



# SEM0104 – Aula 9

## Exemplo de Aplicação: Software TEPiciclo

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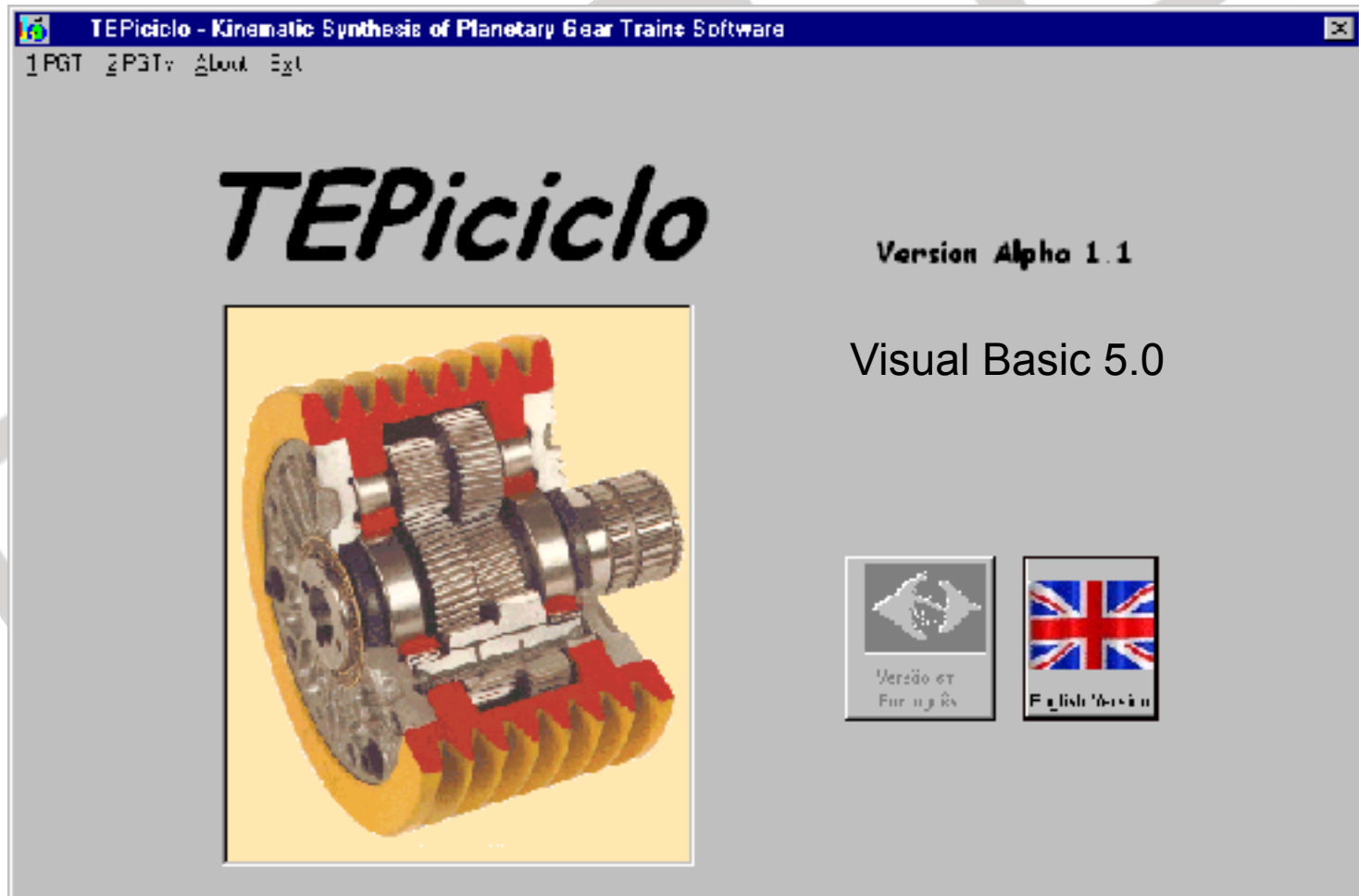
**LabRoM**

Prof. Dr. Marcelo Becker - SEM - EESC - USP

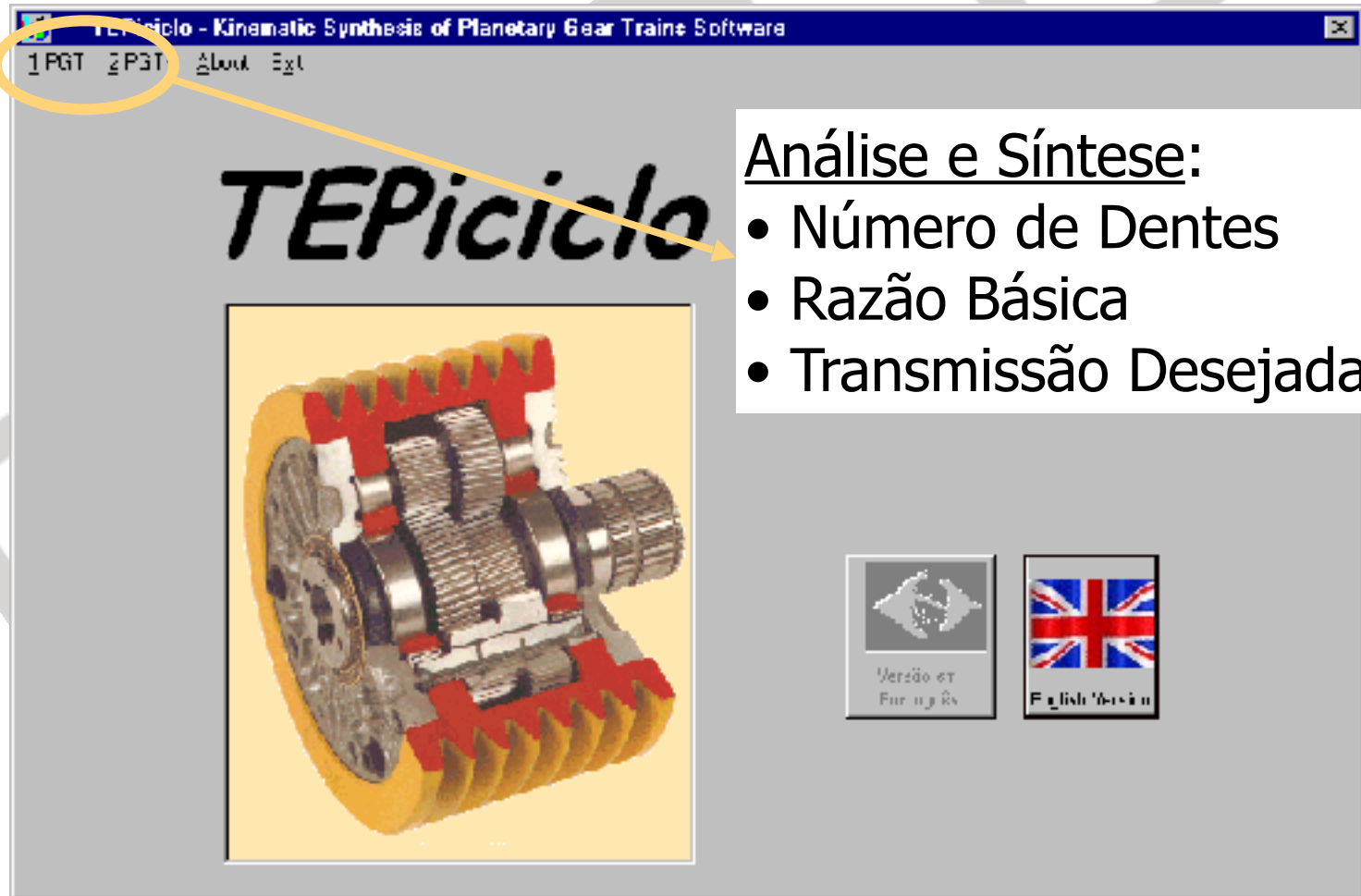
# Sumário da Aula

- **Software TEPiciclo**
- Exemplo 1 TEP: Análise
- Exemplo 1 TEP: Síntese
- Exemplo 2 TEPs: Análise
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# Software TEPiciclo



# Software TEPiciclo



# Sumário da Aula

- Software TEP Ciclo
- **Exemplo 1 TEP: Análise**
- Exemplo 1 TEP: Síntese
- Exemplo 2 TEPs: Análise
- Exemplo 2 TEPs: Síntese

# Exemplo 1 TEP: Análise

## Software TEPiciclo – Número de Dentes

The screenshot shows the '1 PGT - Determination of the Kinematic Relations through the Number of Teeth' window. It is divided into several sections:

- PGT Configuration:**
  - Driving Data:** Motors Quantity (radio buttons for 'only 1' and '2 motors'), Motor Position (dropdown for 'Sun'), Velocity (rpm) (input field '1200'), and Direction (dropdown for 'clockwise').
  - Output(s) Data:** Output (radio buttons for '1 output' and '2 outputs'), Output Position (dropdown for 'Ring').
  - Fixed Element:** Input field with 'Confirm' and 'Change' buttons.
- PGT Diagram:** A large empty rectangular area for the diagram.
- Gears Characteristics:**
  - Planets Quantity (dropdown for '3') and a gear diagram icon.
  - Teeth Quantity section with input fields for 'Teeth Quantity in the Sun' (value '1'), 'Teeth Quantity in the Planets' (value '2'), and 'Teeth Quantity in the Ring' (value '11').
  - 'Confirm', 'Change', and 'Cancel' buttons.
- Kinematic Results:**
  - PGT Type, Gear Ratio, and Output Angular velocity (rpm) input fields.
  - 'Torque Analysis' button (highlighted with a dashed border) and 'Change' button.
  - Silenciosos:** Checkboxes for 'Configuration' and 'Gears Characteristics', with 'Ok' and 'Cancel' buttons.

# Exemplo 1 TEP: Análise

## Software TEPiciclo – Número de Dentes

**1 PGT - Determination of the Kinematic Relations through the Number of Teeth**

File Print Results Back Exit

PGT Configuration

Driving Data

motors Quantity:  only 1  2 motors

motor 1: Sun Velocity (rpm): 1200 Direction: clockwise

Output(s) Data

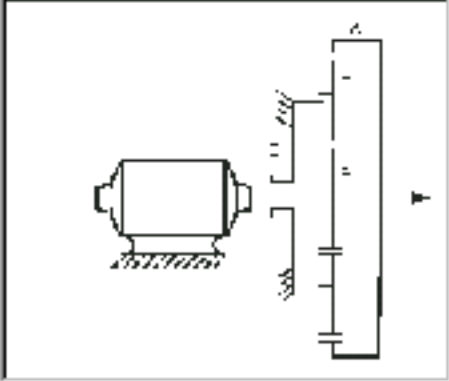
1 output  2 outputs

Output Position: Ring

Fixed Element: Arm


Confirm Change

PGT Diagram



Gears characteristics

Planets Quantity: 3



Teeth Quantity

Teeth Quantity in the Sun: 1

Teeth Quantity in the Planets: 2

Teeth Quantity in the Ring: 11

Confirm Change Cancel

Kinematic Results

PGT Type:

Gear Ratio:

Output Angular velocity (rpm):

Torque Analysis Change

Silencios:  Configuration  Gears Characteristics

Ok Cancel

# Exemplo 1 TEP: Análise

## Software TEPiciclo – Número de Dentes

**1 PGT - Determination of the Kinematic Relations through the Number of Teeth**

File Print Results Exit Edit

**1 PGT Torque Analysis**

Close View Print

AC Data

Teeth Quantity

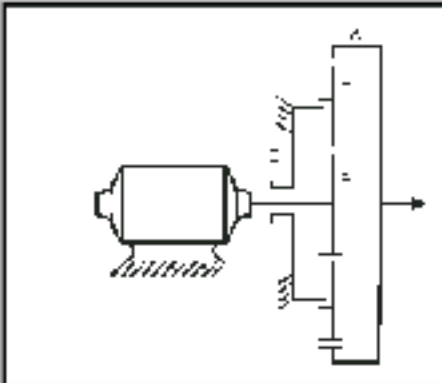
Ring:

sun:

Planets:

Train Value:

OK Cancel



PGT Diagram

Results

Values as a function of  $T_{in}$ :

$T_1$  :   $\times T_{in}$

$T_2$  :   $\times T_{in}$

$T_3$  :   $\times T_{in}$

$T_4$  :   $\times T_{in}$

$T_5$  :   $\times T_{in}$

$T_6$  :   $\times T_{in}$

$T_7$  :   $\times T_{in}$

$T_{out}$  :   $\times T_{in}$

The calculated values are a function of the input Torque  $T_{in}$  and the signs (+) or (-) indicate the Torque Flow Direction.

Values as a function of  $T_{in}$

Component	Value	Sign
$T_1$	2.73	(+)
$T_2$	1.87	(-)
$T_3$	0.07	(-)
$T_4$	1.87	(-)
$T_5$	0.07	(+)
$T_6$	1.00	(+)
$T_7$	3.73	(-)
$T_{out}$	2.73	(-)

Confirm Change Cancel



# Exemplo 1 TEP: Análise

## Software TEPiciclo – Número de Dentes

**1 PGT - Determination of the Kinematic Relations through the Number of Teeth**

File Print Results Back Exit

PGT Configuration

Driving Data

motors Quantity:  only 1  2 motors

motor 1:

Output(s) Data

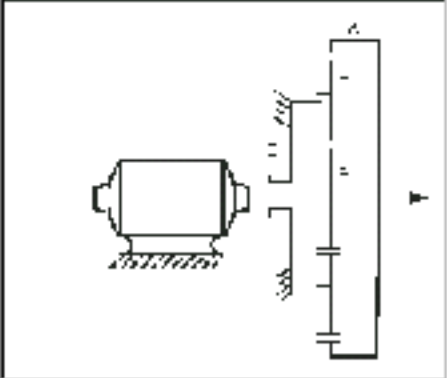
1 output  2 outputs

Output Position:

Fixed Element:


Confirm Change

PGT Diagram



Gears characteristics

Planets Quantity:



Teeth Quantity

Teeth Quantity in the Sun:

Teeth Quantity in the Planets:

Teeth Quantity in the Ring:

Confirm Change Cancel

Kinematic Results

PGT Type:

Gear Ratio: - 2.733 : 1

Output Angular velocity (rpm): - 439.0

Torque Analysis Change

Iterations:

Configuration  Gears Characteristics

Ok Cancel

# Exemplo 1 TEP: Análise

## Software TEPiciclo – Número de Dentes

The screenshot shows the '1 PGT - Determination of the Kinematic Relations through the Number of Teeth' window. It is divided into several sections:

- PGT Configuration:**
  - Driving Data:** Includes 'Motors Quantity' (radio buttons for 'only 1' and '2 motors'), 'Motor Position' (dropdowns for 'Sun' and 'Ring'), 'Velocity (rpm)' (input fields for 1200 and 9400), and 'Direction' (dropdowns for 'clockwise').
  - Output(s) Data:** Includes '1 output' (radio button) and 'Output Element' (text field).
  - Fixed Element:** Set to 'none'.
  - Buttons: 'Confirm' and 'Change'.
- PGT Diagram:** A large empty rectangular area for the gear train diagram.
- Gears Characteristics:**
  - Planets Quantity:** Dropdown set to '3', with a small gear diagram showing 3 planets.
  - Teeth Quantity:** Input fields for 'Teeth Quantity in the Sun' (1), 'Teeth Quantity in the Planets' (2), and 'Teeth Quantity in the Ring' (11).
  - Buttons: 'Confirm', 'Change', and 'Cancel'.
- Kinematic Results:**
  - Output Angular Velocity (rpm):** Input field with a 'Plot' button.
  - Torque Analysis:** A dashed box containing a 'Change' button.
  - Silenciosos:** Checkboxes for 'Configuration' (checked) and 'Gears Characteristics' (unchecked), with 'Ok' and 'Cancel' buttons.

# Exemplo 1 TEP: Análise

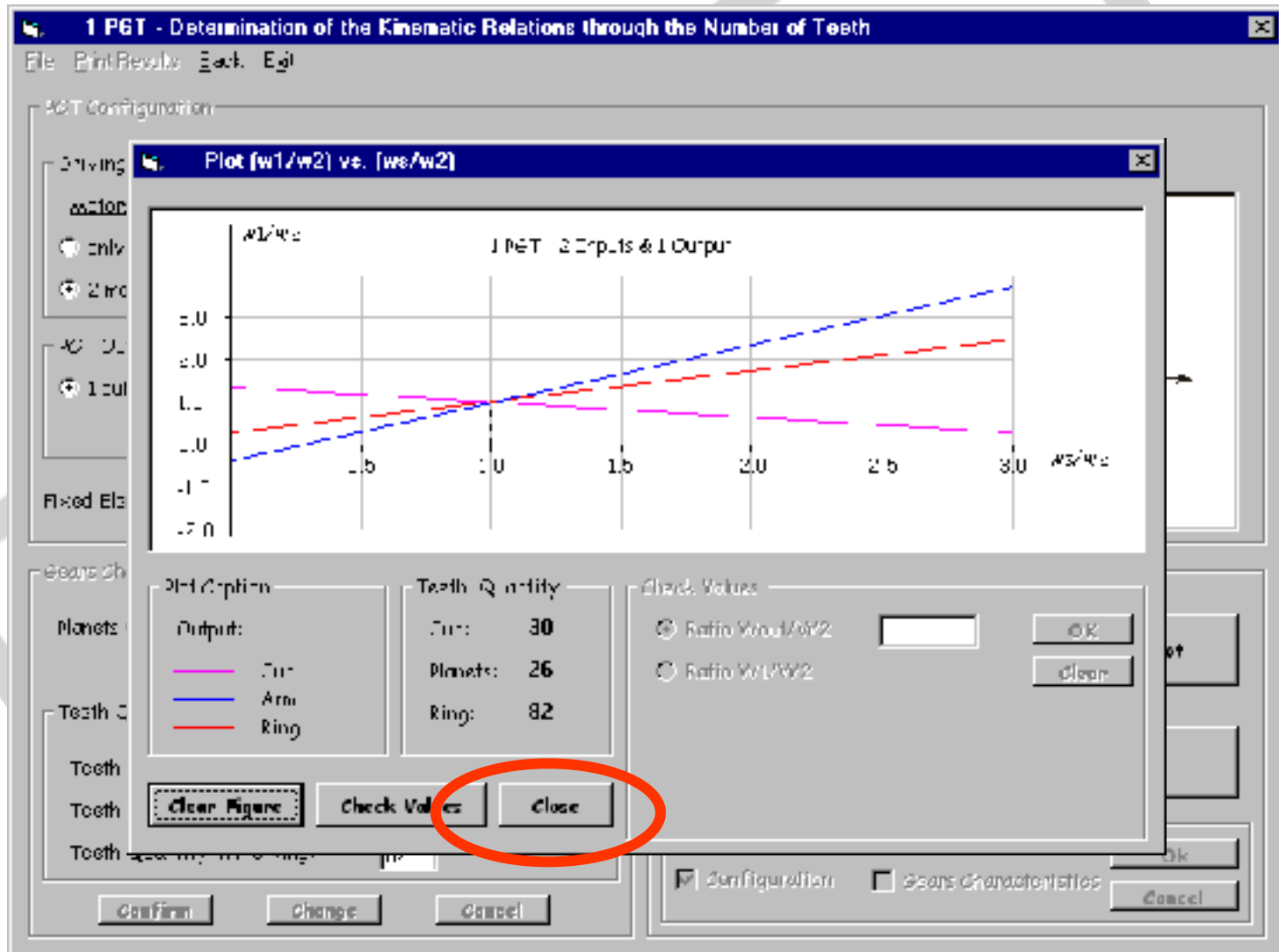
## Software TEPiciclo – Número de Dentes

The screenshot shows the '1 PGT - Determination of the Kinematic Relations through the Number of Teeth' window. It is divided into several sections:

- PGT Configuration:**
  - Driving Data:** Includes 'Motors Quantity' (radio buttons for 'only 1' and '2 motors'), 'Motor Position' (dropdowns for 'Sun' and 'Ring'), 'Velocity (rpm)' (input fields for 1200 and 9400), and 'Direction' (dropdowns for 'clockwise').
  - Output(s) Data:** Includes '1 output' selected and 'Output Element: Arm'.
  - Fixed Element:** Set to 'none'.
- PGT Diagram:** A schematic diagram of a planetary gear train with two input motors (I and II) and an output arm.
- Gears Characteristics:**
  - Planets Quantity:** Set to 3, with a small diagram of a 3-planet gear set.
  - Teeth Quantity:** Input fields for 'Teeth Quantity in the Sun' (1), 'Teeth Quantity in the Planets' (2), and 'Teeth Quantity in the Ring' (11).
- Kinematic Results:**
  - Output Angular Velocity (rpm):** 1789.3.
  - Plot:** A button highlighted with a red circle.
  - Torque Analysis:** A dashed box around a button.
  - Change:** A button.
- Options:** Checkboxes for 'Configuration' (checked) and 'Gears Characteristics' (unchecked).

# Exemplo 1 TEP: Análise

## Software TEPiciclo – Número de Dentes



# Exemplo 1 TEP: Análise

## Software TEPiciclo – Número de Dentes

The screenshot shows the '1 PGT - Determination of the Kinematic Relations through the Number of Teeth' window. It is divided into several sections:

- PGT Configuration:**
  - Driving Data:** Motors Quantity (radio buttons for 'only 1' and '2 motors'), Motor Position (dropdown 'Sun'), Velocity (rpm) (input '1200'), and Direction (dropdown 'clockwise').
  - Output(s) Data:** Radio buttons for '1 output' and '2 outputs'. The ratio between the outputs is  $\omega_{Ring} = 0.7 \omega_{Arm}$ .
  - Fixed Element: 'none'. Buttons: 'Confirm', 'Change'.
- PGT Diagram:** A large empty box for the gear diagram.
- Gears Characteristics:**
  - Planets Quantity: dropdown '3'. Includes a small gear diagram icon.
  - Teeth Quantity:
    - Teeth Quantity in the Sun: input '1'
    - Teeth Quantity in the Planets: input '2'
    - Teeth Quantity in the Ring: input '11'
  - Buttons: 'Confirm', 'Change', 'Cancel'.
- Kinematic Results:**
  - Output Velocity of the Arm (rpm): empty input field.
  - Output Velocity of the Ring (rpm): empty input field.
  - Buttons: 'Torque Analysis', 'Change'.
- Silenciosas:**
  - Checkboxes:  Configuration,  Gears Characteristics.
  - Buttons: 'Ok', 'Cancel'.

# Exemplo 1 TEP: Análise

## Software TEPiciclo – Número de Dentes

The screenshot shows the '1 PGT - Determination of the Kinematic Relations through the Number of Teeth' window. It is divided into several sections:

- PGT Configuration:**
  - Driving Data:** Motors Quantity:  only 1,  2 motors. Motor 1: . Velocity (rpm): . Direction: .
  - Output(s) Data:**  2 outputs. Ratio between the Outputs:  $\omega_{Ring} = 0.7 \omega_{Sun}$ .
  - Fixed Element: . Buttons:  .
- PGT Diagram:** A schematic diagram showing a motor connected to a planetary gear set with a sun gear (S), planet carrier (P), and ring gear (R). The output shaft is labeled with  $\omega$ .
- Gears Characteristics:** Planets Quantity: . A diagram of a 3-planet gear set is shown. Teeth Quantity: Teeth Quantity in the Sun: ; Teeth Quantity in the Planets: ; Teeth Quantity in the Ring: . Buttons:   .
- Kinematic Results:** Output Velocity of the Arm (rpm): **669.3**; Output Velocity of the Ring (rpm): **481.5**. A **Torque Analysis** button is highlighted with a red circle. A  button is also present.
- Screenshots:**  Configuration,  Gears Characteristics. Buttons:  .

# Exemplo 1 TEP: Análise

## Software TEPiciclo – Número de Dentes

The screenshot displays the '1 PGT Torque Analysis' window. On the left, the 'Data' section shows input values: Teeth (E2), Ring (E0), Planets (76), and Train Value (0.066). The central 'PGT Diagram' shows a motor connected to a planetary gear set with components labeled A, P, S, and W. On the right, the 'Results' section lists torque values as a function of input torque  $T_{in}$ :

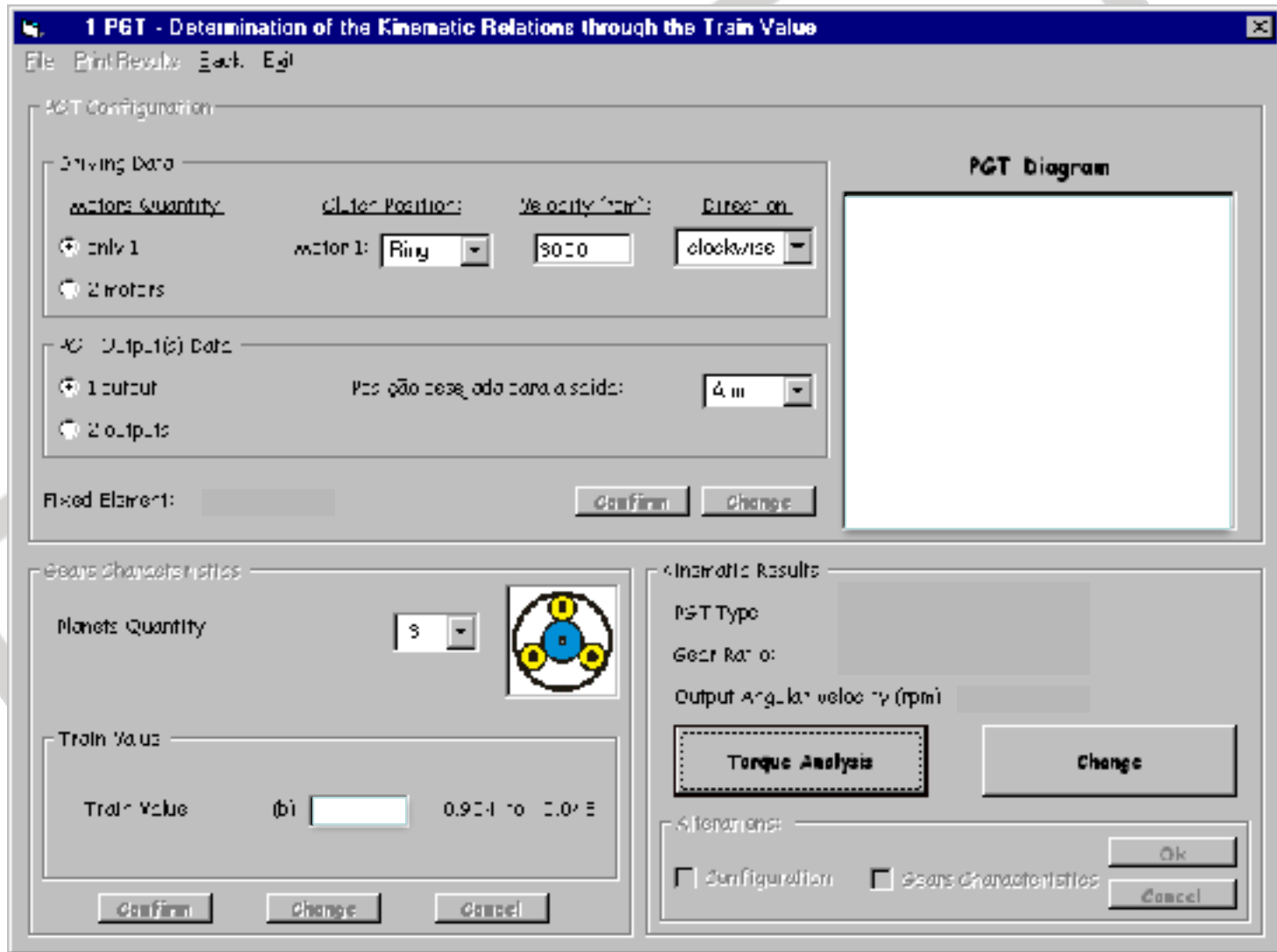
- $T_1 : 2.799 \times T_{in}$
- $T_2 : -1.867 \times T_{in}$
- $T_3 : -0.067 \times T_{in}$
- $T_4 : -1.067 \times T_{in}$
- $T_5 : 0.067 \times T_{in}$
- $T_6 : 1.0 \times T_{in}$
- $T_{out} : -2.799 \times T_{in}$
- $T_{out1} : 3.799 \times T_{in}$

Below the results, a bar chart shows the magnitude of torques for gears 61 and 62. Gear 61 has torques of 2.799, 1.867, 0.067, 1.867, and 1.0. Gear 62 has torques of 2.799 and 0.067. A small diagram on the right shows torque flow directions for gears 61, 62, and 63.

A note at the bottom right states: "The calculated values are a function of the input Torque  $T_{in}$  and the signs (+) or (-) indicate the Torque Flow Direction."

# Exemplo 1 TEP: Análise

## Software TEPiciclo – Razão Básica





# Exemplo 1 TEP: Análise

## Software TEPiciclo – Razão Básica

The screenshot displays the '1 PGT - Determination of the Kinematic Relations through the Train Value' window. It is divided into several sections:

- PGT Configuration:**
  - Driving Data:** Motor Quantity is set to 'only 1'. Motor 1 is 'Ring' with a velocity of '9000' rpm and 'clockwise' direction.
  - Output(s) Data:** '1 output' is selected with a 'Razão desejada para a saída' of '4,00'.
  - Fixed Element:** Set to 'Sun'.
- PGT Diagram:** A schematic showing a motor connected to a planetary gear set with a ring gear (A) and a carrier (B).
- Gears Characteristics:** Planets Quantity is '3'. A diagram shows a 3-planet gear set.
- Train Value:** The Train Value is '4157' with a range of '0,924 to 2,073'.
- Kinematic Results:** PGT Type is 'Reduction Gearbox'. Gear Ratio is '1,578 : 1'. Output Angular velocity (rpm) is '1910,8'. A 'Torque Analysis' button is highlighted.
- Silenciosas:** Checkboxes for 'Configuration' and 'Gears Characteristics' are present.

# Exemplo 1 TEP: Análise

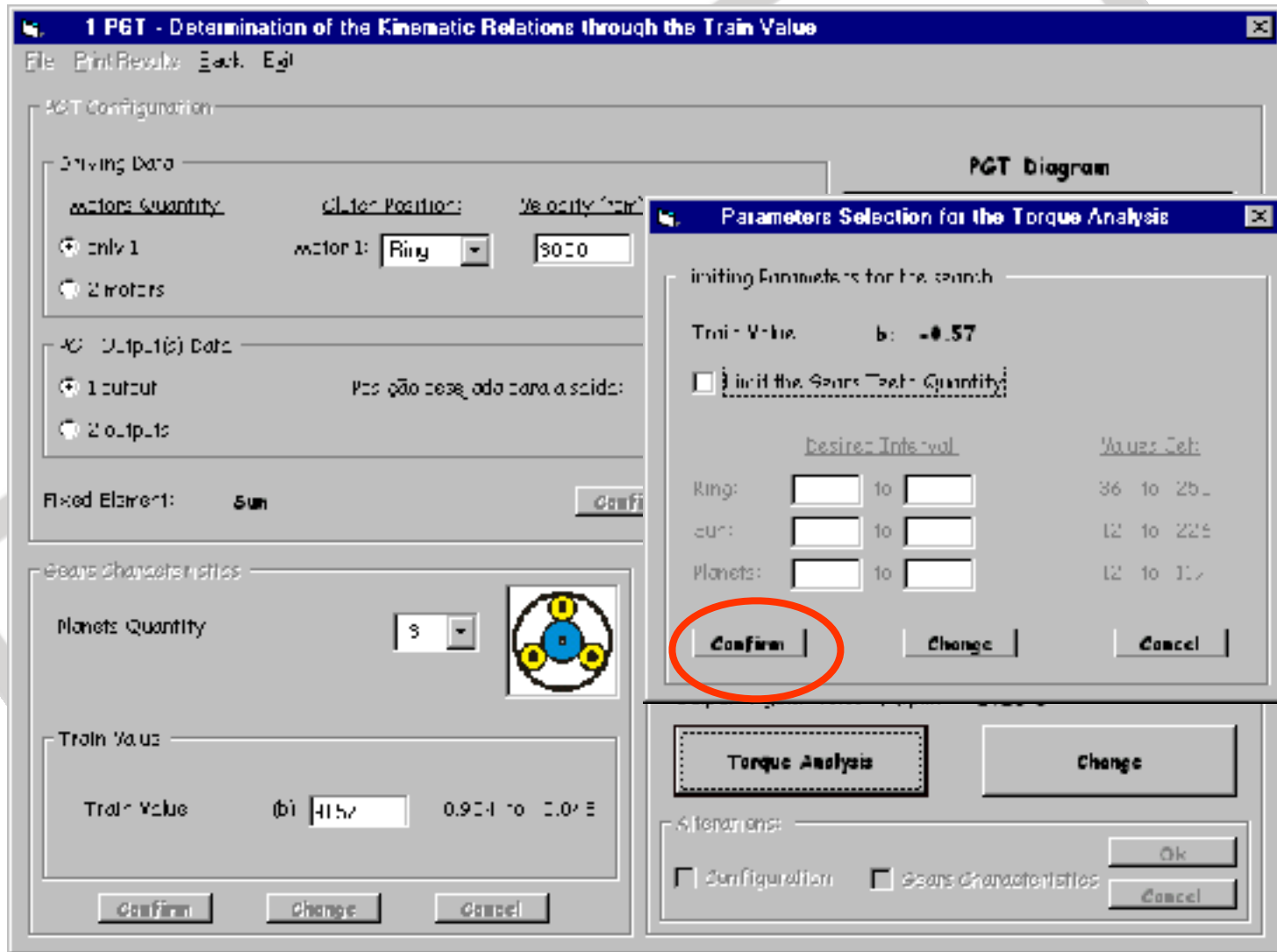
## Software TEPiciclo – Razão Básica

The screenshot displays the '1 PGT - Determination of the Kinematic Relations through the Train Value' window. The interface is divided into several sections:

- PGT Configuration:**
  - Driving Data:** Motors Quantity:  only 1,  2 motors. Motor 1: Ring, Velocity (rpm): 9000, Direction: clockwise.
  - Output(s) Data:**  1 output,  2 outputs. Razão desejada para a saída: 4,00.
  - Fixed Element: Sun. Buttons: Confirm, Change.
- PGT Diagram:** A schematic diagram showing a motor connected to a planetary gear set. The input shaft is labeled 'A' and the output shaft is labeled 'B'. The gear set includes a central sun gear and surrounding planet gears.
- Gears Characteristics:** Planets Quantity: 3. Includes a small diagram of a 3-planet gear set. Buttons: Confirm, Change, Cancel.
- Train Value:** Train Value (bi): 4157, 0,924 to 2,073. Buttons: Confirm, Change, Cancel.
- Kinematic Results:** PGT Type: Reduction Gearbox. Gear Ratio: 1,578 : 1. Output Angular velocity (rpm): 1910,8. A red circle highlights the 'Torque Analysis' button. Buttons: Change, Ok, Cancel.
- Options:**  Configuration,  Gears Characteristics.

# Exemplo 1 TEP: Análise

## Software TEPiciclo – Razão Básica



# Exemplo 1 TEP: Análise

## Software TEPiciclo – Razão Básica

**1 PGT - Determination of the Kinematic Relations through the Train Value**

File Print Results Exit Help

PGT Configuration

Driving Data

PGT Diagram

**Parameters Selection for the Torque Analysis**

Limiting Parameters for the search

Train Value:  $b = -0.57$

Limit the Gears Teeth Quantity

	Desired Interval	Values Set
Ring:	<input type="text"/> to <input type="text"/>	36 to 250
Gears:	<input type="text"/> to <input type="text"/>	12 to 225
Planets:	<input type="text"/> to <input type="text"/>	12 to 117

Results

Select the PGT for the Torque Analysis:

PAT: 11 options

- Z<sub>1</sub> = 55 Z<sub>2</sub> = 37 Z<sub>p</sub> = 11
- Z<sub>1</sub> = 79 Z<sub>2</sub> = 45 Z<sub>p</sub> = 17
- Z<sub>1</sub> = 78 Z<sub>2</sub> = 53 Z<sub>p</sub> = 20
- Z<sub>1</sub> = 107 Z<sub>2</sub> = 41 Z<sub>p</sub> = 29
- Z<sub>1</sub> = 121 Z<sub>2</sub> = 69 Z<sub>p</sub> = 26
- Z<sub>1</sub> = 135 Z<sub>2</sub> = 77 Z<sub>p</sub> = 29
- Z<sub>1</sub> = 175 Z<sub>2</sub> = 78 Z<sub>p</sub> = 27
- Z<sub>1</sub> = 107 Z<sub>2</sub> = 107 Z<sub>p</sub> = 47

Change Confirm

Train Value

Train Value (b)  0.924 to 2.073

Confirm Change Cancel

Torque Analysis Change

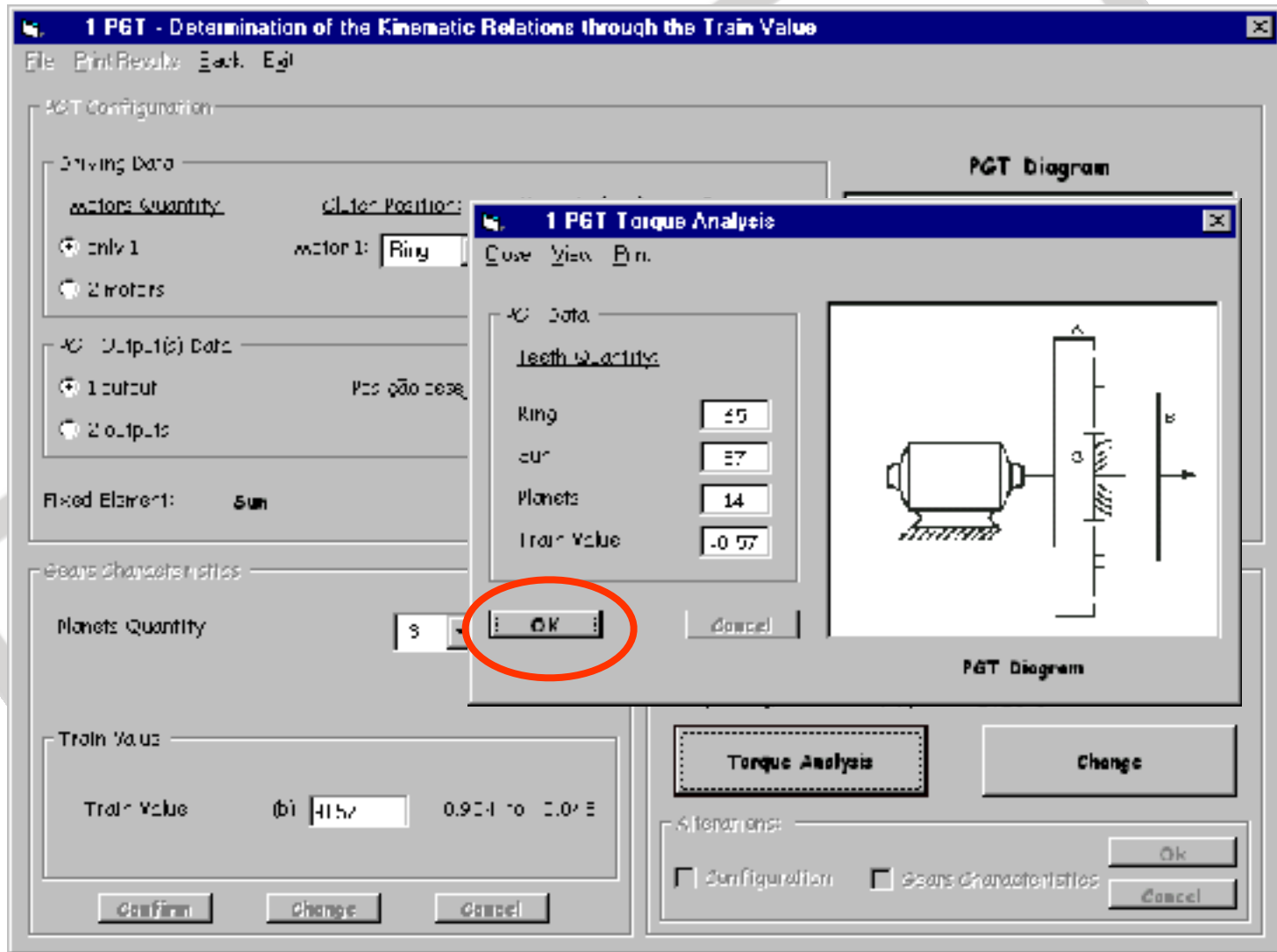
Silencios:

Configuration  Gears Characteristics

Ok Cancel

# Exemplo 1 TEP: Análise

## Software TEPiciclo – Razão Básica



# Exemplo 1 TEP: Análise

## Software TEPiciclo – Razão Básica

**1 PGT - Determination of the Kinematic Relations through the Train Value**

File Print Results Back Edit

**1 PGT Torque Analysis**

Close View Print

AC Input

Teeth Quantity:

Ring: 45

c.u.: 37

Planets: 14

Train Value: -0.57

OK Cancel

**PGT Diagram**

Results

Values as a function of  $T_{in}$ :

$T_1$  : 1.0  $\times T_{in}$

$T_2$  : -0.785  $\times T_{in}$

$T_3$  : -0.215  $\times T_{in}$

$T_4$  : -0.705  $\times T_{in}$

$T_5$  : 0.215  $\times T_{in}$

$T_6$  : 0.569  $\times T_{in}$

$T_7$  : 0.569  $\times T_{in}$

$T_{out}$  : 1.569  $\times T_{in}$

The calculated values are a function of the input Torque  $T_{in}$  and the signals (+) or (-) indicates the Torque Flow Direction

Values as a function of  $T_{in}$

1.0 0.785 0.215 0.705 0.215 0.569 0.569 1.569

61 62

Confirm Change Cancel

# Exemplo 1 TEP: Análise

## Software TEPiciclo – Razão Básica

**1 PGT - Determination of the Kinematic Relations through the Train Value**

**1 PGT Torque Analysis**

Case View Prin.

AC Data

Teeth Quantity

Ring: 45

cUP: 37

Planets: 14

Train Value: -0.57

OK Cancel

PGT Diagram

Torque Diagram

Val. ac in modulus for as a function of  $\omega_{in}$

$\tau_1$	$\tau_2$	$\tau_3$	$\tau_4$	$\tau_5$	$\tau_6$	$\tau_7$	$\tau_{out} \times \tau_{in}$
1.00	0.73	0.22	0.73	0.22	0.57	0.57	1.57
G1		G2					

# Sumário da Aula

- Software TEP ciclo
- Exemplo 1 TEP: Análise
- **Exemplo 1 TEP: Síntese**
- Exemplo 2 TEPs: Análise
- Exemplo 2 TEPs: Síntese



# Exemplo 1 TEP: Síntese

## Software TEPiciclo – Transmissão

**1 PG1 - Determination of the Kinematic Relation through the Gear Ratio**

File | Back | Print | Exit

**Driving Data:**  
 Angular Velocity:  rpm    Direction:    
   

**Gear Ratio:**  
 Gear Ratio Value:    
       

**Possible Ratio Values Sets for teeth quantity from 12 to 250:**

<b>Reduction</b>	1.248 to 1.904	2.108 to 21.833
<b>Reverse Reduction</b>	-1.126 to -21.833	
<b>Multiplication</b>	0.076 to 2.777	0.525 to 2.957
<b>Reverse Multiplication</b>	-0.048 to -0.904	

**Results:**

Limiting Data to search the triple teeth set:

Gear Ratio Tolerance (0.01 to 10%)            

Limit the Gears Teeth Quantity

	Desired Gear Interval	Valid Set
Ring:	<input type="text"/> to <input type="text"/>	36 to 250
Sun:	<input type="text"/> to <input type="text"/>	12 to 225
Planets:	<input type="text"/> to <input type="text"/>	12 to 112

The PG is quantity that satisfies the conditions is:

**Possible Solutions:**

**Gear Ratio Interval (GRI):**

**Selected Solutions:**

      
       
 Thomas Garbacz

Windows taskbar: TEPiciclo... | Ap15 - Paint | 1 PG... | 10:0

# Exemplo 1 TEP: Síntese

## Software TEPiciclo – Transmissão

**1 PGT - Determination of the Kinematic Relation through the Gear Ratio**

File Back Print Exit

Driving Data

Angular Velocity:  rpm    Direction:

Gear Ratio

Gear Ratio Value:

PGT Type    Reduction Gearbox

Output Velocity:  rpm   

PGT Diagram

Results

Limiting Data to search the triple teeth set

Gear Ratio Tolerance (0.01 to 10%)

Limit the Gears Teeth Quantity

	Desired Teeth Interval	Values Set
Ring:	<input type="text"/> to <input type="text"/>	36 to 250
sun:	<input type="text"/> to <input type="text"/>	12 to 225
Planets:	<input type="text"/> to <input type="text"/>	12 to 117

The P.G. is quantity that satisfies the conditions is:

Possible Solutions:

Selected Solutions:

Transm. Ambedro

# Exemplo 1 TEP: Síntese

## Software TEPiciclo – Transmissão

**1 PGT - Determination of the Kinematic Relation through the Gear Ratio**

File Edit Print Exit

Driving Data:

Angular Velocity:  rpm Direction:

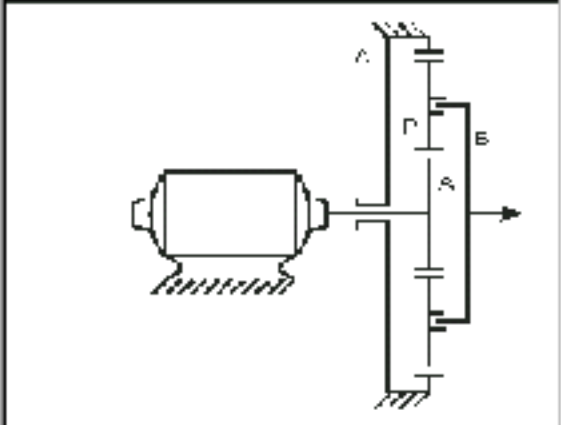
Gear Ratio:

Gear Ratio Value:

PGT Type: Reduction Gearbox

Output Velocity:  rpm

PGT Diagram



Results:

Limiting Data to search the triple teeth set:

Gear Ratio Tolerance (0.01 to 10%)

Limit the Gears Teeth Quantity

	Desired Gear Interval	Valid set:
Ring:	<input type="text"/> to <input type="text"/>	36 to 250
Sun:	<input type="text"/> to <input type="text"/>	12 to 225
Planets:	<input type="text"/> to <input type="text"/>	12 to 112

The PG is quantity that satisfies the conditions is:

Possible Solutions:

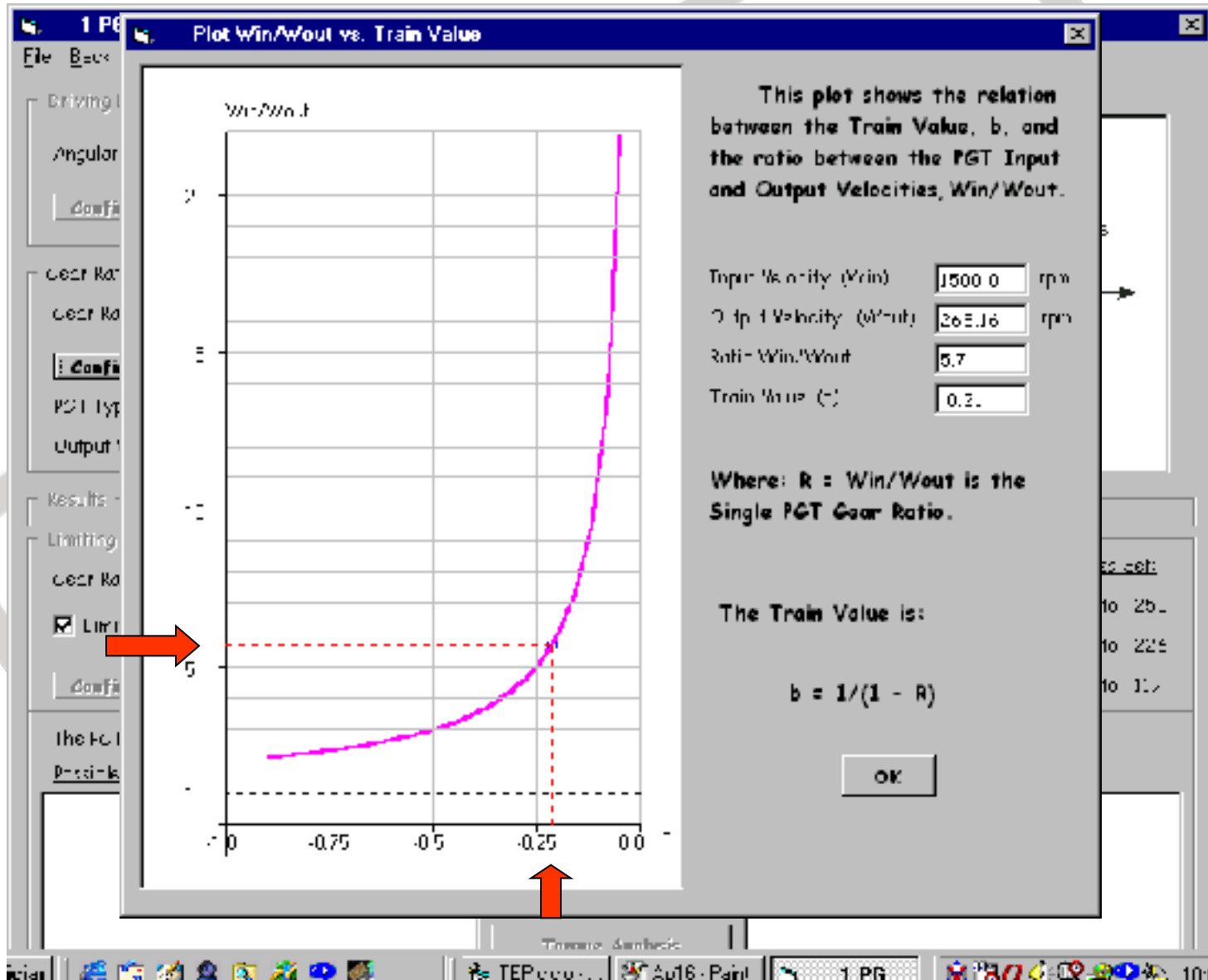
Gear Ratio Interval (GRI):

Selected Solutions:

TEP... Ap16 - Paint 1 PG... 10:0

# Exemplo 1 TEP: Síntese

## Software TEPiciclo – Transmissão



# Exemplo 1 TEP: Síntese

## Software TEPiciclo – Transmissão

**1 PGT - Determination of the Kinematic Relation through the Gear Ratio**

File B=OK Print Exit

Driving Data:

Angular Velocity:  rpm Direction:

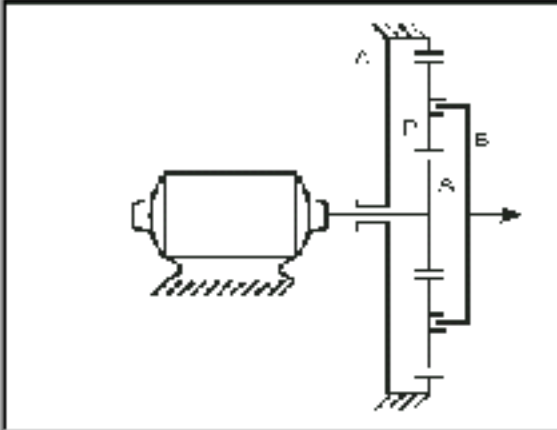
Gear Ratio:

Gear Ratio Value:

PGT Type: Reduction Gearbox

Output Velocity:  rpm

PGT Diagram



Results:

Limiting data to search the triple teeth set:

Gear Ratio Tolerance (0.01 to 10 %):

Limit the Gears set Quantity

	Desired set Interval	Valid set
Ring:	<input type="text"/> to <input type="text"/>	36 to 251
sun:	<input type="text"/> to <input type="text"/>	12 to 225
Planets:	<input type="text"/> to <input type="text"/>	12 to 117

The P.G.T. is quantity that satisfies the conditions is:

Proposed Solutions:

Gear Ratio Interval (GRI):

Selected Solutions:

Transm. Gearbox

TEP... Ap16 - Paint 1 PG... 10:0

# Exemplo 1 TEP: Síntese

## Software TEPiciclo – Transmissão

**1 PGT - Determination of the Kinematic Relation through the Gear Ratio**

File B... Prn. Exl

Driving Data:

Angular Velocity:  rpm    Direction:

Gear Ratio:

Gear Ratio Value:

PGT Type: **Reduction Gearbox**

Output Velocity: **263.2 rpm**   

**PGT Diagram**

Results:

Limiting Data to search the triple teeth set:

Gear Ratio Tolerance (0.01 to 10 %):

Limit the Gears set Quantity

Desired set Interval	Valid set
Ring: <input type="text"/> to <input type="text"/>	36 to 250
sun: <input type="text"/> to <input type="text"/>	12 to 225
Planets: <input type="text"/> to <input type="text"/>	12 to 110

The P.G.T.s quantity that satisfies the conditions is: **5**    Gear Ratio Interval (GRI): **5.694 to 5.706**

Possible Solutions:

- Zr = 61   Zs = 19   Zp = 24   GR = 5.692
- Zr = 122   Zs = 38   Zp = 48   GR = 5.692
- Zr = 183   Zs = 57   Zp = 72   GR = 5.692
- Zr = 244   Zs = 76   Zp = 96   GR = 5.692
- Zr = 305   Zs = 95   Zp = 120   GR = 5.692

Selected Solutions:

- Zr = 61   Zs = 19   Zp = 24   GR = 5.692

# Exemplo 1 TEP: Síntese

## Software TEPiciclo – Transmissão

**1 PGT - Determination of the Kinematic Relation through the Gear Ratio**

File Back Print Exit

Driving Data

Angular Velocity:  rpm Direction:

Gear Ratio

Gear Ratio Value:

PGT Type:

Output Velocity:  rpm

PGT Diagram

Results

Limiting Data to search the prime teeth set

Gear Ratio Tolerance (0.01 to 10 %):

Limit the Gears Teeth Quantity

	Desired	set Interval	Values set:
Ring:	<input type="text"/>	to <input type="text"/>	36 to 250
sun:	<input type="text"/>	to <input type="text"/>	12 to 225
Planets:	<input type="text"/>	to <input type="text"/>	12 to 117

The PGTs quantity that satisfies the conditions is: **5** Gear Ratio Interval (GRI): **5.694 to 5.706**

Proposed Solutions:

<input checked="" type="checkbox"/>	Zr = 61	Zs = 19	Zp = 24	GR = 5.692
<input type="checkbox"/>	Zr = 122	Zs = 38	Zp = 48	GR = 5.692
<input type="checkbox"/>	Zr = 183	Zs = 57	Zp = 72	GR = 5.692
<input type="checkbox"/>	Zr = 244	Zs = 76	Zp = 96	GR = 5.692

Selected Solutions:

<input checked="" type="checkbox"/>	Zr = 61	Zs = 19	Zp = 24	GR = 5.692
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# Exemplo 1 TEP: Síntese

## Software TEPiciclo – Transmissão

**1 PGT - Determination of the Kinematic Relation through the Gear Ratio**

File Base Prin. Ext

**PGT Diagram**

Driving Data

**1 PGT Torque Analysis**

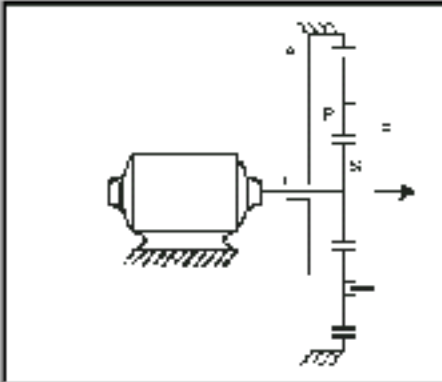
Case View Prin.

AC Data

Teeth Quantity

Ring: 61  
 Sun: 19  
 Planets: 74  
 Train Value: -0.217

OK Cancel



PGT Diagram

Result

Values as a function of  $T_{in}$ :

$T_1$  : 4.692  $\times T_{in}$   
 $T_2$  : -2.846  $\times T_{in}$   
 $T_3$  : -1.046  $\times T_{in}$   
 $T_4$  : -2.046  $\times T_{in}$   
 $T_5$  : 1.046  $\times T_{in}$   
 $T_6$  : 1.0  $\times T_{in}$   
 $T_7$  : 4.692  $\times T_{in}$   
 $T_{out}$  : 5.692  $\times T_{in}$

The calculated values are a function of the input Torque  $T_{in}$  and the signals (+) or (-) indicate the Torque Flow Direction.

Values in modulus as a function of  $T_{in}$

Component	Value	Sign
$T_1$	4.69	(+)
$T_2$	2.85	(-)
$T_3$	1.85	(-)
$T_4$	2.85	(-)
$T_5$	1.85	(+)
$T_6$	1.00	(+)
$T_7$	4.69	(+)
$T_{out}$	5.69	(+)

61 62

$T_{in} = 100$   $T_{out} = 569$   $T_p = 77$   $R_2 = 5.792$   
 $Z_r = 216$   $Z_s = 45$   $Z_p = 80$   $62 = 5.696$

Torque Analysis

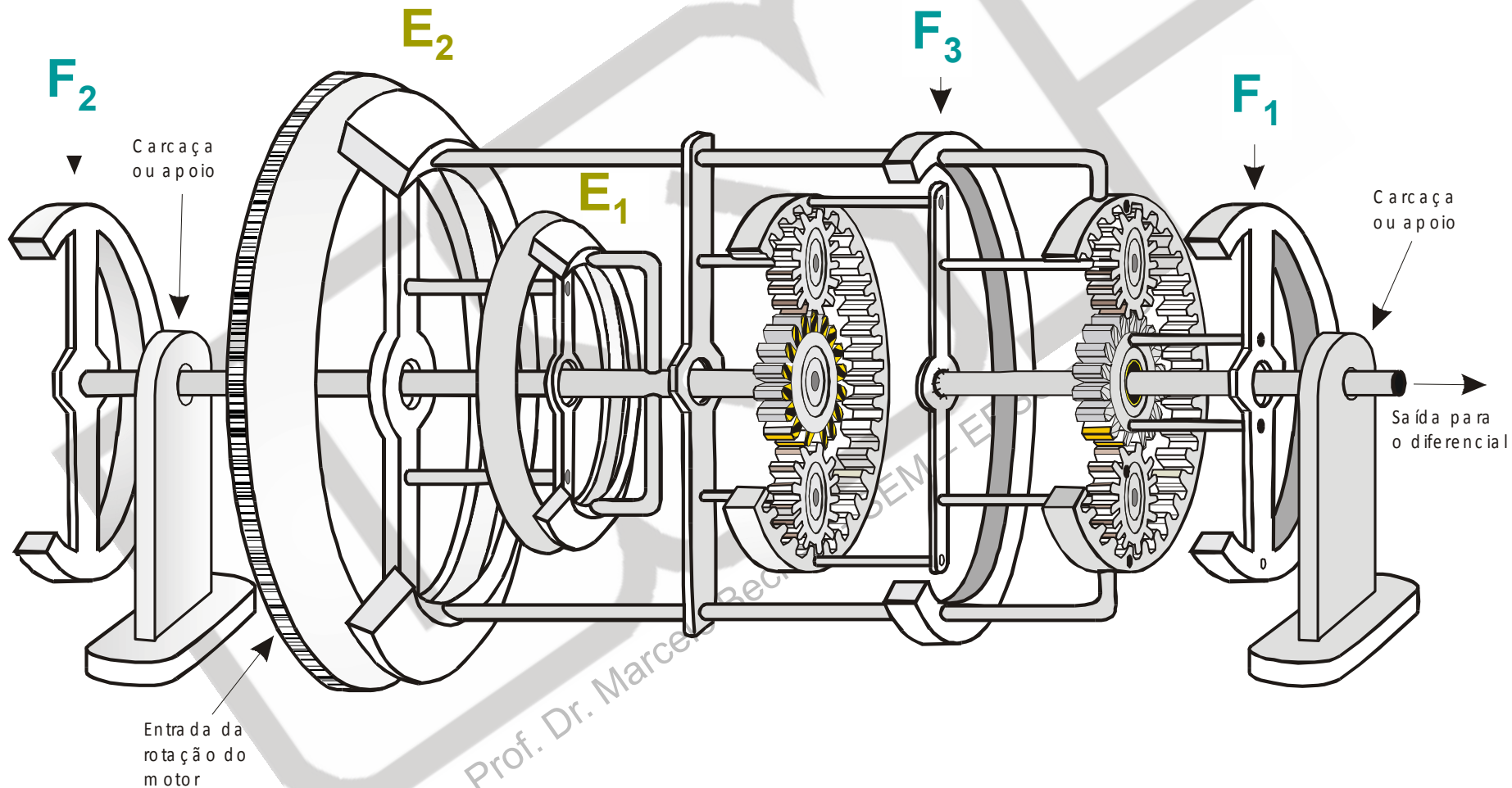


# Sumário da Aula

- Software TEPiciclo
- Exemplo 1 TEP: Análise
- Exemplo 1 TEP: Síntese
- **Exemplo 2 TEPs: Análise**
- Exemplo 2 TEPs: Síntese

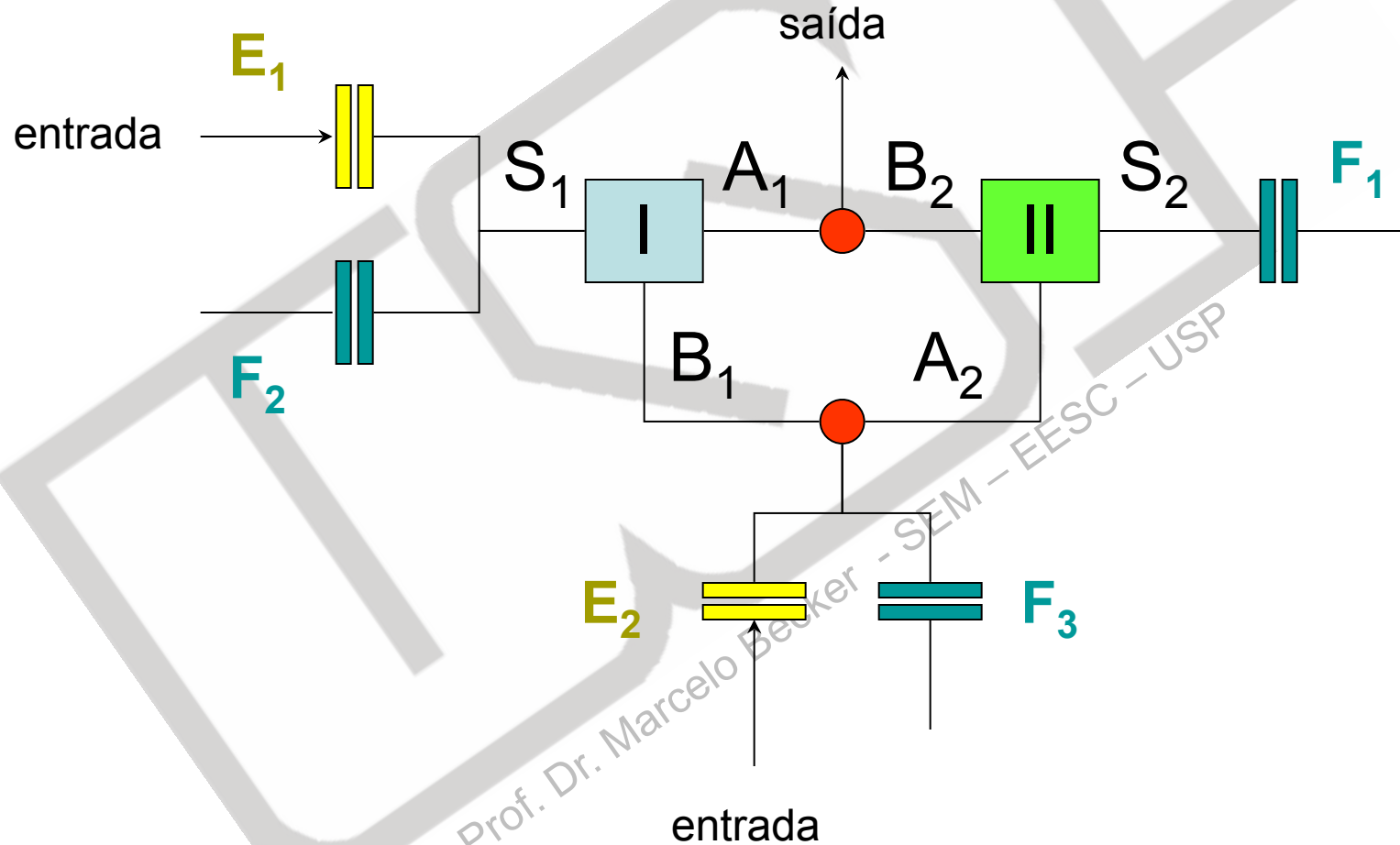
# Transmissões Veiculares

## Caixa GM HIDRA-MATIC THM – 440 PGT



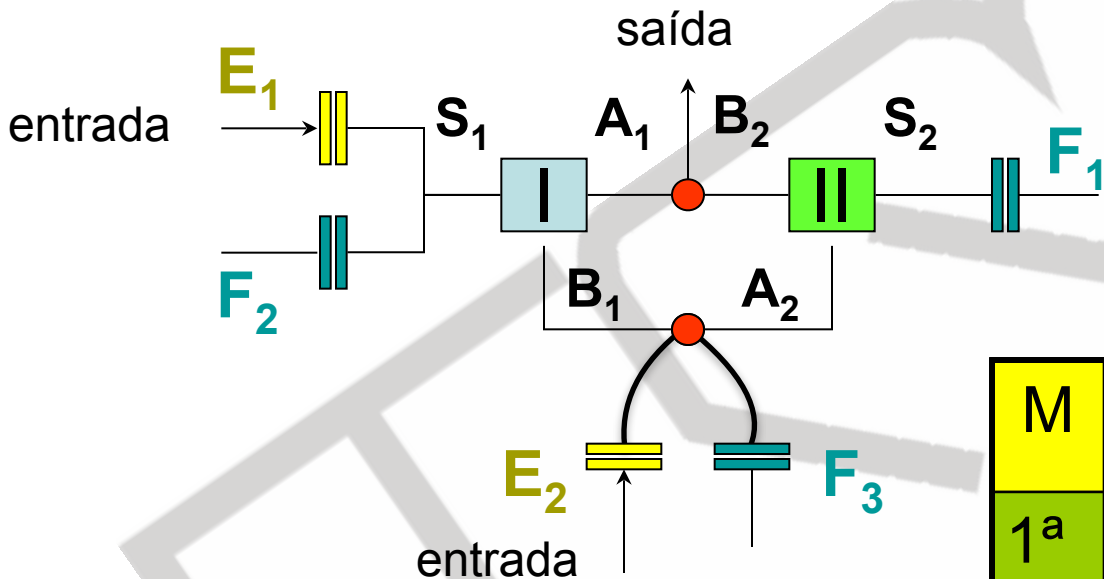
# Transmissões Veiculares

## Caixa GM HIDRA-MATIC THM – 440 PGT



# Transmissões Veiculares

## Caixa GM HIDRA-MATIC THM – 440 PGT

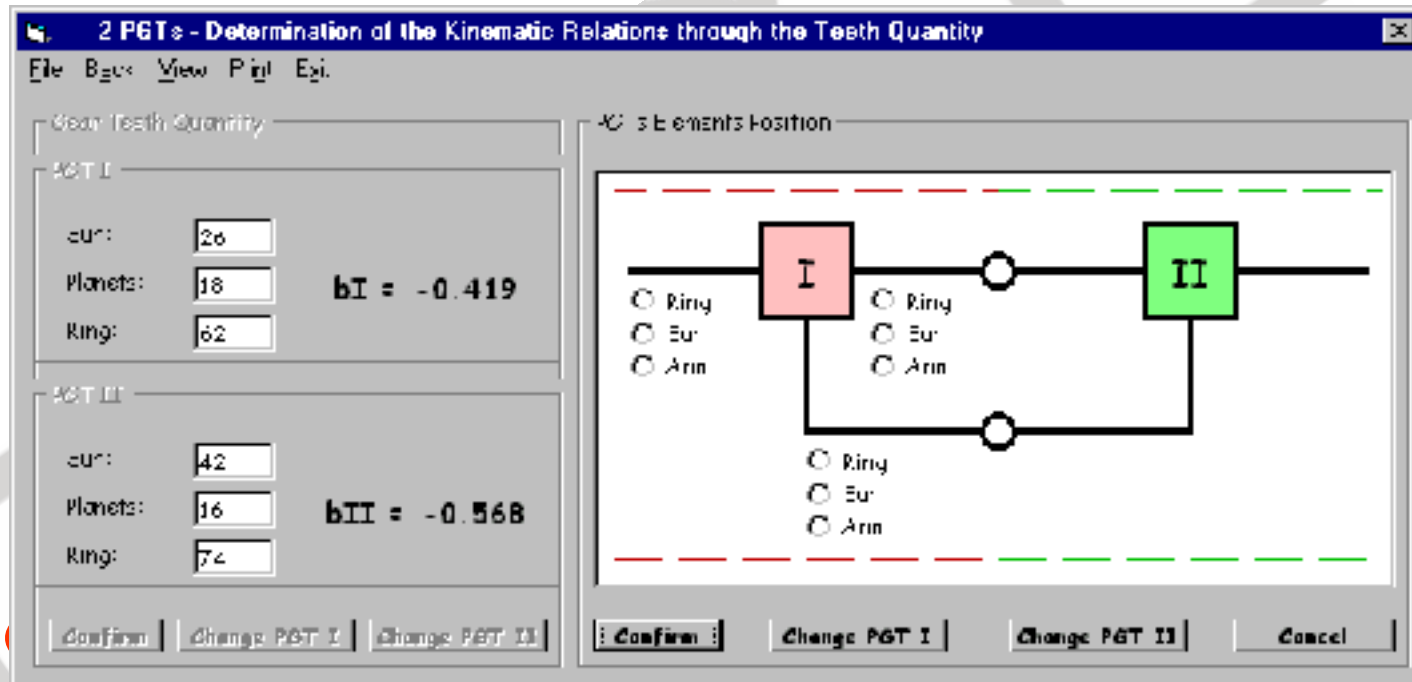


	$Z_S$	$Z_P$	$Z_A$
TEP I	26	18	62
TEP II	42	16	74

M	RT:1	$E_1$	$E_2$	$F_1$	$F_2$	$F_3$
1 <sup>a</sup>	2,92	X		X		
2 <sup>a</sup>	1,57		X	X		
3 <sup>a</sup>	1,00	X	X			
4 <sup>a</sup>	0,71		X		X	
ré	-2,38	X				X

# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes



# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes

2 PGT - Determination of the Kinematic Relations through the Teeth Quantity

File Back View Print Exit

Gear Teeth Quantity

PGT I

sun:

Planets:   $bI = -0.419$

Ring:

PGT II

sun:

Planets:   $bII = -0.568$

Ring:

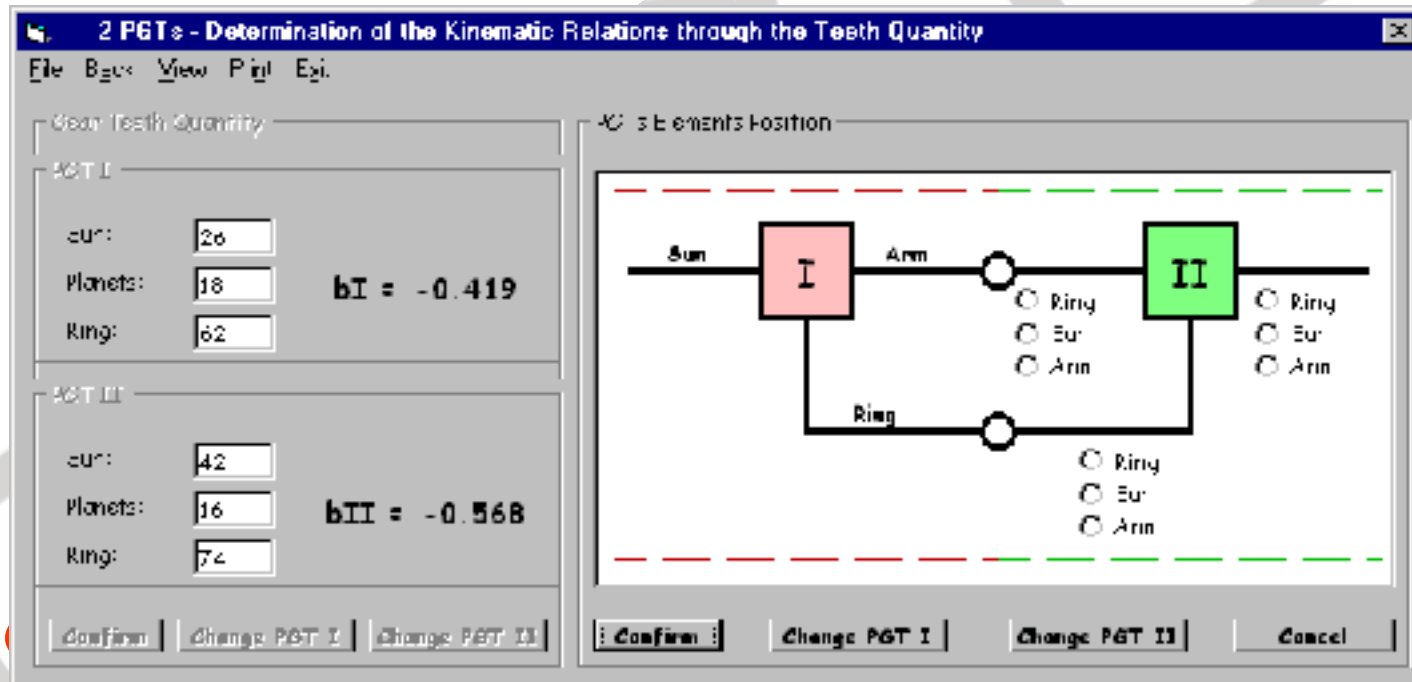
Confirm | Change PGT I | Change PGT II

Elements Position

Confirm | Change PGT I | Change PGT II | Cancel

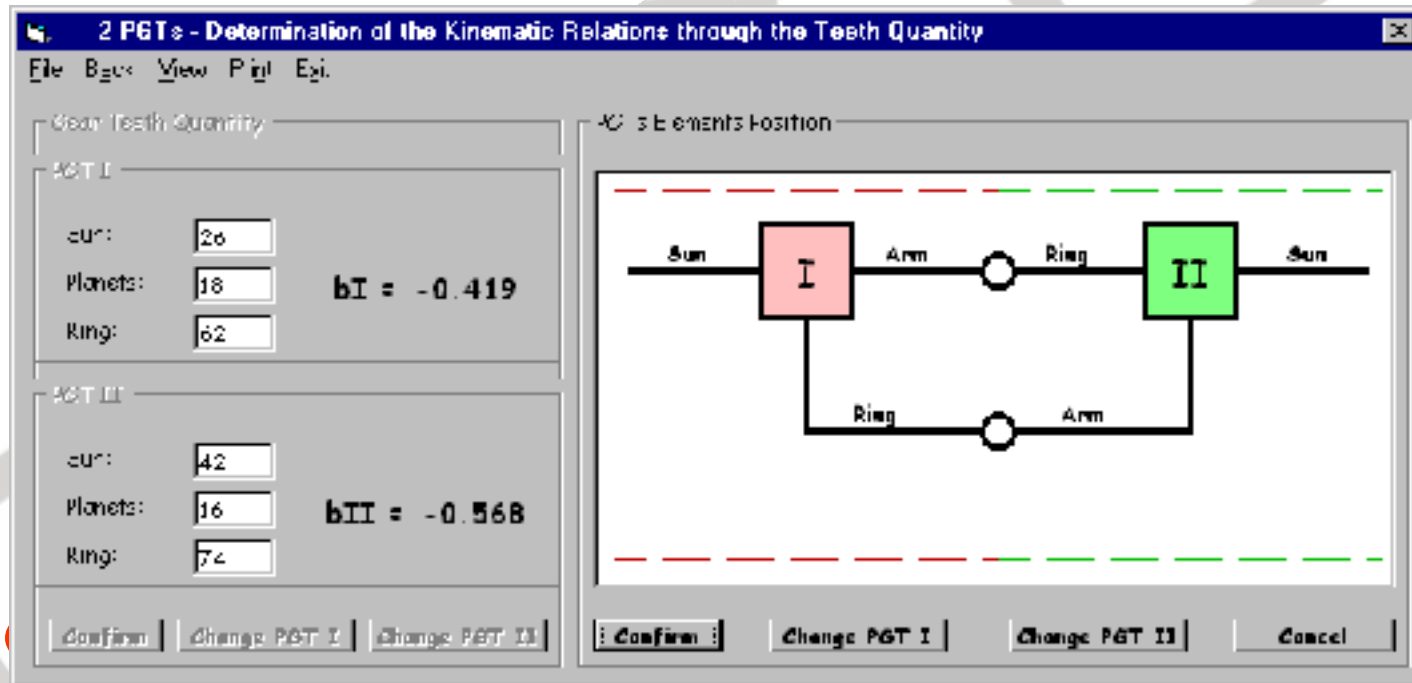
# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes



# Exemplo 2 TEPs: Análise

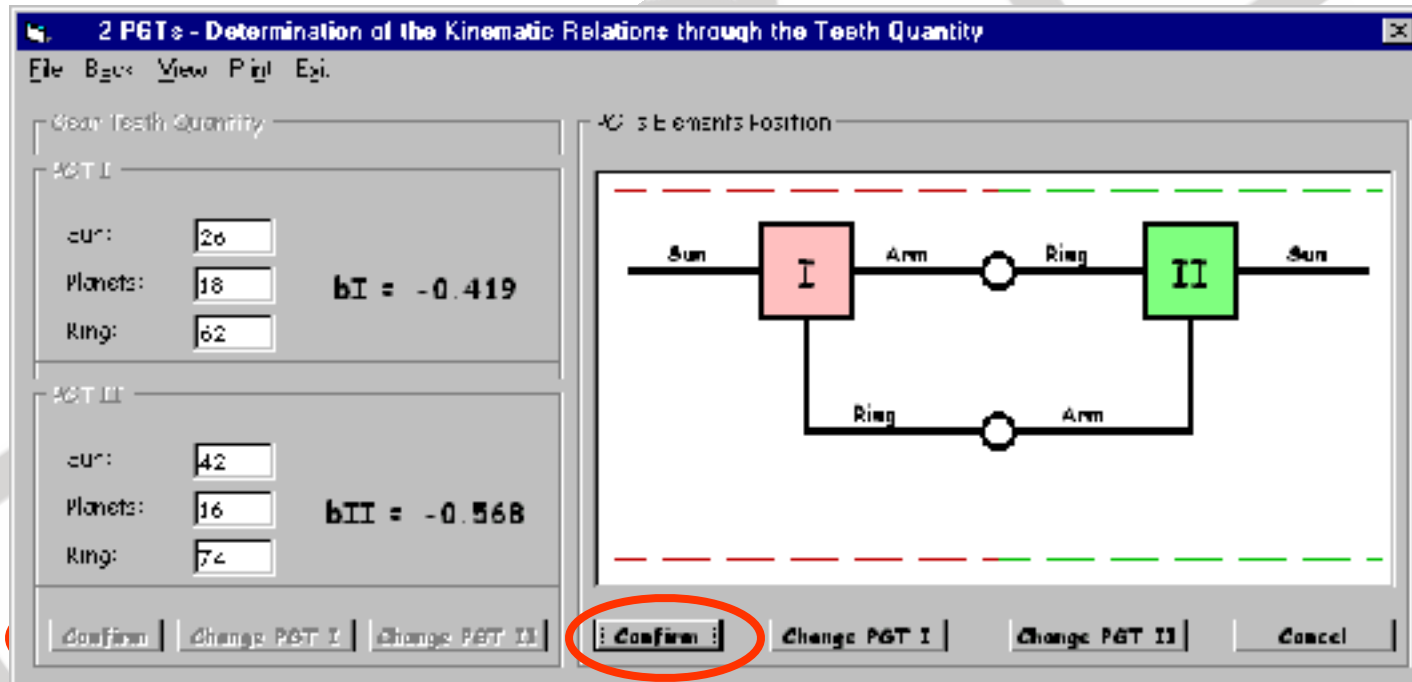
## Software TEPiciclo – Número de Dentes





# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes



# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes

**2 PGTs - Determination of the Kinematic Relations through the Teeth Quantity**

File Back View Print Exit

**PGT I**

sun:       **bI = -0.419**

Planets:

Ring:

---

**PGT II**

sun:       **bII = -0.568**

Planets:

Ring:

**PGTs Elements Position**

Confirm | Change PGT I | Change PGT II | Confirm | Change PGT I | Change PGT II | Cancel

Results - Assemblies and Possible Gear Ratios

Option	Diagram	1st	2nd	3rd	4th	5th	6th	bd
A		1.5645 :1	0.4378 :1	2.1567 :1	1.4190 :1	-1.7606 :1	3.5866 :1	1.0000 :1
B		2.5296 :1	1.2680 :1	1.5199 :1	0.7047 :1	2.7606 :1	-2.5866 :1	1.0000 :1
C		0.2963 :1	0.5420 :1	-1.1567 :1	-0.4190 :1	0.2973 :1	-0.5199 :1	1.0000 :1
D		0.4637 :1	0.4580 :1	-0.5645 :1	0.5622 :1	-0.2680 :1	-1.5296 :1	1.0000 :1

Torque Analysis  
Change Assembly  
Change Position  
Change Teeth Quantity  
Cancel

# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes

**2 PGTs - Determination of the Kinematic Relations through the Teeth Quantity**

File Back View Print Exit

**PGT I**

sun:       **bI = -0.419**

Planets:

Ring:

---

**PGT II**

sun:       **bII = -0.568**

Planets:

Ring:

PGTs Elements Position

Confirm | Change PGT I | Change PGT II | Confirm | Change PGT I | Change PGT II | Cancel

Results - Assemblies and Possible Gear Ratios

Assembly	1st	2nd	3rd	4th	5th	6th	bd
<input type="radio"/> A	1.5645 :1	0.4378 :1	2.1567 :1	1.4190 :1	-1.7606 :1	3.5866 :1	1.0000 :1
<input checked="" type="radio"/> B	2.5296 :1	1.6680 :1	1.5199 :1	0.7047 :1	2.7606 :1	-2.5866 :1	1.0000 :1
<input type="radio"/> C	0.2963 :1	0.5420 :1	-1.1567 :1	-0.4190 :1	0.2953 :1	-0.5199 :1	1.0000 :1
<input type="radio"/> D	0.4637 :1	0.4580 :1	-0.5645 :1	0.5622 :1	-0.6680 :1	-1.5296 :1	1.0000 :1

Torque Analysis  
Change Assembly  
Change Position  
Change Teeth Quantity  
Cancel

# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes

2 PGTs - Determination of the Kinematic Relations through the Teeth Quantity

File Back View Print Exit

Gear Teeth Quantity

PGT I

sun: 26  
Planets: 18  $bI = -0.419$   
Ring: 62

PGT II

sun: 42  
Planets: 16  $bII = -0.568$   
Ring: 74

PGTs Elements Position

Confirm Change PGT I Change PGT II Cancel

Results - Assemblies and Possible Gear Ratios

Assembly	1st	2nd	3rd	4th	5th	6th	bd
A	1.3645 : 1	0.4378 : 1	2.1567 : 1	1.4190 : 1	-1.7606 : 1	3.3866 : 1	1.0000 : 1
B	2.3296 : 1	1.2680 : 1	1.5199 : 1	0.7047 : 1	2.7606 : 1	-2.3866 : 1	1.0000 : 1
C	0.2363 : 1	0.3420 : 1	-1.1567 : 1	-2.4190 : 1	0.2953 : 1	-2.5199 : 1	1.0000 : 1
D	0.4637 : 1	0.2580 : 1	-0.3645 : 1	0.3622 : 1	-0.2680 : 1	-1.3296 : 1	1.0000 : 1

Torque Analysis  
Change Assembly  
Change Position  
Change Teeth Quantity  
Cancel

# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes

**Torque Analysis vs. Gear Ratio**

File Edit View Print

Case View Print

Position

Teeth Quantity:

Ring: 42  
Sun: 26  
Planets: 10

Teeth Quantity:

Ring: 74  
Sun: 40  
Planets: 16

Confirm Back

Select a Gear for the analysis:

1st 2.924 : 1  
2nd 1.565 : 1  
3rd 1.520 : 1  
4th 0.705 : 1  
5th 2.761 : 1  
6th -2.357 : 1

4th	1.4190	-1	4th	0.7047	-1	4th	-1.4190	-1	4th	0.6622	-1
5th	-1.7606	:1	5th	2.7606	:1	5th	0.2953	:1	5th	-0.2680	:1
6th	9.8866	:1	6th	-2.8866	:1	6th	-2.5199	:1	6th	-1.8296	:1
bd	1.0000	:1	bd	1.0000	:1	bd	1.0000	:1	bd	1.0000	:1

Torque Analysis  
Change assembly  
Change position  
Change Teeth Quantity  
Cancel

# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes

The screenshot displays the 'Torque Analysis vs. Gear Ratio' window in the TEPiciclo software. The interface includes a menu bar (File, Edit, Case, View, Print), a gear train diagram, and a list of gear analysis options.

**Left Panel (Gear Parameters):**

- SET I:** Teeth Quantity: Ring (42), Cur (26), Planets (10)
- SET II:** Teeth Quantity: Ring (74), Cur (49), Planets (16)

**Center Panel (Diagram and Selection):**

The diagram shows a planetary gear set with two sun gears (I and II) and two planet gears. Below the diagram, the text 'Select a Gear for the analysis' is followed by six gear selection icons. The '1st' option is selected, showing a gear ratio of 2.924 : 1.

**Right Panel (Actions):**

- Torque Analysis (circled in red)
- Change assembly
- Change position
- Change Teeth Quantity
- Cancel

**Bottom Panel (Gear Ratios Table):**

Gear	Ratio	Direction
1st	2.924	: 1
2nd	1.565	: 1
3rd	1.520	: 1
4th	0.705	: 1
5th	2.761	: 1
6th	-2.357	: 1
4th	1.4190	-1
5th	-1.7606	: 1
6th	9.3866	: 1
bd	1.0000	: 1
4th	0.7047	-1
5th	2.7606	: 1
6th	-2.3866	: 1
bd	1.0000	: 1
4th	-1.4190	-1
5th	0.2953	: 1
6th	-1.5199	: 1
bd	1.0000	: 1
4th	0.3622	-1
5th	-0.2680	: 1
6th	-1.3236	: 1
bd	1.0000	: 1

# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes

**Torque Analysis vs. Gear Ratio**

Case View Prin.

AC I

Teeth Quantity:

Ring: 42  
Sun: 26  
Planets: 10

AC II

Teeth Quantity:

Ring: 74  
Sun: 42  
Planets: 16

Confirm  
Back

PGT Assembly

Results (in modulus) for the 1st Gear Ratio

Values in modulus and as a function of  $T_{in}$

PGT I

PGT I

PGT II

Values as a function of  $T_{in}$

Results for PGT I I.

Values in modulus and as a function of  $T_{in}$

PGT II

Input and Output Elements

Results for PGT II.

$T_1$	$2.985 \times T_{in}$
$T_2$	$-1.692 \times T_{in}$
$T_3$	$-0.692 \times T_{in}$
$T_4$	$0.692 \times T_{in}$
$T_5$	$-1.692 \times T_{in}$
$T_6$	$1.0 \times T_{in}$
$T_7$	$0.005 \times T_{in}$
$T_8$	$-0.702 \times T_{in}$
$T_9$	$-2.653 \times T_{in}$
$T_{10}$	$0.732 \times T_{in}$
$T_{11}$	$-2.653 \times T_{in}$
$T_{12}$	$1.951 \times T_{in}$
$T_{13}$	$1.951 \times T_{in}$
$T_{out}$	$2.951 \times T_{in}$

5th	-1.7606	:1	5th	2.7606	:1	5th	0.2953	:1	5th	-0.1680	:1	Teeth Quantity
6th	9.3866	:1	6th	-2.3866	:1	6th	-1.5199	:1	6th	-1.3236	:1	Cancel
bd	1.0000	:1	bd	1.0000	:1	bd	1.0000	:1	bd	1.0000	:1	

# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes

**Torque Analysis vs. Gear Ratio**

Close View Print

Case I

Teeth Quantity:

Ring: 42  
Sun: 26  
Planets: 10

Case II

Teeth Quantity:

Ring: 74  
Sun: 42  
Planets: 16

Confirm  
Back

PGT Assembly

Results (in modules) for the 1st Gear Ratio

Values in modulus and as a function of  $T_{in}$

PGT I

PGT I

PGT II

Values as a function of  $T_{in}$

$T_1 = 2.985 \times T_{in}$   
 $T_2 = -1.692 \times T_{in}$   
 $T_3 = -0.692 \times T_{in}$   
 $T_4 = 0.692 \times T_{in}$   
 $T_5 = -1.692 \times T_{in}$   
 $T_6 = 1.0 \times T_{in}$   
 $T_7 = 0.005 \times T_{in}$   
 $T_8 = -0.702 \times T_{in}$   
 $T_9 = -2.653 \times T_{in}$   
 $T_{10} = 0.732 \times T_{in}$   
 $T_{11} = -2.653 \times T_{in}$   
 $T_{12} = 1.921 \times T_{in}$   
 $T_{13} = 1.921 \times T_{in}$   
 $T_{out} = 2.921 \times T_{in}$

Results for PGT I I.

Values in modulus and as a function of  $T_{in}$

PGT II

Input and Output Elements

Results for PGT II.

5th	-1.7606	:1	5th	2.7606	:1	5th	0.2953	:1	5th	-0.2680	:1	Teeth Quantity
6th	9.3866	:1	6th	-2.3866	:1	6th	-1.5199	:1	6th	-1.5296	:1	Cancel
bd	1.2000	:1	bd	1.2000	:1	bd	1.2000	:1	bd	1.2000	:1	



# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes

**Torque Analysis vs. Gear Ratio**

Close View Print

Case I

Teeth Quantity:

Ring: 42  
Sun: 26  
Planets: 10

Case II

Teeth Quantity:

Ring: 74  
Sun: 42  
Planets: 16

Confirm  
Back

Resulting Chart for the 6 Gears

	$\tau_1$	$\tau_2$	$\tau_3$	$\tau_4$	$\tau_5$	$\tau_6$	$\tau_7$	$\tau_8$	$\tau_9$	$\tau_{10}$	$\tau_{11}$	$\tau_{12}$
<b>1st</b> 2.924 : 1	2.985	1.592	0.672	0.672	1.592	1.0	3.385	0.772	2.673	0.772	2.673	1.921
<b>2nd</b> 1.592 : 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.216	0.774	2.216	0.774	0.598
<b>3rd</b> 1.520 : 1	1.241	2.881	0.56	0.56	2.881	2.521	1.762	2.381	1.351	2.381	1.351	0.0
<b>4th</b> 1.705 : 1	0.775	0.0	0.275	0.275	0.0	0.275	0.0	0.0	0.0	0.0	0.0	0.0
<b>5th</b> 2.761 : 1	0.0	0.0	0.0	0.0	0.0	0.0	1.762	2.381	1.351	2.381	1.351	0.0
<b>6th</b> -2.887 : 1	2.985	1.592	0.672	0.672	1.592	1.0	0.0	0.0	0.0	0.0	0.0	0.0

The values are a function of  $\tau_n$

	1st	2nd	3rd	4th	5th	6th
$\tau_n$	1.921	0.598	2.521	0.275	1.762	3.385
$\tau_{out}$	2.921	1.568	1.521	0.775	2.762	2.985

5th	-1.7606	: 1	5th	2.7606	: 1	5th	0.2953	: 1	5th	-0.2680	: 1	Teeth Quantity Cancel
6th	3.3866	: 1	6th	-2.3866	: 1	6th	-1.5199	: 1	6th	-1.5236	: 1	
bd	1.2000	: 1	bd	1.2000	: 1	bd	1.2000	: 1	bd	1.2000	: 1	

# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes

2 TEPs

2 TEPs Analysis - Gear Ratio

Case View (n)

Case I

Teeth Quantity:

Ring

Sun

Planets

Case II

Teeth Quantity:

Ring

Sun

Planets

Resulting Chart for the 6 Gears

	$\tau_1$	$\tau_2$	$\tau_3$	$\tau_4$	$\tau_5$	$\tau_6$	$\tau_7$	$\tau_8$	$\tau_9$	$\tau_{10}$	$\tau_{11}$	$\tau_{12}$
1st 2.924 : 1	2.924	1.592	0.672	0.672	1.592	1.0	3.355	0.752	2.658	0.752	2.658	1.921
2nd 1.592 : 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.216	0.754	2.216	0.754	0.558
3rd 1.520 : 1	1.241	2.881	0.56	0.56	2.881	2.521	1.762	2.381	1.351	2.381	1.351	0.0
4th 1.705 : 1	0.725	0.0	0.255	0.255	0.0	0.255	0.0	0.0	0.0	0.0	0.0	0.0
5th 2.761 : 1	0.0	0.0	0.0	0.0	0.0	0.0	1.762	2.381	1.351	2.381	1.351	0.0
6th -2.387 : 1	2.387	1.592	0.652	0.652	1.592	1.0	0.0	0.0	0.0	0.0	0.0	0.0

The values are a function of  $\tau_n$

	1st	2nd	3rd	4th	5th	6th
$\tau_n$	1.921	0.558	2.521	0.255	1.762	3.355
$\tau_{out}$	2.921	1.268	1.521	0.725	2.762	2.387

5th	<input type="text" value="-1.7606"/>	: 1	5th	<input type="text" value="2.7606"/>	: 1	5th	<input type="text" value="0.2953"/>	: 1	5th	<input type="text" value="-0.2680"/>	: 1	Teeth Quantity <input type="button" value="Cancel"/>
6th	<input type="text" value="3.3866"/>	: 1	6th	<input type="text" value="-2.3866"/>	: 1	6th	<input type="text" value="-1.5199"/>	: 1	6th	<input type="text" value="-1.5236"/>	: 1	
BD	<input type="text" value="1.2000"/>	: 1	BD	<input type="text" value="1.2000"/>	: 1	BD	<input type="text" value="1.2000"/>	: 1	BD	<input type="text" value="1.2000"/>	: 1	

# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes

Map of the Results

	1'	2'	3'	4'	5'	6'
	A D C D	A D C D	A D C D	A B C D	A B C D	A B C D
1	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6
2	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6
3	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6
4	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6
5	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6
6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6	2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6

Legend:

- 1st Gear (Red)
- 2nd Gear (Magenta)
- 3rd Gear (Yellow)
- 4th Gear (Green)
- 5th Gear (Teal)
- 6th Gear (White)

Train Values:

$h_T$  -0.419

$h_{TT}$  -0.563

Loorance: 0.01 %

Gear Values:

- 1st: 2.9e8 \* 2.9e4
- 2nd: 1.5e8 \* 1.5e8
- 3rd: 1.52 \* 1.52
- 4th: 0.7e5 \* 0.7e5
- 5th: 2.7e7 \* 2.7e1
- 6th: -2.3e7 \* -2.3e6

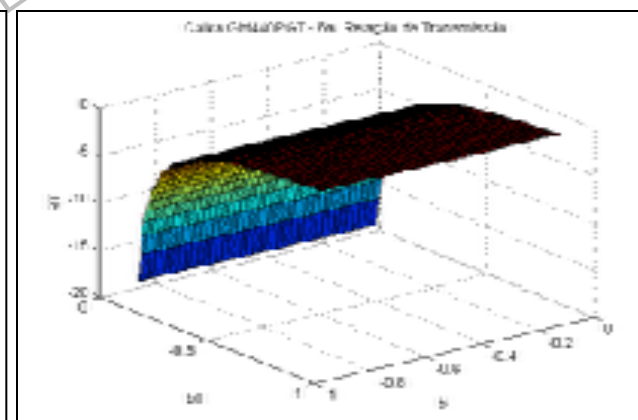
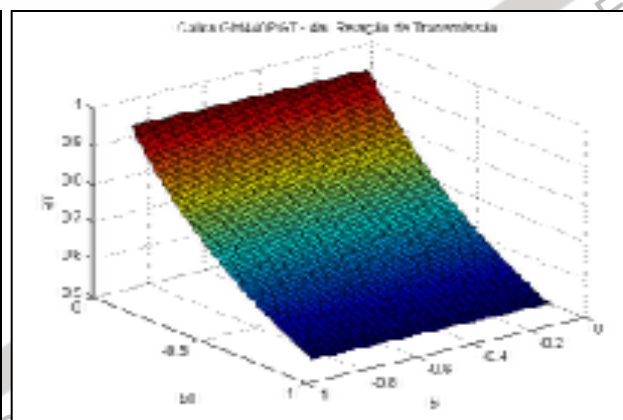
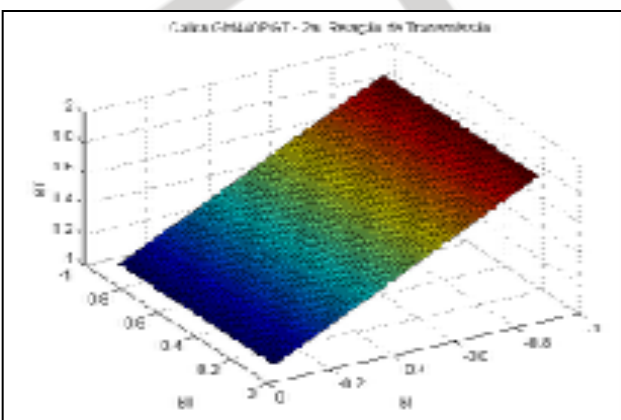
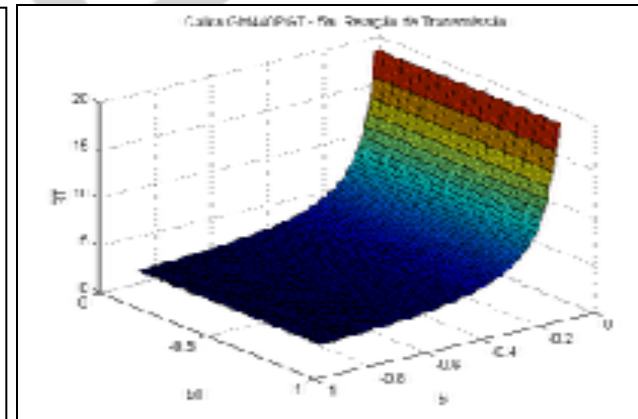
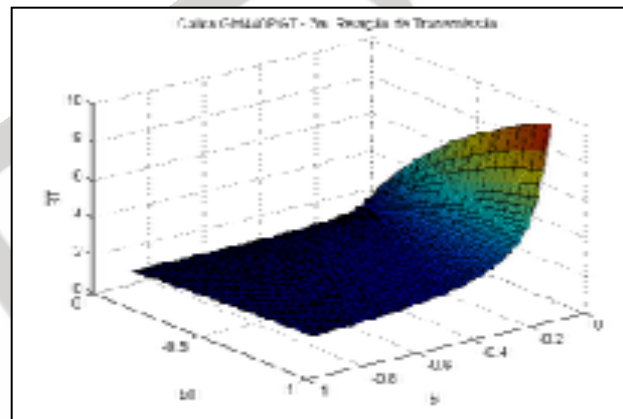
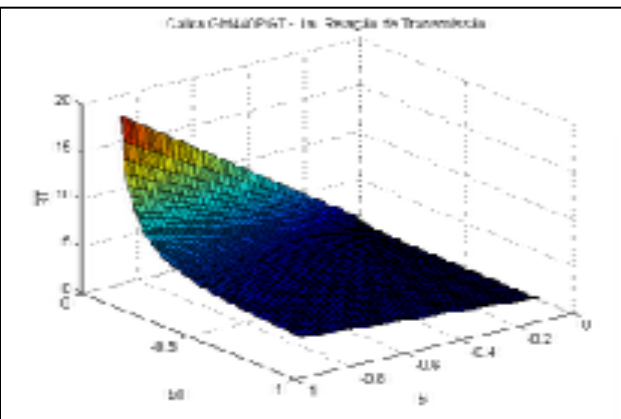
View Assemblies

Back

# Exemplo 2 TEPs: Análise

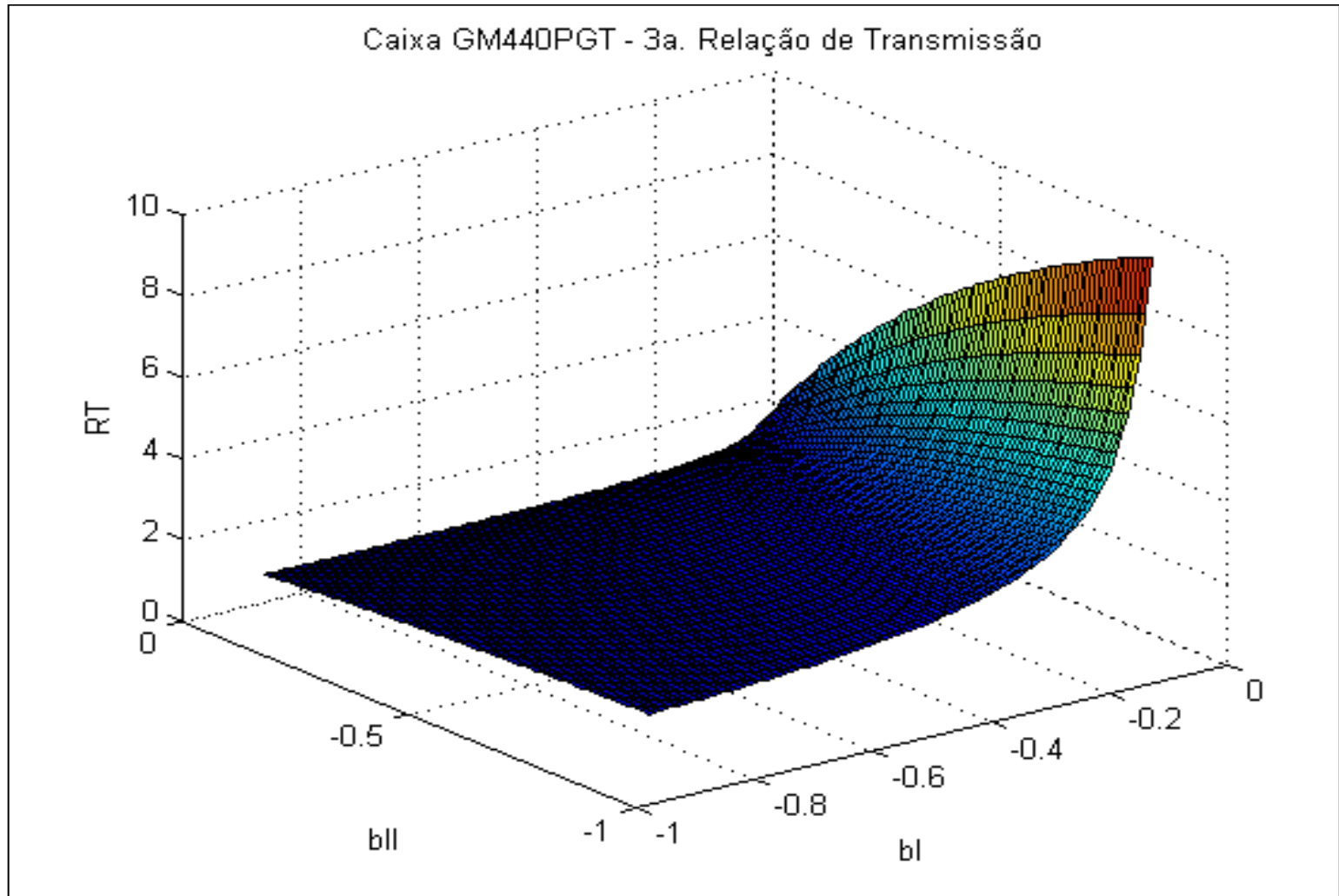
## Caixa GM HIDRA-MATIC THM – 440 PGT

Gráficos 3D:  $b_I$  x  $b_{II}$  x  $RT$



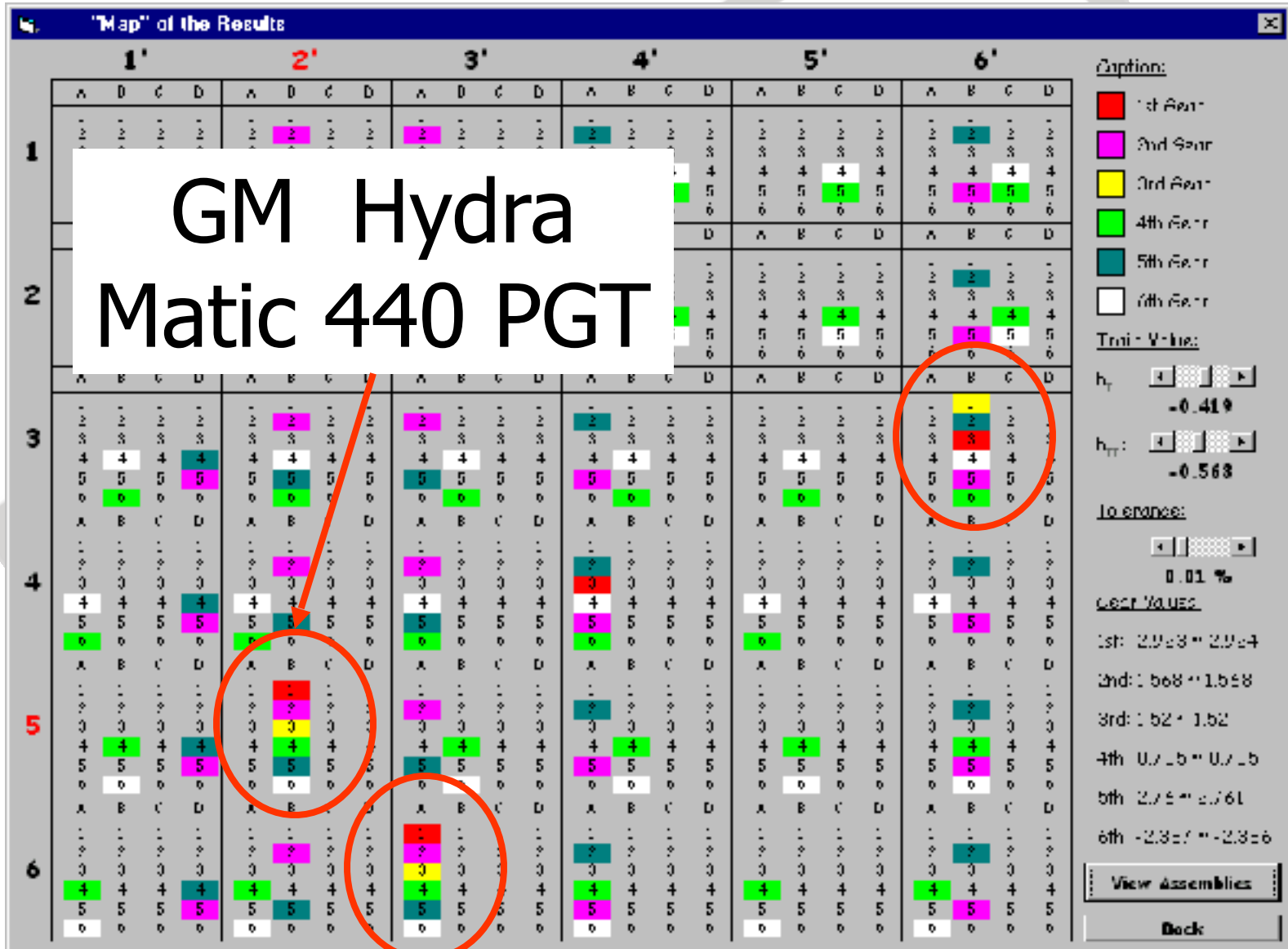
# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Transmissão



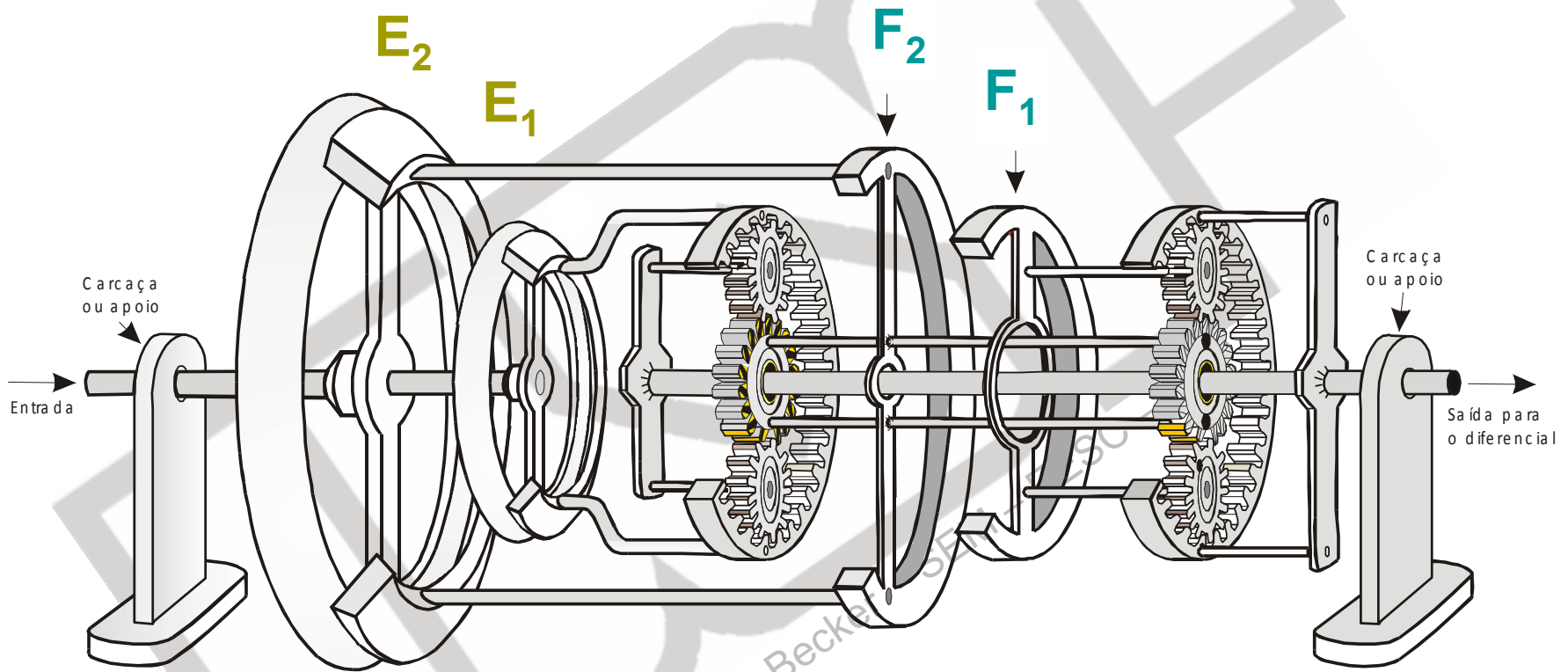
# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes



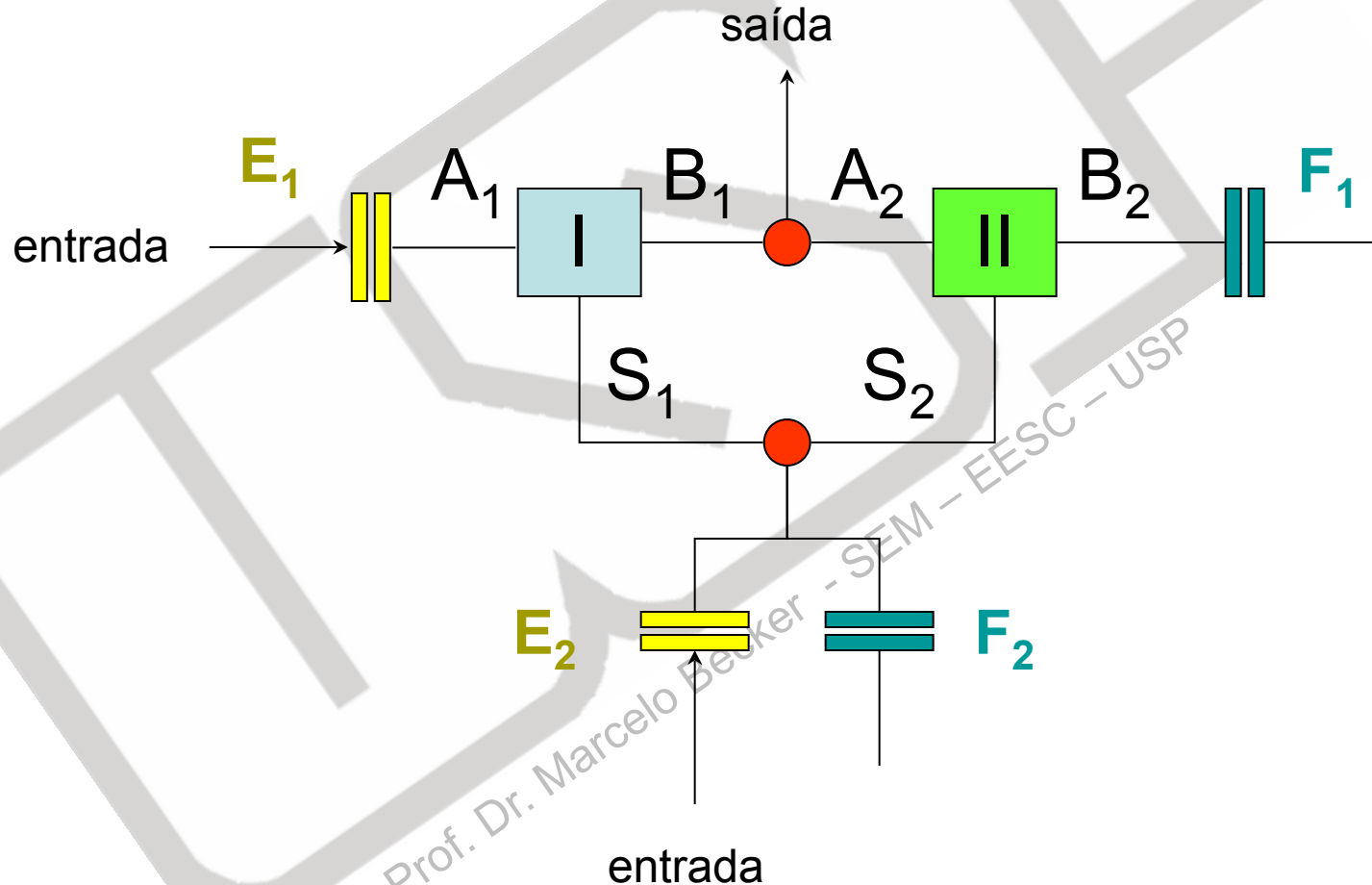
# Transmissões Veiculares

## Caixa Simpson



# Transmissões Veiculares

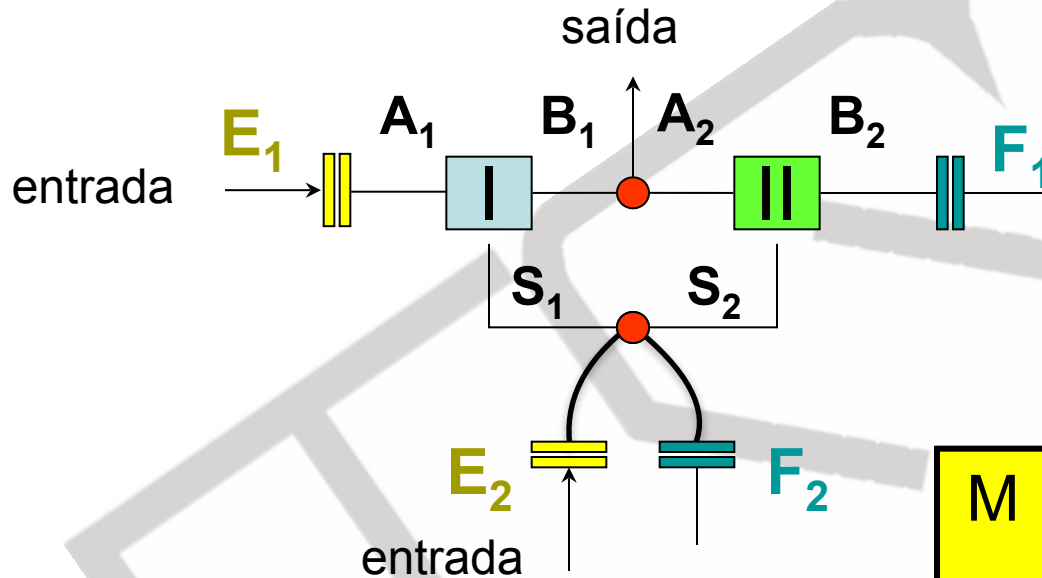
## Caixa Simpson





# Transmissões Veiculares

## Caixa Simpson



	$Z_S$	$Z_P$	$Z_A$
TEP I	36	16	68
TEP II	32	22	76

M	RT:1	$E_1$	$E_2$	$F_1$	$F_2$
1 <sup>a</sup>	2,79	X		X	
2 <sup>a</sup>	1,53	X			X
3 <sup>a</sup>	1,00	X	X		
ré	-2,38		X	X	

# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes

**Map of the Results**

	1'				2'				3'				4'				5'				6'			
	A	D	C	D	A	D	C	D	A	D	C	D	A	B	C	D	A	B	C	D	A	B	C	D
<b>1</b>	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
<b>2</b>	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
<b>3</b>	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
<b>4</b>	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
<b>5</b>	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
<b>6</b>	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D

**Options:**

- 1st Gear
- 2nd Gear
- 3rd Gear
- 4th Gear
- 5th Gear
- 6th Gear

**Tolerances:**

$h_f$ : -0.52%

$h_{fr}$ : -0.421

Tolerance: 0.11%

**Gear Values:**

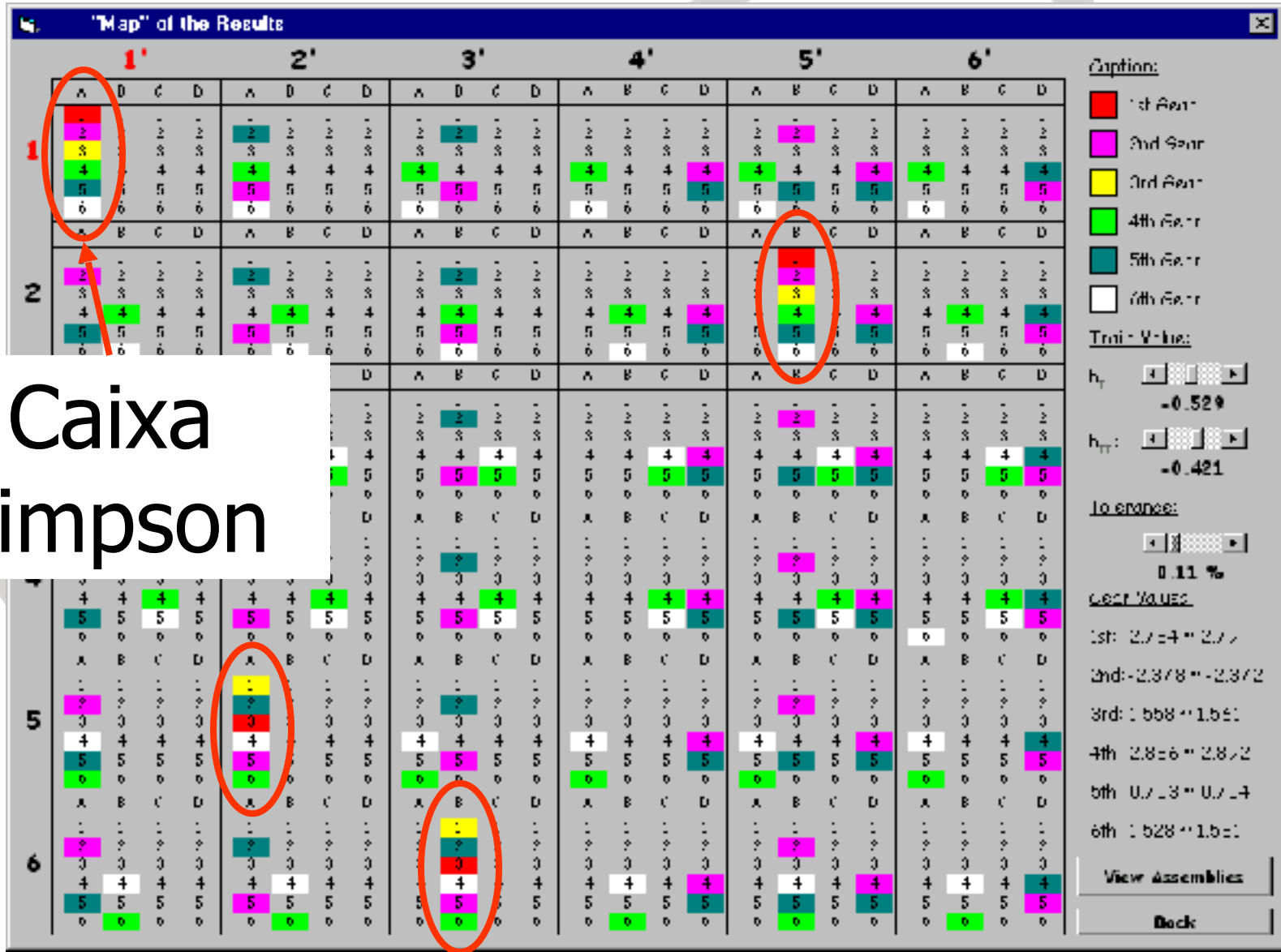
- 1st: 2.754 \* 2.7
- 2nd: 2.378 \* 2.372
- 3rd: 1.558 \* 1.551
- 4th: 2.856 \* 2.852
- 5th: 0.753 \* 0.754
- 6th: 1.528 \* 1.551

View Assemblies

Back

# Exemplo 2 TEPs: Análise

## Software TEPiciclo – Número de Dentes



# Sumário da Aula

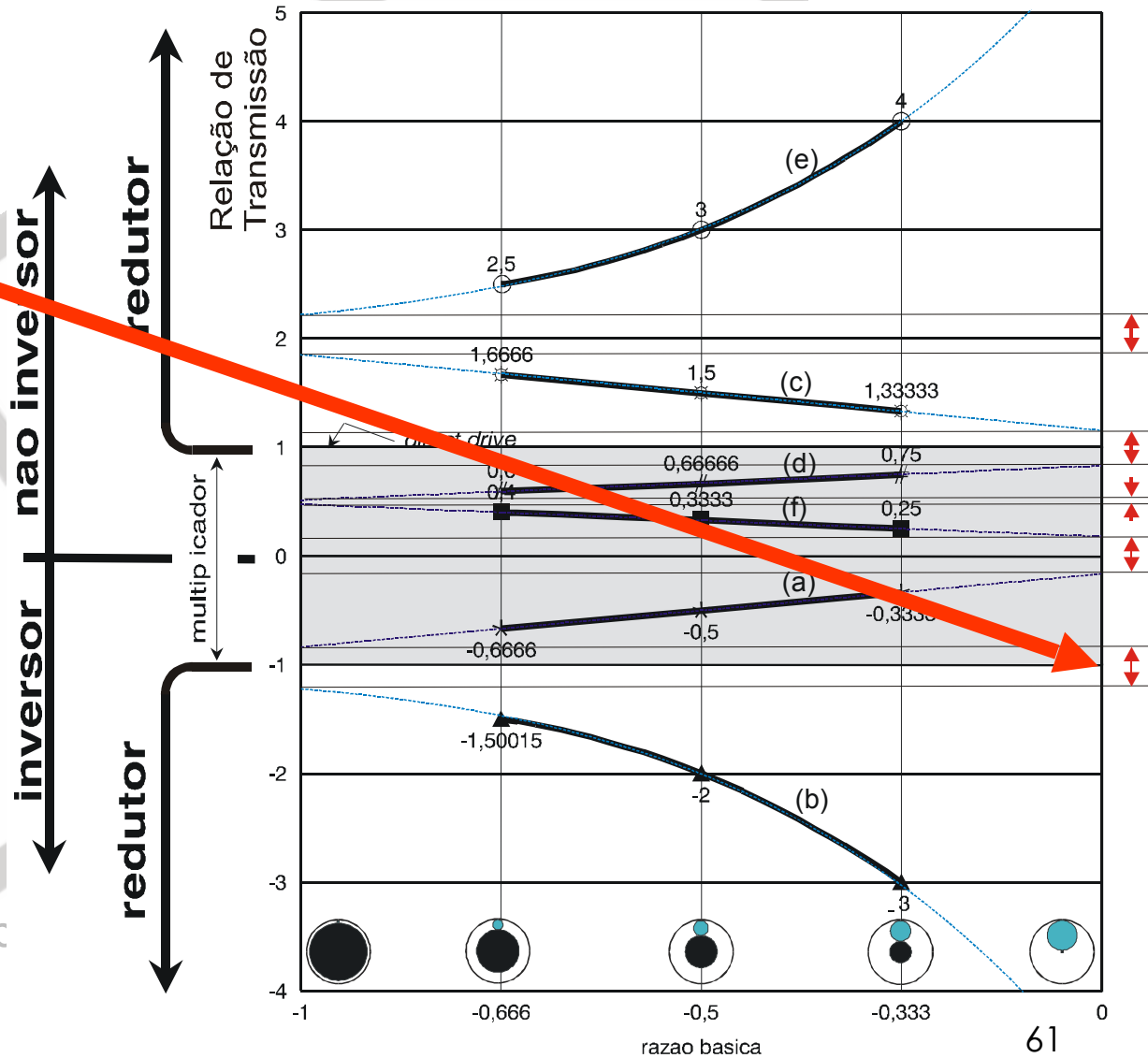
- Software TEPiciclo
- Exemplo 1 TEP: Análise
- Exemplo 1 TEP: Síntese
- Exemplo 2 TEPs: Análise
- **Exemplo 2 TEPs: Síntese**

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

$[-1.105; -0.905]$

$RT = -1 : 1$



# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

2 PGTs - Determination of the Kinematic Relations through the Gear Ratios

File Back Change View Print Save/Save As Exit

Gear ratios

Gear Ratio Quantity (1 to 6)

Gear Ratios:  : 1

To errance (0.01 to 10)  %

Limit the search to specific positions between 2 PGTs

Limit the Train values interval (b1 and b2) standard interval: -0.004 to -0.048

b1  to  b2  to

Limit the Teeth Quantity of the Gears

Gears Teeth Quantity

	Interval:	Values set:
Ring:	<input type="text"/> to <input type="text"/>	36 to 250
Sun:	<input type="text"/> to <input type="text"/>	12 to 226
Planets:	<input type="text"/> to <input type="text"/>	12 to 110

Antenna: It is not necessary to select the "Direct Drive" (1).

Confirm

Cancel

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

2 PGTs - Determination of the Kinematic Relations through the Gear Ratios

File Back Change View Print Save Exit

Gear ratios

Gear Ratio Quantity (1 to 6)

To errance (%:0.01 to 10)

Gear Ratios:  :1

To errance Set:  Limit the search to specific positions between 2 PGTs

Limit the Train values interval (b1 and b2) standard interval: -0.004 to -0.048

b1  to  b2  to

Limit the Teeth Quantity of the Gears

Gears Teeth Quantity

	Interval:	Values set:
Ring:	<input type="text"/> to <input type="text"/>	36 to 25
Sun:	<input type="text"/> to <input type="text"/>	12 to 22
Planets:	<input type="text"/> to <input type="text"/>	12 to 11

Antenna: It is not necessary to select the "Direct Drive" (1).

Confirm

Cancel

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

B=00 Egi.

	1'	2'	3'	4'	5'	6'
1	 <input checked="" type="checkbox"/> Position 1	 <input type="checkbox"/> Pos - on 2	 <input type="checkbox"/> Pos - on 3	 <input type="checkbox"/> Pos - on 4	 <input type="checkbox"/> Pos - on 5	 <input type="checkbox"/> Pos - on 6
2	 <input type="checkbox"/> Pos - on 7	 <input type="checkbox"/> Pos - on 8	 <input type="checkbox"/> Pos - on 9	 <input type="checkbox"/> Pos - on 10	 <input type="checkbox"/> Pos - on 11	 <input type="checkbox"/> Pos - on 12
3	 <input type="checkbox"/> Pos - on 13	 <input type="checkbox"/> Pos - on 14	 <input type="checkbox"/> Pos - on 15	 <input type="checkbox"/> Pos - on 16	 <input type="checkbox"/> Pos - on 17	 <input type="checkbox"/> Pos - on 18
4	 <input type="checkbox"/> Pos - on 19	 <input type="checkbox"/> Pos - on 20	 <input type="checkbox"/> Pos - on 21	 <input type="checkbox"/> Pos - on 22	 <input type="checkbox"/> Pos - on 23	 <input type="checkbox"/> Pos - on 24
5	 <input type="checkbox"/> Pos - on 25	 <input type="checkbox"/> Pos - on 26	 <input type="checkbox"/> Pos - on 27	 <input type="checkbox"/> Pos - on 28	 <input type="checkbox"/> Pos - on 29	 <input type="checkbox"/> Pos - on 30
6	 <input type="checkbox"/> Pos - on 31	 <input type="checkbox"/> Pos - on 32	 <input type="checkbox"/> Pos - on 33	 <input type="checkbox"/> Pos - on 34	 <input type="checkbox"/> Pos - on 35	 <input type="checkbox"/> Pos - on 36



# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

The screenshot displays the TEPiciclo software interface, showing a grid of 36 transmission diagrams arranged in 6 rows and 6 columns. Each diagram is labeled with a row number (1-6) and a column number (1'-6'). The first diagram (row 1, column 1') is circled in red and labeled "Position 1". Each diagram shows a sequence of components (R, A, S, R, A) connected by lines, with a checkbox below it indicating its position. The diagrams are arranged in a grid, with the first diagram (row 1, column 1') circled in red and labeled "Position 1".

	1'	2'	3'	4'	5'	6'
1	<input checked="" type="checkbox"/> Position 1	<input type="checkbox"/> Pos - on 2	<input type="checkbox"/> Pos - on 3	<input type="checkbox"/> Pos - on 4	<input type="checkbox"/> Pos - on 5	<input type="checkbox"/> Pos - on 6
2	<input type="checkbox"/> Pos - on 7	<input type="checkbox"/> Pos - on 8	<input type="checkbox"/> Pos - on 9	<input type="checkbox"/> Pos - on 10	<input type="checkbox"/> Pos - on 11	<input type="checkbox"/> Pos - on 12
3	<input type="checkbox"/> Pos - on 13	<input type="checkbox"/> Pos - on 14	<input type="checkbox"/> Pos - on 15	<input type="checkbox"/> Pos - on 16	<input type="checkbox"/> Pos - on 17	<input type="checkbox"/> Pos - on 18
4	<input type="checkbox"/> Pos - on 19	<input type="checkbox"/> Pos - on 20	<input type="checkbox"/> Pos - on 21	<input type="checkbox"/> Pos - on 22	<input type="checkbox"/> Pos - on 23	<input type="checkbox"/> Pos - on 24
5	<input type="checkbox"/> Pos - on 25	<input type="checkbox"/> Pos - on 26	<input type="checkbox"/> Pos - on 27	<input type="checkbox"/> Pos - on 28	<input type="checkbox"/> Pos - on 29	<input type="checkbox"/> Pos - on 30
6	<input type="checkbox"/> Pos - on 31	<input type="checkbox"/> Pos - on 32	<input type="checkbox"/> Pos - on 33	<input type="checkbox"/> Pos - on 34	<input type="checkbox"/> Pos - on 35	<input type="checkbox"/> Pos - on 36

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

**2 TEPs - Determination of the Kinematic Relations through the Gear Ratios**

File Back Change View Print Save/Exit

Gear ratios

Gear Ratio Quantity (1 to 6)  To ranges (-.01 to 10)  %

Gear Ratios: To ranges set:

:1 -1.0001 ~ -0.9999

Limit the search to specific Positions between 2 TEPs

Limit the Train values interval (bL and bU) standard interval: -1.904 to -0.048

bL  to  bU  to

Limit the Teeth Quantity of the Gears

Gears Teeth Quantity

	interval	Values set
Ring:	<input type="text"/> to <input type="text"/>	36 to 25
sun:	<input type="text"/> to <input type="text"/>	12 to 22
Planets:	<input type="text"/> to <input type="text"/>	12 to 11

Antenna: It is not necessary to select the "Direct Drive" (1).

**5**

<input type="checkbox"/> Pos. n on 25	<input type="checkbox"/> Pos. n on 26	<input type="checkbox"/> Pos. n on 27	<input type="checkbox"/> Pos. n on 28	<input type="checkbox"/> Pos. n on 29	<input type="checkbox"/> Pos. n on 30

**6**

<input type="checkbox"/> Pos. n on 31	<input type="checkbox"/> Pos. n on 32	<input type="checkbox"/> Pos. n on 33	<input type="checkbox"/> Pos. n on 34	<input type="checkbox"/> Pos. n on 35	<input type="checkbox"/> Pos. n on 36

Confirm

Cancel

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

**2 TEPs - Determination of the Kinematic Relations through the Gear Ratios**

File Back Change View Print Save/Exit

Gear ratios

Gear Ratio Quantity (1 to 6)  To ranges (-.01 to 10)  %

Gear Ratios: To ranges set:

:1 -1.0001 ~ -0.9999

Limit the search to specific Positions between 2 TEPs

Limit the Train values interval (bL and bU) standard interval: -1.904 to -0.048

bL  to  bU  to

Limit the Teeth Quantity of the Gears

Gears Teeth Quantity

	Interval	Values set
Ring:	<input type="text"/> to <input type="text"/>	36 to 25
sun:	<input type="text"/> to <input type="text"/>	12 to 225
Planets:	<input type="text"/> to <input type="text"/>	12 to 11

Antenna: It is not necessary to select the "Direct Drive" (1).

**Confirm**

**Cancel**

5

<input type="checkbox"/> Pos. on 25	<input type="checkbox"/> Pos. on 26	<input type="checkbox"/> Pos. on 27	<input type="checkbox"/> Pos. on 28	<input type="checkbox"/> Pos. on 29	<input type="checkbox"/> Pos. on 30

6

<input type="checkbox"/> Pos. on 31	<input type="checkbox"/> Pos. on 32	<input type="checkbox"/> Pos. on 33	<input type="checkbox"/> Pos. on 34	<input type="checkbox"/> Pos. on 35	<input type="checkbox"/> Pos. on 36

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

**2 PGTs - Determination of the Kinematic Relations through the Gear Ratios**

File Back Change View Print Save/Exit

**Gear Ratios:**

Gear Ratio Quantity (1 to 6):       Tolerance (0.01 to 10):  %

Gear Ratios: Values Set:  
 : 1    -1.0001 ~ -0.9999

Limit the search to specific Positions between Z-Points

Limit the main values interval (bL and bLI) standard interval: -0.504 to -0.048

bL:  to       bLI:  to

Limit the Teeth Quantity of the Gears

**Gears Teeth Quantity**

	Interval:	Values Set:
Ring:	<input type="text"/> to <input type="text"/>	36 to 25
Gear:	<input type="text"/> to <input type="text"/>	12 to 225
Planets:	<input type="text"/> to <input type="text"/>	12 to 11

Searching Time: 1 min 2 sec

Attention: It is not necessary to select the "Direct Drive" (1).

**Result:**

The quantity of possible combinations of Z-Points that satisfy the conditions is: **100**

Possible solutions:

<input type="checkbox"/>	bL = -0.497	bLI = -0.036	Position 1 (1-1)	Assembly B	<input type="button" value="Cancel"/> <input type="button" value="Ok"/> <input type="button" value="Torque Analysis"/>
<input type="checkbox"/>	bL = -0.497	bLI = -0.036	Position 1 (1-1)	Assembly C	
<input type="checkbox"/>	bL = -0.487	bLI = -0.045	Position 1 (1-1)	Assembly B	
<input type="checkbox"/>	bL = -0.407	bLI = -0.045	Position 1 (1-1)	Assembly C	

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

The screenshot shows the '2 PGTs - Determination of the Kinematic Relations through the Gear Ratios' window. The 'View' menu item is circled in red. The 'Gear Ratios' section includes a 'Gear Ratio Quantity (1 to 6)' set to 1, a 'Tolerance' of 0.01%, and a 'Gear Ratios' list with a value of 1. The 'Limit the search to specific positions between 2 PGTs' and 'Limit the main values interval (bI and bII) standard interval: -0.504 to -0.488' options are checked. The 'bI' and 'bII' values are set to -0.504 and -0.488 respectively. The 'Limit the Teeth Quantity of the Gears' option is unchecked. The 'Gears Teeth Quantity' table shows values for Ring, Sun, and Planets gears. The 'Searching Time' is 1 min 2 sec. The 'Results' section indicates 100 possible combinations and lists the first few solutions.

**Searching Time**  
1 min 2 sec

**Results**  
The quantity of possible combinations of 2 PGTs that satisfy the conditions is: **100**

**Possible solutions:**

Position	Assembly
Position 1 (1-1)	Assembly B
Position 1 (1-1)	Assembly C
Position 1 (1-1)	Assembly B
Position 1 (1-1)	Assembly C

Pentium III  
650 MHz (ano 2000)

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

Assembled vs. Gears (as a function of a fixed output axle)

	A	B	C	D
1st				
2nd				
3rd				
4th				
5th				
6th				

**Legend:**

- Base Elements:**
  - PGI I:
  - PGI II:
  - Input Element:
  - Output Element:
  - Fixed Element:
- Used PGIs:**
  - PGI I and PGI II:
  - only PGI I:
  - only PGI II:
- Gears:**
  - Functions from 1 to 6
- Assemblies:**
  - Letters from A to D

Ok

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

Assembled vs. Gears (as a function of a fixed output axle)

	A	B	C	D
1st				
2nd				
3rd				
4th				
5th				
6th				

**Legend:**

- PC1 I** (pink square)
- PC1 II** (green square)
- Input Element** (blue arrow)
- Output Element** (red arrow)
- Fixed Element** (black T-shape)
- Used PC1s**
  - PC1 I and PC1 II (orange diamond)
  - only PC1 I (orange triangle)
  - only PC1 II (orange inverted triangle)
- Gears** (numbers from 1 to 6)
- Assemblies** (Letters from A to D)

Ok

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

**2 PGTs - Determination of the Kinematic Relations through the Gear Ratios**

File Back Change View Print Save/Save As Exit

**Gear Ratios:**

Gear Ratio Quantity (1 to 6)  To ranges (1.01 to 10)  %

Gear Ratios: To ranges set:

:1 -1.0001 ~ -0.9999

Limit the search to specific Positions between Z-P-Gs

Limit the Train values interval (bI and bII) standard interval: -1.904 to -0.048

bI  to  bII  to

Limit the Teeth Quantity of the Gears

**Gears Teeth Quantity**

	Interval	Values set
Ring:	<input type="text"/> to <input type="text"/>	36 to 250
sun:	<input type="text"/> to <input type="text"/>	12 to 225
Planets:	<input type="text"/> to <input type="text"/>	12 to 117

Searching Time  
1 min 2 sec

**Results:**

The quantity of possible combinations of Z-P-Gs that satisfy the conditions is: **100**

Possible solutions:

<input checked="" type="checkbox"/>	bI = -0.497	bII = -0.596	Position 1 (1-1)	Assembly B
<input type="checkbox"/>	bI = -0.497	bII = -0.596	Position 1 (1-1)	Assembly C
<input type="checkbox"/>	bI = -0.487	bII = -0.545	Position 1 (1-1)	Assembly B
<input type="checkbox"/>	bI = -0.407	bII = -0.745	Position 1 (1-1)	Assembly C

Ante-attento: It is not necessary to select the "Direct Drive" (1-1).



# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

**2 PGTs - Determination of the Kinematic Relations through the Gear Ratios**

File Back Change View Print Save/Exit

**Gear Ratios**

Gear Ratio Quantity (1 to 6)       Tolerance (0.01 to 10)  %

Gear Ratios:      Tolerance Set:

: 1    -1.0001 ~ -0.9999

Limit the search to specific positions between 2 PGTs

Limit the Train values interval (b1 and b2) standard interval: -0.994 to -0.048

b1  to       b2  to

Limit the Teeth Quantity of the Gears

**Gears Teeth Quantity**

	<u>Interval:</u>	<u>Values set:</u>
Ring:	<input type="text"/> to <input type="text"/>	36 to 250
sun:	<input type="text"/> to <input type="text"/>	12 to 225
Planets:	<input type="text"/> to <input type="text"/>	12 to 117

**Searching Time**  
1 min 2 sec

Attention: It is not necessary to select the "Direct Drive" (1).

**Results**

selected solution for Torque Analysis:

b1 -- 0.497    b2 -- 0.936    Position 1 (1-1)    Assembly B

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

Exemplo do Projeto de uma Nova Transmissão Automática

### RTs:

3,0 :1  
1,5 :1  
1,0 :1  
0,7 :1  
-2,5 :1

Tolerância:  $\pm 3\%$

Razão Básica [-0,7; -0,5]

TEP II maior que TEP I

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

2 PGTs - Determination of the Kinematic Relations through the Gear Ratios

File Back Change View Print Save/Exit

Gear ratios

Gear Ratio Quantity (1 to 6)  To errance (-.01 to 10)  %

Gear Ratios:      To errance Set:

:1

:1

:1

:1

:1

:1

:1

Antenna: It is not necessary to select the "Direct Drive" (1).

Limit the search to specific positions between 2 PGTs

Limit the Train values interval (b1 and b2) standard interval: -0.004 to -0.048

b1  to       b2  to

Limit the Teeth Quantity of the Gears

Gears Teeth Quantity

	Interval:	Values set:
Ring:	<input type="text"/> to <input type="text"/>	36 to 250
sun:	<input type="text"/> to <input type="text"/>	12 to 226
Planets:	<input type="text"/> to <input type="text"/>	12 to 110

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

**2 PGTs - Determination of the Kinematic Relations through the Gear Ratios**

File Back Change View Print Save/Exit

Gear ratios

Gear Ratio Quantity (1 to 6)

Gear Ratios: To errand Set:

<input type="text" value="3"/>	:1	2.91 ~ 3.09
<input type="text" value="1.5"/>	:1	1.455 ~ 1.545
<input type="text" value="0.7"/>	:1	0.679 ~ 0.721
<input type="text" value="2.2"/>	:1	-2.575 ~ -2.425

To errand: (1.01 to 10)  %

Limit the search to specific positions between 2 PGTs

Limit the Train values interval (b1 and b11) standard interval: -1.904 to -0.048

b1  to  b11  to

Limit the Teeth Quantity of the Gears

Gears Teeth Quantity

	Interval:	Values set:
Ring:	<input type="text"/> to <input type="text"/>	36 to 252
sun:	<input type="text"/> to <input type="text"/>	12 to 228
Planets:	<input type="text"/> to <input type="text"/>	12 to 117

Antenna: It is not necessary to select the "Direct Drive" (1).

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

**2 PGTs - Determination of the Kinematic Relations through the Gear Ratios**

File Back Change View Print Save/Exit

Gear ratios

Gear Ratio Quantity (1 to 6)

To errance (1.01 to 10)  %

Limit the search to specific positions between 2 PGTs

Limit the Train values interval (b1 and b2) standard interval: -1.904 to -0.048

b1  to  b2  to

Limit the Teeth Quantity of the Gears

Gears Teeth Quantity

	Interval	Values set
Ring:	<input type="text"/> to <input type="text"/>	36 to 25
Sun:	<input type="text"/> to <input type="text"/>	12 to 22
Planets:	<input type="text"/> to <input type="text"/>	12 to 11

Antennas: It is not necessary to select the "Direct Drive" (1).

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

2 PGTs - Determination of the Kinematic Relations through the Gear Ratios

File Back Change View Print Save/Exit

Gear ratios

Gear Ratio Quantity (1 to 6)

To errance (1.01 to 10)  %

Limit the search to specific positions between 2 PGTs

Limit the Train values interval (b1 and b2) standard interval: -1.904 to -0.048

b1  to  b2  to

Limit the Teeth Quantity of the Gears

Gears Teeth Quantity

	Interval:	Values set:
Ring:	<input type="text"/> to <input type="text"/>	36 to 25
sun:	<input type="text"/> to <input type="text"/>	12 to 22
Planets:	<input type="text"/> to <input type="text"/>	12 to 11

Antenna: It is not necessary to select the "Direct Drive" (1).

**Confirm**

**Cancel**

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

**2 PGTs - Determination of the Kinematic Relations through the Gear Ratios**

File Back Change View Print Save/Exit

**Gear Ratios**

Gear Ratio Quantity (1 to 6)       Tolerance (0.01 to 10)  %

Gear Ratios:      Tolerance Set:

<input type="text" value="3"/>	:1	2.91 ~ 3.09
<input type="text" value="1.5"/>	:1	1.455 ~ 1.545
<input type="text" value="0.7"/>	:1	0.679 ~ 0.721
<input type="text" value="2.2"/>	:1	-2.575 ~ -2.425

Limit the search to specific Positions between 2 PGTs

Limit the Train values interval (bL and bLL) standard interval: -0.904 to -0.048

bL  to       bLL  to

Limit the Teeth Quantity of the Gears

**Gears Teeth Quantity**

	Interval	Maximum Set
Ring:	<input type="text"/> to <input type="text"/>	36 to 25
sun:	<input type="text"/> to <input type="text"/>	12 to 22
Planets:	<input type="text"/> to <input type="text"/>	12 to 11

**Searching Time**  
2 min 34 sec

Anticipation: It is not necessary to select the "Direct Drive" (1).

**Result**

The quantity of possible combinations of 2 PGTs that satisfy the conditions is: **1249**

Possible solutions:

<input type="checkbox"/>	bL = -0.545	bLL = -0.497	Position 20 (4-2')	Assembly C
<input type="checkbox"/>	bL = -0.545	bLL = -0.536	Position 20 (4-2')	Assembly C
<input type="checkbox"/>	bL = -0.545	bLL = -0.535	Position 20 (4-2')	Assembly C
<input type="checkbox"/>	bL = -0.545	bLL = -0.704	Position 20 (4-2')	Assembly C

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

**2 PGTs - Determination of the Kinematic Relations through the Gear Ratios**

File Back Change View Print Save/Exit

**Gear Ratios:**

Gear Ratio Quantity (1 to 6)  To tolerance (1.001 to 10)  %

Gear Ratios: To tolerance set:

<input type="text" value="3"/>	:1	2.91 ~ 3.09
<input type="text" value="1.5"/>	:1	1.455 ~ 1.545
<input type="text" value="0.7"/>	:1	0.679 ~ 0.721
<input type="text" value="2.2"/>	:1	-2.575 ~ -2.425

Limit the search to specific Positions between 2 PGTs

Limit the Train values interval (bL and bLI) standard interval: -0.904 to -0.048

bL  to  bLI  to

Limit the Teeth Quantity of the Gears

**Gears Teeth Quantity**

	Interval	Maximum set
Ring:	<input type="text"/> to <input type="text"/>	36 to 25
sun:	<input type="text"/> to <input type="text"/>	12 to 22
Planets:	<input type="text"/> to <input type="text"/>	12 to 11

**Searching Time**  
2 min 34 sec

Antennas: It is not necessary to select the "Direct Drive" (1).

**Result:**

The quantity of possible combinations of 2 PGTs that satisfy the conditions is: **1249**

Possible solutions:

<input type="checkbox"/>	bL = -0.545	bLI = -0.497	Position 20 (4-2')	Assembly C
<input type="checkbox"/>	bL = -0.545	bLI = -0.536	Position 21 (4-2')	Assembly C
<input type="checkbox"/>	bL = -0.545	bLI = -0.535	Position 22 (4-2')	Assembly C
<input type="checkbox"/>	bL = -0.545	bLI = -0.704	Position 27 (4-2')	Assembly C



# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

**2 PGTs - Determination of the Kinematic Relations through the Gear Ratios**

File Back Change View Print Save/Exit

**Gear Ratios**

Gear Ratio Quantity (1 to 6)       To range (1.01 to 10)  %

Gear Ratios:      To range set:

<input type="text" value="3"/>	:1	2.91 ~ 3.09
<input type="text" value="1.5"/>	:1	1.455 ~ 1.545
<input type="text" value="0.7"/>	:1	0.679 ~ 0.721
<input type="text" value="2.2"/>	:1	-2.575 ~ -2.425

Limit the search to specific Positions between 2 P.G.T.s

Limit the Train values interval (bL and bLL) standard interval: -0.904 to -0.048

bL  to       bLL  to

Limit the Teeth Quantity of the Gears

**Gears Teeth Quantity**

	Interval	Maximum set
Ring:	<input type="text"/> to <input type="text"/>	36 to 25
sun:	<input type="text"/> to <input type="text"/>	12 to 22
Planets:	<input type="text"/> to <input type="text"/>	12 to 11

**Searching Time**  
2 min 34 sec

Attention: It is not necessary to select the "Direct Drive" (1).

**Result**

The quantity of possible combinations of 2 P.G.T.s that satisfy the conditions is: **1249**

Possible solutions:

<input checked="" type="checkbox"/>	bL = -0.545	bLL = -0.497	Position 2 <sup>o</sup> (4-2 <sup>o</sup> )	Assembly C
<input type="checkbox"/>	bL = -0.545	bLL = -0.536	Position 2 <sup>o</sup> (4-2 <sup>o</sup> )	Assembly C
<input type="checkbox"/>	bL = -0.545	bLL = -0.535	Position 2 <sup>o</sup> (4-2 <sup>o</sup> )	Assembly C
<input type="checkbox"/>	bL = -0.545	bLL = -0.704	Position 2 <sup>o</sup> (4-2 <sup>o</sup> )	Assembly C

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

**2 PGTs - Determination of the Kinematic Relations through the Gear Ratios**

File Back Change View Print Save Exit

**Gear Ratios**

Gear Ratio Quantity (1 to 6)

To errance (1.01 to 10)  %

**Gear Ratios:** To errance set:

<input type="text" value="3"/>	:1	2.91 ~ 3.09
<input type="text" value="1.5"/>	:1	1.455 ~ 1.545
<input type="text" value="0.7"/>	:1	0.679 ~ 0.721
<input type="text" value="2.2"/>	:1	-2.575 ~ -2.425

Limit the search to specific Positions between 2 P.G.Ts

Limit the Train values interval (bI and bII) standard interval: -1.904 to -0.048

bI  to       bII  to

Limit the Teeth Quantity of the Gears

**Gears Teeth Quantity**

	<u>Interval:</u>	<u>Values set:</u>
Ring:	<input type="text"/> to <input type="text"/>	36 to 25
sun:	<input type="text"/> to <input type="text"/>	12 to 22
Planets:	<input type="text"/> to <input type="text"/>	12 to 11

Searching Time  
2 min 34 sec

Confirm

Cancel

Antennas: It is not necessary to select the "Direct Drive" (1).

**Result**

selected solution for Torque Analysis:

<input checked="" type="checkbox"/>	bI -- 0.545    bII -- 0.497    Position 20 (4-2)    Assembly 0
-------------------------------------	--

Cancel

OK

**Torque Analysis**

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

**2 PGTs - Determination of the Kinematic Relations through the Gear Ratios**

File Back Change View Print Save Exit

**Parameters Selection for the Torque Analysis**

Initial Parameters for the search

Train Value:  $bI = -0.545$   $bII = -0.637$

Limit the Gears Teeth Quantity

	Desired Interval	Values Set
Ring:	[ ] to [ ]	36 to 250
Sun:	[ ] to [ ]	12 to 225
Planets:	[ ] to [ ]	12 to 110

Buttons: Confirm Change Cancel

Searching Time: 2 min 34 sec

Buttons: Confirm Cancel

selected solution for Torque Analysis:

- $bI = -0.545$   $bII = -0.637$  Position 20 (4-2) Assembly 0

Buttons: Cancel Ok Torque Analysis

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

**2 PGTs - Determination of the Kinematic Relations through the Gear Ratios**

File Back Change View Print Save Exit

**Parameters Selection for the Torque Analysis**

Initial Parameters for the search

Train Value:  $bI: -0.545$   $bII: -0.637$

Limit the Gears Teeth Quantity

	Desired Interval	Values Set
Ring:	[ ] to [ ]	36 to 25
Sun:	[ ] to [ ]	12 to 22
Planets:	[ ] to [ ]	12 to 11

Buttons: Confirm Change Cancel

Searching Time: 2 min 34 sec

Buttons: Confirm Cancel

selected solution for Torque Analysis:

- $bI -- 0.545 -- bII -- 0.637$  Position 20 (4-2) Assembly 0

Buttons: Cancel Ok Torque Analysis

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

2 PGTs - Determination of the Kinematic Relations through the Gear Ratios

File Back Change View Print Save Exit

Parameters Selection for the Torque Analysis

Limiting Parameters for the search

Train Value:  $bI: -0.545$   $bII: -0.437$

Limit the Gears Teeth Quantity

Desired Interval: Ring: [ ] to [ ] Values Set: 36 to 25  
Sun: [ ] to [ ] 12 to 22  
Planets: [ ] to [ ] 12 to 11

Confirm Change Cancel

Results

Select the PGTs for the Torque Analysis:

PATT: 10 options

- $Z_1 = 56$   $Z_2 = 36$   $Z_p = 11$
- $Z_1 = 58$   $Z_2 = 48$   $Z_p = 20$
- $Z_1 = 101$   $Z_2 = 55$   $Z_p = 23$

PGT II: 10 options

- $Z_1 = 56$   $Z_2 = 42$   $Z_p = 12$
- $Z_1 = 77$   $Z_2 = 49$   $Z_p = 14$
- $Z_1 = 58$   $Z_2 = 56$   $Z_p = 15$

Change Cancel Confirm

selected solution for Torque Analysis:

- $bI = -0.545$   $bII = -0.437$  Position 20 (4-2) Assembly 0

Cancel

Ok

Torque Analysis

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

2 PGTs - Determination of the Kinematic Relations through the Gear Ratios

File Back Change View Prin. Save/Save As Exit

**Parameters Set**

Limiting Parameters

Train Value

Limit the Gears

Basic

Ring:

Sun:

Planets:

**Torque Analysis vs. Gear Ratio**

Case View Prin.

Case I

Teeth Quantity

Ring:

Sun:

Planets:

Case II

Teeth Quantity

Ring:

Sun:

Planets:

Position

Select a Gear for the analysis

<input checked="" type="radio"/> 1st 1.159 : 1	<input type="radio"/> 3rd 2.956 : 1	<input type="radio"/> 5th 1.545 : 1
<input type="radio"/> 2nd 0.703 : 1	<input type="radio"/> 4th 2.335 : 1	<input type="radio"/> 6th -2.425 : 1

selected solution for

GI - 0.545 - II

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

2 PGTs - Determination of the Kinematic Relations through the Gear Ratios

File Back Change View Print Save Exit

Parameters Set Torque Analysis vs. Gear Ratio

Close View Print

Limiting Parameters

Train Value

Limit the Gears

Basic

Ring:

Sun:

Planets:

Confirm

Teeth Quantity

Ring:

Sun:

Planets:

Teeth Quantity

Ring:

Sun:

Planets:

Confirm

Back

Position

Select a Gear for the analysis

1st 1.159 : 1

3rd 2.956 : 1

5th 1.545 : 1

2nd 0.703 : 1

4th 2.335 : 1

6th -2.425 : 1

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

**"Map" of the Results**

	1'				2'				3'				4'				5'				6'			
	A	D	C	D	A	D	C	D	A	D	C	D	A	B	C	D	A	B	C	D	A	B	C	D
<b>1</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
<b>2</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
<b>3</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
<b>4</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
<b>5</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
<b>6</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D

**Options:**

- 1st Gear
- 2nd Gear
- 3rd Gear
- 4th Gear
- 5th Gear
- 6th Gear

**Train Values:**

$h_T$

$h_{TT}$

**Tolerances:**

**Gear Values:**

1st: 1.412 \* 1.412

2nd: 1.636 \* 1.636

3rd: 3.429 \* 3.429

4th: -0.545 \* -0.545

5th: 2.572 \* 2.572

6th: 0.323 \* 0.323



# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

**"Map" of the Results**

	1'				2'				3'				4'				5'			
	A	D	C	D	A	D	C	D	A	D	C	D	A	B	C	D	A	B	C	D
<b>1</b>	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
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	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
<b>3</b>	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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<b>4</b>	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
<b>5</b>	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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<b>6</b>	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D

**Options:**

- 1st Gear
- 2nd Gear
- 3rd Gear
- 4th Gear
- 5th Gear
- 6th Gear

**Train Values:**

$h_T$

$h_{TT}$

**Tolerances:**

**Gear Values:**

1st: 1.412 \* 1.412

2nd: 1.636 \* 1.636

3rd: 3.429 \* 3.429

4th: -0.545 \* -0.545

5th: 2.572 \* 2.572

6th: 0.323 \* 0.323

# Transmissões Veiculares

## Transmissão Automática



- ZF 6HP26
- 1ª Transmissão 6-marchas para automóveis em série fabricada no mundo (~ ano 2001)

RT	1ª	2ª	3ª	4ª	5ª	6ª	ré
	4,17	2,34	1,52	1,14	0,86	0,69	-3,40

# Transmissões Veiculares

## Transmissão Automática



### BMW 7 Series Sedan

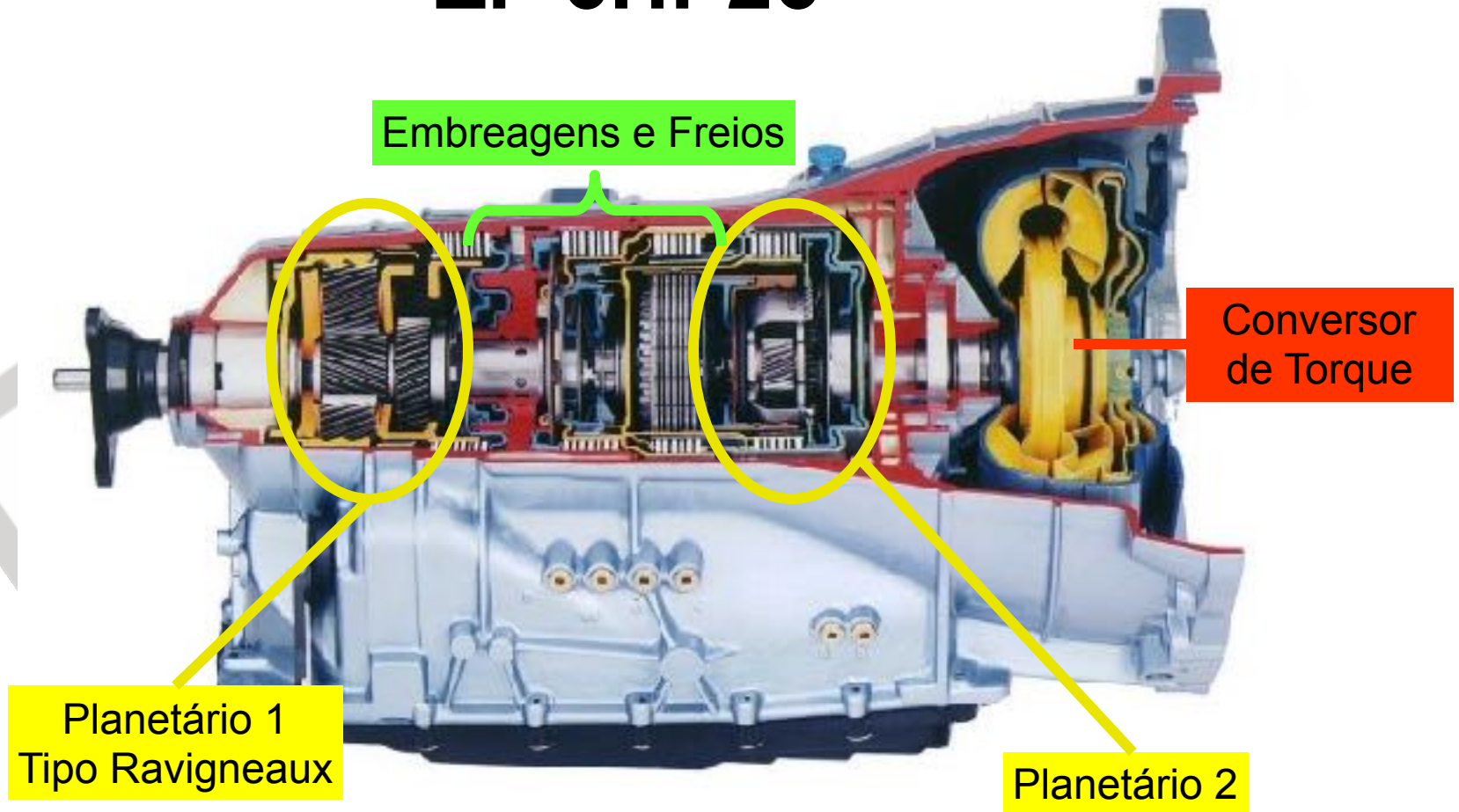


# Transmissões Veiculares

## Caixas ZF



### ZF 6HP26

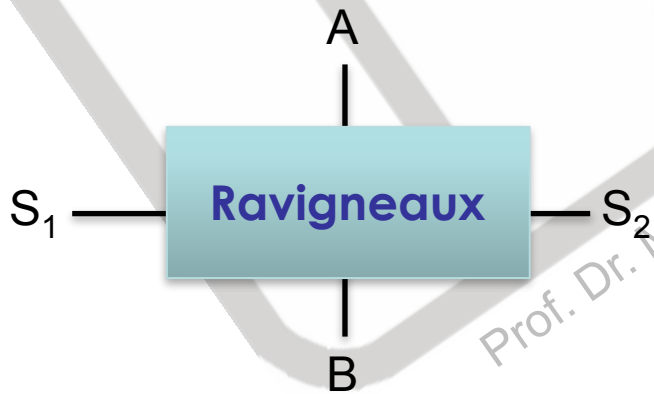
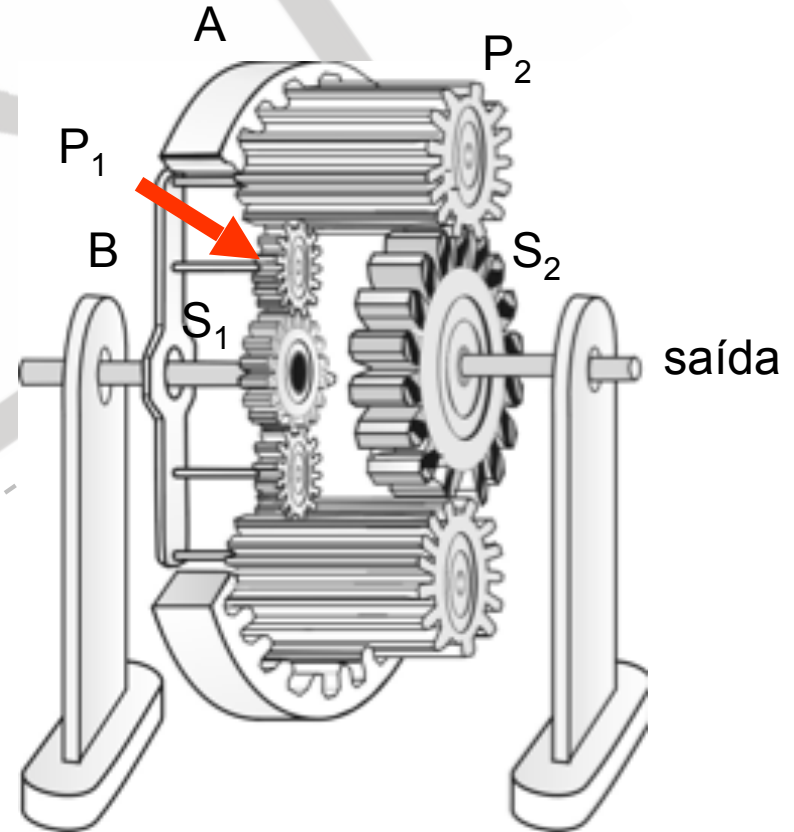
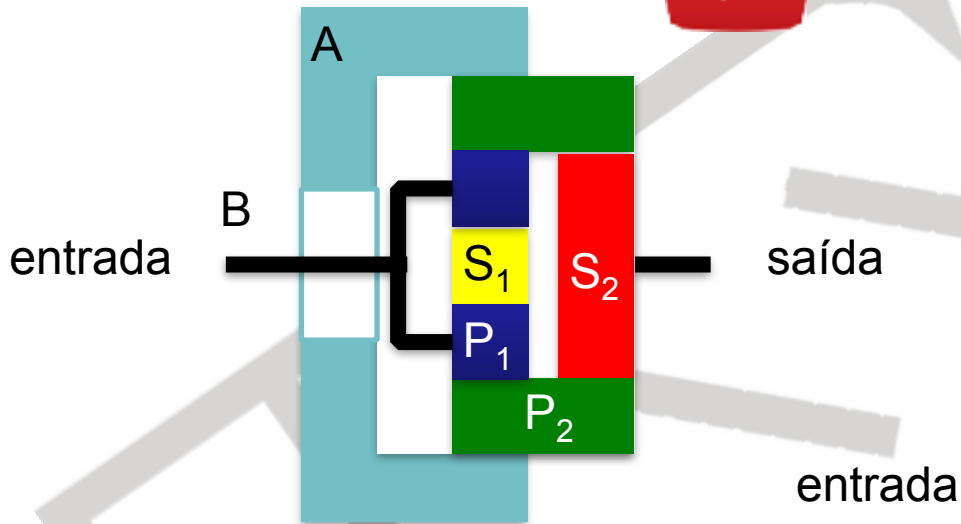


# Transmissões Veiculares

## Caixas Ravigneaux



<http://www.youtube.com/watch?v=7iTn8OWxVFU>



Prof. Dr. Marcelo Becker

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

- Resultados obtidos para 2 TEPs Simples (RT):

ZF 6HP26 (RT:1)	2 TEPs Simples (RT:1)	Diferença (%)
4,171	4,068	2,47
2,340	2,468	6,24
1,521	1,673	9,99
1,143	1,000	12,51
0,867	0,781	9,96
0,691	0,674	2,45
-3,403	-3,559	4,58

Região próxima à Direct-Drive (1:1)

Fonte: TEPiciclo - A Software to Help the Planetary Gear Trains Design – SAE Technical Paper #: 2003-01-0679, DOI: 10.4271/2003-01-0679  
Authors: Becker, M., Amaral, D., and Dediñi, F.

# Exemplo 2 TEPs: Síntese

## Software TEPiciclo – Transmissão

- Resultados obtidos para a Mudança de Marcha:

Troca de	ZF 6HP26	2 TEPs	Diferença (%)
1 → 2	1,78	1,63	8,43
2 → 3	1,53	1,48	3,27
3 → 4	1,33	1,67	25,6
4 → 5	1,32	1,27	3,78
5 → 6	1,25	1,16	7,20

Região próxima à Direct-Drive (1:1)

Fonte: TEPiciclo - A Software to Help the Planetary Gear Trains Design – SAE Technical Paper #: 2003-01-0679, DOI: 10.4271/2003-01-0679  
Authors: Becker, M., Amaral, D., and Dediñi, F.