White Paper

Acuity™

Direct X-ray Photon Detection (DXPD)
Digital Intraoral X-ray Sensor

Feb. 2024

1. Background

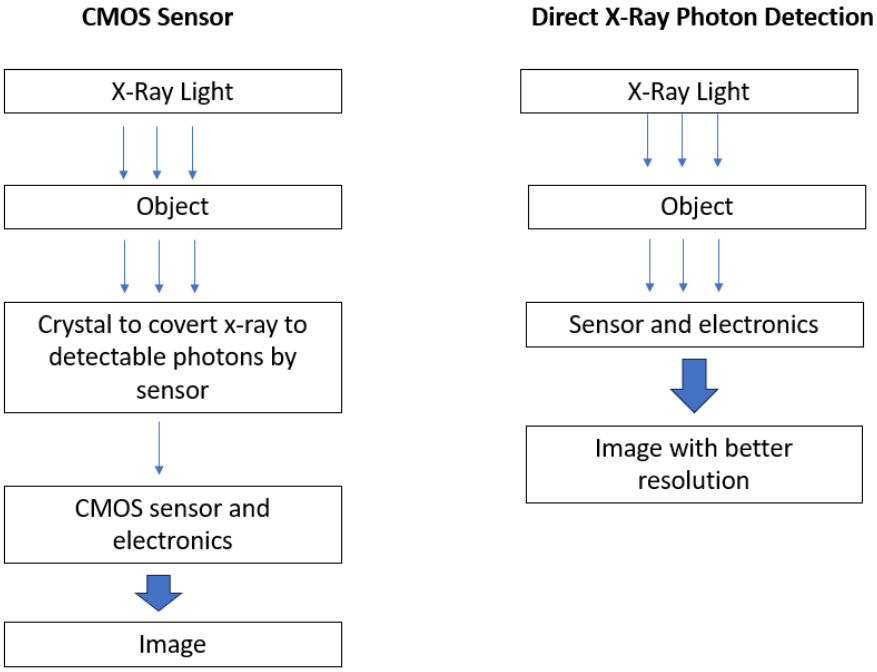
X-ray imaging is an essential tool for diagnostics in today's dental practice. The tradition of x-ray imaging using film has been replaced recently by digital imaging due to the efficiency of getting x-ray images offered through digital technology. As for digital imaging, photostimulable phosphor plates (PSPs) and solid-state detectors, mainly CMOS, are the types of detectors in widespread use today. Advantages of PSPs include minimal bulkiness although at the cost of lower spatial resolution and the need to be placed in a scanner for readout. An advantage of CMOS includes their ability to generate a digital image to a computer without any external device and in relatively less time than PSPs. Based on a market survey, most dentists prefer CMOS over PSPs due to the convenience. However, CMOS has its own issues including image quality, high price, durability, and bulk. An improved x-ray sensor that overcomes these issues is highly desired in dental practice.

Acuity™, a new generation of intraoral x-ray sensor, was developed utilizing a new detection technology to resolve the above issues.

2. New Technology – Direct X-ray Photon Detection (DXPD)

Acuity utilizes a revolutionary new generation of direct x-ray photon detection (DXPD) technology to produce high resolution images. DXPD has less loss of x-ray photons compared to CMOS which must have a crystal layer to convert x-ray photons to a visible photon in order for the CMOS component to detect it.

Below is a comparison of DXPD and CMOS technologies.



DXPD technology provides better image resolution compared to CMOS technology due to reduced loss of photons in the imaging process.

3. Products and Usage

Acuity has a thinner cross-section profile compared to other sensors due to fewer components being needed. The dimension of the Acuity sensors are as follows:

Part #	Size	Physical Dimension	Active Area
005-00123	Size 1	27x32 mm	21x 21mm
005-00124	Size 1.5	31x38 mm	25x 30mm

Following components are provided in the package

- Sensor and control box
- Sensor holder for wall attachment
- Sensor positioner
- Protection sheeve
- Calibration block
- USB drive for imaging software

Acuity is easy to install and use.

1. Open the product box and identify all components
2. Install provide Acuity imaging software to a computer
3. Open the Acuity imaging software
4. Plug in the sensor into computer's USB portal
5. Getting image per process procedure
6. Store image in local drive or cloud storage
7. Transfer images to practice management software through Twain driver or designated procedure

4. Technical Comparisons of DXPD with CMOS

The following tests were conducted to compare DXPD with CMOS sensors on the market:
1). Spatial resolution
2). Contrast resolution
3). Dynamic range

The testing conditions for these comparison tests:

X-ray emitter conditions

- 65KV, 7mA, SID-25cm

Comparing Categories:

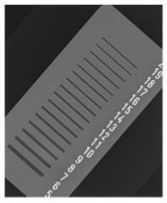
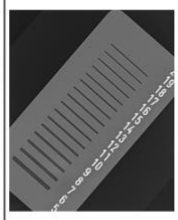
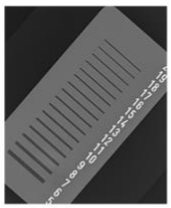
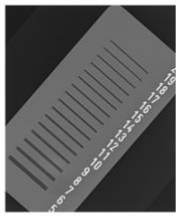
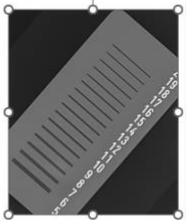
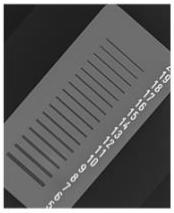
- Spatial resolution - Line pair resolution test card
- Contrast resolution
- Pure aluminum ladder （Gray Levels）
- Low contrast resolution test card (Low Contract Resolution）
- Dynamic range (exposure time)

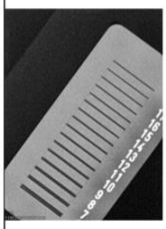
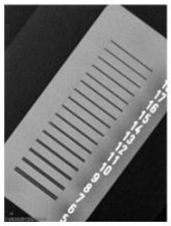
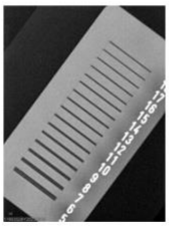
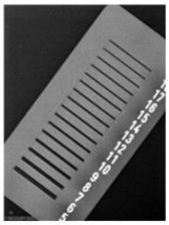
Sensor used for comparison:

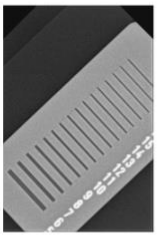
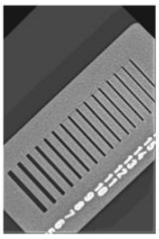
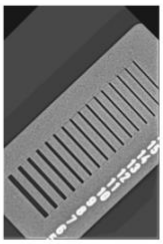
- Acuity – Direct x-ray photon detection (DXPD) from AMD Lasers
- HDR500A - CMOS APS sensor from Handy
- Pluto0001X - CMOS APS sensor from iRay
- RVG 5200 - CMOS APS sensor from Carestream
- XIOS XG - CMOS APS sensor from Dentsply Sirona

Data for different categories are shown below.

1). Spatial resolution – Line pair resolution test card

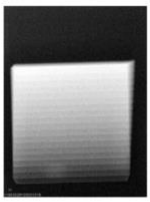
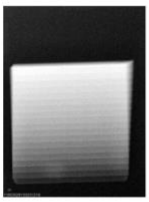
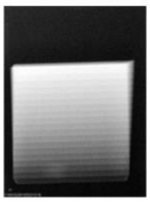
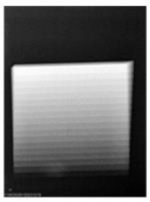
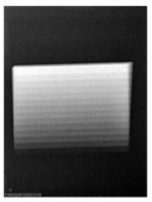
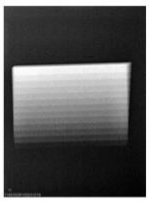
Exposure Time	0.04s	0.08s	0.12s	0.16s	0.2s	0.25s
Acuity						

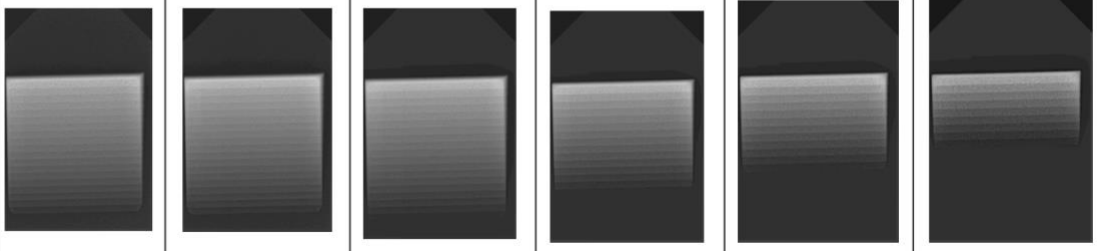
Exposure Time	0.04s	0.08s	0.12s	0.16s	0.2s	0.25s
HDR500A						

Exposure Time	0.04s	0.08s	0.12s	0.16s	0.2s	0.25s
Pluto0001X						

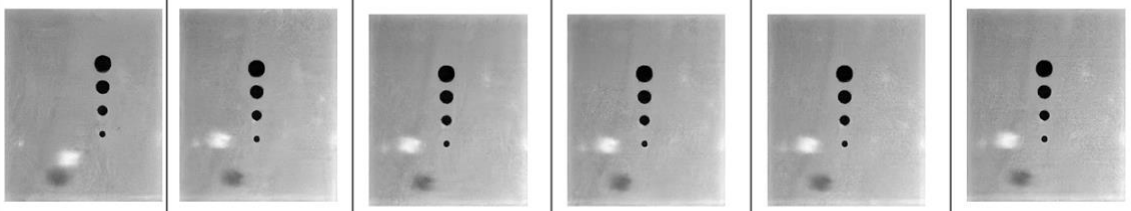
2). Contrast resolution – Pure aluminum ladder (Gray Level)

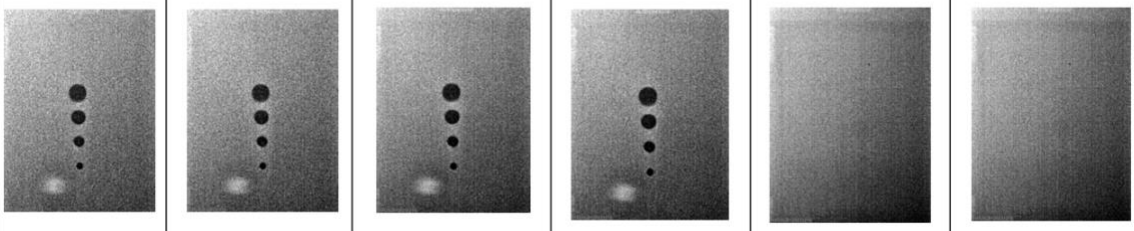
Exposure Time	0.04s	0.08s	0.12s	0.16s	0.2s	0.25s
Acuity						

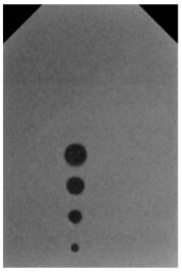
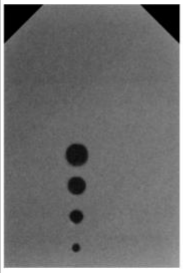
Exposure Time	0.04s	0.08s	0.12s	0.16s	0.2s	0.25s
HDR500A						

Exposure Time	0.04s	0.08s	0.12s	0.16s	0.2s	0.25s
Pluto0001X						

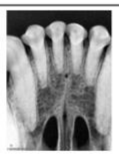
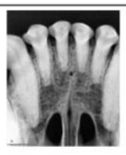
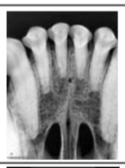
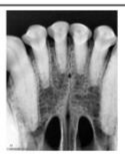
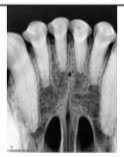
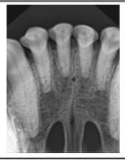
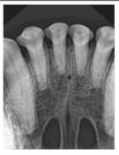
3). Contrast resolution – Low contrast resolution test card

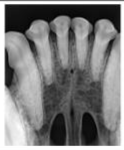
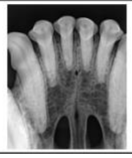
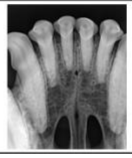
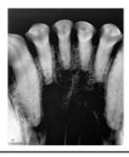
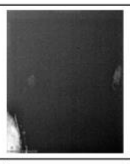
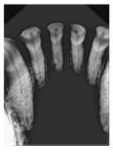
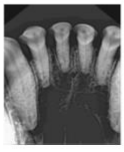
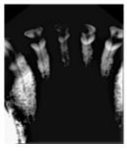
Exposure Time	0.04s	0.08s	0.12s	0.16s	0.2s	0.25s
Acuity						

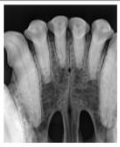
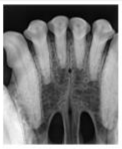
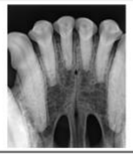
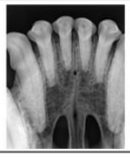
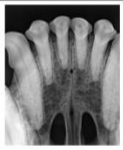
Exposure Time	0.04s	0.08s	0.12s	0.16s	0.2s	0.25s
HDR500A						

Exposure Time	0.04s	0.08s	0.12s	0.16s	0.2s	0.25s
Pluto0001X						

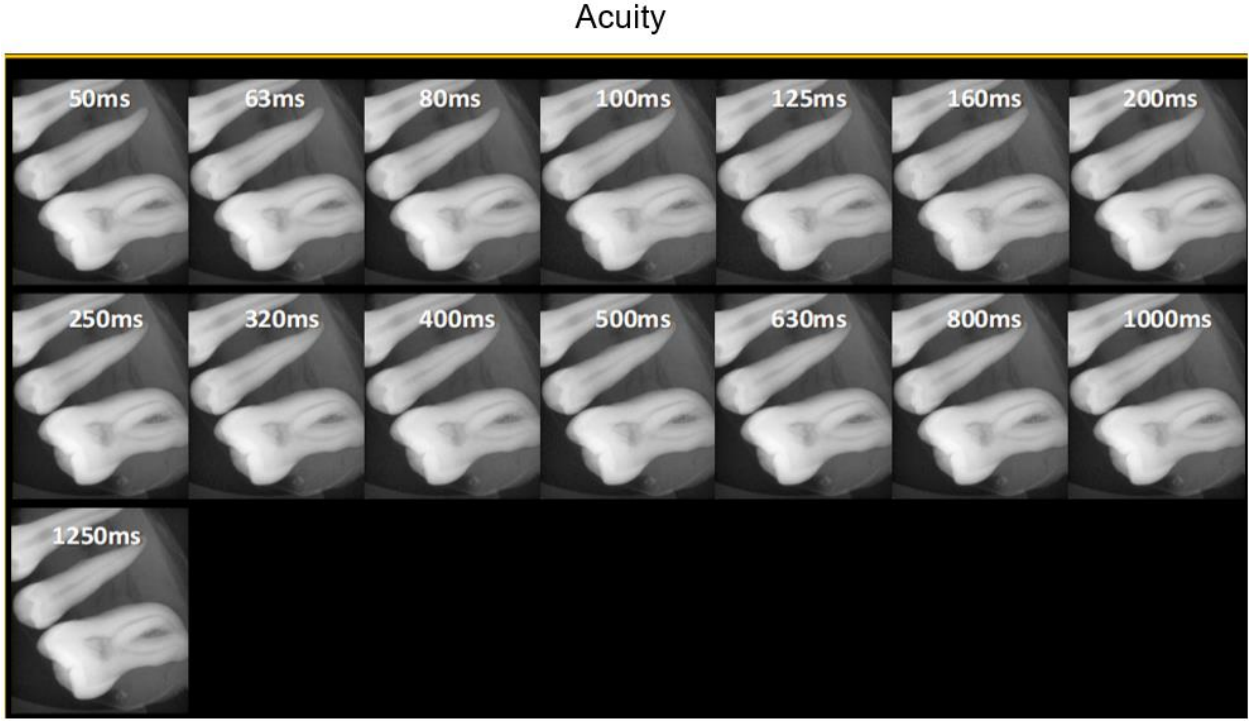
4). Dynamic range (Canine model)

Exposure Time	0.04s	0.05s	0.06s	0.08s	0.1s	0.12s
Acuity						
HDR500A						
Pluto0001X						

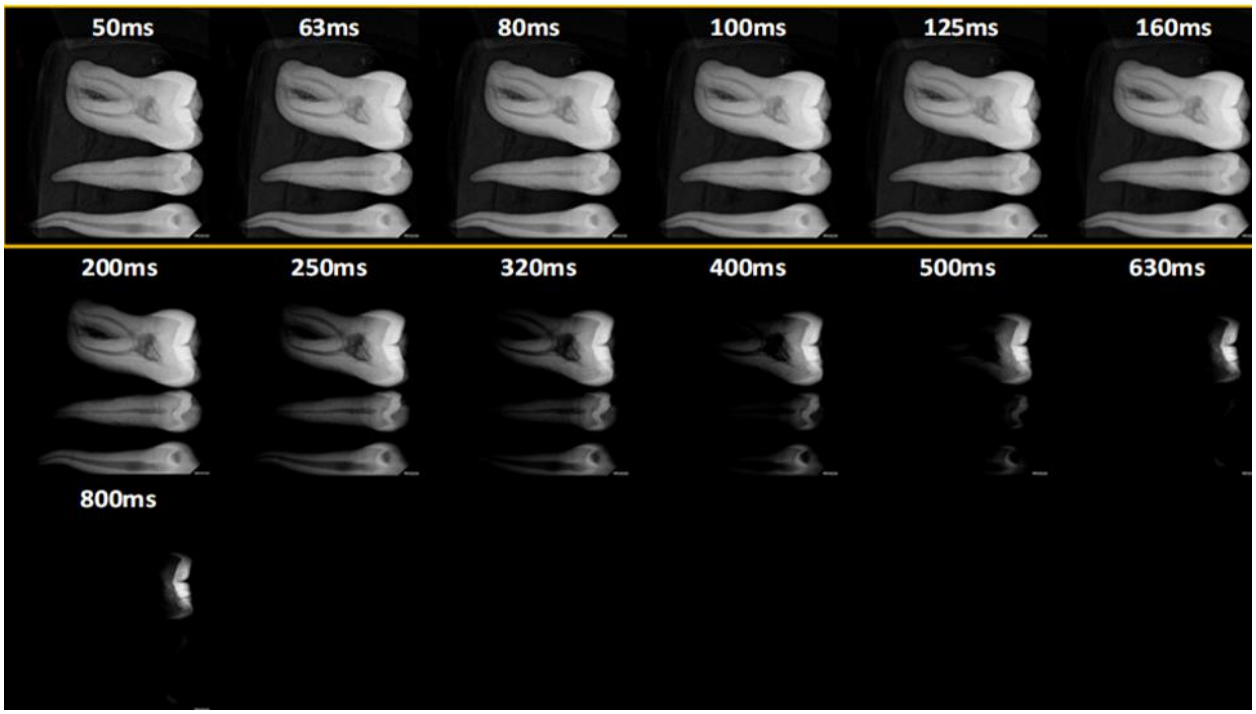
Exposure Time	0.16s	0.2s	0.25s	0.32s	0.4s	0.5s
Acuity						
HDR500A						
Pluto0001X						

Exposure Time	0.63s	0.8s	1s	1.25s	1.6s	2s
Acuity						
HDR500A						
Pluto0001X						

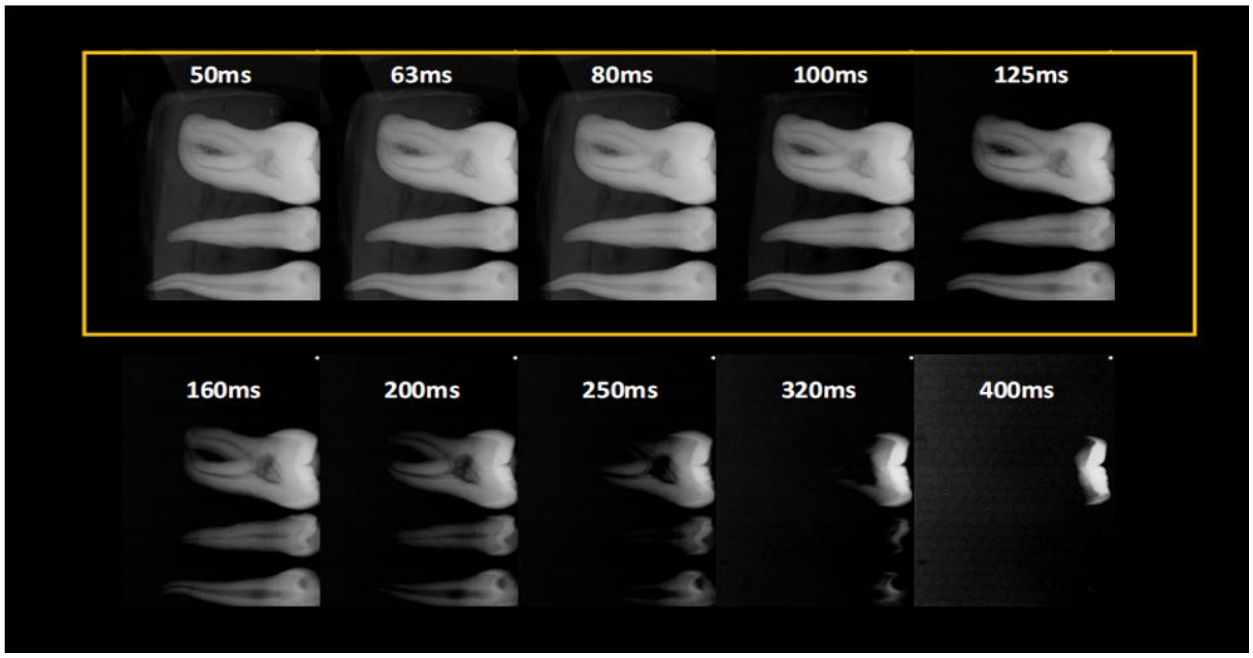
5) Dynamic range (clinical model)



Carestream RVG5200



Sirona XIOS XG



Below is the summary of technical comparison of DXPD with CMOS.

	Spatial Resolution	Gray Levels	Exposure Range
Acuity (DXPD)	≥ 10lp/mm	≤ 16bit	0.04s-2s
CMOS APS sensor --HDR500A	≥ 7lp/mm	≤ 12bit	0.04s-0.16s
CMOS APS sensor --Pluto0001X	≥ 7lp/mm	≤14bit	0.04s-0.12s

The data shows that DXPD technology has an advantage over CMOS in spatial resolution, contract resolution, and dynamic range.

Below are examples of *in vivo* images of CMOS and DXPD, respectively.

CMOS

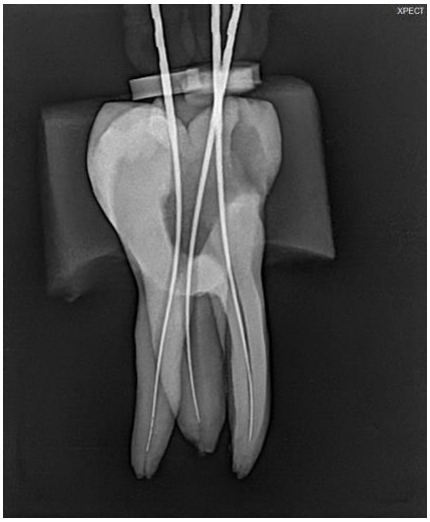
DXPD

The images above are 'raw capture' images under the same dose and were not processed by any enhancement software.

It can be seen that DXPD provides a much clearer image clinically.

Below are in vitro images for endo treatments:

CMOS DXPD



It can be seen that DXPD offers great clarity of tooth structure with files to show details of anatomy of the tooth. A clear image will be very beneficial for diagnoses before, during, and after treatment.

5. Cable Reliability

The connecting cable is the most frequently broken part within current x-ray sensors, due to the high quantity of wire connections required by CMOS electronics. The Acuity's DXPD sensor has fewer wire connections and less possibility of a broken cable.

6. Cost, Warranty, and Insurance

Acuity is available for MSRP $4,499 for size 1.5, and MSRP $3,499 for size 1 - both **with a 3-year manufacturing defect warranty!**

Wholesale price is available through engaged dealers with shipment from dealer or drop ship to dealer's customers.

Trade in and trade up (TITU) for dental practices to trade in their existing sensors (CMOS or PSPs) for 20% off of the MSRP price.

AMD Care™ is offered for Acuity users:

- AMD Care offers free replacement for any damage caused by the user, up to two sensors per year with a price of $89 per month or $799 per year up to 5 years from the date of purchase. Replacement can be refurbished unit. The replacement unit will carry a standard three-year manufacturing defect warranty.

7. Additional Features and Benefits

Cloud storage: AMD will offer cloud storage for images obtained from Acuity and the images can be shared conveniently. The cloud storage site is www.aviouscloud.com.

Acuity is assembled in the USA.

8. Comparison with competitors

Below is a comparison of Acuity with other sensors on the market.

SENSOR	SIZE	MSRP	5-YEAR LEASE	DXPD TECHNOLOGY*	RESOLUTION**	THIN ERGONOMIC***	3-YEAR WARRANTY
ACUITY™	1	$3,499	✘	✔	High	✔	✔
	1.5	$4,499	✘	✔	High	✔	✔
CARESTREAM® RVG	1	$10,650	✘	✘	Standard	✘	✘
	2	$12,650	✘	✘	Standard	✘	✘
DENTIMAX® DREAM SENSOR	1	$5,999‡	✘	✘	Standard	✔	✔
	2	$6,999‡	✘	✘	Standard	✔	✔
DENTIMAX® OPEN SENSOR	1	$2,499‡	total: $6439‡‡	✘	Low	✔	✔
	2	$2,999‡	total: $6439‡‡‡	✘	Low	✔	✔
DEXIS™ IXS	1	$9,715	✘	✘	Low	✘	✘
	2	$10,995	✘	✘	Low	✘	✘
JAZZ IMAGING	Minor	$5,299	total: $7638‡‡‡	✘	Standard	✘	✘
	Solo	$5,999	total: $8838‡‡‡‡	✘	Standard	✘	✘
SCHICK® 33	1	$6,995	✘	✘	Standard	✘	✘
	2	$7,995	✘	✘	Standard	✘	✘

9. Integration to Practice Management platforms

A Twain interface driver is provided in the Acuity imaging software, allowing images to transfer through the Twain driver to all major practice software platforms.

10. Summary

Acuity utilizes a new generation of direct x-ray photon detection (DXPD) technology for its intraoral x-ray sensor. DXPD offers better spatial resolution, contrast resolution, and dynamic range over current CMOS technology. With better image quality, better product quality, and better price, Acuity is the choice for the next generation of intraoral x-ray sensors.