Simulink Report: Compressor_

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Model - Compressor_

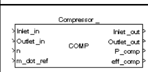
Tabelle 1.1. Compressor_ Simulation Parameters

Solver ode14x	*ZeroCross* on	*StartTime* 0.0*StopTime* 10.0
RelTol 1e-3	*AbsTol* auto	*Refine* 1
InitialStep auto	*FixedStep* auto	*MaxStep* auto

Tabelle 1.2. Compressor_ Summary Information

NumModelInputs	N/A	*NumModelOutputs*	N/A
NumVirtualSubsystems	N/A	*NumNonvirtSubsystems*	N/A
NumNonVirtBlocksInModel	N/A	*NumBlockTypeCounts*	N/A
NumBlockSignals	N/A	*NumBlockParams*	N/A
NumZCEvents	N/A	*NumNonsampledZCs*	N/A

Systems

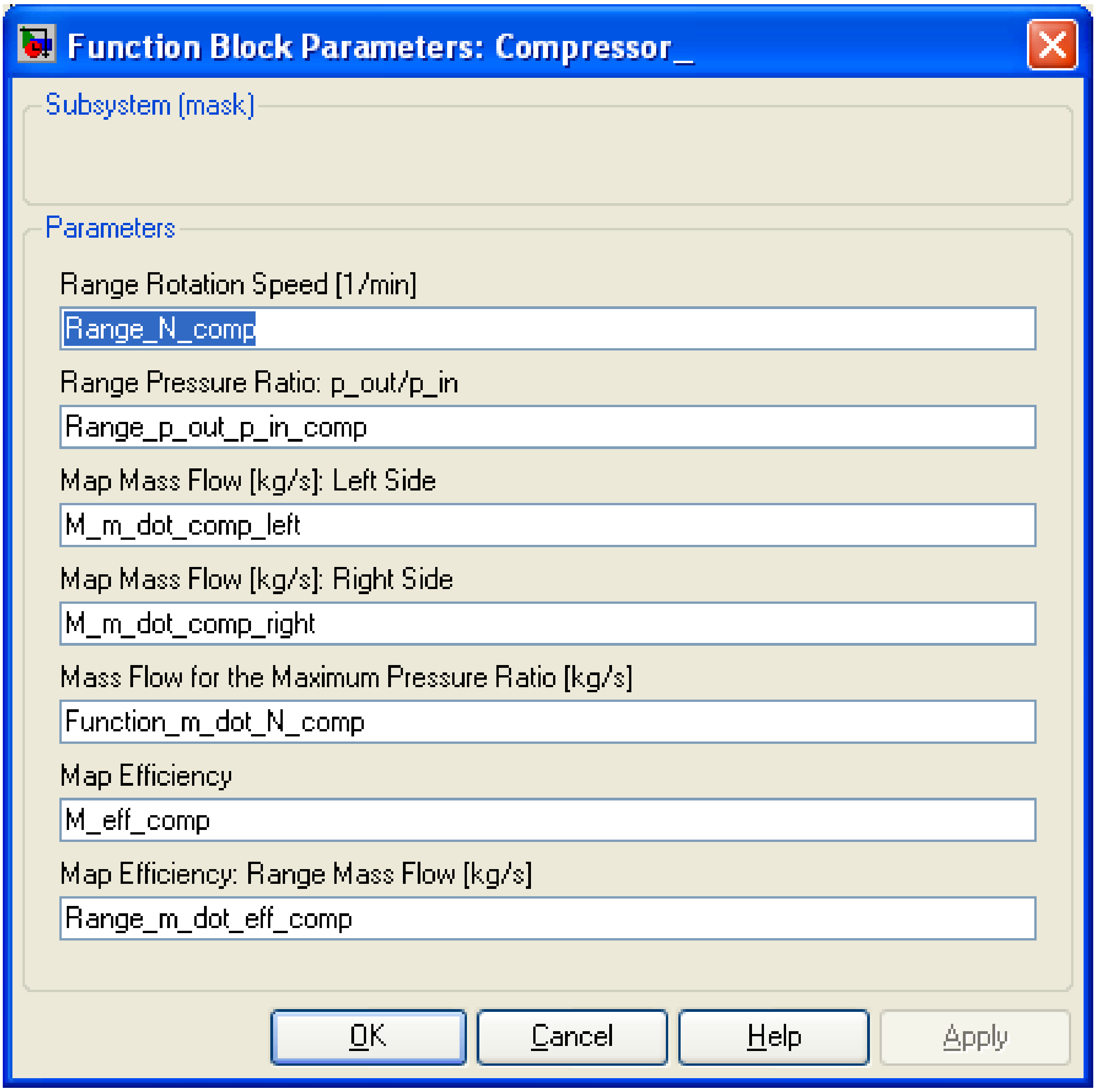
Name	**Parent**	**Snapshot**	**Blocks**	**Signals**
Compressor_	<root>		Compressor_	Compressor_<1> Compressor_<2> Compressor_<3> Compressor_<4>

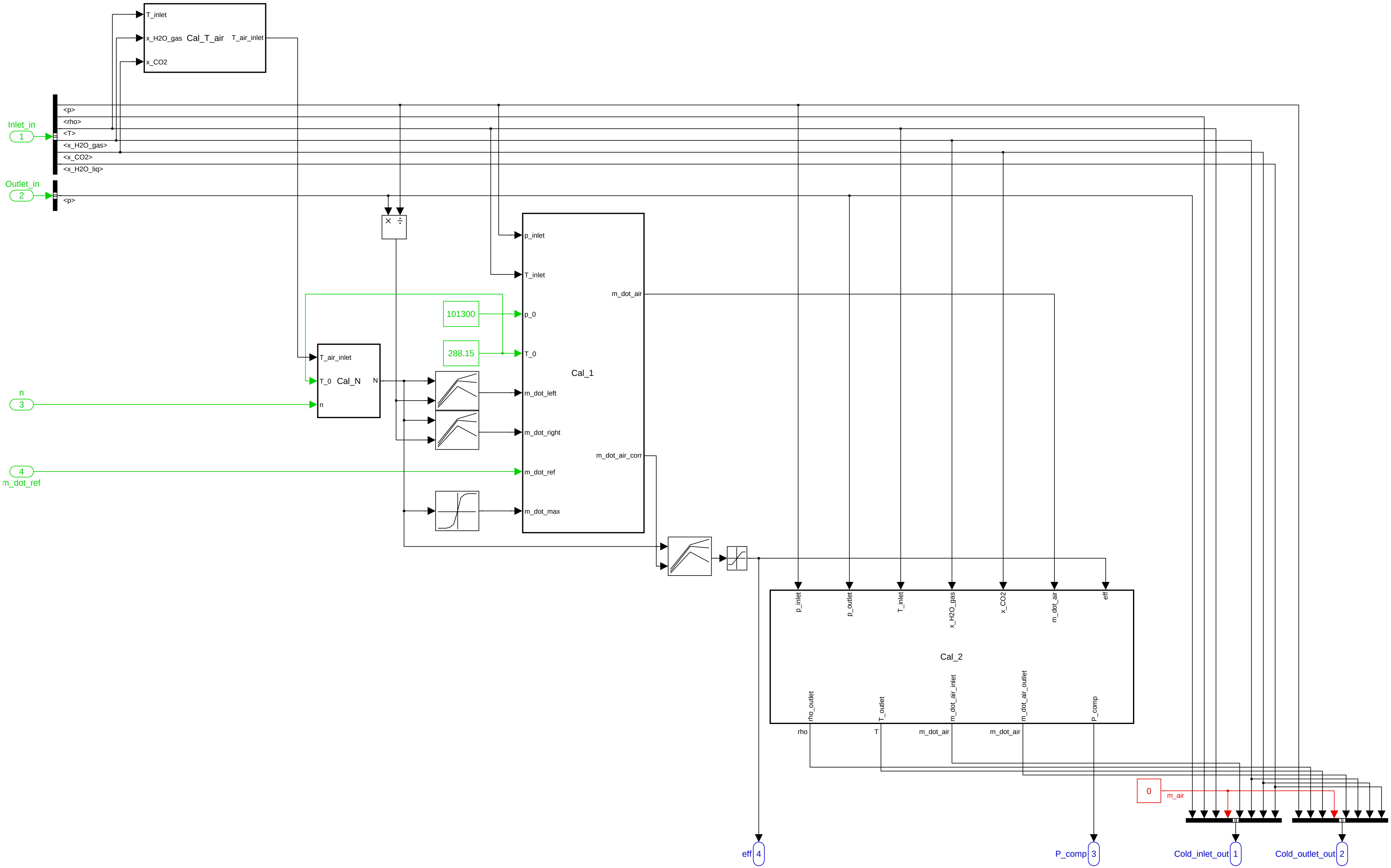
Blocks

Tabelle 1.3. Block Type Count

BlockType	**Count**	**Block Names**
Inport	25	Inlet_in, Outlet_in, n, m_dot_ref, p_inlet, p_outlet, T_inlet, x_H2O_gas, x_CO2, m_dot_air, eff, p_inlet, T_inlet, p_0, T_0, m_dot_left, m_dot_right, m_dot_ref, m_dot_max, T_air_inlet, T_0, n, T_inlet, x_H2O_gas, x_CO2
Outport	13	rho_outlet, T_outlet, m_dot_air_inlet, m_dot_air_outlet,

BlockType	**Count**	**Block Names**
		P_comp, m_dot_air, m_dot_air_corr, N, T_air_inlet, Cold_inlet_out, Cold_outlet_out, P_comp, eff
Terminator	4	Terminator , Terminator , Terminator , Terminator
Stateflow (m)	4	Embedded MATLA Function1, Embedded MATLA Function2, Embedded MATLA Function3, Embedded MATLA Function4
S-Function	4	SFunction , SFunction , SFunction , SFunction
Demux	4	Demux , Demux , Demux , Demux
Lookup2D	3	Lookup Table (2-D)2, Lookup Table (2-D)3, Lookup Table (2-D)4
Constant	3	T_0, m_air, p_0
BusSelector	2	Bus Selector, Bus Selector3
BusCreator	2	Bus Creator1, Bus Creator2
SubSystem	1	Compressor_
Saturate	1	Saturation1
Product	1	Divide
Lookup	1	Lookup Table1


Function Block Parameters: Compressor_
Subsystem (mask)
Parameters
Range Rotation Speed [1/min]
Range_N_comp
Range Pressure Ratio: p_out/p_in
Range_p_out_p_in_comp
Map Mass Flow [kg/s]: Left Side
M_m_dot_comp_left
Map Mass Flow [kg/s]: Right Side
M_m_dot_comp_right
Mass Flow for the Maximum Pressure Ratio [kg/s]
Function_m_dot_N_comp
Map Efficiency
M_eff_comp
Map Efficiency: Range Mass Flow [kg/s]
Range_m_dot_eff_comp
OK
Cancel
Help
Apply



T_inlet
x_H2O_gas
Cal_T_air
T_air_inlet
x_CO2
Inlet_in
1
<p>
<rho>
<T>
<x_H2O_gas>
<x_CO2>
<x_H2O_liq>
Outlet_in
2
<p>
p_inlet
T_inlet
m_dot_air
101300
p_0
288.15
T_0
Cal_1
T_air_inlet
T_0
Cal_N
N
n
n
3
m_dot_left
m_dot_right
m_dot_air_corr
4
m_dot_ref
m_dot_ref
m_dot_max
p_inlet
p_outlet
T_inlet
x_H2O_gas
x_CO2
m_dot_air
eff
Cal_2
rho_outlet
T_outlet
m_dot_air_inlet
m_dot_air_outlet
P_comp
rho
T
m_dot_air
m_dot_air
0
m_air
eff
4
P_comp
3
Cold_inlet_out
1
Cold_outlet_out
2

```
function T_air_inlet = Cal_T_air(T_inlet,x_H2O_gas,x_CO2)

% **************************************************************************
% * Definition of a compressor
% *
% * Number of inputs :                4
% *
% * Parameter: Characteristic Maps:    Mass Flow, Efficiency
% *
% *
% * Relevant input variables of Compressor
% *
% * Pressure:                          p_in
% * Density:                           rho_in
% * Temperature:                       T_in
% * Content water vapor:               x_H2O_gas_in
% * Content CO2:                       x_CO2_in
% * Content water:                     x_H2O_liq_in
% *
% *
% * Relevant output variables of Compressor
% *
% * Temperature:                       T
% * Mass flow dry air:                 m_dot_air
% * Content water vapor:               x_H2O_gas
% * Content CO2:                       x_CO2
% * Content water:                     x_H2O_liq
% *
% *************************************************************************
% * Embedded Matlab Function Cal_T_air:
% *
% * Calculations:
% * 1. Calculation dry bulb temperature T_air.
% *
% *
% * Assumptions:
% * 1. The specific enthalpy of the inflowing gas mixture is equal the enthalpy
% *    of a dry air flow.
% *
% *
% * Last modification : 15.03.2008
% * Author : Christian Müller(HAW)
% *
% *************************************************************************

% * 1. Calculation dry bulb temperature T_air
c_p_air     = 1005;
c_p_H2O_gas = 1870;
c_p_CO2     = 830;
r_0         = 2500000;
T_air_inlet =↙
(c_p_air*T_inlet+x_H2O_gas*c_p_H2O_gas*T_inlet+x_CO2*c_p_CO2*T_inlet+x_H2O_gas*r_0)↙
/c_p_air;
% *************************************************************************
```

```
function N = Cal_N(T_air_inlet,T_0,n)

% *************************************************************************
% * Definition of a compressor
% *
% * Number of inputs :               4
% *
% * Parameter: Characteristic Maps:    Mass Flow, Efficiency
% *
% *
% * Relevant input variables of Compressor
% *
% * Pressure:                          p_in
% * Density:                           rho_in
% * Temperature:                       T_in
% * Content water vapor:               x_H2O_gas_in
% * Content CO2:                       x_CO2_in
% * Content water:                     x_H2O_liq_in
% *
% *
% * Relevant output variables of Compressor
% *
% * Temperature:                       T
% * Mass flow dry air:                 m_dot_air
% * Content water vapor:               x_H2O_gas
% * Content CO2:                       x_CO2
% * Content water:                     x_H2O_liq
% *
% ************************************************************************
% * Embedded Matlab Function Cal_N:
% *
% * Calculations:
% * 1. Calculation corrected rotational speed N.
% *
% *
% * Last modification : 15.03.2008
% * Author : Christian Müller(HAW)
% *
% ************************************************************************

% * 1. Calculation corrected rotational speed N
N = n/sqrt(T_air_inlet/T_0);
% ************************************************************************
```

```
function [m_dot_air,m_dot_air_corr]  = Cal_1(p_inlet,T_inlet,p_0,T_0,m_dot_left,↙
m_dot_right,m_dot_ref,m_dot_max)

% *************************************************************************
% * Definition of a Compressor
% *
% * Number of inputs :                 4
% *
% * Parameter: Characteristic Maps:    Mass Flow, Efficiency
% *
% *
% * Relevant input variables of Compressor
% *
% * Pressure:                          p_in
% * Density:                           rho_in
% * Temperature:                       T_in
% * Content water vapor:               x_H2O_gas_in
% * Content CO2:                       x_CO2_in
% * Content water:                     x_H2O_liq_in
% *
% *
% * Relevant output variables of Compressor
% *
% * Temperature:                       T
% * Mass flow dry air:                 m_dot_air
% * Content water vapor:               x_H2O_gas
% * Content CO2:                       x_CO2
% * Content water:                     x_H2O_liq
% *
% ************************************************************************
% * Embedded Matlab Function Cal_1:
% *
% * Calculations:
% * 1. Calculation mass flow.
% *
% *
% * Assumptions:
% * 1.
% *
%   p_outlet/p_inlet |       Left Side       |        Right Side
%                    |                     __|__
%                    |               ____    |    ____
%                    |         ____          |          ____
%                    |    ____               |                  _____
%                   0|_______________________|________________________
%                     0             Mass Flow Corrected
% *
% *
% * Last modification : 15.03.2008
% * Author : Christian Müller(HAW)
% *
% ************************************************************************

% * 1. Calculation mass flow
m_dot_air_corr    = 0;
```

```
if m_dot_max < 0
   m_dot_max      = 0;
end

if m_dot_left < 0
   m_dot_left     = 0;
end

if m_dot_right < 0
   m_dot_right    = 0;
end

if m_dot_left > m_dot_max
   m_dot_left     = m_dot_max;
end

if m_dot_right < m_dot_max
   m_dot_right    = m_dot_max;
end

if m_dot_ref >= m_dot_max
   m_dot_air_corr = m_dot_right;
end

if m_dot_ref < m_dot_max
   m_dot_air_corr = m_dot_left;
end

m_dot_air         = m_dot_air_corr*(p_inlet/p_0)*(1/sqrt(T_inlet/T_0));

if m_dot_air < 0
   m_dot_air      = 0;
   m_dot_air_corr = 0;
end

if m_dot_air > 5*m_dot_max
   m_dot_air      = 5*m_dot_max;
   m_dot_air_corr = 5*m_dot_max;
end
% ************************************************************************
```

```
function [rho_outlet,T_outlet,m_dot_air_inlet,m_dot_air_outlet,P_comp] = Cal_2(p_inlet,↙
p_outlet,T_inlet,x_H2O_gas,x_CO2,m_dot_air,eff)

% *************************************************************************
% * Definition of a Compressor
% *
% * Number of inputs :                 4
% *
% * Parameter: Characteristic Maps:    Mass Flow, Efficiency
% *
% *
% * Relevant input variables of Compressor
% *
% * Pressure:                          p_in
% * Density:                           rho_in
% * Temperature:                       T_in
% * Content water vapor:               x_H2O_gas_in
% * Content CO2:                       x_CO2_in
% * Content water:                     x_H2O_liq_in
% *
% *
% * Relevant output variables of Compressor
% *
% * Temperature:                       T
% * Mass flow dry air:                 m_dot_air
% * Content water vapor:               x_H2O_gas
% * Content CO2:                       x_CO2
% * Content water:                     x_H2O_liq
% *
% ************************************************************************
% * Embedded Matlab Function Cal_2:
% *
% * Calculations:
% * 1. Definition specific gas constants.
% * 2. Calculation specific work.
% * 3. Calculation outlet temperature and density.
% * 4. Calculation absorbed power.
% *
% *
% * Assumptions:
% *
%   Efficiency |                       |
%              |                     __|__
%              |               ____    |    ____
%              |          ____         |          ____________
%              |  _______              |
%             0|_______________________|________________________
%                0             Mass Flow Corrected
% *
% *
% * Last modification : 15.03.2008
% * Author : Christian Müller(HAW)
% *
% ************************************************************************

% * 1. Definition specific gas constants
```

```
R_air            = 287.058;
R_H2O_gas        = 461.523;
R_CO2            = 188.924;
c_p_air          = 1005;
c_p_H2O_gas      = 1870;
c_p_CO2          = 830;
R_avg            = (R_air+x_H2O_gas*R_H2O_gas+x_CO2*R_CO2)/(1+x_H2O_gas+x_CO2);
c_p_avg          = (c_p_air+x_H2O_gas*c_p_H2O_gas+x_CO2*c_p_CO2)/(1+x_H2O_gas+x_CO2);
c_v_avg          = c_p_avg-R_avg;
gamma_avg        = c_p_avg/c_v_avg;
% ************************************************************************

% * 2. Calculation specific work
w_comp           = 0;

if eff >= 0.01
   w_comp        = (1/eff)*c_p_air*T_inlet*(((p_outlet/p_inlet)^((gamma_avg-1)↙
/gamma_avg))-1);
end
% ************************************************************************

% * 3. Calculation outlet temperature and density
T_outlet         = T_inlet+(1/c_p_air)*w_comp;

if T_outlet < T_inlet
   T_outlet      = T_inlet;
end

rho_outlet       = p_outlet/(R_avg*T_outlet);
% ************************************************************************

% * 4. Calculation absorbed power
if p_outlet == p_inlet
   m_dot_air     = 0;
end

P_comp           = m_dot_air*c_p_air*(T_outlet-T_inlet);

m_dot_air_inlet  = -m_dot_air;
m_dot_air_outlet =  m_dot_air;
% ************************************************************************
```