

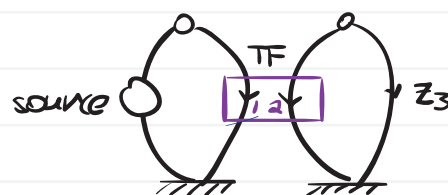
## Impedance relationships for two-port elements 016 | 1/2

Recall from SD Chapter 6 the two types of two-port energy transducing elements **transformers** and **gyrators**.

The input impedance of one port is related to the input impedance of the system connected to the other port through the transformer and gyrator ratios **TF** + **GY**.

### Transformers

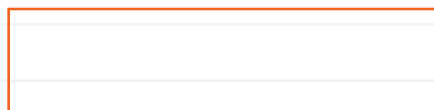
Transformers have elemental equation



Considering exponential inputs and outputs, continuity + compatibility equations imply

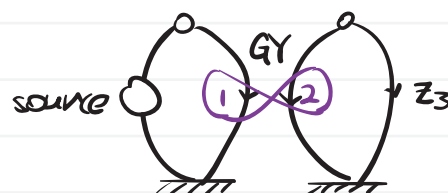
$$\begin{bmatrix} v_i(s) \\ f_i(s) \end{bmatrix} = \begin{bmatrix} TF & 0 \\ 0 & -1/TF \end{bmatrix} \begin{bmatrix} z_3 f_3(s) \\ -f_3(s) \end{bmatrix},$$

and since, by definition,  $z_i(s) = \frac{v_i(s)}{f_i(s)}$ ,



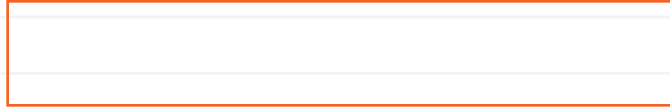
### Gyrators

Gyrators have the elemental equation



In a manner similar to that for the transformer,

it can be shown that



### Example

Consider the fluid system at right. What is the input impedance at the piston-cylinder?

