Synopsis of Direct and Indirect Digital Radiography Systems (Project 05-03)

A synopsis table listing specifications for many currently available DIRECT digital x-ray systems can be at the end of this article.  

**Synopsis Table: DIRECT Digital Radiography Systems**

A synopsis table listing specifications for many currently available INDIRECT (photostimulable phosphor plates [PSP]) digital x-ray systems can be at the end of this article.  

**Synopsis Table: INDIRECT Digital Radiography Systems**

NOTE FOR AIR FORCE USERS: The Air Force Dental Service, through the Dental Operations Panel, has chartered an Air Force Dental Technology Board (AFDenT) to address USAF dental digital radiography issues. All dental digital radiography procurement requests must be forwarded to the clinic’s MAJCOM AFDenT Board representative and approved by the AFDenT prior to being submitted for purchase. Contact your MAJCOM/SGD for your representative's name.

Digital radiography systems may be grouped into two main image acquisition categories: direct systems and indirect systems. Direct digital systems acquire images with a solid-state sensor that is connected to a computer (with a wire or wirelessly) to produce an image almost instantaneously following exposure. The other category of digital radiography, indirect digital systems, includes products utilizing photostimulable phosphor plates (PSP). Phosphor plates have a similar size and thickness to conventional film. Following intraoral placement and exposure, a phosphor plate is placed in a scanner that converts the image "stored" on the plate into a digital image. The plate is then "erased" by exposing it to a bright light prior to reusing it for further image acquisitions. There are advantages and disadvantages to both systems.

**Direct systems**

The primary advantage of direct sensor systems is the speed with which images are acquired. The sensor is connected either by a wire or wirelessly to an analog-to-digital converter box (or card), which is connected to the computer. Images are produced within seconds of sensor exposure. Most of the current sensors utilize cords (rather than wireless) and this, along with sensor thickness, may make placement more difficult than conventional film or phosphor plates. However, proper positioning techniques may minimize this disadvantage for most views. (Position the sensor further away from the teeth, more toward the center of the mouth.) Providers are reporting significant difficulty in obtaining vertical bitewing radiographs with corded sensors. Pediatric practices may have problems if younger children "chew" on the cord. Cost is another consideration. At several thousand dollars per sensor, sensors will likely be shared between operatories rather than purchasing one or two sensors for each operatory.
The wire leading from a direct sensor varies in length by manufacturer, commonly being two to three meters long. This wire plugs into an analog-to-digital converter box or card. Some converter boxes connect to the computer with a USB cable. Others have an Ethernet jack for connection to a network. Some manufacturers offer both types of boxes. The analog-to-digital converter box varies in size by manufacturer. Some are small enough to secure to the arm of an x-ray unit. Others are large enough that they either sit on a counter or are wall mounted. The planned location for your converter box will affect the needed cord length on the sensor itself. The total cable length from the sensor to the computer will be the length of the sensor cable plus the length of either the USB or Ethernet cable. Some systems utilize a PCMCIA card for analog-to-digital conversion rather than a "box." This card plugs directly into the computer, so in this case the cord on the sensor itself will need to be long enough to reach from the patient to the computer. When calculating the cost of additional sensors, remember to include the cost of additional converter boxes. If sharing sensors between operatories, you can either purchase enough converter boxes to have one in every operatory or leave the sensor plugged into the converter box and share the sensor/converter box as a unit. At least one company's Ethernet box has inputs for two sensor control boxes and could potentially be shared between two operatories.

Direct digital panoramic and cephalometric units may also be purchased, or some conventional film models can be upgraded from a conventional model to a direct digital model. Once a panoramic unit has been outfitted with direct sensors it can no longer be used with conventional films (without physically converting it back to a conventional unit).

**Indirect systems**

As with direct systems, there are advantages and disadvantages to indirect systems. The smaller size and lack of a cord may make intraoral placement of phosphor plates easier than placement of direct sensors. Phosphor plates are somewhat flexible, but the corners...
cannot be bent (as is sometimes done with film) without damaging the plates. Phosphor plates can potentially be reused hundreds of times, but are susceptible to scratching which will shorten their useful life. Phosphor plates are light sensitive and exposure to ambient light must be minimized during the time period between removal from their protective cover and placement into the scanner. The length of time that plates are exposed to ambient light during this transfer process will determine the level of allowable ambient light at the scanner location. Scanners in which plates are loaded directly into a slot can generally be used in areas of higher ambient light compared to systems in which the plates are loaded on drums prior to placement in the scanner.

The primary disadvantage of phosphor plate systems involves the time required to scan and erase the plates. Following exposure, plates must be removed from their contaminated barrier pouches, run through the scanner, "erased" with bright light, and repackaged in clean barrier pouches prior to using again. For plate erasure, some scanners incorporate an "erase" cycle within the scanner itself. With other units the plates are moved to a separate plate eraser following the scanning process.

It is less expensive to purchase enough phosphor plates to place in every operatory compared to purchasing enough direct sensors for every operatory. The cost for an intraoral phosphor plate is less than twenty-five dollars compared to several thousand dollars for each direct sensor. Most existing panoramic and cephalometric units do not require expensive upgrades for use with phosphor plates. Phosphor plates are simply placed in cassettes similar to film, except that no intensifying screens are used. Therefore, the same panoramic or cephalometric unit can be used to expose either conventional film or phosphor plates. Phosphor plate systems require purchase of a scanner. Large clinics may want to purchase two or more scanners to distribute throughout the clinic.

Imaging area dimensions

| Size 0: 22 x 35 mm |
| Size 1: 24 x 40 mm |
| Size 2: 31 x 41 mm |
| Size 3: 27 x 54 mm |
| Size 4: 57 x 76 mm |

The imaging area of direct sensors and phosphor plates listed in the synopsis tables can be compared to the imaging area of conventional dental film. Listed here are conventional film sizes for comparison purposes.

Imaging software

Prior to the development of DICOM (Digital Imaging and Communications in Medicine) standards, most manufacturers utilized proprietary image file formats that were not compatible with other manufacturers' systems. However, more and more dental imaging systems are becoming DICOM compliant. DICOM compliant systems can share image files. This makes it easier to transfer saved images from one manufacturer's system to another. While this improves the transfer of saved images, most manufacturers' imaging software still will only acquire images using that same manufacturer's sensors. In other words, with most systems, if a large clinic happened to own ten of company A's direct sensors, company B's direct pano unit, and was considering the purchase of two new sensors from company C, they could not use company A's imaging software to directly acquire images from company B's pano and company C's sensors. However, there are some "open platform" imaging software programs that can acquire digital images from a variety of different sensors.
radiography images using multiple manufacturers’ image acquisition hardware (intraoral and pano/ceph
direct sensors and phosphor plate systems). These programs are usually purchased separately from
hardware purchases. In addition to radiography images, these programs also typically integrate digital
images from other sources including intraoral and digital cameras. Using open platform software allows a
clinic to choose from multiple available sensors, pano/ceph units, phosphor plate systems, and intraoral
digital cameras. Purchasing a sensor from one manufacturer would not lock the clinic into purchasing
all sensors from that same manufacturer in the future. In large organizations such as the military, if all
clinics utilize the same open platform imaging software, there is a consistent user interface from clinic to
clinic, even though there may be some variability in the imaging hardware used. Always confirm
compatibility of your desired hardware prior to purchasing open platform imaging software.

Any software installed on an Air Force networked computer must be taken through a formal certification
and accreditation procedure prior to installation. This can be a lengthy process if the software has not
been previously certified. Clinic personnel must coordinate software installations with information systems
staff to ensure this requirement is met.

**Spatial and contrast resolution**

Spatial resolution and contrast resolution are two specifications often mentioned by digital product
manufacturers.

**Spatial resolution**

Spatial resolution is generally stated in line pairs per mm (lp/mm). A line is a black or white "bar." A line pair is a set of one black
and one white "bar." Resolution in line pairs per millimeter represents how many of these alternating black and white line
pairs can be distinguished in a one-millimeter width. The naked eye can generally perceive between 8-10 lp/mm. Most digital
sensors fall in the range of 8-15 lp/mm, which provides very satisfactory resolution for viewing dental structures. There may
be a small benefit to slightly higher resolutions than this when magnification is used, but as resolution continues to increase,
there comes a point where the additional resolution no longer provides more information on the object being viewed. The
maximum "usable" resolution for any given object depends on the size of the object being viewed. There
is an upper limit to the resolution "needed" to view dentin, enamel, alveolar bone, endodontic files, etc.
Care must be taken when interpreting manufacturer resolution claims. Some manufacturers quote
theoretical resolution, some quote actual (measured) resolution, and frequently there is no statement as
to whether the numbers quoted are theoretical or actual values. Theoretical resolution represents the
maximum theoretical resolution based on pixel size and is always greater than the actual, or measurable
resolution. A pixel, or picture element, may be thought of as one of the thousands of tiny dots that make
appears as an image. Digital sensors are composed of an array of thousands of tiny electron wells. Each of these
wells typically represents one pixel in the final image. Smaller and more tightly packed wells, and thus
pixels, generally result in increased resolution, but other construction factors will also affect resolution.
Also, some manufacturers will use 2x2 pixel binning which effectively combines 4 small pixels (for
example 19 or 20 micron) into one larger pixel (ex: 38 or 40 micron) for image production purposes.

**Contrast resolution**

Each pixel in an image can present as a shade of gray. Contrast resolution refers to the dynamic range, or number of
grays available. This may be stated as the actual number of grays, such as 4096, or it may be stated as bit depth, such as
12 bits. Bit depth progresses in powers of 2.
1 bit \[2^1 = 2 \text{ shades of gray (black and white)}\]
2 bits \[2^2 = 2 \times 2 = 4 \text{ shades of gray}\]
3 bits \[2^3 = 2 \times 2 \times 2 = 8 \text{ shades of gray}\]
8 bits \[2^8 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 256 \text{ shades of gray}\]
12 bits \[2^{12} = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 4096 \text{ shades of gray}\]
16 bits \[2^{16} = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 65,536 \text{ shades of gray}\]

Many sensors capture 12 bit images (4096 grays), some sensors capture 16 bit images (65,536 grays). Most computer monitors can only display 8 bit grayscale images (256 grays) and the human eye can typically only differentiate between 32-64 grays. If an image contains data for additional grays above what the monitor can display, the additional data may be of some benefit if the imaging software is capable of a digital processing method called windowing. Windowing is the process of selecting a certain segment of the total range of grays captured, then displaying that segment on the monitor over the full grayscale range from white to black. Windowing gives the ability to focus in on specific segments of the large number of grays captured by 12 and 16 bit sensors. While this ability may provide some advantages, current research has not supported the concept that increasingly greater bit depths improve diagnostic ability. 8 bit data provides very satisfactory images and diminishing returns are obtained from bit depths greater than this.

**Infection Control Issues**

The USAF Guidelines for Infection Control in Dentistry and the CDC's Guidelines for Infection Control in Dental Health-Care Settings - 2003 offer similar guidance regarding the use of digital sensors. Quoting from the USAF Guidelines, sensors are categorized as semi-critical items and they:

"...should be cleaned and ideally should be heat-sterilized or high-level disinfected between patients. However, these items vary by manufacturer or type of device in their ability to be sterilized or high-level disinfected. The following apply for digital radiography sensors:

a. Use FDA-cleared barriers.
b. To minimize the potential for device-associated infections, after removing the barrier, clean and disinfect using an EPA-registered hospital disinfectant with an intermediate-level activity after each patient."

Because sensors and associated components vary by manufacturer and are expensive, manufacturers should be consulted regarding specific disinfection products and procedures. Some manufacturers recommend against using certain chemicals on their sensors. Also, some manufacturers allow immersion of their sensors while others do not.

**Other considerations**

Other considerations when selecting a digital radiography system include company service/support, system cost, length of warranty, and ease of use/capability of imaging software. Compatibility with open platform imaging software will be a consideration for those clinics utilizing these software packages. Adequate cable length and sensor size/shape is another consideration. Sensors with rounded edges may be more comfortable. Sensor wires exiting from the back of the sensor may make for easier placement in some situations compared to configurations where the wire exits from the end of the sensor. Sensor thickness disadvantages may be minimized when sensors are positioned properly (more toward the center of the mouth). Multiple considerations come into play when selecting a digital radiography package and there are advantages and disadvantages to all systems.
Direct Dental Digital Radiography Systems (CCD, CMOS)

<table>
<thead>
<tr>
<th>Model</th>
<th>Dent-X EVA</th>
<th>DEXIS Digital X-ray System</th>
<th>GE Healthcare Sigma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company</td>
<td>Dent-X Corporation USA 250 Clearbrook Road Elmsford, NY 10523 (800) 225-1702</td>
<td>Dexis 2550 Northwinds Parkway Suite 100 Alpharetta, GA 30004 (888) 883-3947</td>
<td>GE Healthcare 300 West Edgerton Avenue Milwaukee, WI 53207-6025 (800) 558-6120</td>
</tr>
<tr>
<td>Gov't point of contact</td>
<td>Adam Rabinovitch (914) 592-6100 ext 210 <a href="mailto:arabinovitch@dent-x.com">arabinovitch@dent-x.com</a></td>
<td>Kim Mercer (888) 883-3947 ext 253 <a href="mailto:kim@dexray.com">kim@dexray.com</a></td>
<td>Mike Null (414) 747-6352 <a href="mailto:mike.null@med.ge.com">mike.null@med.ge.com</a></td>
</tr>
<tr>
<td>Components in package ¹</td>
<td>Sensor - choice of size 1 or 2 USB box Imaging software (Site license) Positioning kit</td>
<td>Sensor - universal size PCMCIA capture card Imaging software (Single user license) Positioning kit</td>
<td>Sensor - see pkgs below USB box Imaging software (5 user licenses) Positioning kit</td>
</tr>
<tr>
<td>Cost of package</td>
<td>Retail/gov't $8,200/$6,295</td>
<td>Retail/gov't $11,000/$9,000</td>
<td>Retail/gov't Size #1: $10,375/$6,336 Size #2: $11,800/$7,207</td>
</tr>
<tr>
<td>Cost of additional sensors</td>
<td>Retail/gov't (Includes ADC ² which is attached to sensor cord) Size 1: $7,500/$6095 Size 2: $7,500/$6095</td>
<td>Retail/gov't (Includes ADC ³ capture card) Universal size: $9,000/$7,000</td>
<td>Retail/gov't (Sensor only) Size 1: $7,272/$4,442 Size 2: $8,587/$5,245</td>
</tr>
<tr>
<td>Other equipment costs</td>
<td>Retail/gov't USB docking station: $300/$200</td>
<td>Retail/gov't USB adaptor for capture card: $499/$499</td>
<td>Retail/gov't USB box (houses ADC ³): $2680/$1637</td>
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<tr>
<td>Sensor warranty ²</td>
<td>3 years</td>
<td>1 year</td>
<td>2 years</td>
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<td>Sensor type</td>
<td>CMOS</td>
<td>CCD</td>
<td>CCD</td>
</tr>
<tr>
<td>Sensor external dimensions</td>
<td>Size 1: 25.6 x 38.4 x 4.8 mm Size 2: 30.8 x 44.1 x 4.8 mm</td>
<td>Universal: 29.3 x 38.7 x 9.0 mm</td>
<td>Size 1: 24 x 36 x 6.8 mm Size 2: 30 x 40 x 6.8 mm</td>
</tr>
<tr>
<td>Sensor imaging area dimensions</td>
<td>Size 1: 20 x 30 mm Size 2: 25.8 x 36 mm</td>
<td>Universal: 25.6 x 32 mm</td>
<td>Size 1: 20 x 32 mm Size 2: 26 x 34 mm</td>
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<tr>
<td>Pixel size</td>
<td>30 micron</td>
<td>40 micron</td>
<td>19.5 micron</td>
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<td>Dynamic range</td>
<td>12 bit</td>
<td>12 bit</td>
<td>12 bit</td>
</tr>
<tr>
<td>Sensor cable length</td>
<td>2 meter</td>
<td>2.44 meter with 1.22 meter extension available</td>
<td>3 meters</td>
</tr>
<tr>
<td>Computer interface options</td>
<td>USB</td>
<td>PCMCIA card USB adaptor for PCMCIA card available</td>
<td>USB</td>
</tr>
</tbody>
</table>

¹Primary items in package are listed. Other items such as cables and hygienic covers may be included. Check with manufacturer for software licensing details. Other package configurations may be available from manufacturer.
²Check with manufacturer for warranty details.
³ADC = Analog-to-digital converter.
<table>
<thead>
<tr>
<th>Model</th>
<th>Gendex GX-S Visualix HDI</th>
<th>Kodak RVG 6000</th>
<th>Lightyear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company</td>
<td>Gendex Dental Systems</td>
<td>Kodak Dental Systems</td>
<td>Lightyear Technology, Inc.</td>
</tr>
<tr>
<td></td>
<td>340 E. Main Street</td>
<td>1765 The Exchange</td>
<td>85-C Mill Street, Suite 100</td>
</tr>
<tr>
<td></td>
<td>Lake Zurich, IL 60047</td>
<td>Atlanta, GA 30339</td>
<td>Roswell, GA 30075</td>
</tr>
<tr>
<td></td>
<td>(888) 275-5286</td>
<td>1-800-944-6365</td>
<td>(866) 946-2431</td>
</tr>
<tr>
<td>Gov't point of contact</td>
<td>Call Gendex to obtain regional rep: (888) 275-5286</td>
<td>William Altvater 800-262-8144 x7277 <a href="mailto:william.altvater@kodak.com">william.altvater@kodak.com</a></td>
<td>George Hummert (866) 946-2431 Ext. 107 <a href="mailto:ghummert@lightyeartechnology.com">ghummert@lightyeartechnology.com</a></td>
</tr>
<tr>
<td>Components in package¹</td>
<td>Sensor - size #2 USB box Imaging software (Site license) Positioning kit</td>
<td>Sensor - see pkgs below Imaging software (Site license) Positioning kit</td>
<td>Sensor - size #2 USB box Imaging software (Site license) Positioning kit</td>
</tr>
<tr>
<td>Cost of package</td>
<td>Retail/gov't $10,050/$6,166</td>
<td>Retail/gov't Size 1: $12,895/$7,737 Size 2: 13,985/$8,337</td>
<td>Retail/gov't $11,995/$8,996</td>
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<td>Cost of additional sensors</td>
<td>Retail/gov't (Sensor only) Size 1: $6,690/$3,206 Size 2: $7,775/$3,991</td>
<td>Retail/gov't (Includes ADC³ which is attached to sensor cord) Size 1: $9,250/$5,550 Size 2: $9,995/$5,997</td>
<td>Retail/gov't (Sensor only) Size 0: $5,995/$4,496 Size 1: $5,995/$4,496 Size 2: $6,995/$5,246</td>
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<tr>
<td>Other equipment costs</td>
<td>Retail/gov't USB box (houses ADC³): $2,165/$1,297</td>
<td>Retail/gov't Separate USB box not required. Optional USB hub: $100/$60</td>
<td>Retail/gov't USB box (houses ADC³): $1,495/$1,121</td>
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<tr>
<td>Sensor warranty²</td>
<td>2 years</td>
<td>2 years</td>
<td>5 years</td>
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<tr>
<td>Sensor type</td>
<td>CCD</td>
<td>CMOS</td>
<td>CCD</td>
</tr>
<tr>
<td>Sensor external dimensions</td>
<td>Size 1: 25 x 39.5 x 5.7 mm Size 2: 32.5 x 42.5 x 5.6 mm</td>
<td>Size 1: 40 mm x 26 mm x 8 mm Size 2: 45 mm x 31 mm x 8 mm</td>
<td>Size 0: 26.4 x 32.5 x 3.2 mm Size 1: 24.7 x 37.8 x 3.2 mm Size 2: 31.8 x 43.0 x 3.2 mm</td>
</tr>
<tr>
<td>Sensor imaging area dimensions</td>
<td>Size 1: 20 x 30 mm Size 2: 28 x 36 mm</td>
<td>Size 1: 22 x 30 mm Size 2: 27 x 36 mm</td>
<td>Size 0: 21.6 x 26.8 mm Size 1: 20.6 x 32.7 mm Size 2: 26.6 x 36.8 mm</td>
</tr>
<tr>
<td>Pixel size</td>
<td>22 micron</td>
<td>18.5 micron</td>
<td>— — — —</td>
</tr>
<tr>
<td>Dynamic range</td>
<td>12 bit</td>
<td>12 bit</td>
<td>12 bit</td>
</tr>
<tr>
<td>Sensor cable length</td>
<td>3 meters</td>
<td>2.5 meter</td>
<td>3 meter</td>
</tr>
<tr>
<td>Computer interface options</td>
<td>USB</td>
<td>USB</td>
<td>USB</td>
</tr>
</tbody>
</table>

Manufacturer provided data for table

¹Primary items in package are listed. Other items such as cables and hygienic covers may be included. Check with manufacturer for software licensing details. Other package configurations may be available from manufacturer.

²Check with manufacturer for warranty details.

³ADC = Analog-to-digital converter.
<table>
<thead>
<tr>
<th>Model</th>
<th>Mediadent MDX</th>
<th>Planmeca Dixi 3&lt;sup&gt;4&lt;/sup&gt;</th>
<th>Progeny MPSe</th>
</tr>
</thead>
</table>
| Company     | Multimedia Dental Systems  
1302 Macy Drive  
Roswell, GA 30076  
(877) 770-8514 | Planmeca USA  
100 N. Gary Ave., Suite A  
Roselle, IL 60172  
(630) 529-2300 | Progeny Dental  
1407 Barclay Boulevard  
Buffalo Grove, Illinois 60089  
(888) 924-3800 |
| Gov't point of contact | Scott McLaughlin  
(770) 998-7386  
scottm@mediadentusa.com | Michelle Bottino  
(630) 529-2300 ext 3015  
michelle.bottino@planmecausa.com | Tony Bavuso  
(847) 850-3800 ext 239  
abavuso@progenydental.com |
| Components in package<sup>1</sup> | Sensor - size #2  
USB box  
Imaging software (5 user license)  
Positioning kit | Sensor - size #2<sup>5</sup>  
CCD Control box  
Ethernet box  
Imaging software (Single user license)  
Positioning kit | Sensor(s) - see pkgs below  
Ethernet box  
Drivers for use with customer's existing imaging software  
Positioning kit |
| Cost of package | Retail/gov't  
$8,790/$6,500 | Retail/gov't  
$12,661/$6,640 | Retail/gov't  
Size #1: $7535/$4520  
Size #2: $8250/$4950  
Size #1 & 2: $15,025/$9015 |
| Cost of additional sensors | Retail/gov't (Sensor only)  
Size 1: $6,250/$5,000  
Size 2: $7,125/$5,700 | Retail/gov't (Sensor only)  
Size 0: $4,819/$2,527  
Size 1: $7,168/$3,759  
Size 2: $9,351/$4,903 | Retail/gov't (Sensor only)  
Size 1: $6,295/$3,777  
Size 2: $7,295/$4,378 |
| Other equipment costs | Retail/gov't  
USB box (houses ADC<sup>3</sup>): $1795/$1436 | Retail/gov't  
CCD control box (houses ADC<sup>3</sup>): $1,634/$857  
USB box or PCI card: $2286/$1198  
Network interface box: $2,547/$1,335 | Retail/gov't  
Ethernet box (houses ADC<sup>3</sup>): $1995/$1197 |
| Sensor warranty<sup>2</sup> | 3 years | 2 years | 2 years |
| Sensor type | CCD | CCD | CCD |
| Sensor external dimensions | Size 1: 25 x 39.5 x 5.7 mm  
Size 2: 32.5 x 45.5 x 5.6 mm | Size 0: 18 x 27 x 6 mm  
Size 1: 24 x 42 x 6 mm  
Size 2: 31 x 44 x 6 mm | Size 1: 25 x 39 x 5 mm  
Size 2: 32.5 x 42.5 x 5.6 mm |
| Sensor imaging area dimensions | Size 1: 20 x 30 mm  
Size 2: 27.5 x 36 mm | Size 0: 15 x 21 mm  
Size 1: 20 x 35 mm  
Size 2: 26 x 37 mm | Size 1: 20.1 x 30.1 mm  
Size 2: 27.5 x 36.1 mm |
| Pixel size | 22 micron | 19 micron | 22 micron |
| Dynamic range | 16 bit | 12 bit | 16 bit |
| Sensor cable length | 2 meter | 0.9 meter or 1.8 meter | 2 meters |
| Computer interface options | USB | USB  
Ethernet  
PCI card | Ethernet (Ethernet to USB adaptor available) |

Manufacturers provided data for table<sup>3</sup>

<sup>1</sup>Primary items in package are listed. Other items such as cables and hygienic covers may be included. Check with manufacturer for software licensing details. Other package configurations may be available from manufacturer.

<sup>2</sup>Check with manufacturer for warranty details.

<sup>3</sup>ADC = Analog-to-digital converter.

<sup>4</sup>Size 0 Planmeca sensor is a DIXI2 sensor. Size 1 and 2 sensors are DIXI3 sensors.

<sup>5</sup>The Planmeca system requires use of a CCD control box (which contains the ADC) plus either an Ethernet box or USB box.
<table>
<thead>
<tr>
<th>Model</th>
<th>Schick CDR</th>
<th>Schick CDR Wireless</th>
<th>Sirona SIDEXIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company</td>
<td>Schick Technologies, Inc. 30-00 47th Avenue Long Island City, NY 11101 (718) 937-5765</td>
<td>Schick Technologies, Inc. 30-00 47th Avenue Long Island City, NY 11101 (718) 937-5765</td>
<td>Sirona Dental Systems LLC 4835 Sirona Drive, Suite 100 Charlotte, NC 28273 (800) 659-5977</td>
</tr>
<tr>
<td>Web link</td>
<td><a href="http://www.schicktech.com">www.schicktech.com</a></td>
<td><a href="http://www.schicktech.com">www.schicktech.com</a></td>
<td><a href="http://www.sirona.com">www.sirona.com</a></td>
</tr>
<tr>
<td>Gov't point of contact</td>
<td>Manny Pena (877) 724-4251 <a href="mailto:mpena@schicktech.com">mpena@schicktech.com</a></td>
<td>Manny Pena (877) 724-4251 <a href="mailto:mpena@schicktech.com">mpena@schicktech.com</a></td>
<td>Patricia Czapilnsky (800) 659-5977 ext 117 <a href="mailto:patricia.czapilnsky@sirona.com">patricia.czapilnsky@sirona.com</a></td>
</tr>
<tr>
<td>Components in package</td>
<td>Sensor - size #2 USB box Imaging software (Single user license) Positioning kit</td>
<td>Sensor - #2 wireless Wireless receiver Imaging Software (Single user license) Positioning Kit</td>
<td>Sensor(s) - see pkgs below USB box Imaging software (Site license) Positioning kit</td>
</tr>
<tr>
<td>Cost of package</td>
<td>Retail/gov't $12,037/$6,418</td>
<td>Retail/gov't $17,766/$9,105</td>
<td>Retail/gov't Size #1: $10,920/$6,047 Size #2: $11,750/$6,509 Size #1 &amp; 2: $18,200/$10,050</td>
</tr>
<tr>
<td>Cost of additional sensors</td>
<td>Retail/gov't (Sensor only) Size 0: $4,658/$2,638 Size 1: $7,108/$3,894 Size 2: $8,335/$4,523</td>
<td>Retail/gov't (Sensor only) Size 1: $10,663/$5,465 Size 2: $12,500/$6,407</td>
<td>Retail/gov't (Sensor only) Size 1: $6,759/$3,866 Size 2: $7,570/$4,342</td>
</tr>
<tr>
<td>Other equipment costs</td>
<td>Retail/gov't USB box (houses ADC³): $1595/$817</td>
<td>Retail/gov't Wireless receiver (houses ADC³): $3432/$1759</td>
<td>Retail/gov't USB box (houses ADC³): $2,080/$1,151 Ethernet box (houses ADC³): $2,599/$1,439</td>
</tr>
<tr>
<td>Sensor warranty</td>
<td>1 year</td>
<td>1 year</td>
<td>2 years</td>
</tr>
<tr>
<td>Sensor type</td>
<td>CMOS</td>
<td>CMOS</td>
<td>CCD</td>
</tr>
<tr>
<td>Sensor external dimensions (mm x mm x mm)</td>
<td>Size 0: 22 x 31 x 5 mm Size 1: 24 x 37 x 5 mm Size 2: 30 x 43 x 5 mm</td>
<td>Size 1: 24 x 37 x 5 mm Size 2: 30 x 43 x 5 mm</td>
<td>Size 1 = 24 x 35.8 x 4.0 mm Size 2 = 30.1 x 40.2 x 5.0 mm</td>
</tr>
<tr>
<td>Sensor imaging area dimensions (mm x mm)</td>
<td>Size 0: 18 x 24 mm Size 1: 20 x 30 mm Size 2: 25.6 x 36 mm</td>
<td>Size 1: 20 x 30 mm Size 2: 25.6 x 36 mm</td>
<td>Size 1 = 20 x 30 mm Size 2 = 26 x 34 mm</td>
</tr>
<tr>
<td>Pixel size</td>
<td>40 micron</td>
<td>40 micron</td>
<td>19.5 micron</td>
</tr>
<tr>
<td>Dynamic range</td>
<td>12 bit</td>
<td>12 bit</td>
<td>12 bit</td>
</tr>
<tr>
<td>Sensor cable length</td>
<td>2 meter</td>
<td>NA</td>
<td>3 meters</td>
</tr>
<tr>
<td>Computer interface options</td>
<td>USB</td>
<td>USB</td>
<td>USB Ethernet</td>
</tr>
</tbody>
</table>

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1. Primary items in package are listed. Other items such as cables and hygienic covers may be included. Check with manufacturer for software licensing details. Other package configurations may be available from manufacturer.
2. Check with manufacturer for warranty details.
3. ADC = Analog-to-digital converter.

Manufacturers provided data for table.
## Indirect Dental Digital Radiography Systems (Phosphor Plates)

<table>
<thead>
<tr>
<th>Model</th>
<th>Air Techniques ScanX</th>
<th>Air Techniques ScanX Intraoral</th>
<th>Gendex DenOptix</th>
</tr>
</thead>
</table>
| **Company** | Air Techniques  
70 Cantiague Rock Road  
P.O. Box 870  
Hicksville, NY 11802  
Ph: (800) 247-8324 | Air Techniques  
70 Cantiague Rock Road  
P.O. Box 870  
Hicksville, NY 11802  
Ph: (800) 247-8324 | Gendex Dental Systems  
340 E. Main Street  
Lake Zurich, IL 60047  
(888) 275-5286 |
| **Gov’t point of contact** | Eugene Heil  
(423) 753-9909  
gheilgov@aol.com | Eugene Heil  
(423) 753-9909  
gheilgov@aol.com | Call Gendex to obtain regional rep: (888) 275-5286 |
| **Components in basic package** | Scanner  
4 each size 2 PSP guides  
1 each size 0, 1, & 3 PSP guides  
20 size 2 PSPs (imaging plates)  
1 plate transfer box | Scanner  
4 each size 2 PSP guides  
1 each size 0, 1, & 3 PSP guides  
20 size 2 PSPs (imaging plates)  
1 plate transfer box | Scanner  
Phosphor plate carousel(s)  
Imaging software  
(Site license)  
Imaging plates (varies by pkg) |
| **Cost of basic package** | Retail/gov’t  
$19,995/$12,597 | Retail/gov’t  
$11,495/$7,047 | Retail/gov’t  
Intraoral: $14,111/$8,018  
Intraoral & pano: $20,497/$11,624  
Intraoral, pano, ceph: $22,145/call |
| **Unit accepts listed plate sizes** | Retail/gov’t  
Size 0: $22.00/$16.80  
Size 1: $22.00/$16.80  
Size 2: $22.00/$16.80  
Size 3: $22.00/$16.80  
Size 4: $60.00/$45.83  
5”x12” pano: $775/$514  
6”x12” pano: $795/$527  
8”x10” ceph: $850/$564  
Plate eraser $875/$536 | Retail/gov’t  
Size 0: $22.00/$16.80  
Size 1: $22.00/$16.80  
Size 2: $22.00/$16.80  
Size 3: $22.00/$16.80  
Size 4: $60.00/$45.83  
Plate eraser $970/$596 | Retail/gov’t  
Size 0: $21.00/$17.00  
Size 1: $21.50/$17.43  
Size 2: $22.50/$16.13  
Size 3: $27.50/$43.35  
Size 4: $65.00/$51.85  
5”x12” pano: $875/543  
6”x12” pano: $885/575  
8”x10” ceph: $970/596 |
| **Scanner warranty** | 2 years | 2 years | 2 years |
| **Intraoral plate imaging area dimensions** | Size 0: 22mm x 35mm  
Size 1: 24mm x 40mm  
Size 2: 31mm x 41mm  
Size 3: 27mm x 54mm | Size 0: 22mm x 35mm  
Size 1: 24mm x 40mm  
Size 2: 31mm x 41mm  
Size 3: 27mm x 54mm | Size 0: 22mm x 35mm  
Size 1: 24mm x 40mm  
Size 2: 31mm x 41mm  
Size 3: 27mm x 54mm |
| **Scan time from plate insertion to image display** | Intraoral: 17 sec for 1st plate, then 4 sec each additional plate at standard resolution  
Pano: 25 sec at std resolution | Intraoral: 17 sec for 1st plate, then 4 sec each additional plate at standard resolution | Intraoral: 72seconds at standard resolution  
Pano: 180seconds at standard resolution |
| **Method to erase plates** | Separate plate eraser | Separate plate eraser | Separate plate eraser |
| **Ambient lighting recommendations at scanner location** | Less than 400 lux; designed for use in normal office lighting; avoid direct sunlight. | Less than 400 lux; designed for use in normal office lighting; avoid direct sunlight. | Low light (10-20 lux) |
| **Scanner dimensions(HxWxD)** | 24” x 14” x 14” | 15.5” x 15” x 15” | 15.5” x 19.4” x 10.1” |
| **Scanner electrical requirements** | 100-240V, 50/60 Hz | 100-240V, 50/60 Hz | 100-240V, 50/60 Hz |
| **Scanner interface with computer** | USB | USB | USB |

Manufacturers provided data in table  
1 Primary items in package are listed. Other items such as cables and hygienic covers may be included. Check with manufacturer for software licensing details.  
2 Check with manufacturer for warranty details.
<table>
<thead>
<tr>
<th>Model</th>
<th>Soredex Digora</th>
<th>Soredex OpTime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company</td>
<td>Soredex USA</td>
<td>Soredex USA</td>
</tr>
<tr>
<td></td>
<td>300 West Edgerton Avenue Milwaukee, WI 53207-6025 (800) 558-6120</td>
<td>300 West Edgerton Avenue Milwaukee, WI 53207-6025 (800) 558-6120</td>
</tr>
<tr>
<td>Web link</td>
<td><a href="http://www.soredexusa.com">www.soredexusa.com</a></td>
<td><a href="http://www.soredexusa.com">www.soredexusa.com</a></td>
</tr>
<tr>
<td>Gov't point of contact</td>
<td>Mike Null (414) 747-6352 <a href="mailto:mike.null@med.ge.com">mike.null@med.ge.com</a></td>
<td>Mike Null (414) 747-6352 <a href="mailto:mike.null@med.ge.com">mike.null@med.ge.com</a></td>
</tr>
<tr>
<td>Components in basic package¹</td>
<td>Scanner and stand imaging software (5 user licenses) One 6x12 pano plate &amp; sleeve</td>
<td>Scanner 20 size 2 plates imaging software (5 user licenses)</td>
</tr>
<tr>
<td>Cost of basic package</td>
<td>Retail/gov’t $28,530/$17,342</td>
<td>Retail/gov’t $11,395/$7,749</td>
</tr>
<tr>
<td>Unit accepts listed plate sizes</td>
<td>6&quot;x12&quot; pano: $788/$489 8&quot;x10&quot; ceph: $735/$456 10&quot;x12&quot; plate: $855/531</td>
<td>Size 0: $22.00/$14.96 Size 1: $22.00/$14.96 Size 2: $22.00/$14.96 Size 3: $26.00/$17.68</td>
</tr>
<tr>
<td>Cost of additional plates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scanner warranty²</td>
<td>2 years</td>
<td>2 years</td>
</tr>
<tr>
<td>Intraoral plate imaging area dimensions</td>
<td>NA</td>
<td>Size 0: 22mm x 31mm Size 1: 24mm x 40mm Size 2: 31mm x 41mm Size 3: 27mm x 54mm</td>
</tr>
<tr>
<td>Scan time from plate insertion to image display</td>
<td>Pano: 75 seconds at standard resolution</td>
<td>Intraoral: 4.3-7.5 seconds at standard resolution</td>
</tr>
<tr>
<td>Method to erase plates</td>
<td>Scanner erases plates</td>
<td>Scanner erases plates</td>
</tr>
<tr>
<td>Ambient lighting recommendations at scanner location</td>
<td>standard room lighting</td>
<td>standard room lighting</td>
</tr>
<tr>
<td>Scanner dimensions(HxWxD)</td>
<td>28.2&quot; x 29.5&quot; x 21.7&quot;</td>
<td>7.5&quot; x 8.7&quot; x 15.5&quot;</td>
</tr>
<tr>
<td>Scanner electrical requirements</td>
<td>100-240V, 50-60 Hz</td>
<td>100-240V, 50-60 Hz</td>
</tr>
<tr>
<td>Scanner interface with computer</td>
<td>Ethernet</td>
<td>Ethernet</td>
</tr>
</tbody>
</table>

¹Primary items in package are listed. Other items such as cables and hygienic covers may be included. Check with manufacturer for software licensing details.
²Check with manufacturer for warranty details.

Manufacturers provided data in table