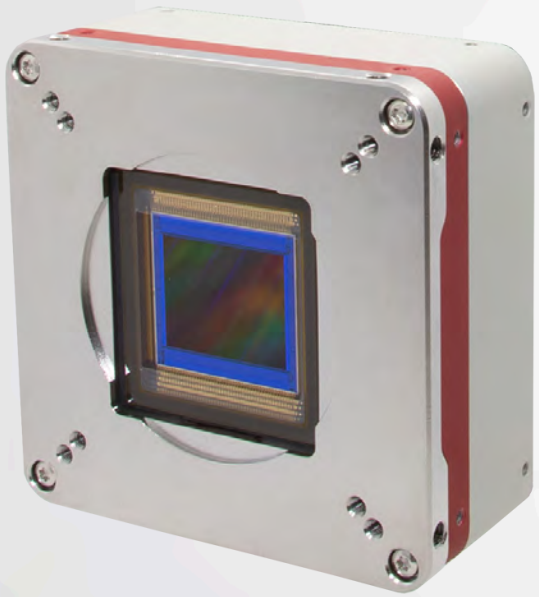
# Preliminary Specification

## Q-21A230x/CXP-PA

Adimec
Excellence in Imaging



CoaXPress

The QUARTZ Q-21A230x/CXP-PA camera, or in short the Q-21 Performance, brings 5120 by 4096 high quality pixels to the image for real time metrology tasks with a reliable high speed CoaXPress interface. With 21 megapixel resolution and 228.8 frames per second of measurement speed, the Q-21A230 can greatly improve the precision and throughput of your system. All image information is preserved by Adimec's True Accurate Imaging technique and state of the art global shutter sensor technology.

The Q-21 Performance delivers the best image quality combined with optimal heat management, which makes it the perfect fit for Semiconductor Back End applications. Different operating modes which optimize for maximum dynamic range, high full well or high sensitivity, provide easy system integration with ideal performance under various demanding conditions. The camera offers Adimec Connect & Grab™ allowing engineers to start system development at camera arrival.

Typical application examples: Semiconductor metrology tools; Wafer inspection; Bump inspection; RDL inspection; Digital pathology

- 5120 x 4096 at 228.8 fps
- Active sensor alignment
- High full well, maximum dynamic range and low read noise
- Device-to-device repeatability
- Low frequency flat field correction in bright
- CXP-12 interface for 4 x 12.5 Gb/s

## Performance

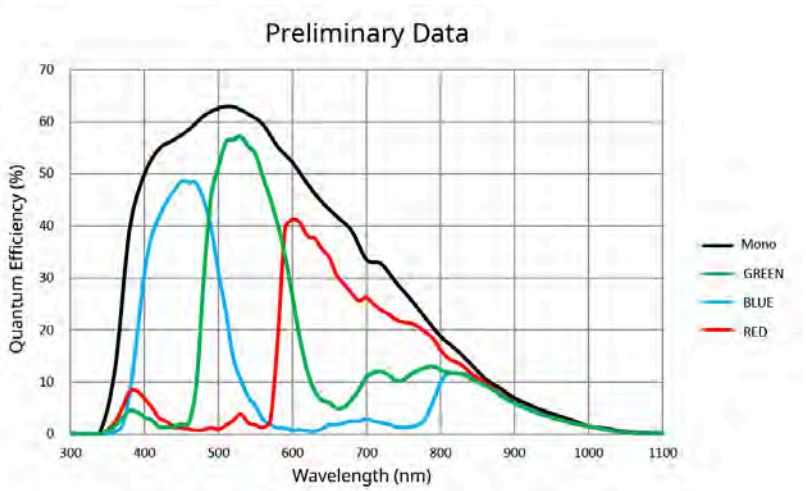
| | |
|---|---|
| Type | GPIXEL GSPRINT4521 |
| Architecture | CMOS progressive scan Global Shutter |
| Sensor diagonal | 29.5 mm (23.04 x 18.43 mm) |
| Pixel size | 4.5 µm x 4.5 µm |
| Active pixels | 5120 (H) x 4096 (V) |
| Maximum framerate | 228.8 in 1X_1Y tap format, 225.6 in 1X_2YE tap format |
| Parasitic light sensitivity | < 1/20000 |
| Microlenses | Yes |

### Gain modes (typical values @ 12 bit)

| Mode | Max full well | High full well | Max dynamic range | High sensitivity |
|---|---|---|---|---|
| Analog gain | 1 | 1.5 | 2.2 | 4.8 |
| Full well | 33.6 ke- | 22.4 ke- | 15.3 ke- | 7.0 ke- |
| Dynamic range | 66.7 dB | 67.3 dB | 68.7 dB | 66.5 dB |
| Temporal dark noise | 15.5 e-* | 9.7 e-* | 5.6 e-* | 3.3 e-* |

* Based on EMVA1288 measurements performed in 12 bit sensor mode at 529 nm.

### Quantum Efficiency




## Environmental

### Operating

| | |
|---|---|
| Sensor temperature | +5°C to +60°C |
| Humidity (relative) | 20% - 80% non-condensing |
| Shock | 10 g, half sine shape, 6-10ms duration in ±X, ±Y and ±Z |
| Vibration | 3 g sinusoidal vibration sweeps 5 - 150 Hz |

### Storage

| | |
|---|---|
| Ambient temperature | -25°C to +65°C |
| Humidity (relative) | 5% - 95% non-condensing |
| Shock | 25 g, half sine shape, 6-10 ms duration in ±X, ±Y and ±Z |
| Vibration | 10 g sinusoidal vibration sweeps 5 - 150 Hz |

# Characterization

## Defect pixel limits

| | |
|---|---|
| Defect pixel threshold in dark image ($t_{exp}$ = 15 µs) | > 205 $DN_{12}$ |
| Defect pixel threshold in bright image ($t_{exp}$ < 50 ms) | +/- 20% wrt local neighborhood pixels |
| Defect pixel threshold in saturated image ($t_{exp}$ < 100 ms) | < -20% wrt local neighborhood pixels |
| Max total defect pixels | 400 |
| Max clusters of size = 2-4 (monochrome) | 12* |
| Max clusters of size = 4 (color)** | 12* |
| Max clusters of size > 4 | 0 |
| Defect column/row threshold in dark image ($t_{exp}$ = 15 µs) | > 123 $DN_{12}$ wrt local neighborhood columns/rows |
| Defect column/row threshold in bright image ($t_{exp}$ < 50 ms) | +/- 5% wrt local neighborhood columns/rows |
| Defect column/row threshold in saturated image ($t_{exp}$ < 100 ms) | +/- 5% wrt local neighborhood columns/rows |
| Max total defect column/row | 0 |

These limits are applied during the factory calibration of the defect pixel map for the defect pixel correction.

Measurement conditions: No filter or lens; Light source: uniform LED; F-number = 2; Sensor temperature = 60°C

* Clusters with 4 consecutive defect pixels in a row are not allowed.

** Clusters are detected within the same Bayer color plane.

## Acceptance Test Limits

| | | |
|---|---|---|
| Dark Signal Non-Uniformity | < 5 e- | |
| Pixel Response Non-Uniformity | < 1.5 % rms | |
| Sensitivity matching per gain mode | Lower limit | Upper limit |
| - Max full well | 0.116 $DN_{12}$/e- | 0.128 $DN_{12}$/e- |
| - High full well | 0.174 $DN_{12}$/e- | 0.192 $DN_{12}$/e- |
| - Max dynamic range | 0.255 $DN_{12}$/e- | 0.278 $DN_{12}$/e- |
| - High sensitivity | 0.556 $DN_{12}$/e- | 0.615 $DN_{12}$/e- |

Measurement conditions: No filter or lens; Light source: uniform LED; F-number = 2; Exposure time = variable

## Functionality

| Functionality | ◨ | | Description |
|---|---|---|---|
| Image acquisiton | √ | √ | Timed, TriggerWidth, SyncControl, TimedTriggerControl |
| Integration time control | √ | √ | Programmable between 4 µs and 5 s in steps of 1 µs |
| Analog gain | √ | √ | Programmable analog gain amplifier selectable between 1x, 1.5x, 2.2x and 4.8x |
| Digital gain | √ | √ | Digital fine gain selectable between 1x and 32x in steps of 0.001 |
| White balance | - | √ | Digital fine gain per color channel selectable between 1x and 4x in steps of 0.001 - manual or one-push |
| Programmable LUT | √ | √ | Look-up table to map the measured video level to a user defined video level |
| Gamma curve | √ | √ | Tone mapping on the video data to match the display image to the image perception of the human eye |
| Region of interest | √ | √ | Programmable size and position of readout image - Increased frame speed via ROI |
| Sensor binning | * | * | Sum or average small groups of pixel on sensor to increase signal-to-noise ratio and frame rate |
| Band ROI | * | * | Multiple regions of interest combined into a single image to increase frame rate |
| Mirroring | √ | √ | The output can be flipped in the horizontal and vertical direction |
| Defect pixel correction | √ | √ | Factory calibrated - Review and editing of defect pixel map |
| Uniformity correction | √ | √ | Factory calibrated uniformity correction to ensure device-to-device repeatability |
| Low Frequency Flat Field Correction (LF FFC) | √ | √ | Up to 50 LF FFC sets can be saved in non-volatile memory -<br>Up to 22 out of 50 can be live switched from frame to frame |
| Plane matching | √ | √ | Sensor specific correction that equalizes response differences between image planes |
| Sensitivity matching | √ | √ | Conversion gain calibrated per camera to achieve sensitivity matching between cameras |
| User data storage | √ | √ | Up to 2 GB eMMC memory available for user to store data |
| Camera settings storage | √ | √ | 1 factory set and 10 user sets for storage of camera settings |
| I/O | √ | √ | Programmable I/O polarity with deglitch function |
| Test mode | √ | √ | Internal test pattern generator available to check the complete digital image chain |
| Frame counter | √ | √ | Add frame number to image in meta data overlay |
| Temperature readout | √ | √ | Readout sensor and FPGA temperature in units of 0.1 °C |
| Identification | √ | √ | Camera type, build state and serial number can be read via software |

* Available on request

## Compliance

| | |
|---|---|
| RoHS | Yes |
| ESD | Contact discharge +/- 4 kV; Air discharge +/- 8 kV |
| Workmanship | In accordance with IPC-J-STD-001 class 2 and inspected according IPC-A-610 class 2 |

## Reliability

| | |
|---|---|
| MTBF camera | > 75,000 h @ 30°C calculated according to the part stress analysis of MIL-HDBK-217F for ground fixed, uncontrolled environment. |
| MTBF fan (optional) | > 70,000 h @ 45°C |

# Interfacing

## Video

| | |
|---|---|
| Video output | CoaxPress V1.1.1 CXP3/6/10/12 - 2 and 4 lanes configurable |
| External Sync | I/O or CXP controlled |
| Output resolution | 8 / 10 / 12 bit |
| Tap geometry | 1X-1Y or 1X-2YE* |
| Connector | 4 x Micro-BNC |

* Check if the 1X-2YE tap geometry is supported by the frame grabber manufacturer.

## Camera Control Protocol

| | |
|---|---|
| Interface | GenICam (SFNC)* |
| Throughput | 40 Mbps for CXP10 and CXP12 / 20 Mbps for CXP3 and CXP6 |
| Protocol | GenTL* |

*Conform CoaXPress standard

## I/O

| | |
|---|---|
| Output | LVDS - Fully programmable flash strobe signal (duration, delay and polarity) |
| Input | LVDS - Trigger signal with programmable polarity |
| Connector | Hirose 12 pin HR10A-10R-12P(73) |

## Power

| | |
|---|---|
| Input voltage | 2 x 24 Vdc nominal, range: 18.5 Vdc to 26 Vdc PoCXP |
| Power dissipation | Typical 16 W @ 24 Vdc full continuous operation at full ROI at maximum framespeed |
| Power connector | Micro-BNC master connection and extension 1 |

## Interface connectors

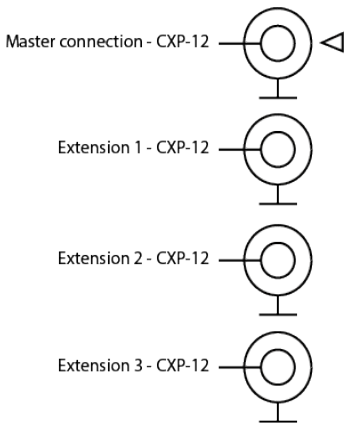



Figure 1. Quad CXP Micro-BNC

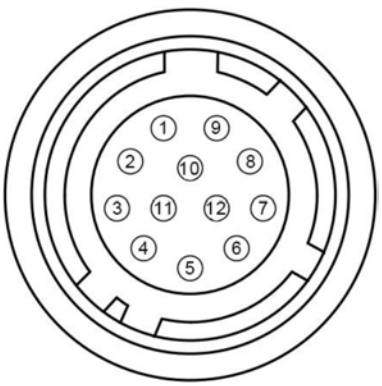


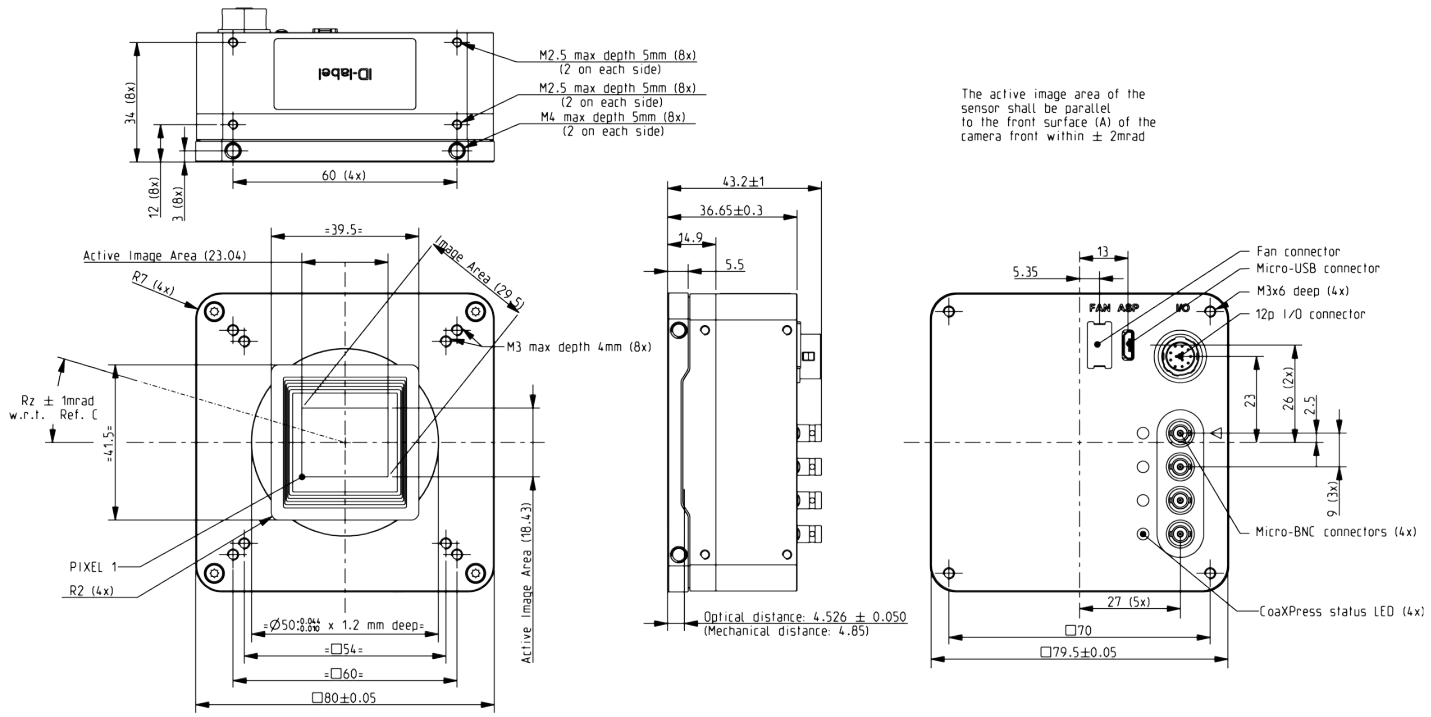

Figure 2. Hirose 12 pin HR10A-10R-12P(73) I/O connector

| I/O pin connection table | |
|---|---|
| 1 | Ground |
| 2 | Not in use |
| 3 | Flash strobe out (LVDS -) |
| 4 | Flash strobe out (LVDS +) |
| 5 | Do not use |
| 6 | Do not use |
| 7 | Do not use |
| 8 | Do not use |
| 9 | Ground |
| 10 | Do not use |
| 11 | Trigger in (LVDS -) |
| 12 | Trigger in (LVDS +) |

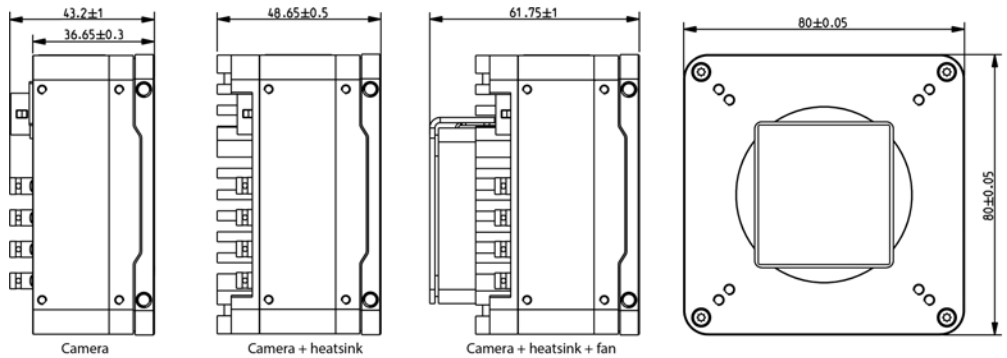
## Mechanical

| | |
|---|---|
| Mounting | 2 x M4 mounting holes per side on camera front |
| Lensmount | 4 x M3 at 60mm pitch - 4 x M3 at 54mm pitch - 50mm G7 reference (on request: F, TFL-II, T2, M42) |
| Camera heatsink | 4 x M3 at 70mm pitch on camera backplate (on request: Heatsink with optional fan available) |
| Image sensor heatsink | 2 x M2.5 mounting holes per camera side |
| Outline | See figure |
| Weight camera | 600 g +/- 5% excl. lensmount, heatsink and fan |
| Weight heatsink | < 75 g |
| Weight heatsink and fan | < 100 g |

### Mechanical outline




### Mechanical outline with accessories




## Sensor Mounting Accuracy

| | |
|---|---|
| XY-centering | ± 0.050 mm |
| Rotation | ± 1 mRad |
| Optical distance | 4.526 ± 0.050 mm (after removing coverglass: 4.85 ± 0.050 mm) |
| Perpendicularity | ± 2 mRad |

All specifications on the sensor alignment are with respect to the camera front without lensmount and lens

## Camera Types

| Sample product name | | | Q -21A230 m /CXP -P A -1.1 |
|---|---|---|---|
| Series | Q | - | High speed CMOS Global Shutter cameras |
| Sensor | -21A230 | - | 21 Mpixel at 228.8 fps |
| Sensor type | m | - | Monochrome |
| | c | - | Color (Bayer output) |
| | r | - | Removable cover glass |
| Interface | /CXP | - | CoaXPress interface at max 12.5 Gb/s |
| Variant | -P | - | Performance product version |
| Sensor alignment | A | - | Active alignment |
| Issue No. | -1.1 | - | Camera issue number |

NOTE: Removable coverglass imperfections (scratches, ditches, dust, etc.) are not covered under warranty.

## Accessories

| | |
|---|---|
| Heatsink with/without fan | Optional |
| Fn-mount | Optional |
| M42-mount fixed | Optional |
| Other lens mounts | Available on request |

### Adimec

Adimec is the leading supplier of high-end cameras for machine vision, medical and outdoor imaging applications. Our Adimec True Accurate Imaging® technology forms the foundation for a broad range of camera products, and brings new levels of precision and accuracy to vision systems.

### Custom cameras

Adimec has the ability to offer additional camera functionality and create customer specific cameras even for small volume programs. Built from platforms, our standard line of cameras give us a flexible base that can be tailored to fit your specifications. Contact us to discuss these options in more detail. Visit: www.adimec.com for product details.

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