/FULL/OFF	5
IMG.ANALYZE.COLOR	COLOR inside ANALYZE	5
IMG.ANALYZE.FOCUS	FOCUS 200/400/FULL/OFF	5
IMG.ANALYZE.FIELD	FIELD/LIVE/TEST/GRID/MAP/CURVE	5
IMG.HOLD_RESET	HOLD IMAGE	5
AIP.OPEN_BACK_RESET	AIP/← AIP/HOLD AIP	6
AIP.STAB.ON_OFF_PRESET	STAB ON/OFF/SOFT/STD/STRONG	6
AIP.STAB.PARAMS	GAIN/RANGE/LIM/RESP/RATE	6
AIP.STAB.RESET	RESET	6
AIP.DENOISE.MODE_LEVEL	STILL/LIVE; LOW/MID/HIGH	6
AIP.DENOISE.RUN	CAPTURE/START/STOP/LIVE/CLEAR	6
AIP.HDR.MODE_STEP	STILL/LIVE/STEP/LOW·MID·HIGH	6
AIP.HDR.RUN	CAPTURE/START/STOP/LIVE/CLEAR	6
MULTI.OPEN_BACK_RESET	MULTI/← MULTI/HOLD MULTI	7
MULTI.EDF.MODE	MANUAL/AUTO	7
MULTI.EDF.MANUAL	START/ADD/BUILD	7
MULTI.EDF.AUTO_ENDPOINTS	SET A/SET B/GO A/GO B	7
MULTI.EDF.AUTO_RUN	FR−/FR＋/RUN (AUTO)/STOP	7
MULTI.EDF.SAVE_CLEAR_EXIT	SAVE/CLEAR/EXIT	7
MULTI.CMP.LOAD_REF	LOAD REF	7
MULTI.CMP.MATCH_POS	MATCH REF/CONFIRM POS	7
MULTI.CMP.VIEW_MODES	LIVE L/R/OVERLAY/BLINK	7
MULTI.CMP.REF_NAV	REF x.xX/STEP/← ↑ ↓ →/DRAG/PINCH	7
MULTI.CMP.ROI_ALIGN	ROI VIS/CTR/ALIGN	7
MULTI.CMP.ANALYZE	COMPARE/SIM/STR/LUM/HEAT ON/OFF	7
MULTI.CMP.CLEAR	CLEAR	7
AUTO.SEARCH_ROI	ROI 120/180/240/300	8
AUTO.RECT	RECT	8
AUTO.CIRCLE	CIRCLE	8
AUTO.TWO_CIRCLE	2 CIRCLE	8
AUTO.SHAPE	SHAPE	8
AUTO.NUT	NUT	8
AUTO.TOOTH	TOOTHS	8
AUTO.TWO_EDGE	2-EDGE	8

ID	Visible label / topic	Chapter
AUTO.P_LINE	P-LINE	8
AUTO.REVIEW_ACCEPT_CANCEL	ACCEPT/CANCEL	8
AUTO.HOLD_RESET	HOLD AUTO	8
MEAS.POINT	POINT	9
MEAS.DIST	DIST	9
MEAS.ANG	ANG	9
MEAS.ARC	ARC	9
MEAS.CURV	CURV	9
MEAS.POLY	POLY	9
MEAS.CIRC	CIRC	9
MEAS.CIRC3	3P CIRC	9
MEAS.RECT	RECT	9
MEAS.DRAW	DRAW	9
MEAS.TEXT	TEXT/ACCEPT/CANCEL	9
MEAS.SEL_QUICK_SELECT	SEL/long-press about 2 seconds	9
MEAS.UNDO	UNDO	9
MEAS.DEL	DEL	9
MEAS.SAVE	SAVE	9
MEAS.LOAD_CSV	LOAD CSV	9
MEAS.CLEAR_ALL	CLEAR ALL (double confirmation)	9
MEAS.EXIT_EDIT	EXIT	9
MEAS.CAL.MANUAL	MAN CAL/CANCEL	10
MEAS.CAL.P_ADJUST	P--/P-/P+/P++	10
MEAS.CAL.ACCEPT	ACCEPT	10
MEAS.CAL.AUTO	AUTO CAL/ACCEPT/CANCEL	10
MEAS.CAL.PATTERN_PDF	PATTERN PDF (A4, 12 markers)	10
FILE.CAL_PATTERN	CAL PATTERN (A4 single-up SVG + GBR)	10
CAL.FOV_RECAL	FOV/display magnification/recalibration rules	10
FILE.RAW	RAW	11
FILE.PHOTO	PHOTO	11
FILE.SCREEN	SCREEN	11
FILE.CLIPBOARD_COPY	HOLD FILE/COPY IN 3-2-1	11
FILE.SAVE_ALL	SAVE ALL	11
FILE.REC	REC/STOP	11
FILE.LOAD	LOAD	11
FILE.LOCK_UNLOCK	LOCK/UNLOCK	11
FILE.LIVE	LIVE	11
CTRL.STOP	STOP	12
CTRL.LED_PLUS_MINUS	LED＋/LED−	12
CTRL.MODE	MODE (M0–M5/AUTO)	12

ID	Visible label / topic	Chapter
CTRL.STATUS	STATUS/Inspection controller fields	12
CTRL.HOLD_RESET	HOLD CTRL	12
VIX.SAVE	VIX SAVE/HOLD 3-2-1	13
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Appendix B Complete built-in HELP reference

> Note The following 10 sections and 67 topics cover the complete v1.1 built-in HELP. VIX information is based on the .vix case file used by v1.1 and also identifies compatible formats; see the command specifications in the main text for the related procedures.

HELP.START — Quick Start

Connection, first image, focus, calibration, and basic gestures

HELP.START.001 — Recommended setup

Use an Android tablet in landscape orientation whenever possible. Keep the tablet powered, use a reliable USB-C/OTG cable, and connect the microscope directly or through a powered high-quality hub. The wide layout keeps the Live image, top controls, main tools, and Inspection panel visible together.

HELP.START.002 — Connect and grant permission

Connect the ViTiny Digital Microscope, open CAM, and select EXT / UVC under SRC. On first use, allow every Android USB request belonging to the camera and controller. Some microscopes contain both a UVC camera and a CP2102 controller behind one USB hub, so two permission prompts may appear. Wait for enumeration and do not repeatedly unplug the cable while permission is being requested.

HELP.START.003 — Confirm that the system is ready

A Live image confirms only the UVC image path. The MICRO, UVC, UART, Focus Position, LED Level, and LED Mode fields in Inspection show the available microscope information. AF, F-AF, Z−, Z＋, STOP, and LED commands require the separate CP2102 controller to be ready. Slower Android TV boxes can deliver CP2102 replies later than tablets; ViTiny UM allows the bounded compatibility wait automatically. A single delayed reply is not a disconnect. Wait for initialization or heartbeat recovery and do not repeat commands while UART is still busy.

HELP.START.004 — Recommended operating order

Select a source and resolution → confirm a stable Live image → use AF, F-AF, or Z− / Z＋ to focus → perform MAN CAL or AUTO CAL before physical measurement → use IMAGE, AIP, AUTO, MULTI, and MEAS as required → save results with FILE or VIX. Calibration should use a clear, stable, minimally processed image.

HELP.START.005 — Hints, touch, mouse, and Back

TIP in CAM controls the main guidance card: TIP 1S, TIP 3S, TIP H, or TIP OFF. HELP and short HINT cards use the language selected here. Drag to move an enabled ROI or editable handle. Use the mouse wheel or touch zoom gesture for Digital Zoom, and pan only when the current tool permits it. Press CLOSE in HELP to return without changing the image, calibration, measurement, or connection state. Pressing the Android system Back key sends ViTiny UM to the background and returns to the desktop; reopening the app resumes the same session, including measurements, Draw/Text annotations, Zoom/Pan, and workspace state. Use the main EXIT icon when you intend to close ViTiny UM completely.

HELP.HEADER — Top Header Controls

RES, Live state, focus, reset, calibration, and Overlay

HELP.HEADER.006 — RES resolution menu

Tap the first RES button to open the resolutions currently permitted for the connected UVC microscope. Duplicate MJPEG and YUYV dimensions are shown once, and the active resolution has a check mark. Selecting another size immediately performs the existing safe close/reopen and real-frame verification. Resolution switching is blocked while F-AF, Auto EDF, AUTO CAL, or another conflicting operation is running. With unchanged optics and horizontal FOV, resolution changes retain calibration.

HELP.HEADER.007 — FREEZE / LIVE

FREEZE holds the current working image for inspection, processing, and measurement. LIVE returns to the camera stream. This is one shared image state, so changing it in the header affects the current IMAGE, AUTO, MEAS, and MULTI workspace. A loaded still image can remain locked until LIVE is selected.

HELP.HEADER.008 — AF

AF performs the microscope controller's normal single autofocus. Wait until CTRL is ready, keep the subject inside the useful image area, and avoid moving the microscope while AF is running. Focus movement changes the physical scale, so an existing calibration becomes invalid and the app requests recalibration.

HELP.HEADER.009 — F-AF

F-AF opens Full-Area Autofocus. Position the yellow 360 × 360 Focus ROI over the important detail, resize or drag it if needed, then press START. The app scans the available Focus Position range, finds the best coarse region, refines it, returns to the strongest position, and stops. Press STOP to cancel safely.

HELP.HEADER.010 — Z− / Z＋

Press and hold Z− or Z＋ for manual motor focus and release to stop. Use short movements near the desired focus. The actual direction on screen depends on the optical setup, so judge by the Live image and Focus Position. Any focus-position change invalidates physical calibration.

HELP.HEADER.011 — Reset Image and Reset All

Reset Image clears image processing, analysis overlays, QR/OCR boxes, and temporary IMAGE results while preserving the accepted calibration. Reset All restores the complete user workspace, removes measurements and overlays, clears calibration, returns TIP to TIP 1S, and restores safe camera defaults. These buttons require confirmation where data may be lost.

HELP.HEADER.012 — AUTO CAL shortcut

The top AUTO CAL button opens the same Auto Calibration workflow provided under MEAS. Digital Zoom is returned to a centered 1.0× view and remains locked while the guide, scan, review, and ACCEPT/CANCEL steps are active.

HELP.HEADER.013 — Inspection window

Drag the Inspection window to move it. Double-tap the window to minimise it; the movable tile disappears and an information icon marked I stays fixed at the far right of the top header. Double-tap I to restore Inspection. The restored window remains movable and keeps its previous position.

HELP.HEADER.014 — OVERLAY and narrow screens

OVERLAY cycles the center crosshair, ruler/scale, and grid combinations. The complete-image center is (0,0), with X negative left and positive right, and Y positive up and negative down. On a narrow display the enlarged header remains horizontally scrollable; scroll sideways to reach controls that are outside the visible area.

HELP.FUNCTIONS — Main Functions

CAM, IMAGE, AIP, MULTI, AUTO, MEAS, FILE, CTRL, and VIX

HELP.FUNCTIONS.015 — CAM

SRC selects BACK, FRONT, or EXT / UVC. AUTO selects a safe UVC mode; R− / R＋ and APLY provide detailed mode selection inside CAM, while the header RES button is the faster resolution shortcut. URST retires and rebuilds the complete microscope USB session: UVC camera/preview plus CP2102 port, initialization, and heartbeat. Android cannot power-cycle a physical USB hub, so URST is a full software reconnect. IQ opens the hardware controls supported by the current camera. TIP sets the guidance-card duration.

HELP.FUNCTIONS.016 — IMAGE

Choose COLOR, GRAY, channel views, EDGE, MAP, FX, Gamma, Adaptive, Sharp, and other processing modes. ROI / FULL selects the processing area. PIP provides a magnified window. QR reads QR codes and barcodes. TEXT OCR lets you draw a rectangle and press READ; when no rectangle is drawn, the full image is used. Leaving QR/TEXT, Reset Image, or Reset All clears their boxes.

HELP.FUNCTIONS.017 — ANALYZE

Histogram, Focus Curve, Color Analysis, and FIELD have independent movable/resizable ROIs. FIELD measures full-view brightness distribution with 7 × 5, 13 × 9, 27 × 19, or 55 × 39 grids. LIVE helps adjust lighting; TEST discards settling frames and averages 30 frames. Switch MAP / CURVE without recapturing the held result.

HELP.FUNCTIONS.018 — AIP

STABILIZE reduces motion, DENOISE combines temporal information, and HDR combines exposure information. Bright monitor-style fields show progress and status; they are information displays, not buttons. Allow an AIP operation to finish before changing the source, resolution, or workspace.

HELP.FUNCTIONS.019 — MULTI — EDF

EDF creates an Enhanced Depth of Focus image from several focus planes. Manual EDF uses START, manual Z adjustment, ADD for each focused plane, then BUILD. Auto EDF uses the controller: move to the first endpoint and SET A, move to the other endpoint and SET B, choose the frame count, then RUN/AUTO. The app moves, settles, captures each plane, and builds the result. Do not operate Z or disconnect USB during the run.

HELP.FUNCTIONS.020 — MULTI — Compare

Compare loads or captures a Reference image and compares it with Live. Use the ROI and alignment controls to match the same area. Nudge or supported position matching can refine alignment. Clear or close Compare when returning to ordinary Live work.

HELP.FUNCTIONS.021 — AUTO

AUTO detects Rectangle, Circle, Two Circle, Shape/Contour, Nut, Tooth/Gear, P-Line, Two Edge, and Line targets. Tap ROI 120 to cycle the search diameter 120 → 180 → 240 → 300 pixels; the visible circular guide and actual search area use the same value. Place the target edge inside the guide, tap the image, review the result, then ACCEPT or CANCEL.

HELP.FUNCTIONS.022 — MEAS

Measure Point, Distance, Angle, Arc, Curve, Polygon, Circle, 3P Circle, and Rectangle. The second row begins with DRAW and TEXT before SEL, UNDO, and DEL. Press DRAW and drag directly on the image for freehand annotation; there is no Free/Line/Arrow submenu. TEXT accepts up to 200 characters with an adjustable 12–96 size. Draw and Text stay attached to image coordinates and scale with Digital Zoom. SAVE writes measurements, Draw, and Text to CSV and DXF with the same center-origin coordinate system. MAN CAL, AUTO CAL, and PATTERN PDF are also under MEAS.

HELP.FUNCTIONS.023 — FILE, CTRL, and VIX

FILE is ordered RAW, PHOTO, SCREEN, SAVE ALL, REC, LOAD, LOCK, LIVE, CAL PATTERN. CAL PATTERN generates one A4 single-up vector master as matching SVG and GBR files under Download/UM Viewer/Calibration Pattern; no camera connection is required. CTRL contains STOP, LED＋, MODE, LED−, and controller status; focus controls remain in the header. VIX SAVE records a repeatable case after a 3-2-1 countdown, and VIX READ offers image/state and compatible hardware restore choices.

HELP.FOCUS — Focus and EDF

Single AF, Full-Area AF, manual focus, and depth fusion

HELP.FOCUS.024 — Choose AF or F-AF

Use AF for a quick controller autofocus on an ordinary subject. Use F-AF when the best focus is uncertain across the full motor travel or when you want the tablet Focus Score to evaluate a selected ROI. Use Z− / Z＋ for final manual adjustment or for choosing Auto EDF endpoints.

HELP.FOCUS.025 — F-AF ROI setup

Opening F-AF centers a 360 × 360 Focus ROI. Drag or resize the yellow box before START so it covers detailed, high-contrast texture and avoids blank background, glare, or moving objects. F-AF uses this ROI only for focus scoring; it does not change IMAGE/AUTO ROIs.

HELP.FOCUS.026 — F-AF progress

Before the motor moves, F-AF saves the current UVC stream, switches to the verified live 640 × 360 mode for faster frame sampling (or the smallest reported mode when 640 × 360 is unavailable), and then begins the five phases. The badge shows 1/5 through 5/5 and the latest confirmed POS value. After reaching Position 0, the coarse scan stops at 100-Position targets. At each confirmed stop it waits for mechanical settling, drains delayed UVC frames, then uses the median of three distinct fresh Focus samples. The fine scan applies the same synchronized sampling at 10-Position spacing before moving to the strongest position. This is slower than continuous scanning but prevents a slow tablet's old image from being assigned to the motor's new Position. After completion, STOP, or failure, the motor stops first and the previous resolution is restored with a real-frame check.

HELP.FOCUS.027 — STOP, failure, and connection

STOP releases the focus motor and exits the active F-AF run. If movement, Position feedback, image sampling, or the USB/UART connection fails, the run stops and may retain the ROI, curve, last Position, and failure phase for inspection. Wait for CTRL to recover before retrying. A real unplug always cancels the operation.

HELP.FOCUS.028 — Auto EDF endpoints

Auto EDF requires two valid Focus Positions. SET A and SET B save the endpoints; GO A / GO B may be used to verify them. The selected frame count determines how many evenly distributed focus planes are captured. Keep the scene and microscope still. Auto EDF and F-AF cannot run at the same time, and both temporarily own the motor and camera sampling path.

HELP.MEASUREMENT — Measurement and Calibration

Coordinates, drawing, calibration, FOV, and recalibration

HELP.MEASUREMENT.029 — Coordinates and units

The complete-image center is (0,0). X is negative left and positive right; Y is positive up and negative down. Before a calibration is accepted, lengths and coordinates use px and areas use px². Only an accepted MAN CAL or AUTO CAL provides physical units. Microscope model, lens, Focus Position, and UVC mode do not estimate the scale.

HELP.MEASUREMENT.030 — Draw, Text, and edit

Press DRAW and immediately drag a finger or stylus on the image to draw freely. For new text, press TEXT: a high-contrast crosshair appears at the image centre. Tap another position or drag the crosshair until its centre marks the intended text origin, then press the first ACCEPT to confirm the position. Enter the text and size in the dialog and press the second ACCEPT to place it. CANCEL leaves either stage without adding text. Select an existing TEXT item and press TEXT again to change its content or size. Draw and Text use image coordinates, so their position, stroke width, and text size follow Pan and scale up or down with Digital Zoom. SEL includes measurements, Draw strokes, and Text in one object order. While MEAS is open, whether a drawing tool is active or MEAS is idle, press and hold for about 2 seconds on any visible control point or on the visible line, curve, arc, circle, rectangle, or polygon boundary of a completed measurement. ViTiny UM switches directly to SEL and selects that exact object; release, then drag a handle to edit it. A normal short tap continues placing measurement points only when a drawing tool is active, and moving before 2 seconds cancels quick selection. Empty image areas do not trigger quick selection or create points while MEAS is idle. Drag selected handles to edit, use UNDO to reverse the latest creation, edit, or deletion, and DEL to remove the selected object. SCREEN and the screen part of SAVE ALL flatten the visible annotations into an image. Draw/Text are not saved in VIX; MEAS SAVE writes them to CSV/DXF and LOAD CSV restores them.

HELP.MEASUREMENT.031 — MAN CAL

Start MAN CAL, mark the two ends of a known reference length, adjust with P−− / P− / P＋ / P＋＋, enter or confirm the physical value, and press ACCEPT. CANCEL restores the previous valid calibration. Use a traceable reference at the same focus plane and optical configuration as the object being measured.

HELP.MEASUREMENT.032 — AUTO CAL

AUTO CAL centers the view at 1.0x and scans the calibration marker. Keep the full circle sharp and evenly lit. If OCR cannot read its letter, tap A-Z and choose the printed letter from the 20-circle pattern. Review the circle, letter and reference diameter, then ACCEPT to apply; CANCEL preserves prior calibration. Undefined letters are disabled. A complete detected circle is required. See Appendix 1.1 for supported letters and resolution-change rules.

HELP.MEASUREMENT.033 — Calibration Pattern PDF

PATTERN PDF saves the built-in A4 12-marker pattern under Download/UM Viewer/Calibration Pattern. Print at 100% / Actual Size, never Fit to Page. Measure the printed edge ruler with a real ruler before using the sheet. Do not use a damaged, scaled, curled, or perspective-distorted print for calibration.

HELP.MEASUREMENT.034 — FOV, magnification, and recalibration

Inspection calculates horizontal FOV and approximate display magnification only from the accepted calibration. Digital Zoom changes the visible FOV and coordinate mapping but not the calibrated source Pixel Size. Recalibrate after changing camera source, lens, focus position, working distance, or any optical/mechanical condition that changes scale.

HELP.UVC — USB / UVC Connection

Identity, permission, formats, resolution, and recovery

HELP.UVC.035 — Camera and controller

A motorized ViTiny microscope can expose both a UVC camera and a CP2102 controller through one internal USB hub. The app treats them as one microscope session: UVC provides images, while CP2102 provides heartbeat, Focus Position, motor, and LED control. Image availability does not by itself mean that CTRL is ready.

HELP.UVC.036 — ViTiny and other UVC devices

A ViTiny UM identity enables all permitted resolutions advertised by the microscope. AF, F-AF, Z− / Z＋, and LED control still require an actual compatible controller. Other UVC devices are limited to their lowest permitted mode when its width is 640 pixels or less; if the lowest mode is wider than 640 pixels, the device is not offered as an external camera.

HELP.UVC.037 — MJPEG and YUYV

MJPEG compresses each frame and normally uses much less USB bandwidth, so it is preferred for high resolution or USB 2.0 paths. YUYV/YUV is uncompressed and can require far more bandwidth. A camera may advertise a mode that the current cable, hub, tablet, or power path cannot stream reliably.

HELP.UVC.038 — Resolution, FPS, and APLY

The header RES menu changes dimensions quickly. CAM provides detailed format, resolution, FPS, and bandwidth choices through R− / R＋ and APLY. A switch is successful only after a real frame arrives, not merely after the native request is accepted. Do not press APLY repeatedly while switching. Higher resolution increases detail but also memory, bandwidth, and processing time.

HELP.UVC.039 — IQ and UM-22 LED Mode

IQ shows only the hardware controls exposed by the current UVC camera; N/A means the firmware does not provide that control. For a verified UM-22, Inspection displays the current LED layout symbol: Modes 1–5 use their matching symbol, while Mode 0/AUTO uses the All symbol. Other microscope models do not show these UM-22 symbols.

HELP.UVC.040 — Disconnect and reconnect

If either side of a combined microscope disappears, the app stops active motor/camera work, releases resources, and enters recovery. Reconnect the cable, grant permission if Android asks again, and wait for UVC plus UART to become ready. The app rebuilds the session; do not rely on the previous preview or send commands while status fields are blank.

HELP.FILES — Files and VIX

Images, video, data, EDF results, and repeatable cases

HELP.FILES.041 — Images

RAW saves the unprocessed UVC source frame at the active camera resolution. PHOTO saves the current processed image. SCREEN saves the complete app interface. SAVE ALL creates RAW, PHOTO, and SCREEN together. Images and EDF results are normally stored under Pictures/UM Viewer.

HELP.FILES.042 — Video

REC saves silent video under Movies/UM Viewer and requires sufficient free storage. ViTiny UM does not request microphone permission or record audio. Stop recording before changing source, switching a conflicting camera mode, disconnecting the microscope, or exiting the app.

HELP.FILES.043 — Measurement, annotation, and OCR files

MEAS → SAVE writes measurements plus Draw/Text as CSV and DXF under Download/UM Viewer using the same center-origin coordinate system. LOAD CSV restores all of them. Draw paths and Text content, anchor, and size are preserved; calibrated units are used when available. Use FILE → SCREEN or SAVE ALL when you also need the exact visible raster appearance. Draw/Text are not written to VIX. IMAGE → TEXT saves OCR text separately under Download/UM Viewer.

HELP.FILES.044 — EDF output

Manual or Auto EDF saves the fused depth image after BUILD completes. The result represents selected focus planes, not a new optical capture. Review edge artifacts, scene movement, illumination changes, and missing planes before saving or measuring the fused image.

HELP.FILES.045 — VIX SAVE

Press and hold VIX SAVE through the 3-2-1 countdown. v1.1 creates VIX_yyyyMMdd_HHmmss.vix under Download/UM Viewer/VIX/Cases. The case file records the complete screen, original UVC frame, supported image settings, measurements, calibration, workspace, UVC settings, and defined microscope state. Verify it immediately with VIX READ.

HELP.FILES.046 — VIX READ

VIX READ primarily opens a v1.1 .vix case and can also validate compatible legacy profile .json and case .zip files. After validation, either load and LOCK the saved Original image or keep the current Live/image and restore STATE. HARDWARE is OFF by default and should be used only when the saved and connected microscope models match. Review source, calibration, Focus, LED, and UVC choices before accepting.

HELP.TROUBLESHOOTING — Troubleshooting

Connection, image, focus, EDF, calibration, and measurement checks

HELP.TROUBLESHOOTING.047 — No UVC device or image

Check microscope power, OTG/USB host support, cable direction, connectors, and Android USB permission. Remove unnecessary USB accessories. Wait for the internal hub to finish enumeration, then reconnect once or use CAM → URST. Try a shorter certified cable and sufficient power before changing software settings.

HELP.TROUBLESHOOTING.048 — Live works but CTRL is unavailable

The UVC camera and CP2102 controller are separate USB functions. Wait for UART initialization and heartbeat recovery. Confirm that Inspection shows the microscope identity and controller fields. Do not press AF, F-AF, Z, Auto EDF, or LED controls until CTRL is ready. If it does not recover, reconnect the complete microscope rather than only restarting the preview.

HELP.TROUBLESHOOTING.049 — Black, flickering, or unstable image

Return to a smaller MJPEG resolution, wait for switching to finish, and verify that real frames continue to arrive. Check LED illumination, exposure, gain, and AE in IQ when supported. Avoid repeated APLY presses. A mode that appears briefly can still be unsuitable for the available cable, hub, power, or bandwidth.

HELP.TROUBLESHOOTING.050 — Low FPS or slow processing

Lower the resolution, prefer MJPEG, close heavy background apps, and disable image functions that are not required. FIELD, OCR, HDR, Denoise, EDF, AUTO detection, and high-resolution recording require additional processing. The measured Live FPS may be lower than the requested descriptor value on a limited USB path.

HELP.TROUBLESHOOTING.051 — F-AF or Auto EDF will not start

Confirm a stable Live UVC image, CTRL ready, valid Focus Position, and no other camera/motor operation in progress. For F-AF, place a detailed ROI and press START. For Auto EDF, SET both A and B to different valid positions and select a frame count. If a real disconnect occurs, wait for recovery and set the endpoints again before retrying.

HELP.TROUBLESHOOTING.052 — AUTO CAL cannot recognize a marker

Keep the entire circle visible, sharp and evenly lit at centered 1.0x. If the circle is outlined but OCR fails, use A-Z to select the printed 20-circle letter, verify the reference diameter, then ACCEPT. CANCEL preserves prior calibration. Without a complete detected circle, improve focus/framing and scan again. See Appendix 1.1.

HELP.TROUBLESHOOTING.053 — Measurement scale looks wrong

Check whether the app reports Need Calibration. Recalibrate after any physical source, lens, focus, or working-distance change. Confirm the printed/manual reference dimension and coordinate units. Digital Zoom alone is mapped automatically, but a loaded image or VIX case must carry a valid matching calibration before physical units can be trusted.

HELP.PRIVACY — Privacy Policy

On-device processing, local files, ML Kit telemetry, and contact

HELP.PRIVACY.054 — On-device processing

Microscope images and video, image processing, OCR, QR/barcode recognition, manual measurement, and automatic measurement are primarily processed on this Android device. ViTiny UM does not upload images, recognized text, codes, or measurement results to a Microlinks-operated server.

HELP.PRIVACY.055 — Files and user control

Images, video, OCR text, measurements, calibration data, and VIX cases are saved or exported only when you request the corresponding action. They remain on the device or in the storage location you choose. If you later open, copy, back up, or share a file with another app or service, that provider's privacy terms apply.

HELP.PRIVACY.056 — No account, ads, or data sale

ViTiny UM has no user account, no advertising, no Microlinks-operated cloud service, and no payment function. Microlinks does not sell personal data collected through this app.

HELP.PRIVACY.057 — Google ML Kit

Bundled Google ML Kit is used for OCR and barcode recognition. According to Google's Android data-disclosure information, ML Kit may transmit app/device information, a per-install identifier, and performance or diagnostic telemetry. The bundled APIs do not send input images or recognized text/barcode results to Google.

HELP.PRIVACY.058 — External links

A web address opened from the app is handled by the device browser. The browser and destination website process any resulting data under their own privacy policies.

HELP.PRIVACY.059 — Contact and complete policy

Questions: mltc@vitiny.com. Complete policy: https://www.vitiny.com/privacy/vitiny-usb-microscope

HELP.ABOUT — Product and Safety

Product information, accuracy limits, compatibility, and licenses

HELP.ABOUT.060 — Company and product

ViTiny UM (UM = USB Microscope) · Microlinks Technology Co. · www.vitiny.com

HELP.ABOUT.061 — Measurement accuracy

ViTiny UM measurements are reference values and are not guaranteed for accuracy. Results depend on calibration, reference quality, focus, image quality, optics, camera/lens/resolution, installation, operator technique, and environment. Independently verify critical results with an appropriate calibrated instrument and procedure.

HELP.ABOUT.062 — Professional and safety use

The app does not replace independent professional inspection, regulatory compliance confirmation, medical diagnosis, or safety-critical measurement. The user is responsible for assessing risk and following all requirements applicable to the intended use.

HELP.ABOUT.063 — Compatibility and data

Functions and results vary with Android device, operating-system version, UVC device, cable/hub, power, and bandwidth. Check saved images, measurements, OCR, EDF, and VIX cases before use, keep separate backups, and do not use one app file as the sole evidence or sole data source.

HELP.ABOUT.064 — Open-source notices

ViTiny UM uses third-party components including saki4510t UVCCamera modules, libuvc, libusb, libjpeg-turbo, and RapidJSON. Original copyright and license notices are retained in the distributed source package and licenses/OPEN_SOURCE_NOTICES.md. Keep the applicable notices when redistributing source or binaries.

HELP.ABOUT.067 — Operating recommendation

Use a landscape tablet, stable power, a short reliable USB cable, and a clean optical setup. Save important results in more than one form and verify calibration before each critical measurement session.

Appendix C On-screen OPTIONS reference

> **Note** The OPTIONS cards contain 15 groups and 167 lines. An icon line is actionable; a context line is a condition or state and must not be treated as a button. The same label can mean different commands in different workspaces.

CAMERA OPTIONS

CAMERA OPTIONS — UI action	Purpose and result	kind
SRC	Select Back, Front, or EXT / UVC camera	icon
R- / R+	Select the previous or next UVC resolution	icon
APLY	Apply the selected UVC mode	icon
AUTO	Select and apply the best available UVC mode	icon
URST	Rebuild the UVC camera and CP2102 controller software session	icon
IQ	Adjust UVC brightness, contrast, sharpness, and related controls	icon
INFO	Show current camera, USB, resolution, and FPS details	icon
TIP	Cycle Hint timing: 1 second (default), Off, Hold, or 3 seconds	icon
HEADER	FREEZE / LIVE, AF, Z-, and Z+ stay available in every workspace	context
TOUCH	Pinch to zoom; drag to pan	icon
HOLD CAM	Open HOME VIEW RESET; confirm RESET WORKSPACE to restore the initial workspace	context

IMAGE OPTIONS

IMAGE OPTIONS — UI action	Purpose and result	kind
ROI / FULL	Cycle 200 / 400 / 800 / FULL processing area	icon
PIP	Open the 2X / 4X / 8X magnifier	icon
PIP PANEL	Use PIP-, PIP xX, PIP+, and LOCK / UNLOCK	icon
QR	Read QR or barcode content from the current image	icon
TEXT	Draw an OCR area; without a box, READ scans the full image	icon
TEXT PANEL	READ, CLEAR, SAVE TXT, or EXIT OCR	icon
COLOR	Color, Red, Green, Blue, HSV, and LAB	icon
GRAY	Gray, Binary, Adaptive Binary, and CLAHE	icon
EDGE	Edge, Sharp, Sobel X/Y, and Canny	icon
MAP	Jet, Hot, and Turbo false-color maps	icon
FX	Emboss, Invert, and Gamma	icon
ANALYZE	Histogram, Color, and Focus use the original centred 1x image and lock Digital Zoom / Pan	icon
HIST	Cycle Histogram: 200, 400, Full Area, then Off	icon
COLOR	Inside ANALYZE, inspect a color sample	icon
FOCUS	Cycle Focus ROI: 200, 400, Full Area, then Off	icon

IMAGE OPTIONS — UI action	Purpose and result	kind
FIELD	Inside ANALYZE, map brightness uniformity relative to the image center	icon
HEADER	FREEZE / LIVE, AF, Z-, and Z+ are global header controls	context
ROI DRAG	Drag the processing frame; available sizes follow source resolution	context
OCR PATH	SAVE TXT writes to Download/UM Viewer	context
HOLD IMAGE	Return to Color and clear every IMAGE Overlay layer	context

AIP OPTIONS

AIP OPTIONS — UI action	Purpose and result	kind
STABILIZE	Reduce movement in the Live display	icon
DENOISE	Reduce sensor noise in Still or Live mode	icon
HDR	Merge exposure frames for bright and dark detail	icon
HEADER	Use global AF / Z- / Z+ for focus; automated scans may temporarily disable them	context
HOLD AIP	Cancel the current temporary AIP workspace state	context

MULTI OPTIONS

MULTI OPTIONS — UI action	Purpose and result	kind
EDF	Fuse multiple focus planes into one extended-depth image	icon
COMPARE	Align and inspect Live against a Reference image	icon
HEADER	Use global AF / Z- / Z+ before collecting focus planes	context
HOLD MULTI	Cancel the current temporary Multi-image workspace state	context

MEASURE OPTIONS

MEASURE OPTIONS — UI action	Purpose and result	kind
POINT	Mark one image coordinate	icon
DIST	Measure distance between two points	icon
ANG	Measure an angle using three points	icon
ARC	Measure arc length and angle	icon
CURV	Measure a multi-point curve	icon
POLY	Measure polygon area and perimeter	icon
CIRC	Measure circle diameter and area	icon
3P CIRC	Create a circle from three circumference points	icon
RECT	Measure rectangle width, height, and area	icon
SEL	Select a saved measurement for editing	icon
UNDO	Undo the latest measurement action	icon
DEL	Delete the selected measurement	icon

MEASURE OPTIONS — UI action	Purpose and result	kind
SAVE	Export measurements + Draw/Text as CSV + DXF to Download/UM Viewer	icon
LOAD CSV	Load previously saved measurements	icon
CLEAR ALL	Press twice to remove all measurements	icon
EXIT	Leave the current selected-measurement edit session	icon
MAN CAL	Draw a known length; press again as CANCEL while drafting	icon
AUTO CAL	Position the calibration marker and run automatic calibration	icon
PATTERN PDF	Save the A4 calibration pattern; print at 100% and verify its edge ruler	icon
P-- / P++	Fine-adjust the manual calibration pixel length	icon
ACCEPT	Apply the prepared manual calibration	icon
HEADER	Use global AF / Z- / Z+ to focus before MAN CAL or AUTO CAL	context
UNITS	Results use mm when calibrated and px when calibration is unavailable	context

AUTO OPTIONS

AUTO OPTIONS — UI action	Purpose and result	kind
RECT	Detect an outer rectangle or object extent	icon
CIRC	Detect one circle	icon
2 CIRCLE (Guidance: 2-CIRC)	Detect two circles and their center distance	icon
SHAPE	Find and review an outer contour	icon
NUT	Find a nut-shaped object	icon
TOOTHS (Guidance: TOOTH)	Measure an external spur gear and bore	icon
2-EDGE	Detect two edges and their spacing	icon
P-LINE (Guidance: LINE)	Detect a single line	icon
SEARCH	Move the search area to the target, then tap the image	icon
ACCEPT	Keep the reviewed result as a measurement	icon
CANCEL	Discard only the current review result	icon
CALIBRATION	MAN CAL and AUTO CAL are now under MEAS	context
HEADER	Global AF / Z- / Z+ remain available until an automatic run locks motor control	context
HOLD AUTO	Clear the current unaccepted Auto result and return Auto to ready state	context

FILE OPTIONS

FILE OPTIONS — UI action	Purpose and result	kind
RAW	Save the source frame before App IMAGE processing at the active UVC resolution; the file is JPEG quality 95	icon
PHOTO	Save the current processed image	icon
SCREEN	Save the current application screen	icon

FILE OPTIONS — UI action	Purpose and result	kind
SAVE ALL	Save RAW, PHOTO, and SCREEN only, in that order; REC/video, CSV, and VIX are not included	icon
REC / STOP	Start or stop silent H.264 MP4 Live recording; UVC is normally 15 fps	icon
LOAD	Open an image or video for inspection	icon
LOCK	Keep a loaded still image active for VIEW and MEAS	icon
UNLOCK	Allow a tap on the loaded still image to return to Live	icon
LIVE	Leave loaded media and return to the live camera	icon
CAL PATTERN	Generate one A4 single-up calibration master as matching vector SVG and GBR files	icon
COMPACT UI	Narrow screens wrap the FILE buttons into additional rows without changing their order	context
IMAGE PATH	PHOTO / RAW / SCREEN: Pictures/UM Viewer	context
VIDEO PATH	REC: Movies/UM Viewer	context
PATTERN PATH	SVG / GBR: Download/UM Viewer/Calibration Pattern	context

MICROSCOPE CONTROL

MICROSCOPE CONTROL — UI action	Purpose and result	kind
STOP	Stop the focus motor immediately	icon
LED+	Hold to raise illumination; release to stop	icon
MODE	Cycle LED modes M0 to M5, then AUTO	icon
LED-	Hold to lower illumination; release to stop	icon
STATUS	The status bar reports controller, focus, LED, and model state	icon
HEADER	AF, Z-, and Z+ are global controls in the top header	context
HOLD CTRL	Cancel the current temporary CTRL workspace state	context

AIP › STABILIZE

AIP › STABILIZE — UI action	Purpose and result	kind
← AIP	Return to the three AIP tools	icon
STAB ON/OFF	Enable or disable Live display stabilization	icon
SOFT	Use gentle correction for low vibration	icon
STD	Use the balanced standard preset	icon
STRONG	Use stronger correction for more movement	icon
GAIN	Cycle correction strength	icon
RANGE	Cycle the maximum motion search distance	icon
LIM	Cycle the maximum applied correction	icon
RESP	Cycle how quickly correction follows movement	icon
RATE	Cycle stabilization sampling rate	icon

AIP › STABILIZE — UI action	Purpose and result	kind
RESET	Clear the current stabilization reference	icon
LIVE ONLY	Does not change RAW, PHOTO, Capture, or measurement coordinates	context

AIP › DENOISE

AIP › DENOISE — UI action	Purpose and result	kind
← AIP	Return to the three AIP tools	icon
STILL / LIVE	Choose one still fusion or continuous Live denoise	icon
LOW / MID / HIGH	Use 3 / 5 / 8 frames for increasing noise reduction	icon
DISPLAY	Bright monitor-style fields show frame information and status only; they are not buttons	context
CAPTURE	In STILL mode, capture and denoise one frame set	icon
START / STOP	In LIVE mode, start or stop continuous denoise	icon
STATUS	Shows frame count, progress, or DENOISE READY	icon
LIVE / CLEAR	Leave the result and return to normal Live	icon
KEEP STILL	Keep the specimen stationary while still frames are collected	context

AIP › HDR

AIP › HDR — UI action	Purpose and result	kind
← AIP	Return to the three AIP tools	icon
STILL / LIVE	Choose one HDR capture or continuous Live HDR	icon
STEP	Cycle the exposure-bracket step	icon
LOW · MID · HIGH	The bright display shows the three exposure levels used for the bracket	icon
DISPLAY	Monitor-style fields show exposure and processing information only; they are not buttons	context
CAPTURE	In STILL mode, collect and merge one HDR bracket	icon
START / STOP	In LIVE mode, start or stop cyclic HDR	icon
STATUS	Shows processing progress or HDR READY	icon
LIVE / CLEAR	Leave the HDR result and return to normal Live	icon
KEEP STILL	Keep the specimen still until HDR processing finishes	context
4K LIMIT	Use a lower UVC resolution when HDR is unavailable at 4K	context

MULTI › EDF

MULTI › EDF — UI action	Purpose and result	kind
← MULTI	Return to the Multi-image tools	icon
MANUAL / AUTO	Select manual frame collection or automatic motor scan	icon
START	Begin a Manual EDF session	icon
ADD	Add the current focus plane to the Manual EDF set	icon

MULTI › EDF — UI action	Purpose and result	kind
BUILD	Fuse two or more captured planes	icon
SET A / SET B	Store the two focus-motor range endpoints for Auto EDF	icon
FR- / FR+	Choose the number of automatic focus planes	icon
RUN / STOP	Start or stop the automatic A-to-B EDF scan	icon
SAVE	Save the fused EDF image to Pictures/UM Viewer	icon
CLEAR	Clear the current EDF session or result	icon
EXIT	Leave EDF and return to the Multi-image tools	icon
HEADER	Use global AF / Z- / Z+ before ADD or SET A / SET B	context
KEEP STILL	Do not move the specimen while planes are being collected	context

MULTI › COMPARE

MULTI › COMPARE — UI action	Purpose and result	kind
← MULTI	Return to the Multi-image tools	icon
LOAD REF	Open a JPEG Reference; it does not replace Live or RAW	icon
MATCH REF	Start matching recorded position and illumination	icon
CONFIRM POS	Confirm the prepared Reference position	icon
LIVE L / R	Choose the Live side in SPLIT view	icon
OVERLAY	Layer Reference over full-size Live at 50% opacity	icon
BLINK	Alternate full Live and Reference every 0.5 seconds	icon
REF x.xX	Reset Reference zoom and pan to 1.0X	icon
STEP	Cycle the Reference nudge distance in pixels	icon
← ↑ ↓ →	Move Reference by the selected nudge step	icon
ROI VIS / CTR	Analyze the visible field or the center 60%	icon
ALIGN	Apply automatic X/Y translation when VIEW zoom matches	icon
COMPARE	Report SIM, STR, and LUM for the current position	icon
HEAT ON/OFF	Show or hide the difference heat-map	icon
CLEAR	Remove the loaded Reference image	icon
DRAG / PINCH	Operate the Reference pane or the overlaid Reference	context

VIX SAVE

VIX SAVE — UI action	Purpose and result	kind
HOLD	Hold through the 3-2-1 countdown to save a case	context
CASE	Save workspace, settings, source image, and current screen	icon
SAVE PATH	Download/UM Viewer/VIX/Cases	context
FORMAT	v1.1 saves a .vix case for validated VIX READ and repeatable setup	icon

VIX READ

VIX READ — UI action	Purpose and result	kind
OPEN	Open `.vix` from Download/UM Viewer/VIX/Cases; compatible `.json`/`.zip` can also be validated	icon
IMAGE	Choose saved image + LOCK or keep the current Live / image	icon
STATE	Restore workspace settings, calibration, and measurements	icon
HARDWARE	Optional only when the saved and current microscope models match	icon

Appendix D Complete short HINT reference

> **Note** A short hint is an immediate status message, not proof that a result is valid or fully saved. After READY or SAVE messages, still verify output, calibration, and source state as described in this manual.

Hint ID	On-screen message
HINT.001	Generating A4 CAL PATTERN...
HINT.002	DEVICE CAMERA ViTiny UM is designed primarily for USB microscopes. Many functions are unavailable with the tablet / phone camera. Need calibration.
HINT.003	POINT mode Tap to place a point marker
HINT.004	DIST / LINE Tap point A Tap DIST off to Zoom/Pan Tap DIST again for point B
HINT.005	ANG mode Tap points; turn ANG off to Zoom/Pan Tap ANG again to continue
HINT.006	ARC mode Tap points; turn ARC off to Zoom/Pan Tap ARC again to continue
HINT.007	CURVE mode Tap points; turn CURV off to Zoom/Pan Tap CURV again to continue
HINT.008	POLY mode Tap points; turn POLY off to Zoom/Pan Tap POLY again to continue
HINT.009	CIRC mode Tap center / edge; turn CIRC off to Zoom/Pan Tap CIRC again to continue
HINT.010	3P CIRC mode Tap three points on the circumference Third point completes the circle
HINT.011	RECT mode Tap corners; turn RECT off to Zoom/Pan Tap RECT again to continue
HINT.012	SELECT No measurement
HINT.013	SELECT exited
HINT.014	CLEAR ALL completed
HINT.015	EDIT saved
HINT.016	CAL DRAFT Tap A and B, adjust P, then ACCEPT
HINT.017	CAL Press CAL to start a draft
HINT.018	CAL DRAFT Tap A and B before adjusting
HINT.019	CAL DRAFT Tap A and B before ACCEPT
HINT.020	CAL CANCELLED Previous calibration restored

Hint ID	On-screen message
HINT.021	CLEAR ALL Press again within 3.5 seconds
HINT.022	VIEW COLOR
HINT.023	VIEW GRAY
HINT.024	VIEW RED CHANNEL
HINT.025	VIEW GREEN CHANNEL
HINT.026	VIEW BLUE CHANNEL
HINT.027	VIEW GAMMA OFF
HINT.028	VIEW FULL PROCESSING Speed may be reduced
HINT.029	Histogram ON
HINT.030	Histogram OFF
HINT.031	Color Analysis OFF
HINT.032	Color Analysis ON Drag sample box Tap: change size Double tap: reset
HINT.033	Focus Curve ON
HINT.034	Focus Curve OFF
HINT.035	FIELD UNIFORMITY ON Grid values = % of center brightness
HINT.036	FIELD UNIFORMITY OFF
HINT.037	OVERLAY ALL
HINT.038	OVERLAY CENTER + UPPER-RIGHT SCALE
HINT.039	OVERLAY CENTER + GRID
HINT.040	OVERLAY UPPER-RIGHT SCALE + GRID
HINT.041	OVERLAY CENTER
HINT.042	OVERLAY UPPER-RIGHT SCALE
HINT.043	OVERLAY GRID
HINT.044	OVERLAY OFF
HINT.045	QR / Barcode ON
HINT.046	QR / Barcode OFF
HINT.047	TEXT OCR ON Drag a rectangle, then press READ No box = full image
HINT.048	TEXT OCR OFF
HINT.049	TEXT OCR CLEARED

Hint ID	On-screen message
HINT.050	PIP MAGNIFIER ON Wheel: 2x / 4x / 8x Double-tap yellow frame
HINT.051	PIP MAGNIFIER OFF
HINT.052	PIP POSITION LOCKED
HINT.053	PIP FOLLOW CURSOR
HINT.054	MANUAL EDF START / Z adjust / ADD / BUILD
HINT.055	AUTO EDF SET A / SET B / choose FR / AUTO
HINT.056	AUTO RECTANGLE Place crosshair on solid object, then tap
HINT.057	AUTO SHAPE Place intended edge inside the ring, then tap
HINT.058	AUTO NUT Place outer hex edge inside the ring, then tap
HINT.059	AUTO TOOTH Place one outside tooth edge inside the ring, then tap
HINT.060	AUTO LINE Tap inside a line or gap
HINT.061	2-EDGE DIST Tap the first black/white boundary

Appendix E AI retrieval rules and synonyms

This appendix defines the answer order and fixed four-language vocabulary for machine retrieval. Human readers can use it to disambiguate abbreviated UI labels as well.

100. First identify the workspace and full command ID. Labels such as LIVE, AUTO, SAVE, LOCK, and TEXT have different meanings in different workspaces.
101. Separate UVC image readiness from CP2102 control readiness. A Live image does not prove that AF, Z, or LED control is available.
102. For an operating answer, give prerequisites, visible label and steps, expected result, output path, limits, and recovery—in that order.
103. Before giving physical dimensions, verify that applicable calibration exists. Without it, report px only. Recalibrate after changes to Focus Position, lens, working distance, or optical/mechanical scale.
104. RAW is the UVC source frame before App IMAGE processing, but the saved output is still JPEG, not Bayer/DNG. SAVE ALL means RAW + PHOTO + SCREEN only; it excludes video, CSV, and VIX.
105. Long-press FILE clipboard capture, FILE SCREEN, PHOTO, and VIX serve different purposes. Ask whether the user needs image content, the full screen, editable measurements, or a reproducible case.
106. AUTO, OCR, QR, EDF, Compare, measurement, and calibration results require human review. Do not treat them as safety, medical, regulatory, or metrology certification.
107. If model, firmware, Android picker behavior, or hardware support has not been verified, say that it depends on the device or requires a physical-device test; do not invent a fixed value.

Fixed vocabulary

ID	English term
T001	ViTiny USB Microscope (Android)
T002	app / application
T003	USB microscope
T004	UVC (USB Video Class)
T005	CP2102 controller
T006	USB Host / OTG
T007	Camera permission
T008	USB device permission
T009	UVC camera
T010	microscope controller
T011	camera source
T012	device camera
T013	external UVC camera
T014	USB session
T015	software reconnect
T016	device enumeration
T017	heartbeat
T018	ready
T019	busy
T020	unavailable / N/A
T021	Live image
T022	still image
T023	loaded media

ID	English term
T024	workspace
T025	Inspection window
T026	Focus Position
T027	Pixel Size
T028	field of view (FOV)
T029	approximate display magnification
T030	working distance
T031	calibration
T032	recalibration
T033	calibration marker
T034	calibration reference
T035	active UVC resolution
T036	frame
T037	frame rate (FPS)
T038	USB bandwidth
T039	hardware image-quality control (IQ)
T040	processed image
T041	top header controls
T042	RES resolution menu
T043	FREEZE
T044	header LIVE
T045	AF autofocus
T046	F-AF fine autofocus
T047	Z− / Z＋ focus movement
T048	STOP focus-motor stop
T049	Reset Image
T050	Reset All
T051	AUTO CAL shortcut
T052	OVERLAY
T053	CAM
T054	SRC
T055	BACK camera
T056	FRONT camera
T057	EXT / UVC
T058	R− / R＋ UVC mode selection
T059	APLY
T060	CAM AUTO
T061	URST

ID	English term
T062	IQ
T063	INFO
T064	TIP
T065	guidance card
T066	short Hint
T067	ROI (region of interest)
T068	FULL processing area
T069	PIP magnifier
T070	PIP LOCK / UNLOCK
T071	QR / Barcode
T072	TEXT OCR
T073	OCR READ
T074	OCR CLEAR
T075	SAVE TXT
T076	EXIT OCR
T077	COLOR
T078	GRAY
T079	Binary
T080	Adaptive Binary
T081	CLAHE
T082	EDGE
T083	Sharp
T084	Sobel X/Y
T085	Canny
T086	false-color MAP
T087	Emboss
T088	Invert
T089	Gamma
T090	ANALYZE
T091	Histogram
T092	Color Analysis
T093	Focus Curve
T094	Field Uniformity
T095	AIP
T096	STABILIZE
T097	DENOISE
T098	HDR
T099	STILL mode

ID	English term
T100	AIP LIVE mode
T101	CAPTURE
T102	START / STOP
T103	LOW / MID / HIGH
T104	GAIN
T105	RANGE
T106	LIM
T107	RESP
T108	RATE
T109	stabilization RESET
T110	MULTI
T111	EDF (extended depth of field)
T112	Manual EDF
T113	Auto EDF
T114	focus plane
T115	EDF START
T116	EDF ADD
T117	EDF BUILD
T118	SET A / SET B
T119	FR− / FR＋
T120	EDF RUN / STOP
T121	EDF SAVE
T122	EDF CLEAR
T123	EDF EXIT
T124	COMPARE
T125	Reference image
T126	LOAD REF
T127	MATCH REF
T128	CONFIRM POS
T129	Split view
T130	BLINK
T131	ALIGN
T132	difference heat map
T133	similarity score (SIM)
T134	structure score (STR)
T135	luminance score (LUM)
T136	AUTO measurement
T137	MEAS

ID	English term
T138	Point
T139	Distance
T140	Angle
T141	Arc
T142	Curve
T143	Polygon
T144	Circle
T145	3-point circle
T146	Rectangle
T147	Two circles
T148	Shape / contour
T149	Nut
T150	Tooth / spur gear
T151	Two-edge distance
T152	Line detection
T153	Search area
T154	ACCEPT
T155	CANCEL
T156	DRAW freehand annotation
T157	MEAS TEXT annotation
T158	SEL
T159	UNDO
T160	DEL
T161	MEAS SAVE
T162	LOAD CSV
T163	CLEAR ALL
T164	MAN CAL
T165	AUTO CAL
T166	PATTERN PDF
T167	CAL PATTERN
T168	pixel unit (px)
T169	millimetre unit (mm)
T170	center-origin coordinate system
T171	editable handle
T172	annotation
T173	measurement object
T174	calibration draft
T175	accepted calibration

ID	English term
T176	RAW source-frame JPEG
T177	PHOTO
T178	SCREEN
T179	SAVE ALL
T180	REC / STOP
T181	FILE LOAD
T182	FILE LOCK / UNLOCK
T183	FILE LIVE
T184	VIX
T185	VIX SAVE
T186	VIX READ
T187	VIX case (.vix; compatible import: .json / .zip)
T188	VIX IMAGE
T189	VIX STATE
T190	VIX HARDWARE
T191	JPEG (.jpg)
T192	measurement CSV / DXF
T193	OCR text (.txt)
T194	Calibration PDF / SVG / GBR
T195	Pictures/UM Viewer
T196	Movies/UM Viewer
T197	Download/UM Viewer
T198	Download/UM Viewer/VIX/Cases
T199	Download/UM Viewer/Calibration Pattern
T200	Android system Back / main EXIT / tool EXIT

Support contact

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ViTiny USB Microscope Android v1.1 | End of User Manual

Appendix 1.1 - Calibration updates

Software 1.1 / version code 286 | Revised 2026-09-08

1.1: calibration after resolution changes

After calibration is accepted, changing UVC resolution alone preserves it when the optics and horizontal field of view remain the same. The app adjusts the preview measurement scale for the new image dimensions after receiving actual frames. Changing resolution does not repair an already invalid calibration. If a mode crops the image or changes the physical field of view, or if the source, lens, focus or working distance changes, recalibrate. Check a known reference dimension after switching modes.

A-Z: manual calibration letter

When AUTO CAL outlines a complete circle but OCR cannot read its center letter, tap A-Z and choose the letter printed inside that circle. This selector uses the 20-circle pattern (30 mm to 0.05 mm): A B C D E F G H J K L M N P R T U V X Y. I O Q S W Z are disabled because no reference diameter is defined. Check the selected letter, reference diameter and detected circle before pressing ACCEPT to apply calibration. CANCEL discards the pending result and preserves the previous calibration. If no complete circle is detected, improve focus, lighting and framing and scan again. Do not use this selector with the legacy 12-marker pattern; its letter-to-size mapping is different.

Some screenshots illustrate the earlier interface. The revised text and this appendix describe version 1.1.

20-circle reference diameters

This table is for the 20-circle pattern. It is not the legacy 12-marker PDF. Reference values below are rounded for display; the app uses its stored precision.

Letter	Diameter (mm)
A	30.000000
B	21.424109
C	15.299748
D	10.926116
E	7.802743
F	5.572227
G	3.979333
H	2.841789
J	2.029427
K	1.449289

Letter	Diameter (mm)
L	1.034991
M	0.739125
N	0.527836
P	0.376948
R	0.269192
T	0.192240
U	0.137286
V	0.098041
X	0.070015
Y	0.050000

Disabled letters: I O Q S W Z. These letters have no defined reference diameter. Do not choose a different letter to force acceptance.