Ingenieurbüro Baumann --- www.leobaumann.de --- Markt 6, 46282 Dorsten

---

Impedanz verschiedener Dipole des Durchmessers d, ungeradzahliger Vielfacher von Lambda/2 im freien Raum, sinusförmige Stromverteilung

---

- `reset():digits:=16:d:=1/1000:ZF0:=120*PI:ur:=1:er:=1:lambda:=1:`

BALANIS-Funktionen

- ```
  Z_Re:=(k)->ZF0*sqrt(ur/er)/(2*PI)*(EULER+ln(2*PI*k)-
  Ci(2*PI*k)+1/2*sin(2*PI*k)*(Si(4*PI*k)-
  2*Si(2*PI*k))+1/2*cos(2*PI*k)*(EULER+ln(PI*k)+Ci(4*PI*k)-
  2*Ci(2*PI*k))):
  ```
- ```
  Z_Im:=(k)-
  >ZF0*sqrt(ur/er)/(4*PI)*(2*Si(2*PI*k)+cos(2*PI*k)*(2*Si(2*PI*k)-
  Si(4*PI*k))-sin(2*PI*k)*(2*Ci(2*PI*k)-Ci(4*PI*k)-
  Ci(2*2*PI*d^2/4/k*(ur*er)/lambda^2))):
  ```

- `m:=[(2*i-1)/2 $ i=1..10];`

$$\left[\frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2}, \frac{9}{2}, \frac{11}{2}, \frac{13}{2}, \frac{15}{2}, \frac{17}{2}, \frac{19}{2}\right]$$

- ```
  for i from 1 to 10 do
  Z[i]:=[op(m,i),float(Z_Re(op(m,i))+I*Z_Im(op(m,i)))]:
  end_for:
  ```

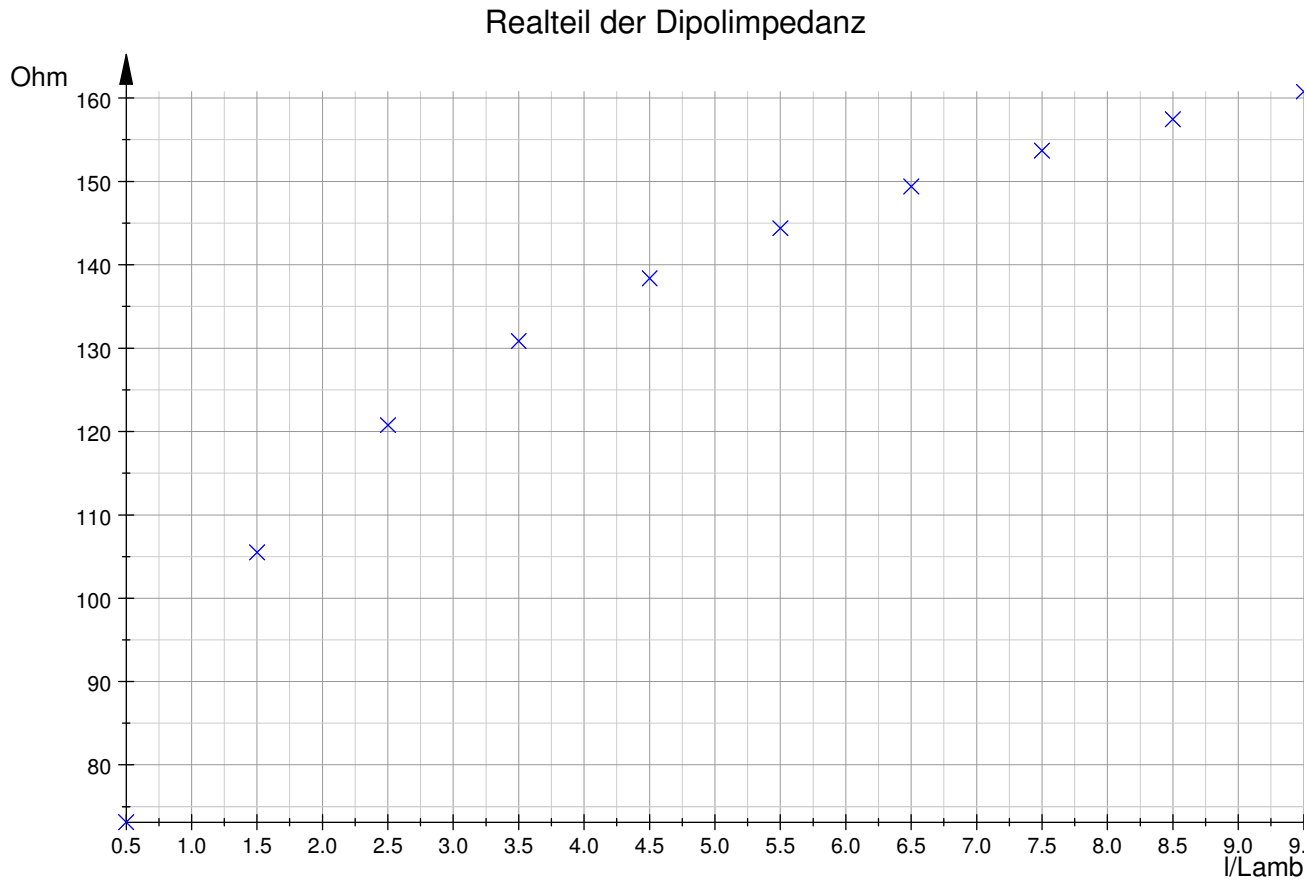
Dipol-Impedanzen für l/Lambda laut Liste m

- `Z;`

$$\begin{aligned}
1 &= [\tfrac{1}{2},\ 73.12960179 + 42.54454728 \cdot i] \\
2 &= [\tfrac{3}{2},\ 105.4942314 + 45.54101884 \cdot i] \\
3 &= [\tfrac{5}{2},\ 120.7661345 + 46.17087239 \cdot i] \\
4 &= [\tfrac{7}{2},\ 130.8455471 + 46.44249809 \cdot i] \\
5 &= [\tfrac{9}{2},\ 138.3788851 + 46.59370815 \cdot i] \\
6 &= [\tfrac{11}{2},\ 144.3959125 + 46.69001215 \cdot i] \\
7 &= [\tfrac{13}{2},\ 149.4057551 + 46.75671907 \cdot i] \\
8 &= [\tfrac{15}{2},\ 153.6976631 + 46.80565149 \cdot i] \\
9 &= [\tfrac{17}{2},\ 157.4518103 + 46.84307732 \cdot i] \\
10 &= [\tfrac{19}{2},\ 160.7880554 + 46.87262776 \cdot i]
\end{aligned}$$

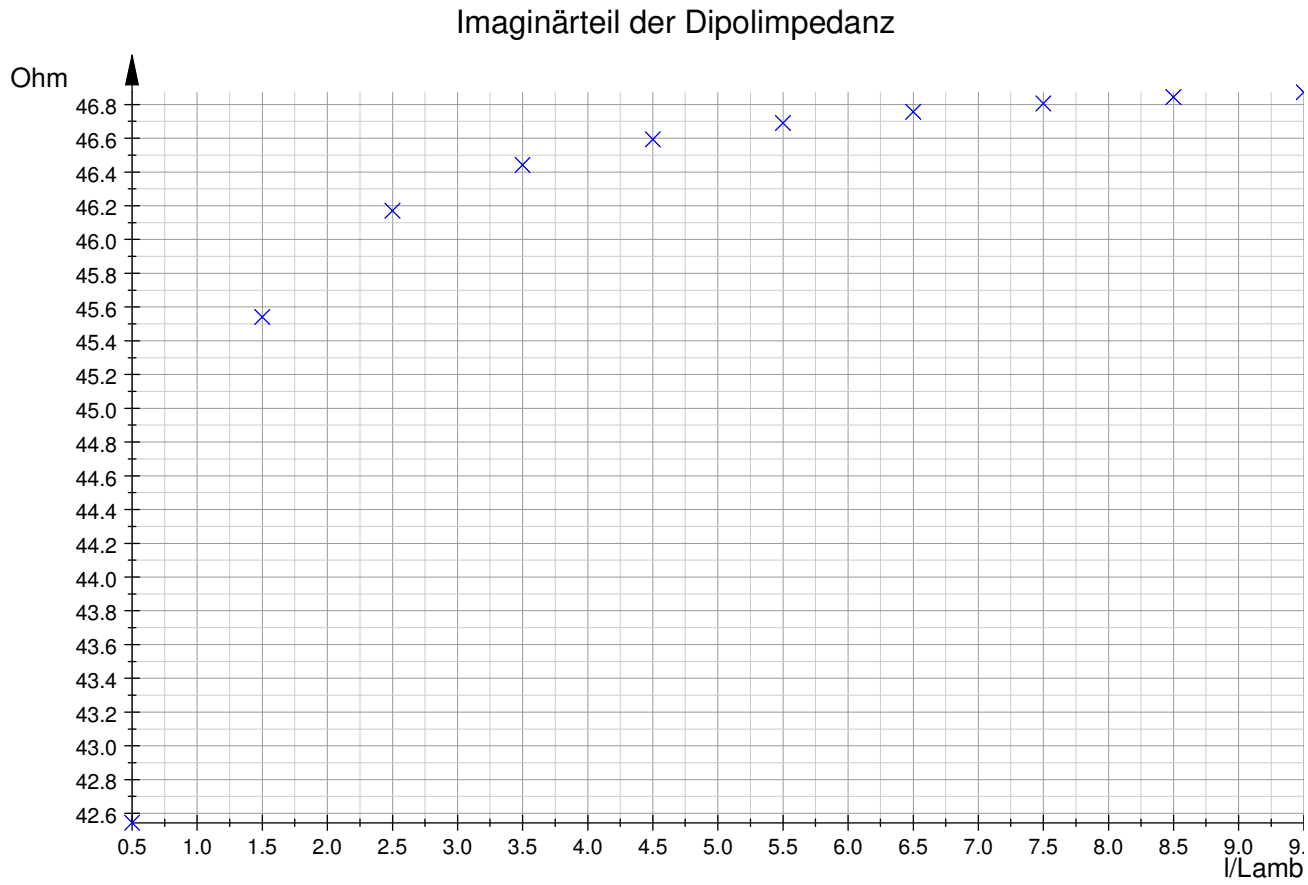
- `Liste:=[[op(Z[i],1),Re(op(Z[i],2)),RGB::Blue] $ i=1..10]:`
- ```
  plot(plot::PointList2d(Liste, PointStyle=XCrosses, PointSize=2,
  Color=RGB::Blue, GridVisible=TRUE, SubgridVisible=TRUE,
  ```

```
                    Scaling=Unconstrained,
  AxesTitles=["l/Lambda","Ohm"]), Height=120*unit::mm,
  Width=180*unit::mm, Header="Realteil der Dipolimpedanz"):
```




- ```
  Liste:=[[op(Z[i],1),Im(op(Z[i],2)),RGB::Blue] $ i=1..10]:
  ```

- ```
  plot(plot::PointList2d(Liste, PointStyle=XCrosses, PointSize=2,
  Color=RGB::Blue, GridVisible=TRUE, SubgridVisible=TRUE,
                    Scaling=Unconstrained,
    AxesTitles=["l/Lambda","Ohm"]), Height=120*unit::mm,
    Width=180*unit::mm, Header="Imaginärteil der Dipolimpedanz"):
  ```



Impedanz verschiedener Dipole des Durchmessers d, geradzahliger Vielfacher von Lambda/2 im freien Raum, sinusförmige Stromverteilung

---

- `m:=[i $ i=1..10];`

  [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]

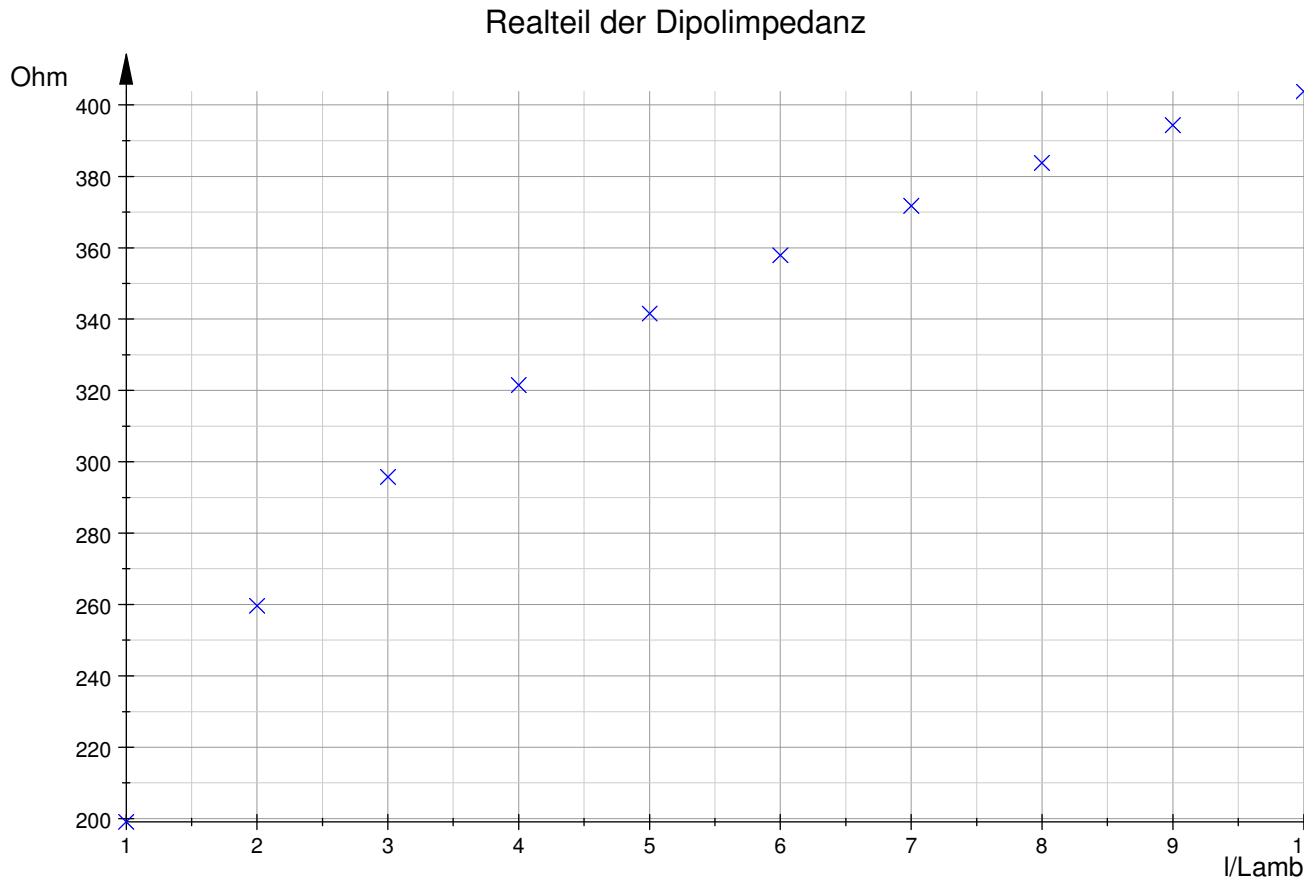
- ```
  for i from 1 to 10 do
  Z[i]:=[op(m,i),float(Z_Re(op(m,i))+I*Z_Im(op(m,i)))]:
  end_for:
  ```

Dipol-Impedanzen für l/Lambda laut Liste m

- `Z;`
  ```

$$
\begin{bmatrix}
1 & = [1,\ 199.0877106 + 125.4133524 \cdot i] \\
2 & = [2,\ 259.6341168 + 133.1254085 \cdot i] \\
3 & = [3,\ 295.7503387 + 135.8348497 \cdot i] \\
4 & = [4,\ 321.5068037 + 137.2082252 \cdot i] \\
5 & = [5,\ 341.5256327 + 138.0378209 \cdot i] \\
6 & = [6,\ 357.9010938 + 138.5907605 \cdot i] \\
7 & = [7,\ 371.7538126 + 138.9870608 \cdot i] \\
8 & = [8,\ 383.7580849 + 139.2845827 \cdot i] \\
9 & = [9,\ 394.3492613 + 139.5161596 \cdot i] \\
10 & = [10,\ 403.8289717 + 139.697487 \cdot i]
\end{bmatrix}
$$

- `Liste:=[[op(Z[i],1),Re(op(Z[i],2)),RGB::Blue] $ i=1..10]:`
- ```
  plot(plot::PointList2d(Liste, PointStyle=XCrosses, PointSize=2,
  Color=RGB::Blue, GridVisible=TRUE, SubgridVisible=TRUE,
                         Scaling=Unconstrained,
    AxesTitles=["l/Lambda","Ohm"]), Height=120*unit::mm,
    Width=180*unit::mm, Header="Realteil der Dipolimpedanz"):
  ```



- `Liste:=[[op(Z[i],1),Im(op(Z[i],2)),RGB::Blue] $ i=1..10]:`
- ```
  plot(plot::PointList2d(Liste, PointStyle=XCrosses, PointSize=2,
  Color=RGB::Blue, GridVisible=TRUE, SubgridVisible=TRUE,
  ```

```
                    Scaling=Unconstrained,
AxesTitles=["l/Lambda","Ohm"]), Height=120*unit::mm,
Width=180*unit::mm, Header="Imaginärteil der Dipolimpedanz"):
```