



Interface definition  
**Device connectivity PMS**  
**Measurements**

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**1. Introduction**

**1.1 Scope**

This documentation describes the general Web service interface on ophthalmic routine diagnostics devices from the Carl Zeiss Vision GmbH and the Carl Zeiss Meditec AG for PMS resp. EMR systems.

PMS is used synonym for PMS and EMR systems in this document.

**1.2 Abbreviations and Terminology**

SW	Software
HW	Hardware
DT&I	Dispensing Tools and Instruments (Service systems and devices on ophthalmic optician)
RD	Routine diagnostics
PMS	Practice Management Software
EMR	Electronic Medical Record
URL	Uniform Resource Locator
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
SOAP	Protocol specification for exchanging structured information in the implementation of Web Services in computer networks
UTC	Coordinated Universal Time (ITU-R TF.460-6)
XML	Extensible Markup Language
XSD	XML Schema (W3C)



## 2. Mapping between Zeiss Connectivity, b2bOptic and i.Profiler

### 2.1 Common

#### 2.1.1 Prism

In the Zeiss Connectivity XML prism are stored always as resultant prism, in b2bOptic mostly as components (horizontal and vertical).

It is possible to convert between this two representations by simple calculation.

#### Component to resultant

First convert the two components to Cartesian coordinates:

$$x_1 := \cos\left(\text{base}_1 \cdot \frac{\pi}{180}\right) \cdot \text{power}_1$$

$$y_1 := \sin\left(\text{base}_1 \cdot \frac{\pi}{180}\right) \cdot \text{power}_1$$

$$x_2 := \cos\left(\text{base}_2 \cdot \frac{\pi}{180}\right) \cdot \text{power}_2$$

$$y_2 := \sin\left(\text{base}_2 \cdot \frac{\pi}{180}\right) \cdot \text{power}_2$$

Summate the Cartesian coordinates:

$$x := x_1 + x_2$$

$$y := y_1 + y_2$$

Calculate the polar coordinates:

$$\text{power} := \sqrt{x^2 + y^2}$$

$$\text{base} := \tan^{-1}\left(\frac{y}{x}\right) \cdot \frac{180}{\pi}$$

Set base to an [interval](#) of (0,360].

Note: It is recommended to use the [hypot](#) and the [atan2](#) function to calculate power and base.



### Resultant to component

First convert the component to Cartesian coordinates:

$$x := \cos\left(\text{base} \cdot \frac{\pi}{180}\right) \cdot \text{power}$$

$$y := \sin\left(\text{base} \cdot \frac{\pi}{180}\right) \cdot \text{power}$$

$$\text{power}_1 := |x|$$

$$\text{base}_1 := \begin{cases} 360, & \text{if } x \geq 0 \\ 180, & \text{if } x < 0 \end{cases}$$

$$\text{power}_2 := |y|$$

$$\text{base}_2 := \begin{cases} 90, & \text{if } y \geq 0 \\ 270, & \text{if } y < 0 \end{cases}$$

### Sample code in C#

```
public static double Hypot(double a, double b)
{
    // for |x|>|y|
    // r = Sqrt(x2 + y2)
    //   = Sqrt(x2(1 + (y/x)2))
    //   = |x| Sqrt(1 + (y/x)2)
    double aAbs = System.Math.Abs(a);
    double bAbs = System.Math.Abs(b);
    double xAbs;
    double yAbs;
    if (aAbs > bAbs)
    {
        xAbs = aAbs;
        yAbs = bAbs;
    }
    else
    {
        xAbs = bAbs;
        yAbs = aAbs;
    }
    // if both 0
    if (xAbs == 0)
        return 0;
    double z = (yAbs / xAbs);
    return xAbs * System.Math.Sqrt(1 + z * z);
}
```



```
public static void PrimToCoordinates(  
    double prismPower, double prismBase, out double x, out double y)  
{  
    double b = prismBase * System.Math.PI / 180;  
    double p = prismPower;  
    x = System.Math.Cos(b) * p;  
    y = System.Math.Sin(b) * p;  
}  
  
public static void CoordinatesToPrism(  
    double x, double y, out double prismPower, out double prismBase)  
{  
    prismPower = Hypot(x, y);  
    prismBase = System.Math.Atan2(y, x) * (180 / System.Math.PI);  
    // Atan2 returns values in the interval -PI..PI  
    if (prismBase <= 0)  
        prismBase += 360;  
}  
  
public static void PrismCartesianToPolar(  
    double prismPower1, double prismBase1, double prismPower2, double prismBase2,  
    out double prismPowerTotal, out double prismBaseTotal)  
{  
    double x1, y1, x2, y2;  
    PrimToCoordinates(prismPower1, prismBase1, out x1, out y1);  
    PrimToCoordinates(prismPower2, prismBase2, out x2, out y2);  
    double x = x1 + x2;  
    double y = y1 + y2;  
    CoordinatesToPrism(x, y, out prismPowerTotal, out prismBaseTotal);  
}  
  
public static void PrismPolarToCartesian(  
    double prismPowerTotal, double prismBaseTotal,  
    out double prismPower1, out double prismBase1,  
    out double prismPower2, out double prismBase2)  
{  
    double x, y;  
    PrimToCoordinates(prismPowerTotal, prismBaseTotal, out x, out y);  
    prismPower1 = System.Math.Abs(x);  
    if (x >= 0)  
        prismBase1 = 360;  
    else  
        prismBase1 = 180;  
    prismPower2 = System.Math.Abs(y);  
    if (y >= 0)  
        prismBase2 = 90;  
    else  
        prismBase2 = 270;  
}
```



# Interface definition

## Device connectivity PMS - Measurements

### 2.2 Subjective Refraction

Zeiss Connectivity	b2bOptic 1.5.1, 1.6.1	Comment
subjectiveRefraction/refraction[@type="Far"]	b2bOptic/items/item[1]/pair	
eye[@side="Right"]	lens[@side="RIGHT"]/rxData	
combined/sphere	sphere	
combined/cylinder/power	cylinder/power	
combined/cylinder/axis	cylinder/axis	
combined/prism	prism	See chapter 2.1.1 Prism.
combined/trialFrame/backVertexDistance	patient/backVertexDistanceRefractionRight	
subjectiveRefraction/refraction[@type="Near"]		
eye[@side="Right"]	lens[@side="RIGHT"]/rxData	
relative/addition	addition	
viewingDistance	patient/nearObjectDistance	Mean value from right and left
subjectiveRefraction/refraction[@type="Far"]		
eye[@side="Left"]	lens[@side="LEFT"]/rxData	
combined/sphere	sphere	
combined/cylinder/power	cylinder/power	
combined/cylinder/axis	cylinder/axis	
combined/prism	prism	See chapter 2.1.1 Prism.
combined/trialFrame/backVertexDistance	patient/backVertexDistanceRefractionRight	
subjectiveRefraction/refraction[@type="Near"]		
eye[@side="Left"]	lens[@side="LEFT"]/rxData	
relative/addition	addition	
viewingDistance	patient/nearObjectDistance	Mean value from right and left



**2.3 i.Profiler**

**2.3.1 Measurement**

Zeiss Connectivity	b2bOptic 1.5.1, 1.6.1	iProfiler	Comment
measurement	b2bOptic/items/item[1]/pair/patient/iProfilerData/identification	iProfiler/measurement/identification	
id[n]/@issuer	device/deviceId	device/deviceId	
id[n]	id	id	
category="ObjectiveRefraction"			
source="PMS"			
device/type="i.Profiler"			
device/generation="plus"			not existing, if i.Profiler 1
device/name	device/deviceId	device/deviceId	
device/version	device/softwareVersion	device/softwareVersion	
timestamp	timeStamp	timeStamp	
	counter="1"	counter="1"	



# Interface definition

## Device connectivity PMS - Measurements

### 2.3.2 Objective Refraction

Zeiss Connectivity	b2bOptic 1.5.1, 1.6.1	iProfiler	Comment
measurement			
data/data[]/type="ObjectiveRefraction"			
data/data[]/version="1.1.7"			
data/data[]/data=<objectiveRefraction>...			
objectiveRefraction/refraction[@type="Far"]	b2bOptic/items/item[1]/pair/patient/iProfilerData	iProfiler/measurement	
eye[@side="Right"]	result[@side="RIGHT"]/autorefractorEye	result[@side="RIGHT"]/autorefractorEye	
sphere	sphere	sphere	
cylinder/power	cylinder/power	cylinder/power	
cylinder/axis	cylinder/axis	cylinder/axis	
eye[@side="Left"]	result[@side="LEFT"]/autorefractorEye	result[@side="LEFT"]/autorefractorEye	
sphere	sphere	sphere	
cylinder/power	cylinder/power	cylinder/power	
cylinder/axis	cylinder/axis	cylinder/axis	





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## Device connectivity PMS - Measurements

### 2.3.3 Wavefront

Zeiss Connectivity	b2bOptic 1.5.1, 1.6.1	iProfiler	Comment
measurement			
data/data[]/type="Wavefront"			
data/data[]/version="1.1.7"			
data/data[]/data=<wavefront>...			
wavefront	b2bOptic/items/item[1]/pair/patient/iProfilerData	iProfiler/measurement	
eye[@side="Right"]/items/item	result[@side="RIGHT"]/wavefrontEye/zernikes/zernikes7	result[@side="RIGHT"]/wavefrontEye/zernikes/zernikes7	
@zernikePupilDiameter	pupilDiameter	pupilDiameter	
zernikes			
zc[@coefficient="01"]	z_0_0	z_0_0	
zc[@coefficient="02"]	z_1_M1	z_1_M1	
zc[@coefficient="03"]	z_1_1	z_1_1	
zc[@coefficient="04"]	z_2_M2	z_2_M2	
zc[@coefficient="05"]	z_2_0	z_2_0	
zc[@coefficient="06"]	z_2_2	z_2_2	
zc[@coefficient="07"]	z_3_M3	z_3_M3	
zc[@coefficient="08"]	z_3_M1	z_3_M1	
zc[@coefficient="09"]	z_3_1	z_3_1	
zc[@coefficient="10"]	z_3_3	z_3_3	
zc[@coefficient="11"]	z_4_M4	z_4_M4	
zc[@coefficient="12"]	z_4_M2	z_4_M2	
zc[@coefficient="13"]	z_4_0	z_4_0	
zc[@coefficient="14"]	z_4_2	z_4_2	
zc[@coefficient="15"]	z_4_4	z_4_4	
zc[@coefficient="16"]	z_5_M5	z_5_M5	
zc[@coefficient="17"]	z_5_M3	z_5_M3	
zc[@coefficient="18"]	z_5_M1	z_5_M1	
zc[@coefficient="19"]	z_5_1	z_5_1	



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Zeiss Connectivity	b2bOptic 1.5.1, 1.6.1	iProfiler	Comment
zc[@coefficient="20"]	z_5_3	z_5_3	
zc[@coefficient="21"]	z_5_5	z_5_5	
zc[@coefficient="22"]	z_6_M6	z_6_M6	
zc[@coefficient="23"]	z_6_M4	z_6_M4	
zc[@coefficient="24"]	z_6_M2	z_6_M2	
zc[@coefficient="25"]	z_6_0	z_6_0	
zc[@coefficient="26"]	z_6_2	z_6_2	
zc[@coefficient="27"]	z_6_4	z_6_4	
zc[@coefficient="28"]	z_6_6	z_6_6	
zc[@coefficient="29"]	z_7_M7	z_7_M7	
zc[@coefficient="30"]	z_7_M5	z_7_M5	
zc[@coefficient="31"]	z_7_M3	z_7_M3	
zc[@coefficient="32"]	z_7_M1	z_7_M1	
zc[@coefficient="33"]	z_7_1	z_7_1	
zc[@coefficient="34"]	z_7_3	z_7_3	
zc[@coefficient="35"]	z_7_5	z_7_5	
zc[@coefficient="36"]	z_7_7	z_7_7	



# Interface definition

## Device connectivity PMS - Measurements

Zeiss Connectivity	b2bOptic 1.5.1, 1.6.1	iProfiler	Comment
wavefront	b2bOptic/items/item[1]/pair/patient/iProfilerData	iProfiler/measurement	
eye[@side="Left"]/items/item @zernikePupilDiameter	result[@side="LEFT"]/wavefrontEye/zernikes/zernikes7 pupilDiameter	result[@side="LEFT"]/wavefrontEye/zernikes/zernikes7 pupilDiameter	
zernikes			
zc[@coefficient="01"]	z_0_0	z_0_0	
zc[@coefficient="02"]	z_1_M1	z_1_M1	
zc[@coefficient="03"]	z_1_1	z_1_1	
zc[@coefficient="04"]	z_2_M2	z_2_M2	
zc[@coefficient="05"]	z_2_0	z_2_0	
zc[@coefficient="06"]	z_2_2	z_2_2	
zc[@coefficient="07"]	z_3_M3	z_3_M3	
zc[@coefficient="08"]	z_3_M1	z_3_M1	
zc[@coefficient="09"]	z_3_1	z_3_1	
zc[@coefficient="10"]	z_3_3	z_3_3	
zc[@coefficient="11"]	z_4_M4	z_4_M4	
zc[@coefficient="12"]	z_4_M2	z_4_M2	
zc[@coefficient="13"]	z_4_0	z_4_0	
zc[@coefficient="14"]	z_4_2	z_4_2	
zc[@coefficient="15"]	z_4_4	z_4_4	
zc[@coefficient="16"]	z_5_M5	z_5_M5	
zc[@coefficient="17"]	z_5_M3	z_5_M3	
zc[@coefficient="18"]	z_5_M1	z_5_M1	
zc[@coefficient="19"]	z_5_1	z_5_1	
zc[@coefficient="20"]	z_5_3	z_5_3	
zc[@coefficient="21"]	z_5_5	z_5_5	
zc[@coefficient="22"]	z_6_M6	z_6_M6	
zc[@coefficient="23"]	z_6_M4	z_6_M4	
zc[@coefficient="24"]	z_6_M2	z_6_M2	
zc[@coefficient="25"]	z_6_0	z_6_0	
zc[@coefficient="26"]	z_6_2	z_6_2	



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## Device connectivity PMS - Measurements

Zeiss Connectivity	b2bOptic 1.5.1, 1.6.1	iProfiler	Comment
zc[@coefficient="27"]	z_6_4	z_6_4	
zc[@coefficient="28"]	z_6_6	z_6_6	
zc[@coefficient="29"]	z_7_M7	z_7_M7	
zc[@coefficient="30"]	z_7_M5	z_7_M5	
zc[@coefficient="31"]	z_7_M3	z_7_M3	
zc[@coefficient="32"]	z_7_M1	z_7_M1	
zc[@coefficient="33"]	z_7_1	z_7_1	
zc[@coefficient="34"]	z_7_3	z_7_3	
zc[@coefficient="35"]	z_7_5	z_7_5	
zc[@coefficient="36"]	z_7_7	z_7_7	

Note: In b2bOptic 1.3.0 and iProfiler XML the sequence of z\_7\_M5, z\_7\_M3, z\_7\_M1 is different to b2bOptic 1.5.1 and later and to Zeiss Connectivity.



**2.3.4 Keratometry**

Zeiss Connectivity	iProfiler	Comment
measurement		
data/data[]/type="Keratometry"		
data/data[]/version="1.1.7"		
data/data[]/data=<keratometry>...		
keratometry	iProfiler/measurement	
eye[@side="Right"]/central	result[@side="RIGHT"]/topography/simK	
steep/radius	k1/power	r1 (Radius)
steep/power	k1/axis	k1 (Power)
steep/axis		
flat/radius	k2/power	r2 (Radius)
flat/power		k2 (Power)
flat/axis	k2/axis	
keratometry	iProfiler/measurement	
eye[@side="Right"]/peripherals	result[@side="RIGHT"]/topography/eccentricity	
peripheral[1]/@tiltAngle="0"		
loop (k=0..3)		
peripheral[@tiltAngle="0"]/reading[1+k]		
radius	ro/v[1+k]	In mm
axis	meridian/v[1+k]	In degree
@direction	dependend of axis and side: "superior", "inferior", "temporal" or "nasal"	See table below
end of loop (k)		
n=	nPeripheralAngles	
loop (i=0..n-1)		
peripheral[2+i]		
@tiltAngle	peripheralAngles/v[1+i]	



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## Device connectivity PMS - Measurements

Zeiss Connectivity	iProfiler	Comment
keratometry	iProfiler/measurement	
eye[@side="Right"]/peripherals	result[@side="RIGHT"]/topography/eccentricity	
peripheral[2+i]		
loop (k=0..3)		
reading[1+k]		
radius	sagittal/v[1+k*n+i]	
axis	meridian/v[1+k]	
@direction	dependend of axis and side: "superior", "inferior", "temporal" or "nasal"	
numericalEccentricity	eccentricity/v[1+k*n+i]	
end of loop (k)		
end of loop (i)		
keratometry	iProfiler/measurement	
eye[@side="Left"]/central	result[@side="LEFT"]/topography/simK	
steep/radius	k1/power	r1 (Radius)
steep/power	k1/axis	k1 (Power)
steep/axis		
flat/radius	k2/power	r2 (Radius)
flat/power		k2 (Power)
flat/axis	k2/axis	
keratometry	iProfiler/measurement	
eye[@side="Left"]/peripherals	result[@side="LEFT"]/topography/eccentricity	
peripheral[1]/@tiltAngle="0"		
loop (k=0..3)		
peripheral[@tiltAngle="0"]/reading[1+k]		
radius	ro/v[1+k]	In mm
axis	meridian/v[1+k]	In degree
@direction	dependend of axis and side: "superior", "inferior", "temporal" or "nasal"	See table below
end of loop (k)		



# Interface definition

## Device connectivity PMS - Measurements

Zeiss Connectivity	iProfiler	Comment
keratometry	iProfiler/measurement	
eye[@side="Left"]/peripherals	result[@side="LEFT"]/topography/eccentricity	
<i>n</i> =	nPeripheralAngles	
<i>loop (i=0..n-1)</i>		
peripheral[2+i]		
@tiltAngle	peripheralAngles/v[1+i]	
<i>loop (k=0..3)</i>		
reading[1+k]		
radius	sagittal/v[1+k*n+i]	
axis	meridian/v[1+k]	
@direction	dependend of axis and side: "superior", "inferior", "temporal" or "nasal"	
numericalEccentricity	eccentricity/v[1+k*n+i]	
<i>end of loop (k)</i>		
<i>end of loop (i)</i>		
keratometry	iProfiler/measurement	
keratometerIndex="1.3375"		
diameter="3"		

Values for direction

axis	@side="Right"	@side="Left"
315..45	nasal	temporal
45..135	superior	superior
135..225	temporal	nasal
225..315	inferior	inferior



**2.3.5 Topography**

Zeiss Connectivity	iProfiler	Comment
measurement		
data/data[]/type="Topography"		
data/data[]/version="1.1.7"		
data/data[]/data=<topography>...		
topography	iProfiler/measurement	
eye[@side="Right"]	result[@side="RIGHT"]/topography/topo	
numberOfRings	nRings	
numberOfPointsPerRing	nPhy	
radii	radii	See hint below.
phy	phy	See hint below.
axial	axial	See hint below.
tangential	tangential	See hint below.
height	height	See hint below.
eye[@side="Left"]	result[@side="LEFT"]/topography/topo	
numberOfRings	nRings	
numberOfPointsPerRing	nPhy	
radii	radii	See hint below.
phy	phy	See hint below.
axial	axial	See hint below.
tangential	tangential	See hint below.
height	height	See hint below.

The radii, phy, axial, tangential and height nodes need to convert between xs:float values and a xs:float list value.

i.Profiler XML:           <radii><v>0.31555</v><v>0.480853</v> ... <v>4.11254</v></radii>  
 Zeiss Connectivity XML: <radii>0.31555 0.480853 ... 4.11254</radii>





**2.4 Prescription (FinalRx)**

Zeiss Connectivity	b2bOptic 1.5.1, 1.6.1	Comment
<i>Condition: prescription/@type="Far" or "FarNear"</i>		
prescription	b2bOptic/items/item[1]/pair	
eye[@side="Right"]	lens[@side="RIGHT"]/rxData	
sphere	sphere	
cylinder/power	cylinder/power	
cylinder/axis	cylinder/axis	
addition[type="Near"]/power	addition	
prism	prism	See chapter 2.1.1 Prism.
backVertexDistance	patient/backVertexDistanceRefractionRight	
addition[type="Near"]/viewingDistance	patient/nearObjectDistance	Mean value from right and left
prescription	b2bOptic/items/item[1]/pair	
eye[@side="Left"]	lens[@side="LEFT"]/rxData	
sphere	sphere	
cylinder/power	cylinder/power	
cylinder/axis	cylinder/axis	
addition[type="Near"]/power	addition	
prism	prism	See chapter 2.1.1 Prism.
backVertexDistance	patient/backVertexDistanceRefractionRight	
addition[type="Near"]/viewingDistance	patient/nearObjectDistance	Mean value from right and left



**2.5 Centration**

**2.5.1 Centration**

Zeiss Connectivity	b2bOptic 1.5.1, 1.6.1	Comment
<i>Condition: centration/@type="Far"</i>		
centration	b2bOptic/items/item[1]/pair	
eye[@side="Right"]	lens[@side="RIGHT"]/centration	
monocularCentrationDistance		
monocularCentrationDistance[@reference="FAR"]	monocularCentrationDistance[@reference="FAR"]	
height		
height[@reference="FAR",@referenceHeight="OVERBOX"]	height[@reference="FAR",@referenceHeight="OVERBOX"]	Only if not NEAR
height[@reference="NEAR",@referenceHeight="OVERBOX"]	height[@reference="NEAR",@referenceHeight="OVERBOX"]	
backVertexDistance	backVertexDistance	
centration	b2bOptic/items/item[1]/pair	
eye[@side="Left"]	lens[@side="LEFT"]/centration	
monocularCentrationDistance		
monocularCentrationDistance[@reference="FAR"]	monocularCentrationDistance[@reference="FAR"]	
height		
height[@reference="FAR",@referenceHeight="OVERBOX"]	height[@reference="FAR",@referenceHeight="OVERBOX"]	Only if not NEAR
height[@reference="NEAR",@referenceHeight="OVERBOX"]	height[@reference="NEAR",@referenceHeight="OVERBOX"]	
backVertexDistance	backVertexDistance	
pantoscopicAngle	frame/pantoscopicAngle[@dimension="DEG"]	

**2.5.2 CentrationLens**

Zeiss Connectivity	b2bOptic 1.5.1, 1.6.1	Comment
centrationLens	b2bOptic/items/item[1]/pair	
eye[@side="Right"]/frameFit	lens[@side="RIGHT"]/frameFit	
eye[@side="Left"]/frameFit	lens[@side="LEFT"]/frameFit	



# Interface definition

## Device connectivity PMS - Measurements

### 2.5.3 Frame

Zeiss Connectivity	b2bOptic 1.5.1, 1.6.1	Comment
frame	b2bOptic/items/item[1]/pair/frame[@quantity="1"]	
material	material	
boxWidth	boxWidth	
boxHeight	boxHeight	
distanceBetweenLenses	distanceBetweenLenses	
frameBowAngle	frameBowAngle[@dimension="DEG"]	
<i>loop (i=1..36)</i>		
eye[@side="Right"]/shape	shape/explicit[@side="RIGHT"]/points	
point[i]/angle	pPoints[i]/angle[@dimension="DEG"]	
point[i]/radius	pPoints[i]/radius	
<i>loop (i=1..36)</i>		
eye[@side="Left"]/shape	shape/explicit[@side="LEFT"]/points	
point[i]/angle	pPoints[i]/angle[@dimension="DEG"]	
point[i]/radius	pPoints[i]/radius	

### 2.6 Tracer

Zeiss Connectivity	b2bOptic 1.5.1, 1.6.1	Comment
tracer	b2bOptic/items/item[1]/pair/frame[@quantity="1"]/shape/tracerData	
tracerType	tracerType	
tracerVersion	tracerVersion	
tracerId	tracerID	
binaries/@format	binaries/@format	
binaries	binaries	
adjustion	adjustion	