Instructions for the use of the
NESTLER Slide Rule
ELECTRONIC 0297

Contents

Page
1. Ohm's law ........................................ 5
2. Power output law ................................ 6
3. Apparent, effective and reactive power .... 7
4. Amplification, Attenuation .................... 9
5. Transformation of impedance, conductance, voltage and
   winding turns .................................. 10
6. dbm - Level ..................................... 11
7. Parallel Connection of Resistance or Inductances
   Series Connection of Conductances or Capacitances 11

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ALBERT NESTLER GMBH • LAHR/Schwarzwald • Western Germany
The Slide Rule ELECTRONIC 0297 offers the possibility to calculate basic electro-technical equations with correct digital values. This essential advantage excludes with certainty decimal faults. The accuracy of calculation lies between 1 to 2%, being in the same category as the acknowledged tolerance limit of most electro-technical measuring apparatus. The tolerances of building materials are between 2 to 30% and thus considerably bigger.

The ranges of the 18 Scales is sufficient for application in the communication-technique as well as in Power technique.

The following examples give a compact picture of the applications:

I. Calculation with correct place value columns:
1. Ohm's law.
2. Output power law.
3. Apparent, effective and reactive power.
5. Conversion conditions of relays and transformers, transformation of R, G, Z, Y;
6. dbm-level.

II. Calculation without place value columns:
1. Parallel connections of resistance or inductance.
2. Series connections of conductance or capacitance.

### 1. OHM'S LAW

**Example:**

\[ R = \frac{220 \, \Omega}{G = 4.45 \, \mu S} - I = 3.5 \, mA \]

To find \( U = 770 \, V \)

Calculation method: Front side

1. Set resistance \( R \) (or Conductance value \( G \)) on the arrow mark ↓ (at R/Z).
2. Place cursor over current intensity \( I \),
   Read wanted voltage on Scale \( U \).

\[ \boxed{ U = J \cdot R } \]

**Example:**

\[ R = 0.5 \, \Omega \quad (G = 2 \, S) \quad U = 2.5 \, V \]

To find \( J = 5 \, A \)

Calculation method: Front side R

1. Set resistance \( R \) (or conductance value \( G \)) on the arrow mark ↓ (at R/Z).
2. Place cursor over voltage \( U \),
   Read wanted current intensity on scale \( J \).

\[ \boxed{ J = \frac{U}{R} } \]

**Example:**

\[ U = 30 \, mV \quad J = 2.3 \, \mu A \]

To find \( R = 13 \, k\Omega \)

Calculation method: Front side R

1. Set resistance \( R \) (or conductance value \( G \)) on the arrow mark ↓ (at R/Z).
2. Place cursor over current intensity \( J \),
   Read wanted voltage on Scale \( U \).

\[ \boxed{ R = \frac{U}{J} } \]
The NESTLER Slide Rule ELECTRONIC 0297

Front Side

Decibel-Scale for Amplification and Attenuation
Relation scale for Amplification and Attenuation
Transformation Scale
Resistance Scale
Conductivity Scale
Voltage Scale
Current Scale

Nepier Scale for Amplification and Attenuation

Reverse Side

Level Scale, in relation to basic value of 1 mW
Power output Scale with double divisions
Voltage Scale
Z-Scale
Power output Scale
Level Scale, in relation to basic value of 1 mW
Phase Angle Scale on Cursor

The upper divisions work together with the Cursor Scale of \( \sin, \cos \phi \).
2. POWER OUTPUT LAW

Example:
\[ U = 220 \, \text{V} \quad J = 0.75 \, \text{A} \]
To find \( P = 165 \, \text{W} \)

Calculation method: Front side R
1. Set voltage \( U \) over current intensity \( J \).
2. Read resistance \( R \) (or conductance value \( G \)) at the arrow mark ↓.

\[ R = \frac{U}{J} \]

\[ P = U^2 \div R \]

Example:
\[ R = 10 \, \text{M} \Omega \quad (G = 100 \, \text{nS}) \quad J = 200 \, \text{nA} \]
To find \( P = 400 \, \text{nW} \)

Calculation method: Front side R
1. Set resistance \( R \) (or conductance value \( G \)) on the arrow mark ↓. Read the voltage \( U \) over current \( J \).
2. Turn slide rule over.

\[ P = J^2 \times R \]

\[ U = \sqrt{P \times R} \]

The scales \( P_i \) and \( P_{II} \) as well as scales \( U_i \) and \( U_{II} \) supplement in continuation by overlapping each other. By positioning the scales on the slide you can read the five corresponding values \( P, U, J, G, R, G \) lie under ↓.

3. APPARENT, EFFECTIVE AND REACTIVE POWER

Example:
\[ P_a = 80 \, \text{W} \quad \cos \varphi = 0.6 \]
To find \( P_e = 135 \, \text{W} \)

\[ \theta \]

\[ 80 \quad 135 \, \text{VA} \]

fig. 4

fig. 5

fig. 6

fig. 7
4. AMPLIFICATION, ATTENUATION

Three scales are used to calculate Amplification and Attenuation in linear and logarithmic gradations. $U_i$ is the input voltage, $U_o$ the output voltage of an arbitrary 4-pole network. For Amplification $\alpha$ is $>1$ in linear or positive in logarithmic proportion scale. The same correspondingly applies for Attenuation when $\alpha$ should be $<1$ or negative.

Example:

<table>
<thead>
<tr>
<th>$U_i$</th>
<th>$U_o$</th>
<th>To find $V$</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 mV</td>
<td>3 V</td>
<td>$3 \cdot 10$ fold</td>
</tr>
</tbody>
</table>

\[ V = \frac{U_o}{U_i} \]

Calculation method:

1. Set $U_i$ under the arrow mark $\phi$ or scale $I = 100 \mu A$.
2. Place cursor over $U_i$ value. Read Amplification in the desired unit of measurement on scale $U_o/U_i$, 20 log $U_o/U_i$ or nepot $U_o/U_i$.

Example:

<table>
<thead>
<tr>
<th>$U_i$</th>
<th>$U_o$</th>
<th>To find $U_o = 3.65$ mV</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 V</td>
<td></td>
<td>$-6.35$ db</td>
</tr>
</tbody>
</table>

\[ V = \frac{U_o}{U_i} \]
5. TRANSFORMATION OF IMPEDANCE, CONDUCTANCE, VOLTAGE AND WINDING TURNS

Transformation calculations with the slide rule ELECTRONIC guarantee a clear and precise work. After choosing the definition, the ratio \( \tilde{U} \) for higher transformation becomes \( >1 \) and for lower transformation \( <1 \).

Therefore the transformation ratio \( 2 \) is similar for both, but one has to decide whether the value is greater or less than 1 to determine whether it is high or low. For all calculations set \( Z \), on the arrow mark \( \downarrow \) or read it as the given result.

Example:
\[
\begin{align*}
Z_1 & = 8 \, \text{kΩ} \\
Z_2 & = 5 \, \text{Ω}
\end{align*}
\]

To find \( \tilde{U} = 2.5 \cdot 10^{-2} \)

To find \( r^2 = 6.25 \cdot 10^{-4} \)

fig. 12

Calculation method: Front side R
1. Set \( Z \), on the arrow mark \( \downarrow \).
2. Read the wanted \( \tilde{U} \) or \( r^2 \) on the \( U/U \) scale.

\[ \tilde{U} = \sqrt{\frac{Z_2}{Z_1}} \]

In order to calculate the winding turns and voltage transformations, use scale \( U/U \).

Example:
\[
\begin{align*}
U_1 & = 31 \, \text{V} \text{ or } n_1 = 280 \, \text{Wdg.} \\
\tilde{U}_1 & = 0.36
\end{align*}
\]

To find \( U_2 = 11.2 \, \text{V} \)

To find \( n_2 = 34 \, \text{Wdg.} \)

fig. 13

6. dbm - LEVEL

The dbm-level is the ratio of power in logarithmic scale between the power \( P_{dbm} \) with a load \( R \) and a power of 1 mW.

\[ P_{dbm} = 10 \log \frac{P_1}{P_{mW}} \]

After setting the \( R \) on the arrow mark \( \uparrow \), you can ensure in one reading the load \( R \) corresponding to power output \( P_{dbm} \) and the level measurement \( n \) dbm.

Example:
\[
\begin{align*}
R & = 800 \, \Omega \\
U_1 & = 11 \, \text{V}
\end{align*}
\]

To find \( P_{dbm} = 200 \, \text{mW} \)

To find \( n = +23 \, \text{dbm} \)

fig. 14

Calculation method: Front side R
1. Set the load resistance \( R \) on the arrow mark \( \downarrow \). Turn the slide rule to reverse side.

Reverse side P
2. Place the cursor over the voltage \( U \).

Read output power on scale \( P \) and \( n \) off scale dbm-level.

In the communication techniques, the relative load values of 75 Ω, 150 Ω and 600 Ω are mostly used and the corresponding voltage values for 0 dbm are characterised by triangle marks.

7. PARALLEL CONNECTION OF RESISTANCES OR INDUCTANCES – SERIES CONNECTION OF CONDUCTANCES OR CAPACITANCES

The Z scale serves in general to solve the equation:

\[ \frac{1}{a} + \frac{1}{b} = \frac{1}{c} \text{ etc. } c = \frac{a \cdot b}{a + b} \]

In the electro-technique with this equation the parallel connection of \( R \) or \( L \) and the series connection of \( C \) or \( G \) is thereby calculated. Unlike other scales of the slide
rule ELECTRONIC, the Z scale is without place value columns i.e., the scale values can be multiplied by necessary indices of 10.

Example: \( R_1 = 12 \ \Omega \quad R_2 = 18 \ \Omega \quad \text{To find } R_{ges} = 7.22 \ \Omega \)

Calculation method: Reverse side P
1. Set \( Z_2 \) at the angular arrow mark.
2. Place cursor over \( Z_1 \).
3. Read \( Z_{ges} \) under cursor.

Example: \( R_{ges} = 53 \ \text{k}\Omega \quad R_1 = 82 \ \text{k}\Omega \quad \text{To find } R_2 = 150 \ \text{k}\Omega \)

Calculation method: Reverse side P.
1. Set \( Z_2 \) with the angular arrow mark.
2. Set cursor over \( Z_{ges} \).
3. Read \( Z_1 \) on the upper scale under cursor.