

9 Anexos

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Imágenes

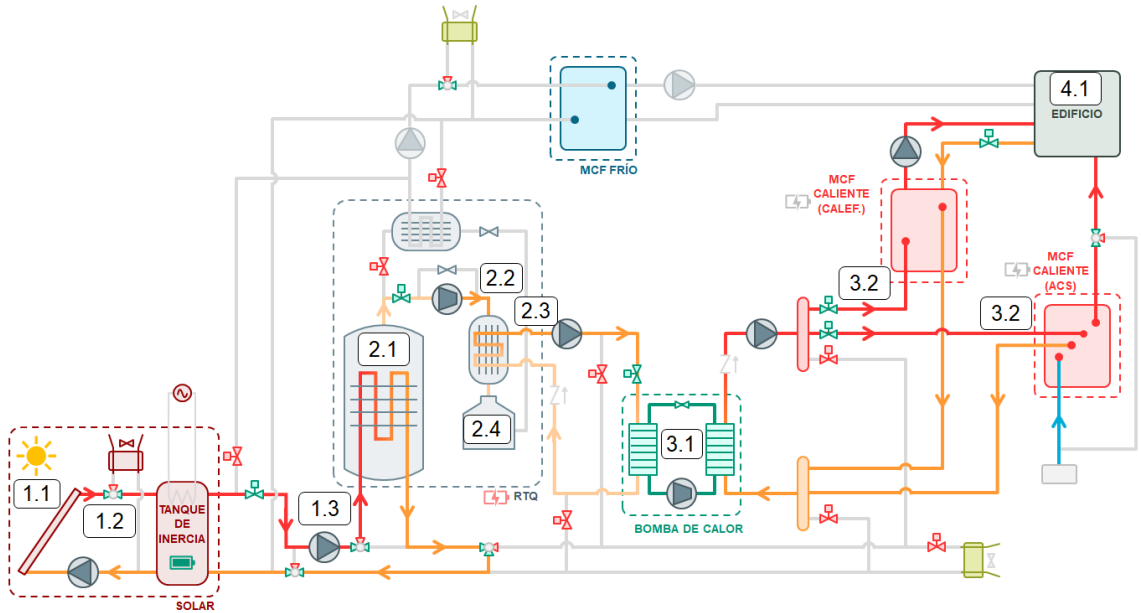


Figura 1: Esquema de operación Carga RTQ con componentes

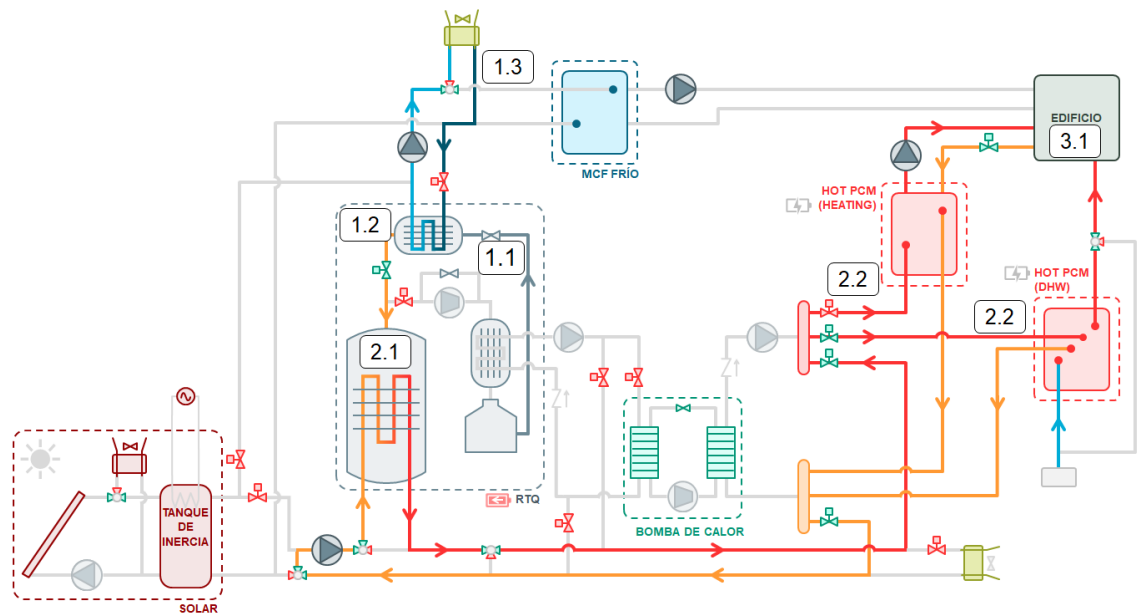


Figura 2: Esquema de operación Desarga RTQ con componentes

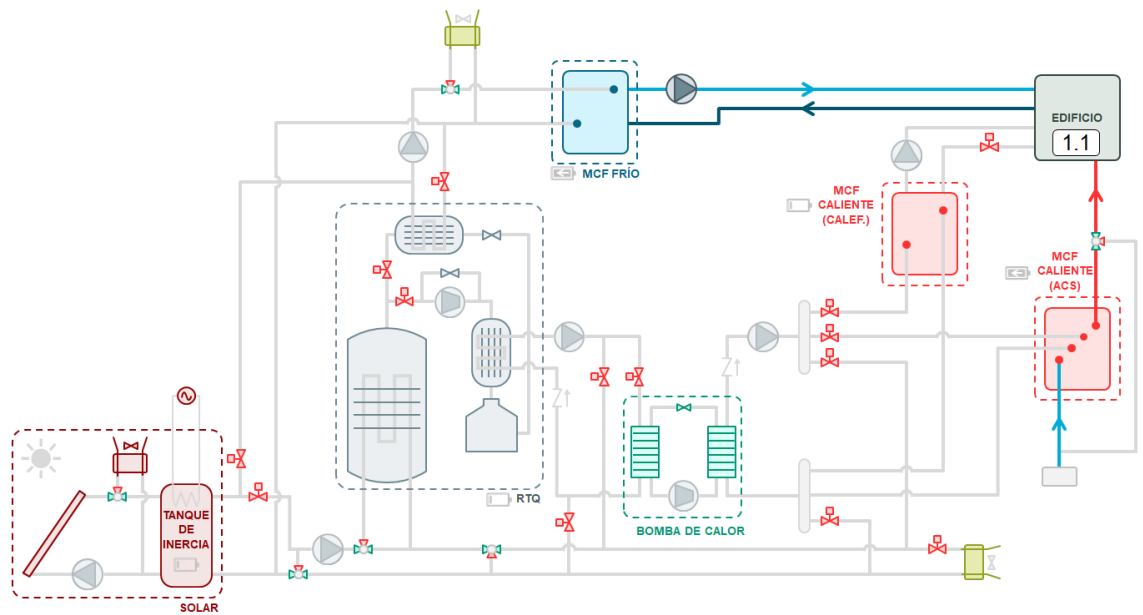


Figura 5: Esquema de operación Demanda cubierta por baterías con componentes

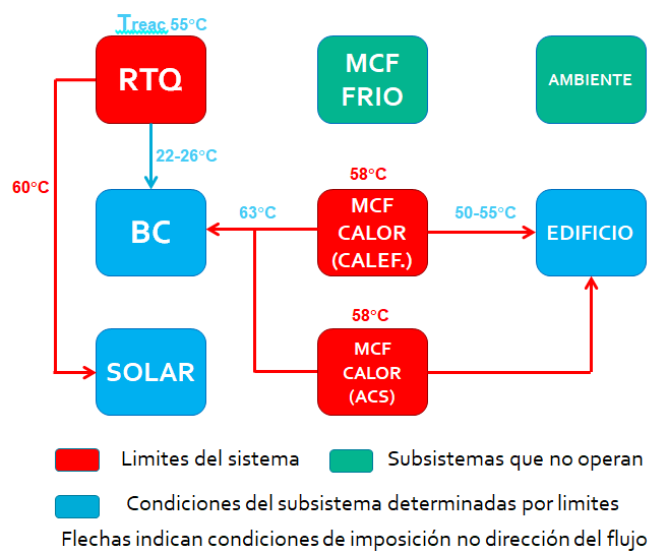


Figura 6: Condiciones de funcionamiento modo carga RTQ en invierno

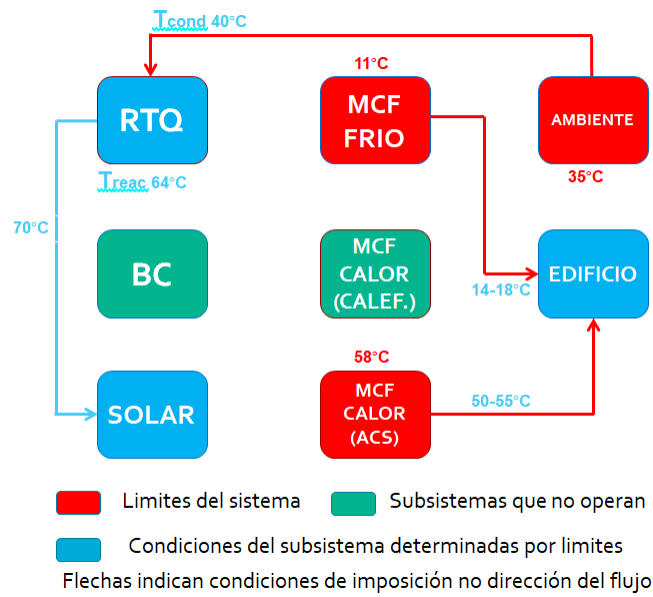


Figura 7: Condiciones de funcionamiento modo carga RTQ en verano

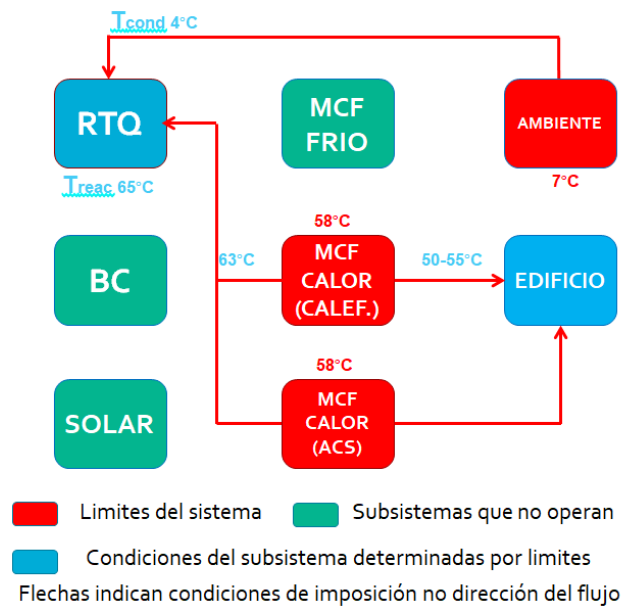


Figura 8: Condiciones de funcionamiento modo descarga RTQ en invierno

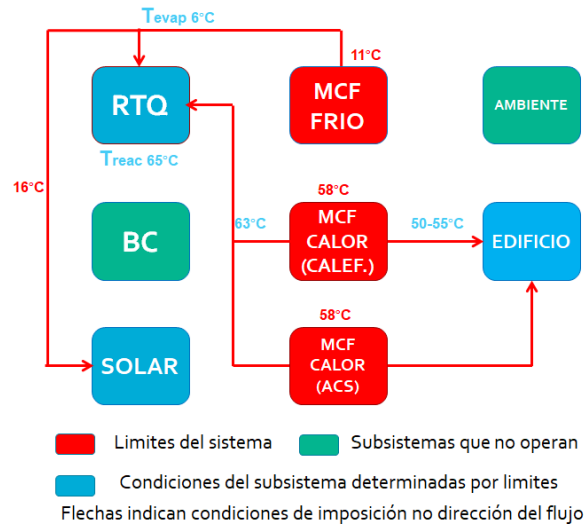


Figura 9: Condiciones de funcionamiento modo descarga RTQ en periodos muy fríos

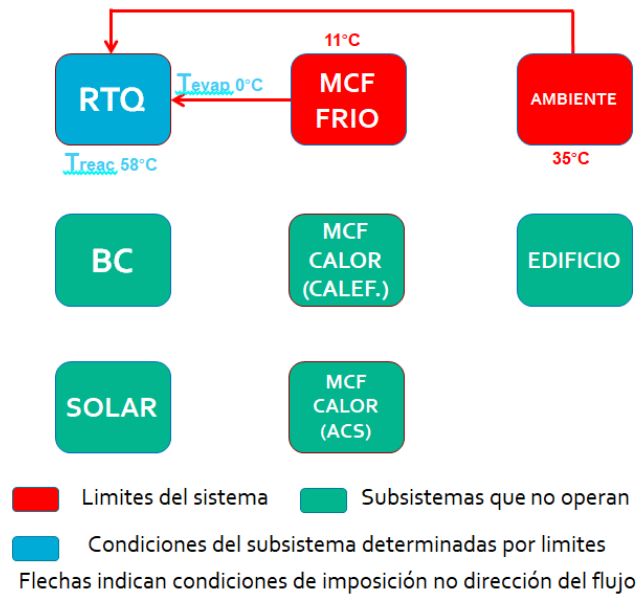


Figura 10: Condiciones de funcionamiento modo descarga RTQ en verano

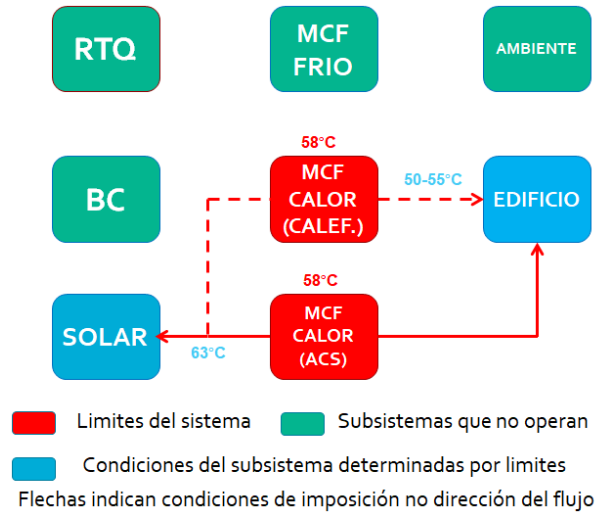


Figura 11: Condiciones de funcionamiento demanda cubierta por solar

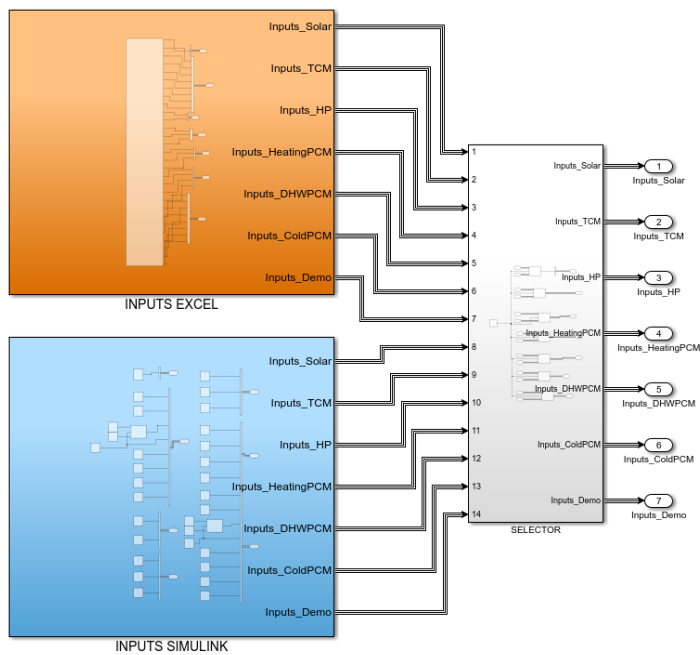


Figura 12: Vista subsistemas de entradas del Modelado Matlab/Simulink

The image shows a software interface for configuring a 'From Spreadsheet' block. On the left, a block diagram lists 29 signals (Signal1 to Signal29) connected to various input blocks. On the right, the 'Block Parameters: From Spreadsheet' dialog box is open, showing the following parameters:

- From Spreadsheet:**
 - Read data values from spreadsheet.
 - The block interprets the first column as time and the first row and remaining columns as signals.
 - If there are empty signals, the block returns an error at import.
 - Fill in all the headings in the columns. If all headings are blank, the block assigns default signal headings using the format Signal#.
- Parameters:**
 - File name: proof.xlsx
 - Sheet name: Hoja1
 - Range: B2:AF95
 - Output data type: Inherit: auto
 - Treat first column as: Time
 - Sample time (-1 for inherited): 1
 - Data extrapolation before first data point: Linear extrapolation
 - Data interpolation within time range: Linear interpolation
 - Data extrapolation after last data point: Linear extrapolation
 - Enable zero-crossing detection

Figura 13: Vista bloques de entrada Excel e inicialización

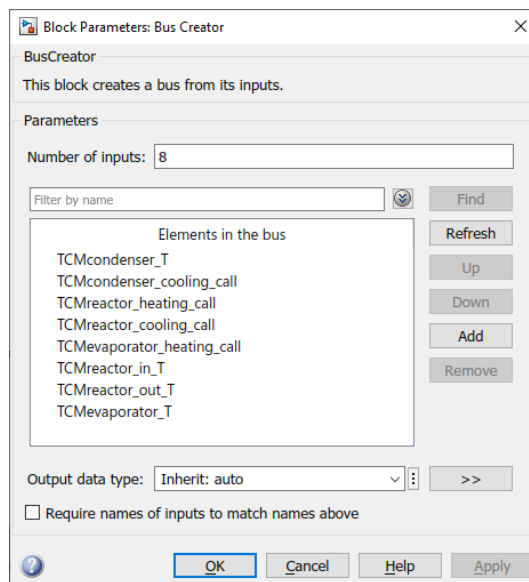
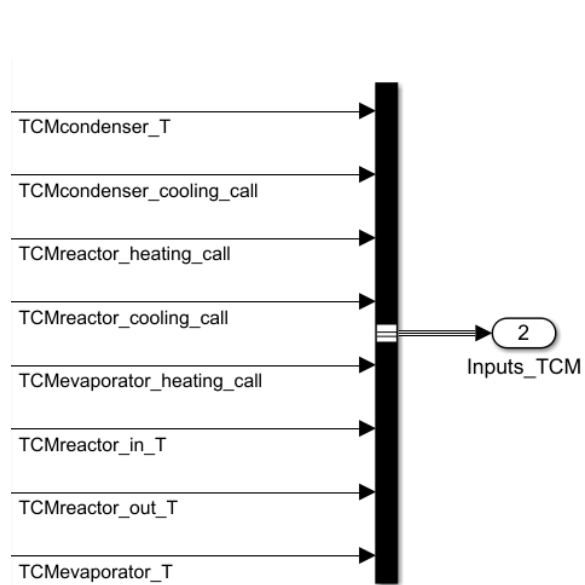


Figura 14: Vista bloque “Bus Creator” e inicialización

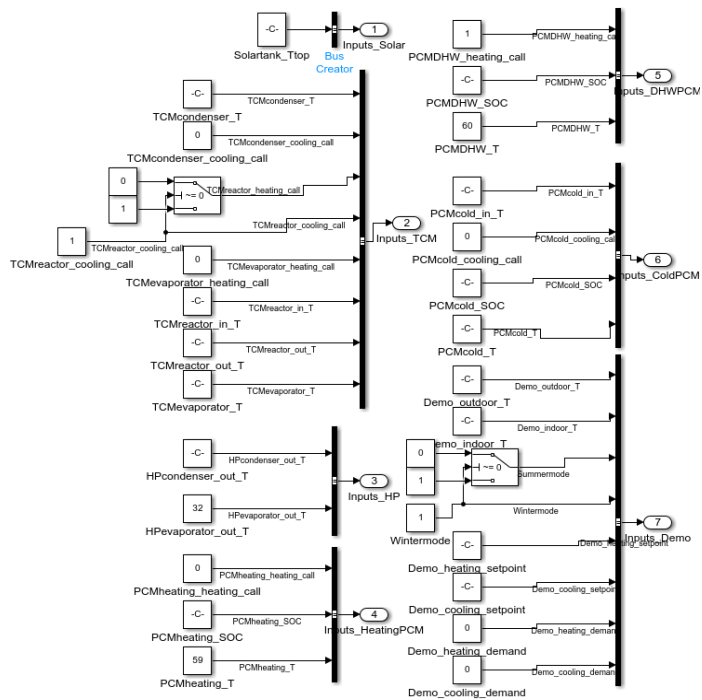


Figura 15: Vista bloques de entrada Simulink

Figura 16: Vista de la consola de control del sistema

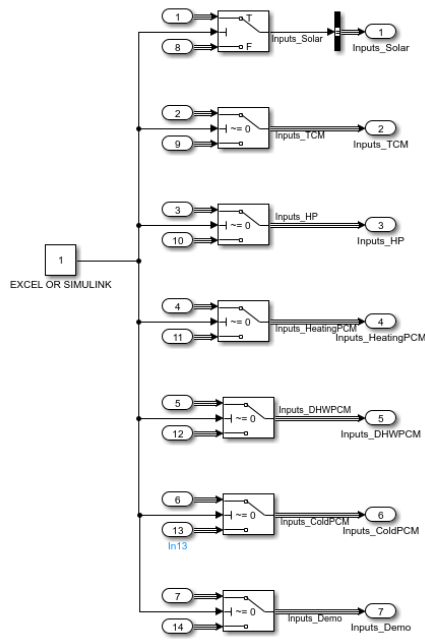


Figura 17: Vista bloque selector de entrada

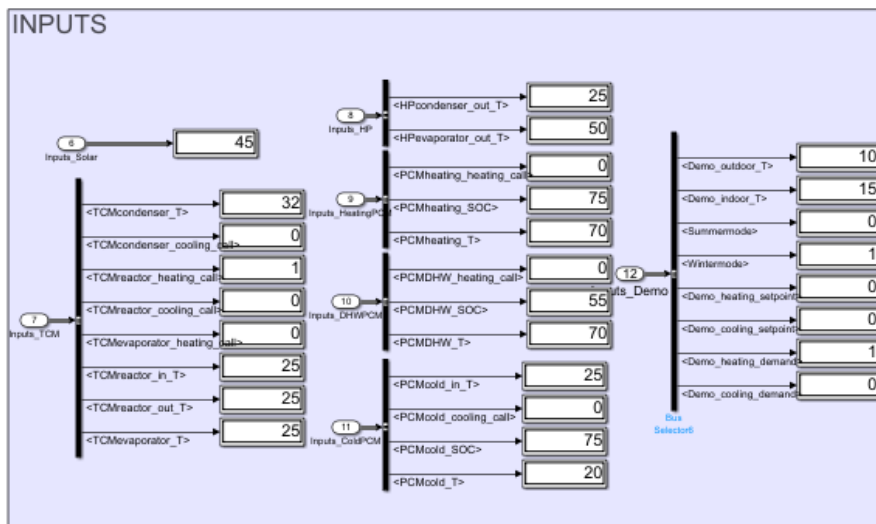


Figura 18: Vista consola valor entradas introducidas

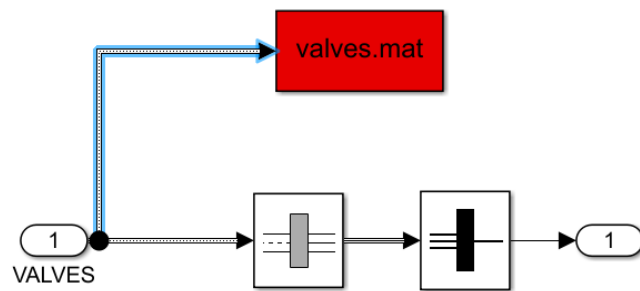


Figura 19: Vista bloque válvulas para salidas .mat

| Variables - ans | | Time series name: PVTtoPRODpump_valve | |
|-------------------------|------------------------|---------------------------------------|--------|
| Field | Value | Time | Data:1 |
| PVTtoPRODpump_valve | 1x1 logical timeseries | | 0 |
| PVTtoColdPCM_valve | 1x1 logical timeseries | | 0 |
| TCMrecirc_in_3wv | 1x1 logical timeseries | 1 | 0 |
| TCMin_3wv | 1x1 logical timeseries | | 0 |
| TCMrecirc_out_3wv | 1x1 logical timeseries | 2 | 0 |
| TCMcondenser_in_valve | 1x1 logical timeseries | | 0 |
| TCMcondenser_out_valve | 1x1 logical timeseries | | 0 |
| HPevaporator_in_valve | 1x1 logical timeseries | 3 | 0 |
| FANCOILheat_in_valve | 1x1 logical timeseries | | 0 |
| PCMheating_in_valve | 1x1 logical timeseries | 4 | 0 |
| PCMDHW_in_valve | 1x1 logical timeseries | | 0 |
| MANIFOLDsupply_valve | 1x1 logical timeseries | 5 | 0 |
| MANIFOLDreturn_valve | 1x1 logical timeseries | | 0 |
| TCMevaporator_in_valve | 1x1 logical timeseries | 6 | 0 |
| FANCOILcold_in_3wv | 1x1 logical timeseries | | 0 |
| DEMANDheating_out_valve | 1x1 logical timeseries | 7 | 0 |

Figura 20: Archivo valves.mat

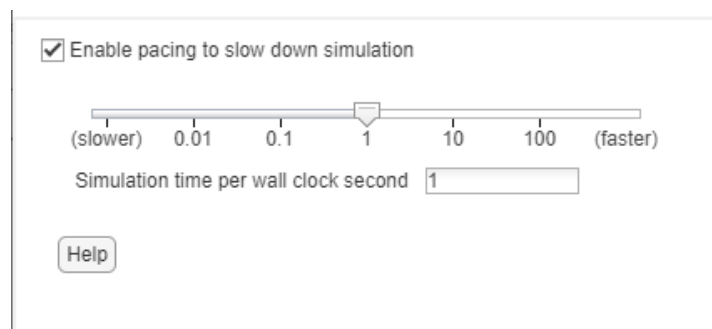


Figura 21: Configuración representación tiempo simulación - tiempo real

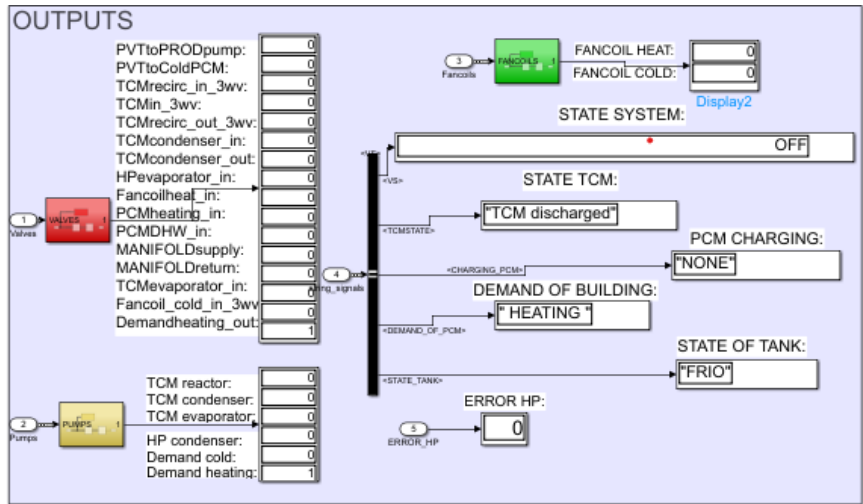


Figura 22: Vista consola valor salidas resultantes del control

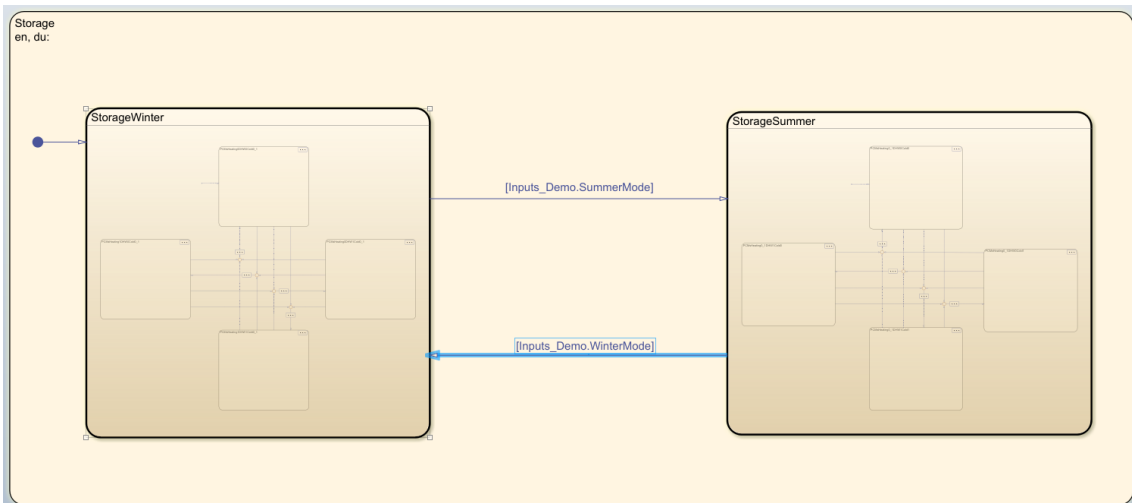


Figura 23: Vista interna del sub-cuadro Storage

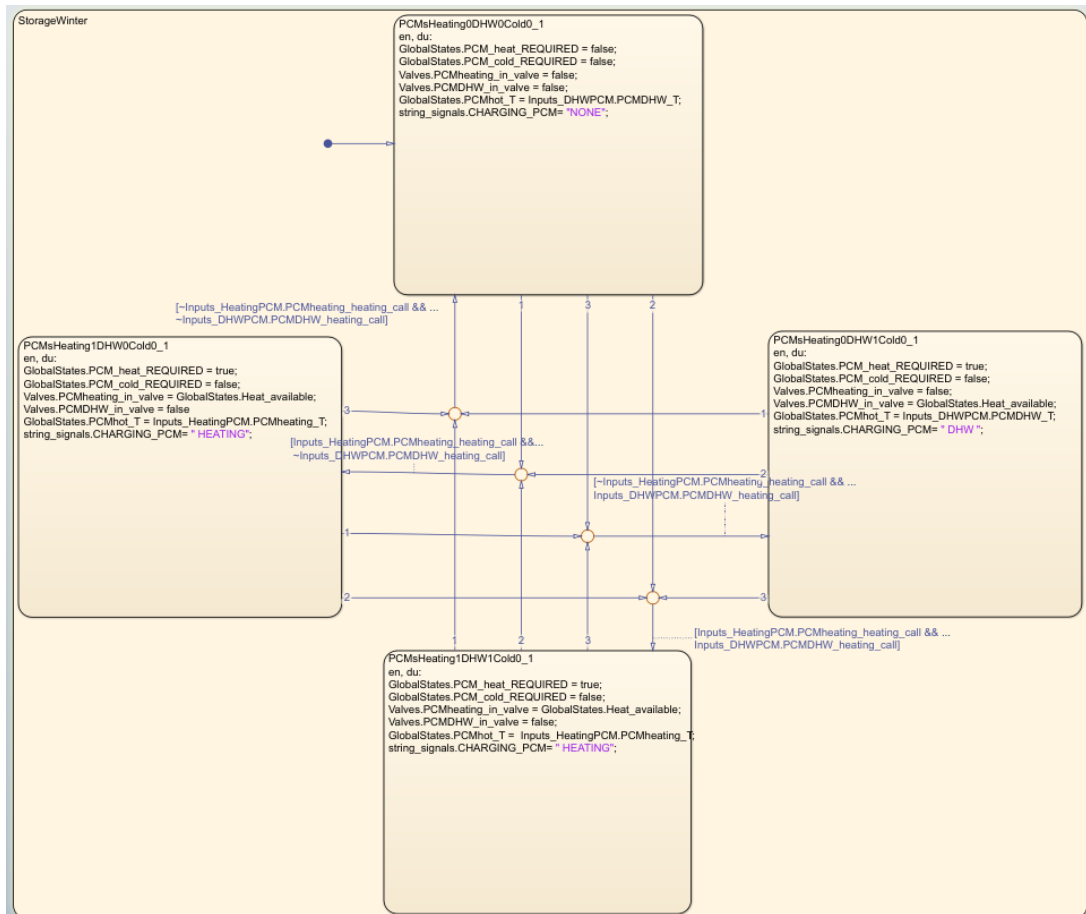


Figura 24: Vista interna del sub-cuadro StorageWinter

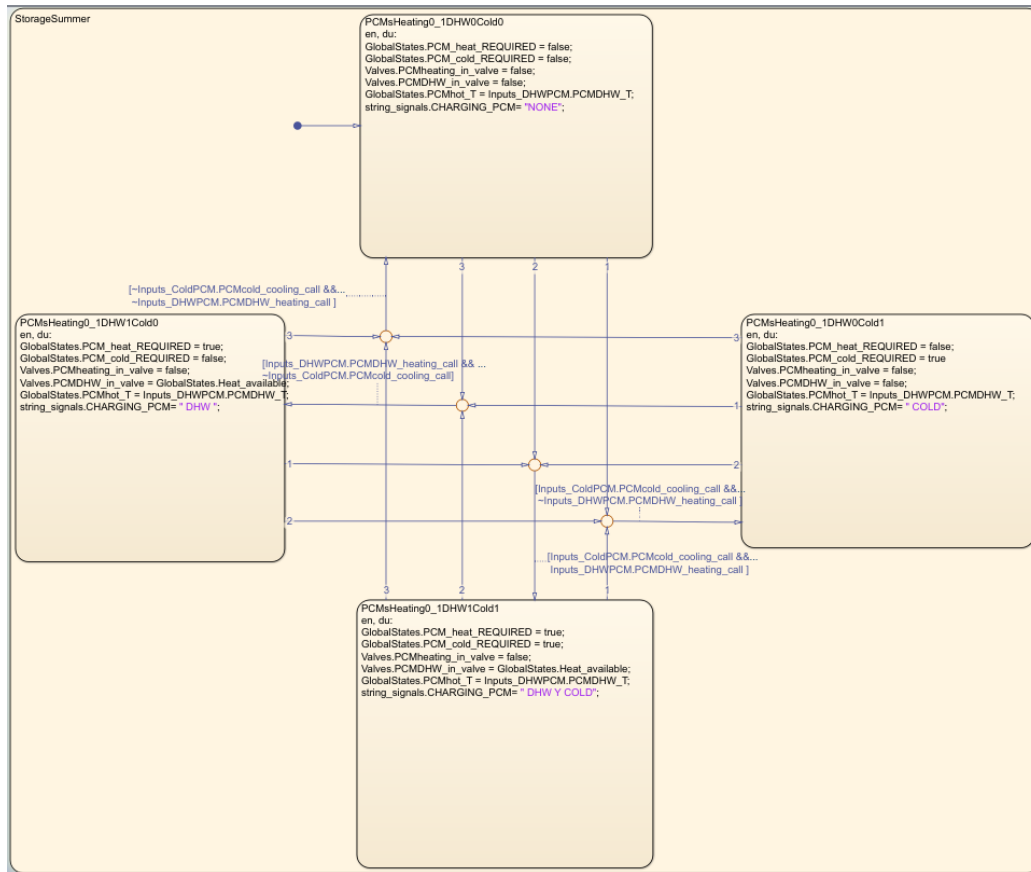


Figura 25: Vista interna del sub-cuadro `StorageSummer`

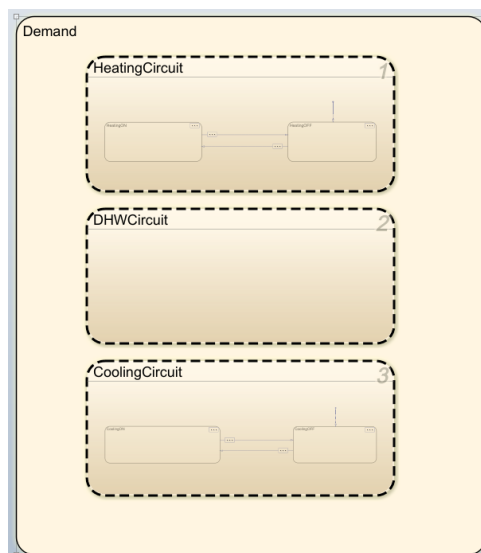


Figura 26: Vista interna del sub-cuadro `Demand`

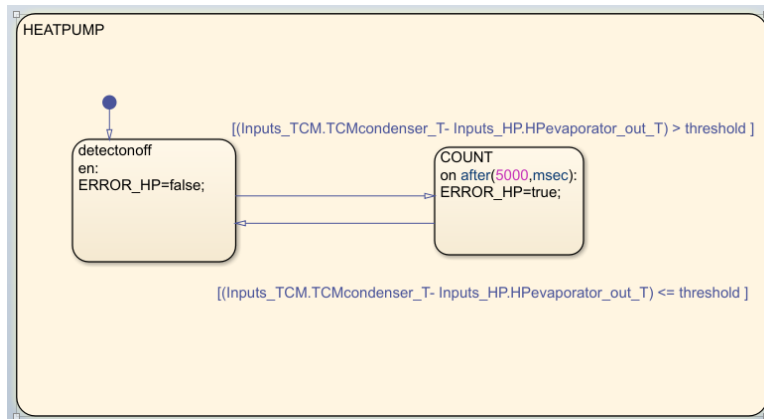


Figura 30: Vista interna del sub-cuadro HEATPUMP

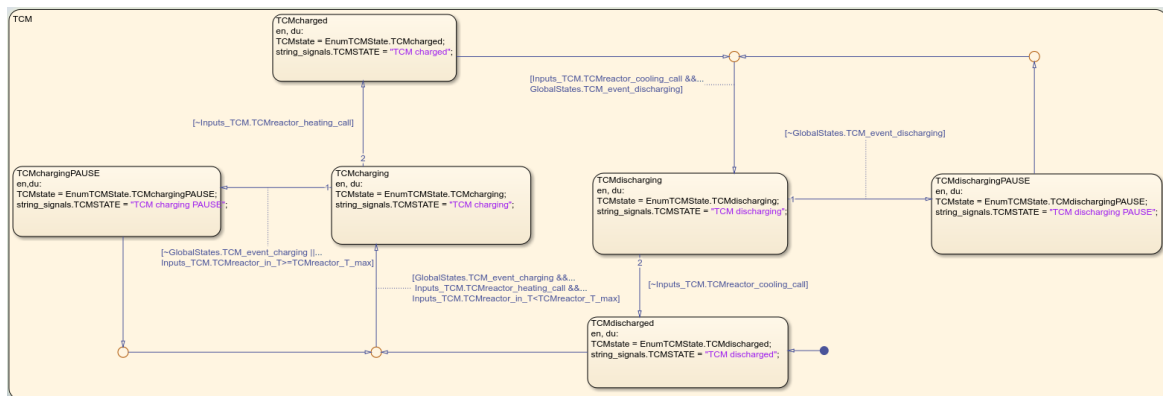


Figura 31: Vista interna del sub-cuadro TCM

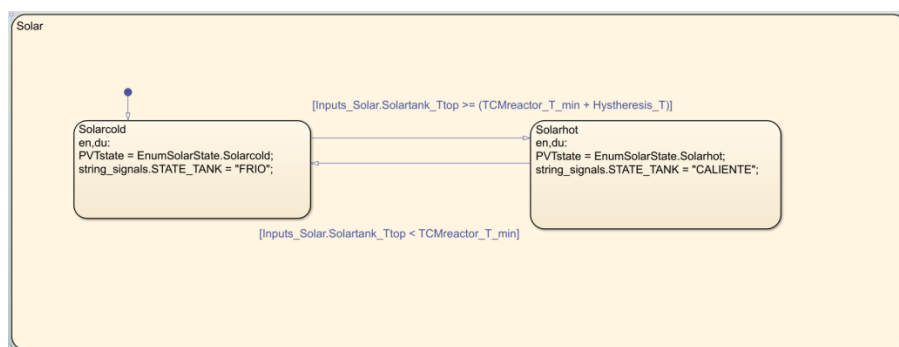


Figura 32: Vista interna del sub-cuadro Solar

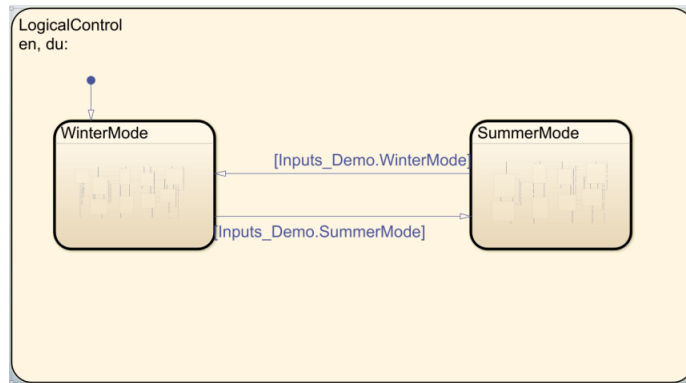


Figura 33: Vista interna del sub-cuadro LogicalControl

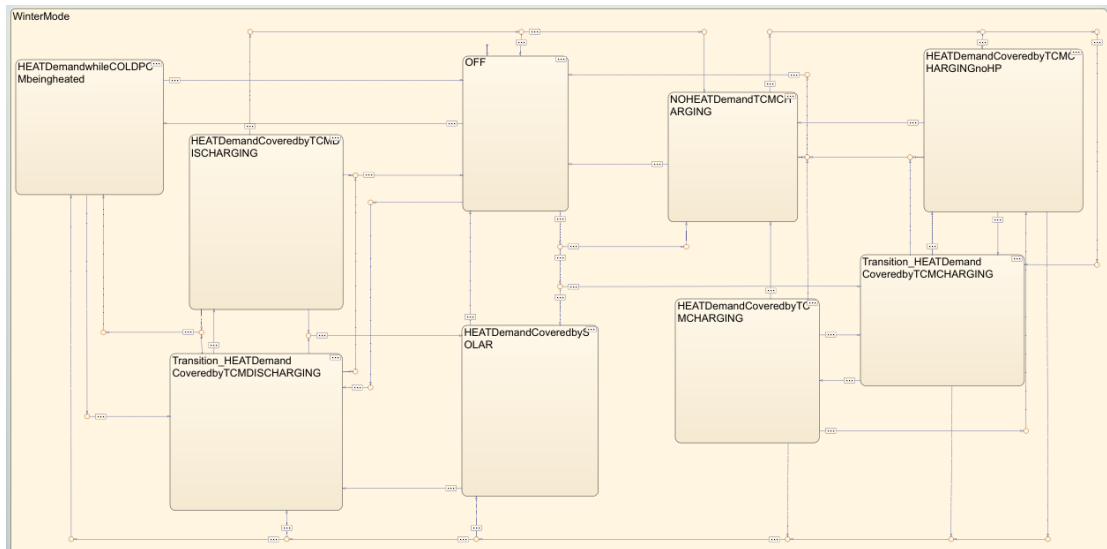


Figura 34: Vista interna del sub-cuadro WinterMode

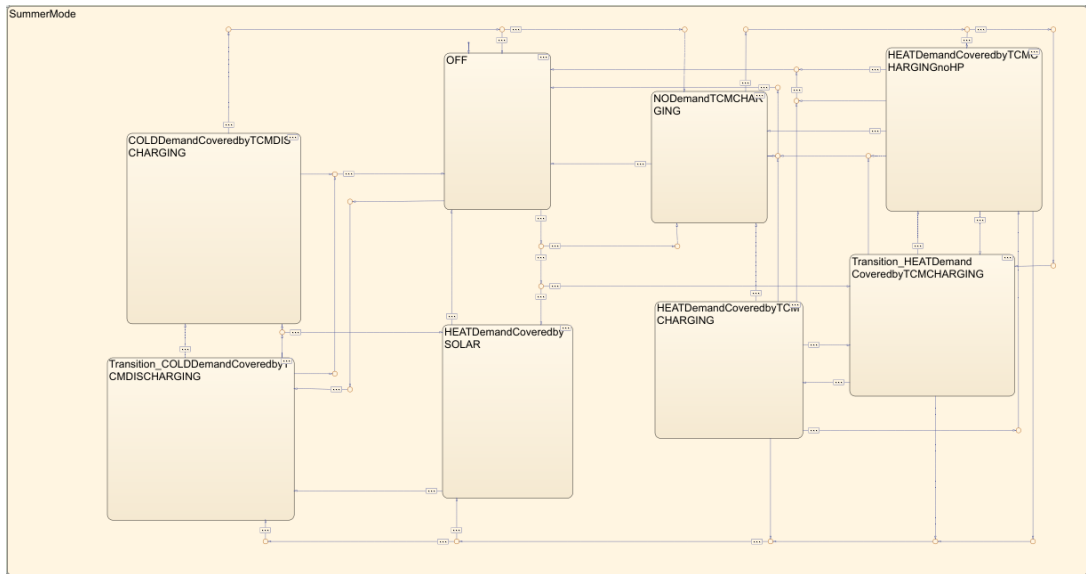


Figura 36: Vista interna del sub-cuadro SummerMode

```

OFF
en, du:
GlobalStates.TCM_event_charging = false;
GlobalStates.TCM_event_discharging = false;
GlobalStates.Heat_available = false;
Valves.PVTtoColdPCM_valve = false;
Valves.PVTtoPRODpump_valve = false;
Pumps.TCMreactor_pump = false;
Valves.TCMrecirc_in_3wv = false;
Valves.TCMin_3wv = false;
Valves.TCMrecirc_out_3wv = false;
Pumps.TCMcondenser_pump = false;
Valves.TCMcondenser_out_valve = false;
Valves.TCMcondenser_in_valve = false;
Pumps.TCMevaporator_pump = false;
Valves.TCMevaporator_in_valve = false;
Valves.FANCOILcold_in_3wv = false;
Fancoils.FANCOILcold = false;
Valves.HPEvaporator_in_valve = false;
Pumps.HPcondenser_pump = false;
Valves.MANIFOLDreturn_valve = false;
Valves.FANCOILheat_in_valve = false;
Fancoils.FANCOILheat = false;
Valves.MANIFOLDsupply_valve = false;
string_signals.VS =EnumStringSysTCM.OFF;

NODemandTCMCHARGING
en, du:
GlobalStates.TCM_event_charging = true;
GlobalStates.TCM_event_discharging = false;
GlobalStates.Heat_available = true;
Valves.PVTtoColdPCM_valve = false;
Valves.PVTtoPRODpump_valve = true;
Pumps.TCMreactor_pump = true;
Valves.TCMrecirc_in_3wv = false;
Valves.TCMin_3wv = true;
Valves.TCMrecirc_out_3wv = true;
Pumps.TCMcondenser_pump = true;
Valves.TCMcondenser_out_valve = true;
Valves.TCMcondenser_in_valve = true;
Pumps.TCMevaporator_pump = false;
Valves.TCMevaporator_in_valve = false;
Valves.FANCOILcold_in_3wv = false;
Fancoils.FANCOILcold = false;
Valves.HPEvaporator_in_valve = false;
Pumps.HPcondenser_pump = false;
Valves.MANIFOLDreturn_valve = false;
Valves.FANCOILheat_in_valve = true;
Fancoils.FANCOILheat = true;
Valves.MANIFOLDsupply_valve = false;
string_signals.VS =EnumStringSysTCM.NODE;

HEATDemandCoveredbyTCMCHARGINGNoHP
en, du:
GlobalStates.TCM_event_charging = true;
GlobalStates.TCM_event_discharging = false;
GlobalStates.Heat_available = true;
Valves.PVTtoColdPCM_valve = false;
Valves.PVTtoPRODpump_valve = true;
Pumps.TCMreactor_pump = true;
Valves.TCMrecirc_in_3wv = false;
Valves.TCMin_3wv = true;
Valves.TCMrecirc_out_3wv = true;
Pumps.TCMcondenser_pump = true;
Valves.TCMcondenser_out_valve = true;
Valves.TCMcondenser_in_valve = true;
Pumps.TCMevaporator_pump = false;
Valves.TCMevaporator_in_valve = false;
Valves.FANCOILcold_in_3wv = false;
Fancoils.FANCOILcold = false;
Valves.HPEvaporator_in_valve = false;
Pumps.HPcondenser_pump = false;
Valves.MANIFOLDreturn_valve = true;
Valves.FANCOILheat_in_valve = false;
Fancoils.FANCOILheat = false;
Valves.MANIFOLDsupply_valve = true;
string_signals.VS =EnumStringSysTCM.HEATD;

```

```

Transition_HEATDemandCoveredbyTCMCHARGING HEATDemandCoveredbyTCMCHARGING HEATDemandCoveredbySOLAR
en, du:
GlobalStates.TCM_event_charging = true;
GlobalStates.TCM_event_discharging = false;
GlobalStates.Heat_available = false;
Valves.PVTtoColdPCM_valve = false;
Valves.PVTtoPRODpump_valve = true;
Pumps.TCMreactor_pump = true;
Valves.TCMrecirc_in_3wv = false;
Valves.TCMin_3wv = true;
Valves.TCMrecirc_out_3wv = true;
Pumps.TCMcondenser_pump = true;
Valves.TCMcondenser_out_valve = false;
Valves.TCMcondenser_in_valve = false;
Pumps.TCMevaporator_pump = false;
Valves.TCMevaporator_in_valve = false;
Valves.FANCOILcold_in_3wv = false;
Fancoils.FANCOILcold = false;
Valves.HPEvaporator_in_valve = true;
Pumps.HPcondenser_pump = true;
Valves.MANIFOLDreturn_valve = true;
Valves.FANCOILheat_in_valve = true;
Fancoils.FANCOILheat = false;
Valves.MANIFOLDsupply_valve = true;
string_signals.VS =EnumStringSysTCM.TransitionHE

en, du:
GlobalStates.TCM_event_charging = true;
GlobalStates.TCM_event_discharging = false;
GlobalStates.Heat_available = true;
Valves.PVTtoColdPCM_valve = false;
Valves.PVTtoPRODpump_valve = true;
Pumps.TCMreactor_pump = true;
Valves.TCMrecirc_in_3wv = false;
Valves.TCMin_3wv = true;
Valves.TCMrecirc_out_3wv = true;
Pumps.TCMcondenser_pump = true;
Valves.TCMcondenser_out_valve = false;
Valves.TCMcondenser_in_valve = false;
Pumps.TCMevaporator_pump = false;
Valves.TCMevaporator_in_valve = false;
Valves.FANCOILcold_in_3wv = false;
Fancoils.FANCOILcold = false;
Valves.HPEvaporator_in_valve = true;
Pumps.HPcondenser_pump = true;
Valves.MANIFOLDreturn_valve = false;
Valves.FANCOILheat_in_valve = false;
Fancoils.FANCOILheat = false;
Valves.MANIFOLDsupply_valve = false;
string_signals.VS =EnumStringSysTCM.HEAT

en, du:
GlobalStates.TCM_event_charging = false;
GlobalStates.TCM_event_discharging = false;
GlobalStates.Heat_available = true;
Valves.PVTtoColdPCM_valve = false;
Valves.PVTtoPRODpump_valve = true;
Pumps.TCMreactor_pump = true;
Valves.TCMrecirc_in_3wv = false;
Valves.TCMin_3wv = false;
Valves.TCMrecirc_out_3wv = false;
Pumps.TCMcondenser_pump = false;
Valves.TCMcondenser_out_valve = false;
Valves.TCMcondenser_in_valve = false;
Pumps.TCMevaporator_pump = false;
Valves.TCMevaporator_in_valve = false;
Valves.FANCOILcold_in_3wv = false;
Fancoils.FANCOILcold = false;
Valves.HPEvaporator_in_valve = false;
Pumps.HPcondenser_pump = false;
Valves.MANIFOLDreturn_valve = true;
Valves.FANCOILheat_in_valve = false;
Fancoils.FANCOILheat = false;
Valves.MANIFOLDsupply_valve = true;
string_signals.VS =EnumStringSysTCM.HEAT

```

```

Transition_COLDDemandCoveredbyTCMDISCHARGING/COLDDemandCoveredbyTCMDISCHARGING
en, du:
GlobalStates.TCM_event_charging = false;
GlobalStates.TCM_event_discharging = true;
GlobalStates.Heat_available = false;
Valves.PVTtoColdPCM_valve = false;
Valves.PVTtoPRODpump_valve = false;
Pumps.TCMreactor_pump = true;
Valves.TCMrecirc_in_3wv = true;
Valves.TCMin_3wv = true;
Valves.TCMrecirc_out_3wv = true;
Pumps.TCMcondenser_pump = false;
Valves.TCMcondenser_out_valve = false;
Valves.TCMcondenser_in_valve = false;
Pumps.TCMevaporator_pump = true;
Valves.TCMevaporator_in_valve = true;
if Inputs_TCM.TCMevaporator_T <= ...
    (Inputs_ColdPCM.PCMcold_T - Hysteresis_T)
    Valves.FANCOILcold_in_3wv = false;
    Fancoils.FANCOILcold = false;
else
    Valves.FANCOILcold_in_3wv = true;
    Fancoils.FANCOILcold = false;
end
Valves.HPEvaporator_in_valve = false;
Pumps.HPcondenser_pump = false;
Valves.MANIFOLDreturn_valve = false;
Valves.FANCOILheat_in_valve = false;
Fancoils.FANCOILheat = false;
Valves.MANIFOLDsupply_valve = false;
string_signals.VS =EnumStringSysTCM.Transition_COLD

en, du:
GlobalStates.TCM_event_charging = false;
GlobalStates.TCM_event_discharging = true;
GlobalStates.Heat_available = true;
Valves.PVTtoColdPCM_valve = false;
Valves.PVTtoPRODpump_valve = false;
Pumps.TCMreactor_pump = true;
Valves.TCMrecirc_in_3wv = true;
Valves.TCMin_3wv = true;
Valves.TCMrecirc_out_3wv = false;
Pumps.TCMcondenser_pump = false;
Valves.TCMcondenser_out_valve = false;
Valves.TCMcondenser_in_valve = false;
Pumps.TCMevaporator_pump = true;
Valves.TCMevaporator_in_valve = true;
if Inputs_TCM.TCMevaporator_T <= ...
    (Inputs_ColdPCM.PCMcold_T - Hysteresis_T)
    Valves.FANCOILcold_in_3wv = false;
    Fancoils.FANCOILcold = false;
else
    %To pause state
end
Valves.HPEvaporator_in_valve = false;
Pumps.HPcondenser_pump = false;
Valves.MANIFOLDreturn_valve = false;
Valves.FANCOILheat_in_valve = true;
Fancoils.FANCOILheat = ( Inputs_TCM.TCMreactor_out_T -
Inputs_Demo.Demo_outdoor_T ) >= FANCOIL_Tdiff;
Valves.MANIFOLDsupply_valve = false;
string_signals.VS =EnumStringSysTCM.COLDDemandCove

```

Figura 37: Vista de estados del modo Verano


```

classdef EnumSolarState < Simulink.IntEnumType

    enumeration
        Solarhot(1)
        Solarcold(0)
    end
end

```

Figura 38: Captura EnumSolarState

```

classdef EnumStringSysTCM < Simulink.IntEnumType

    enumeration
        OFF(0)
        NOHEATDemandTCMCHARGING (1)
        TransitionHEATDemandCoveredByTCMCHARGING (2)
        HEATDemandCoveredByTCMCHARGING(3)
        HEATDemandCoveredByTCMCHARGINGnoHP(4)
        Transition_HEATDemandCoveredByTCMDISCHARGING(5)
        HEATDemandCoveredByTCMDISCHARGING(6)
        HEATDemandCoveredBySOLAR(7)
        HEATDemandwhileCOLDPCMbeingheated(8)
        COLDDemandCoveredByTCMDISCHARGING(9)
        Transition_COLDDemandCoveredByTCMDISCHARGING(10)
        NODemandTCMCHARGING (11)
    end
end

```

Figura 39: Captura EnumStringSysTCM

```

classdef EnumTCMState < Simulink.IntEnumType

    enumeration
        TCMdischarged(0)
        TCMcharging(1)
        TCMchargingPAUSE(2)
        TCMcharged(3)
        TCMdischarging(4)
        TCMdischargingPAUSE(5)
    end
end

```

Figura 40: Captura EnumTCMState













| ENTRADAS DE TEMPERATURA | | VALOR | ENTRADAS DE ESTADO | | | ACTIVADO |
|-------------------------|--|-------|-------------------------|---|--|----------|
| SolarTank_Ttop | | 70 | TCMreactor_heating_call |   | | 1 |
| TCMreactor_In_T | | 25 | TCMreactor_cooling_call |   | | 0 |
| TCMreactor_out_T | | 25 | Demo_cooling_demand |   | | 0 |
| TCMcondenser_T | | 25 | Demo_heating_demand |   | | 0 |
| TCMevaporator_T | | 25 | WinterMode |   | | 1 |
| HP_evaporator_T | | 25 | SummerMode |   | | 0 |
| HPcondenser_out_T | | 25 | PCMheating_DHW_call |   | | 0 |
| PCMcold_in_T | | 25 | PCMheating_heating_call |   | | 0 |
| PCMcold_T | | 25 | PCMcold_cooling_call |   | | 0 |
| PCMDHW_T | | 25 | | | | |
| PCMheating_T | | 25 | | | | |
| Demo_outdoor_T | | 10 | | | | |

Figura 41: Vista de la ventana Controles en ENVYSION

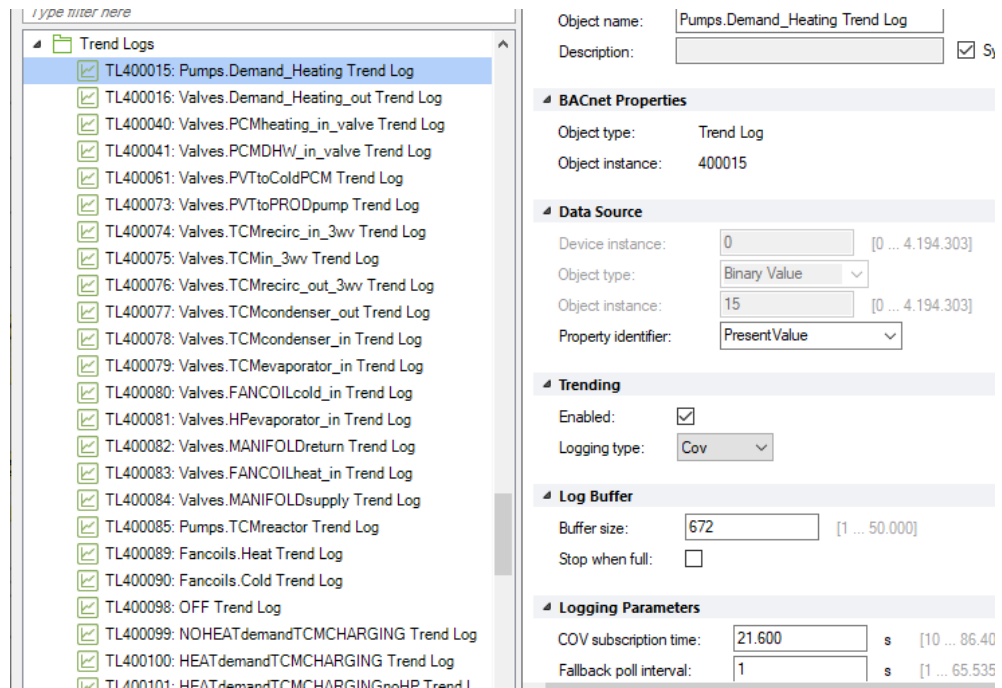


Figura 42: Vista de ventana de configuración trends en EC-GFX

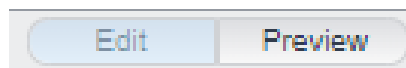


Figura 43: Vista pestaña de edición y Vista



Figura 44: Vista controles del sistema

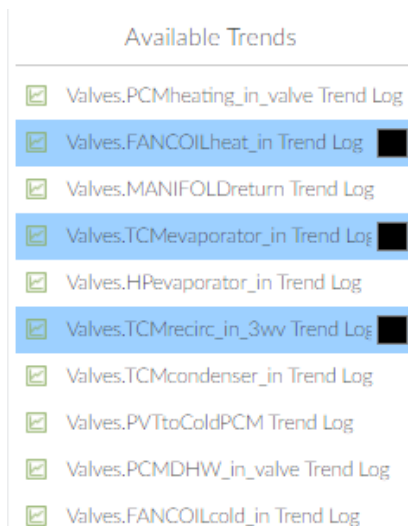


Figura 45: Vista pestaña de selección de Grafica

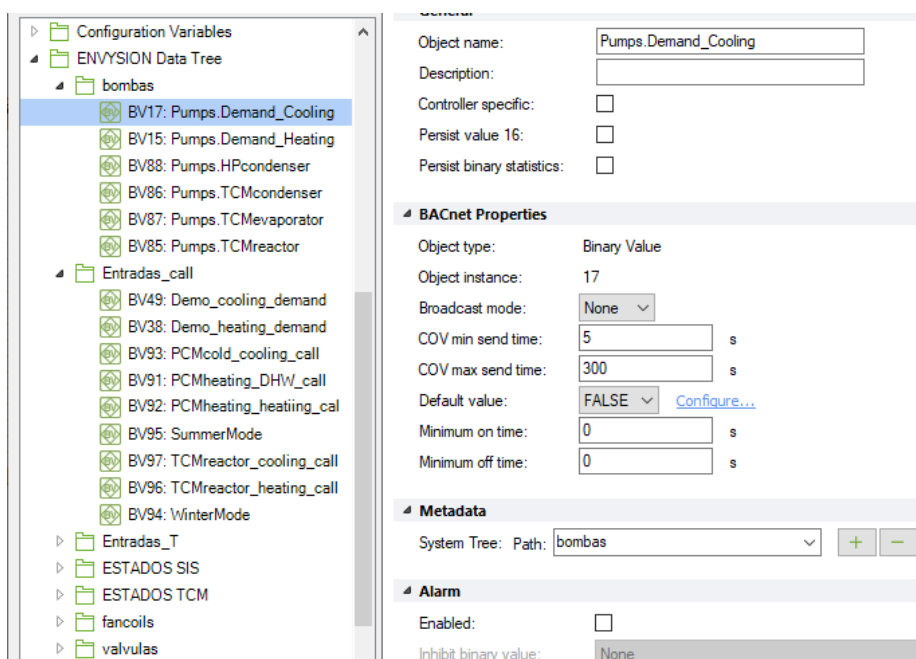


Figura 46: Configuración intercambio de variables EC-GFX y ENVYSION

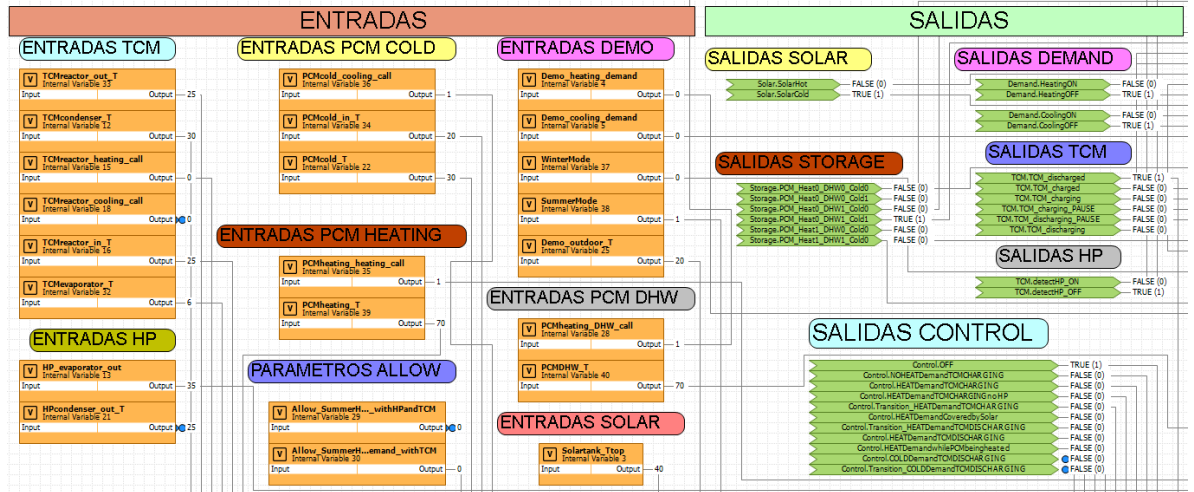


Figura 47: Vista interfaz de entradas y salidas en EC-GFX

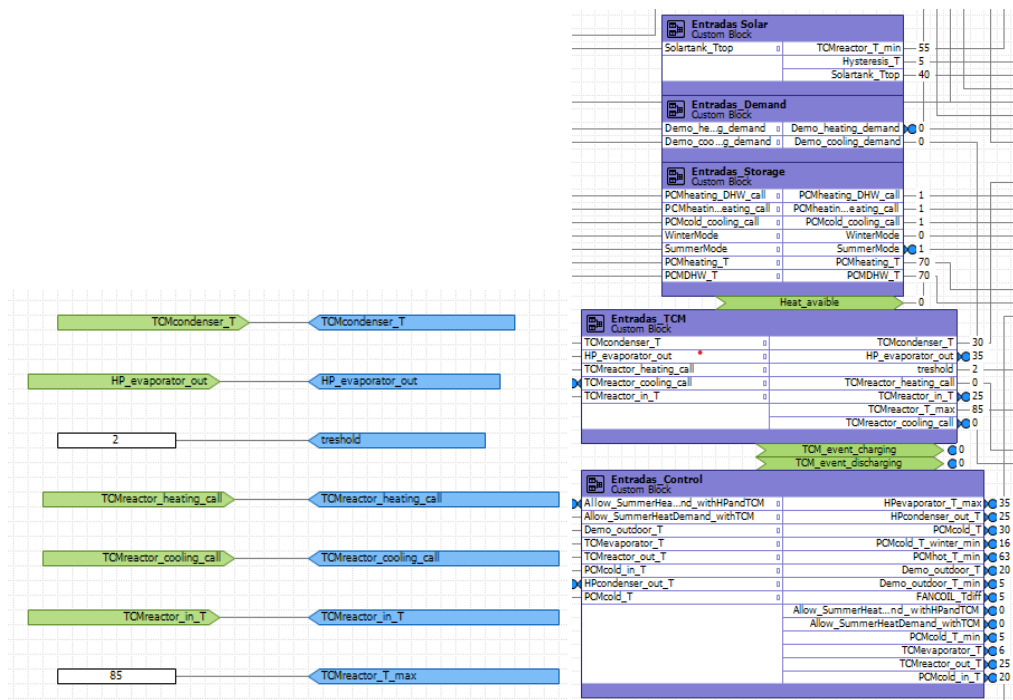


Figura 48: Vista bloque de parámetros y Vista interna del bloque Entradas RTQ

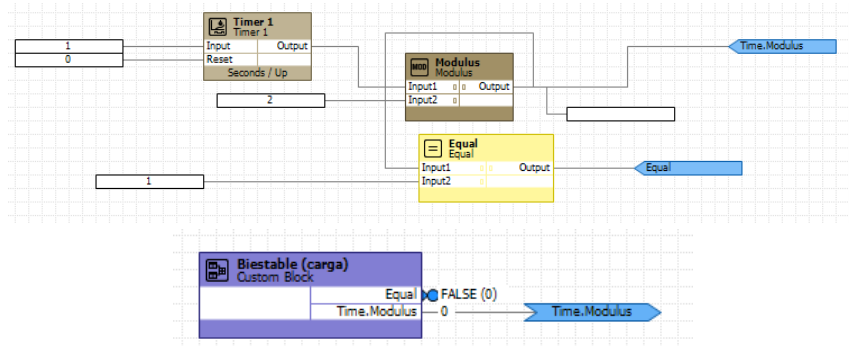


Figura 49: Vista bloque biestable Vista externa e interna

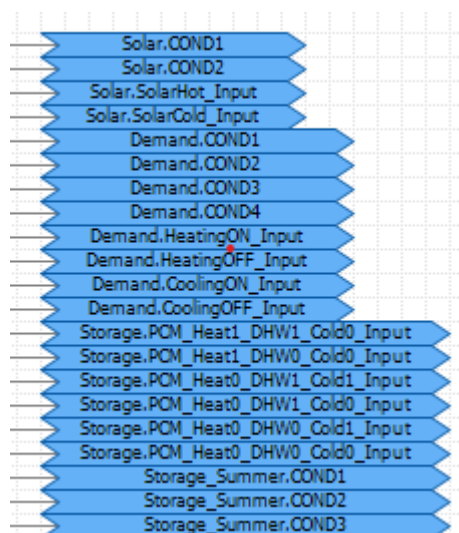


Figura 50: Vista salidas del bloque central de entradas

| Entradas MiniStor | | |
|--------------------------|---|------------------------------------|
| Conditional Custom Block | | |
| TOMreactor_T_min | 0 | Solar.COND1 |
| Hysteresis_T | 0 | Solar.COND2 |
| Solartank_Top | 0 | Solar.SolarHot_Input |
| SolarHot | 0 | Solar.SolarCold_Input |
| SolarCold | 0 | Demand.COND1 |
| Demo_heating_demand | 0 | Demand.COND2 |
| Demo_cooling_demand | 0 | Demand.COND3 |
| HeatingON | 0 | Demand.COND4 |
| HeatingOFF | 0 | Demand.HeatingON_Input |
| CoolingON | 0 | Demand.HeatingOFF_Input |
| CoolingOFF | 0 | Demand.CoolingON_Input |
| POMheating_DHW_call | 0 | Demand.CoolingOFF_Input |
| POM_Heat0_DHW0_Cold0 | 0 | Storage.POM_Heat1_DHW1_Cold0_Input |
| POM_Heat0_DHW0_Cold1 | 0 | Storage.POM_Heat1_DHW0_Cold0_Input |
| POM_Heat0_DHW1_Cold0 | 0 | Storage.POM_Heat0_DHW1_Cold1_Input |
| POM_Heat0_DHW1_Cold1 | 0 | Storage.POM_Heat0_DHW1_Cold0_Input |
| POM_Heat1_DHW0_Cold0 | 0 | Storage.POM_Heat0_DHW0_Cold1_Input |
| POM_Heat1_DHW1_Cold0 | 0 | Storage.POM_Heat0_DHW0_Cold0_Input |
| POMheating_heating_call | 0 | Storage_Summer.COND1 |
| POMcold_cooling_call | 0 | Storage_Summer.COND2 |
| WinterMode | 0 | Storage_Summer.COND3 |
| SummerMode | 0 | Storage_Summer.COND4 |
| TOM_charged | 0 | Storage_Winter.COND1 |
| TOM_charging | 0 | Storage_Winter.COND2 |
| TOM_charging_PAUSE | 0 | Storage_Winter.COND3 |
| TOM_discharging_PAUSE | 0 | Storage_Winter.COND4 |
| TOM_discharging | 0 | TOM.HP_COND1 |
| detectHP_ON | 0 | TOM.HP_COND2 |
| detectHP_OFF | 0 | TOM.TOM_discharged_Input |

Figura 51: Vista bloque central de entradas

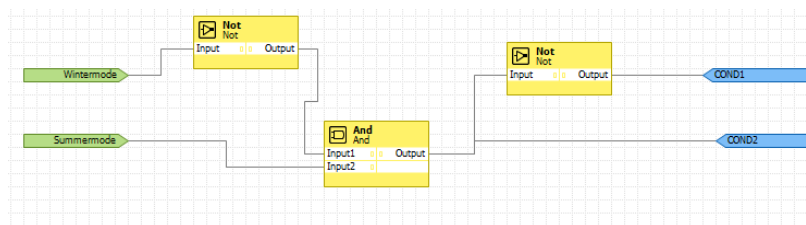


Figura 52 Vista general del interior del sub-bloque Modo

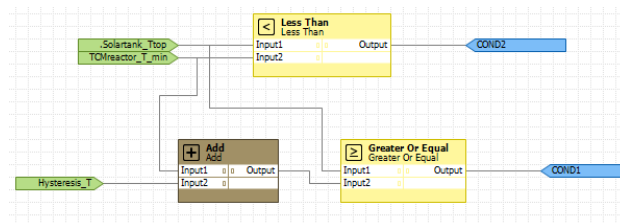


Figura 53 Vista general del interior del sub-bloque Solar

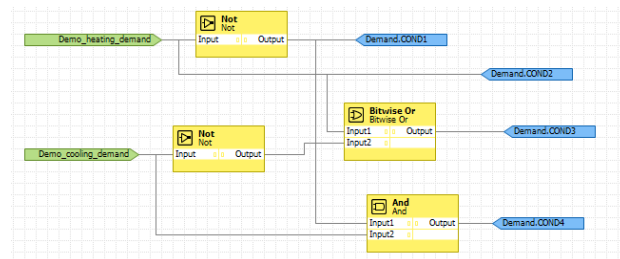


Figura 54: Vista general del interior del sub-bloque Demand

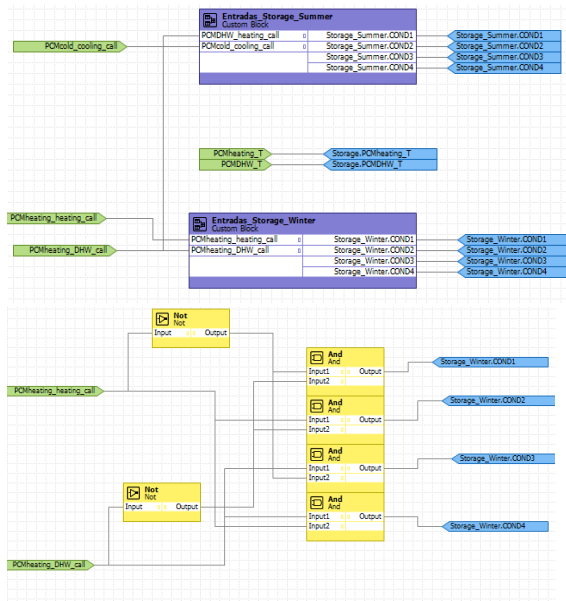


Figura 55: Vista general del interior del sub-bloque Storage y del interior del sub-bloque Storage Winter

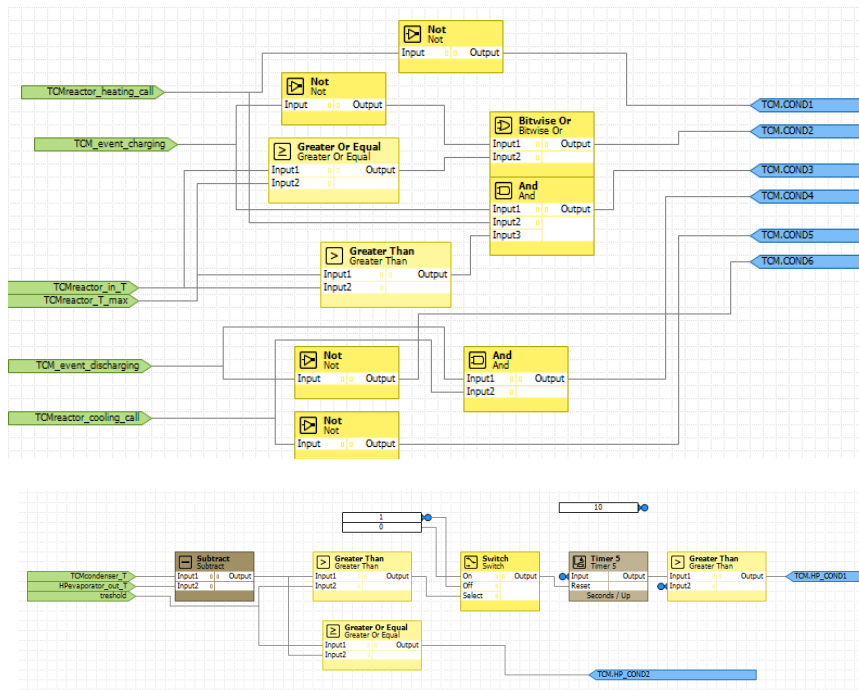


Figura 56: Vista general del interior del sub-bloque RTQ

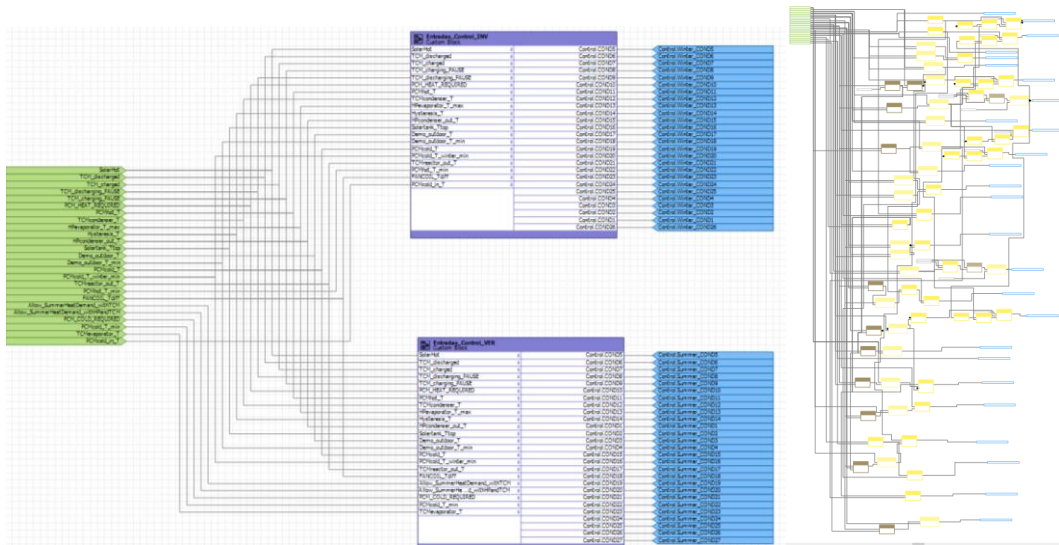


Figura 57: Vista general del interior del sub-bloque Control y del interior del sub-bloque Control Winter

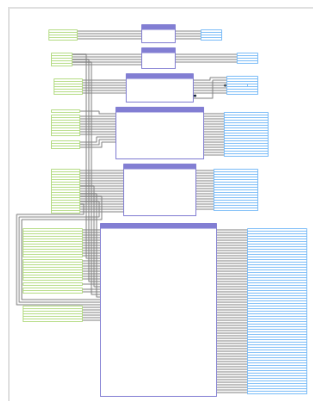


Figura 58: Vista general del interior del bloque entradas

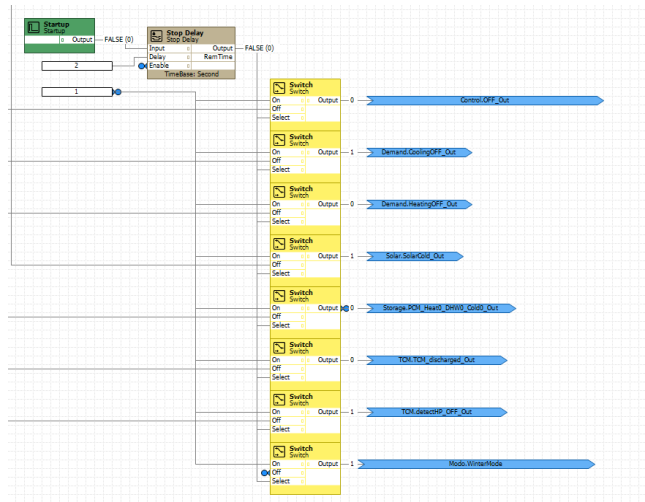


Figura 59 Vista de la programación del reseteo o primer arranque

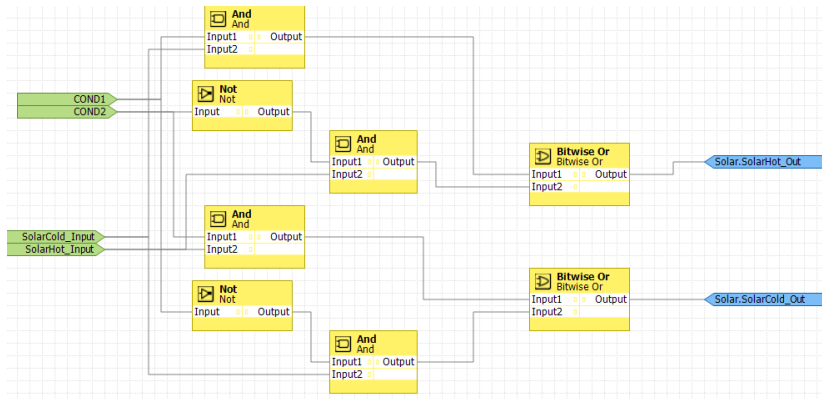


Figura 60: Vista interna del sub-bloque Solar

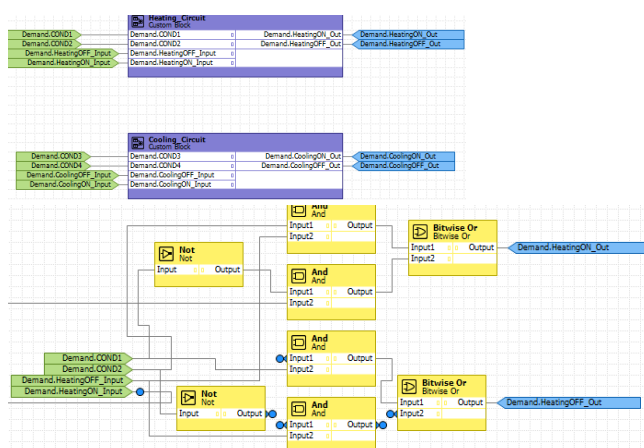


Figura 61: Vista interna sub-bloque Demand y Vista interna sub-bloque heatingcircuit

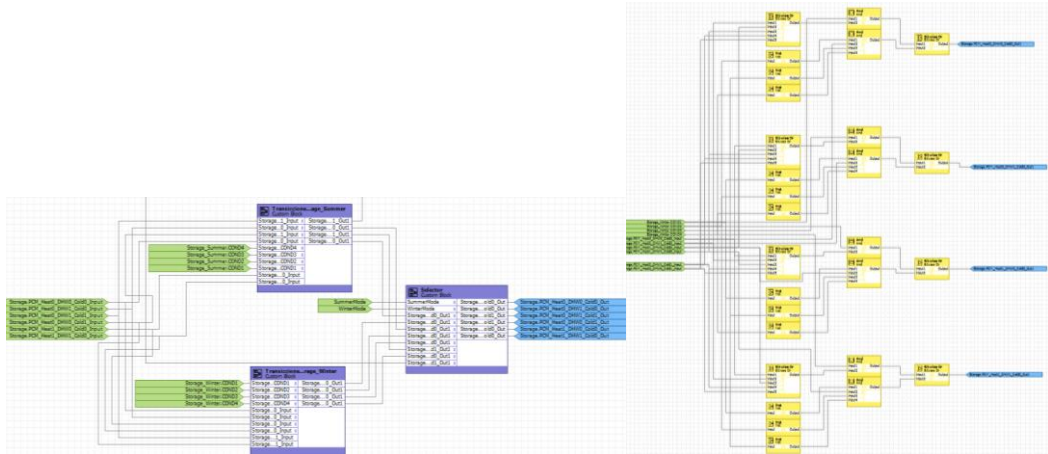


Figura 62: Vista interna sub-bloque Storage y Vista interna sub-bloque WinterStorage

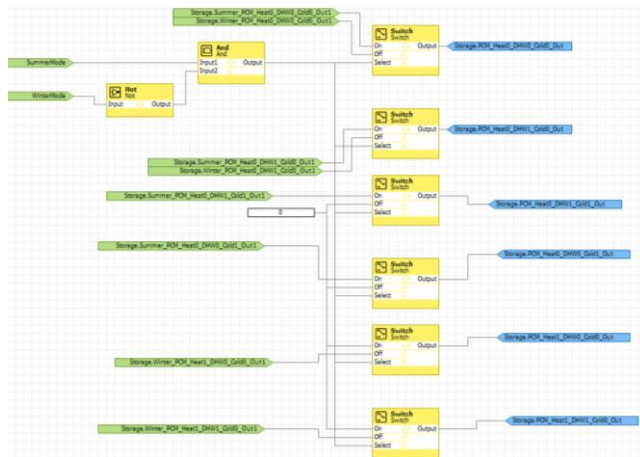


Figura 63: Vista interna sub-bloque Selector

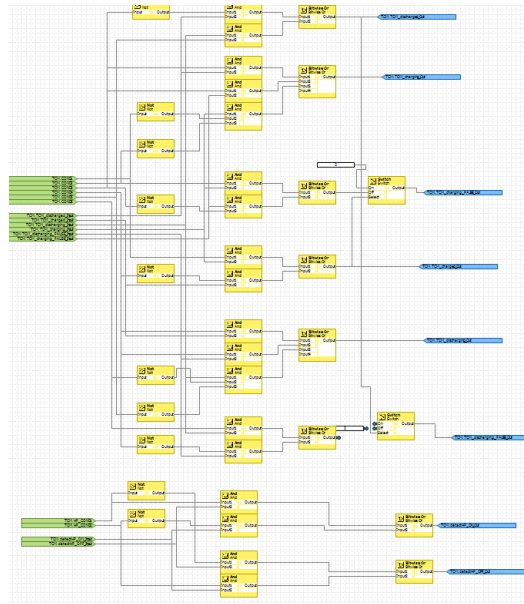


Figura 64: Vista interna sub-bloque RTQ

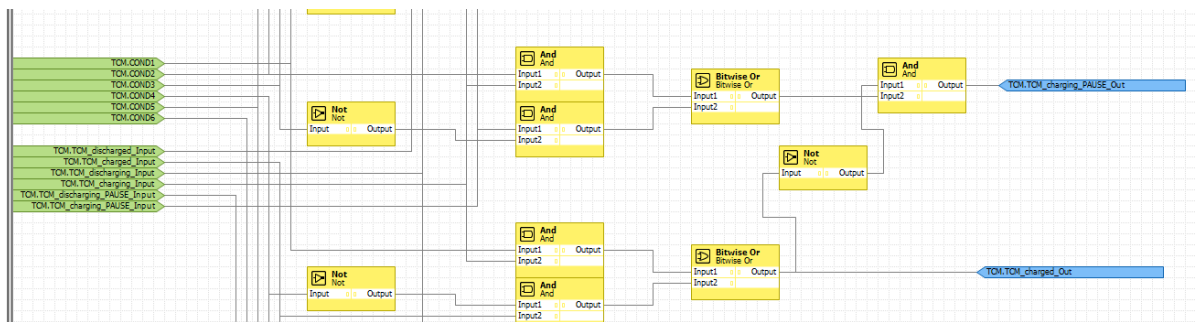


Figura 65: Vista de la programación de dos estados con prioridad

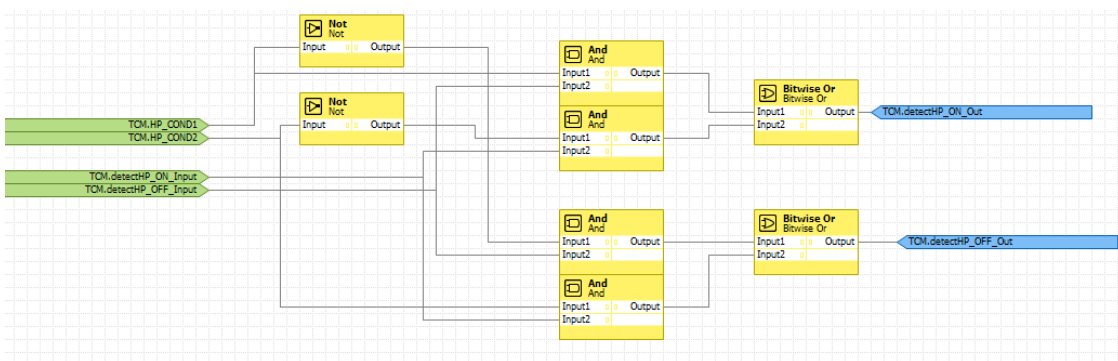


Figura 66: Vista de la programación de la alarma del BC

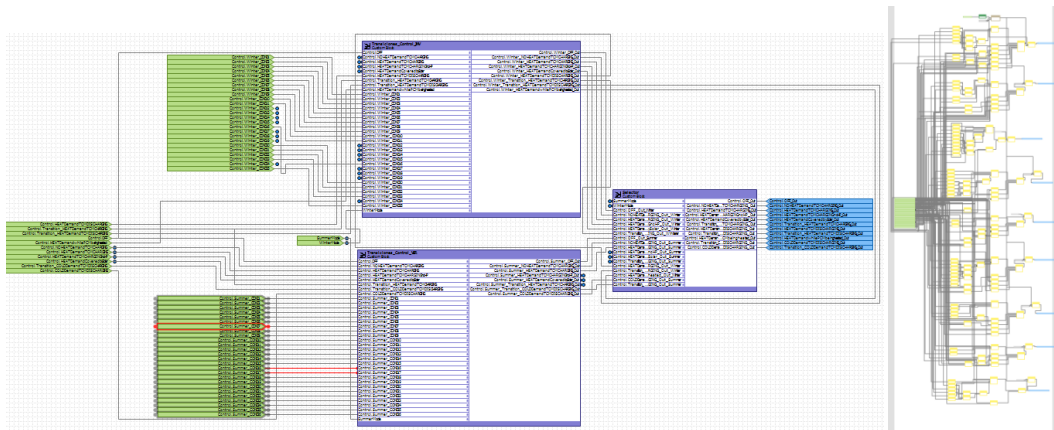


Figura 67: Vista interna sub-bloque Control y Vista interna sub-bloque Control Winter

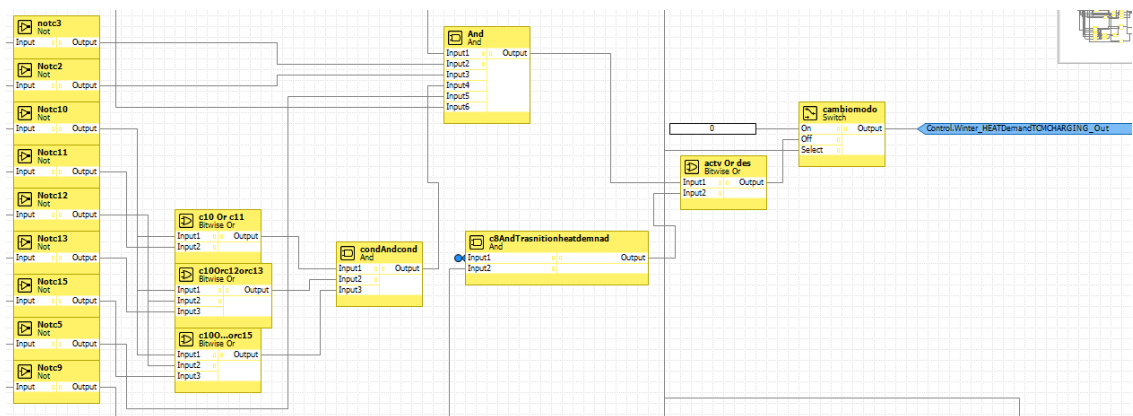


Figura 68 Vista del estado HEATDemandTCMCHARGING

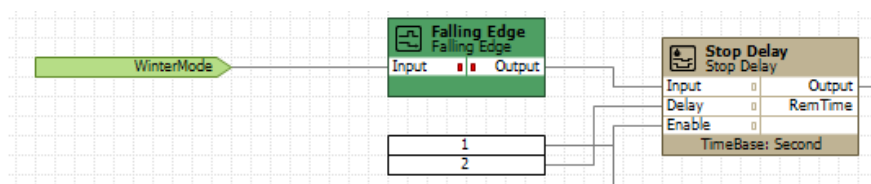


Figura 69 Vista de la programación de cambio de modo

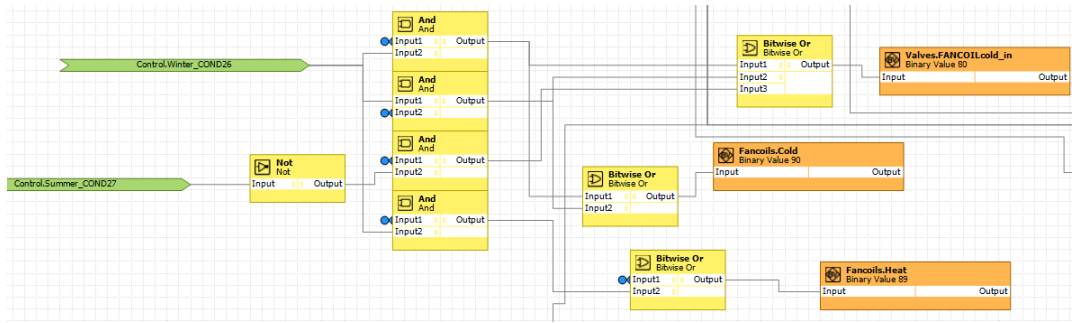


Figura 70: Vista de las condiciones en salidas para activar salidas no estados

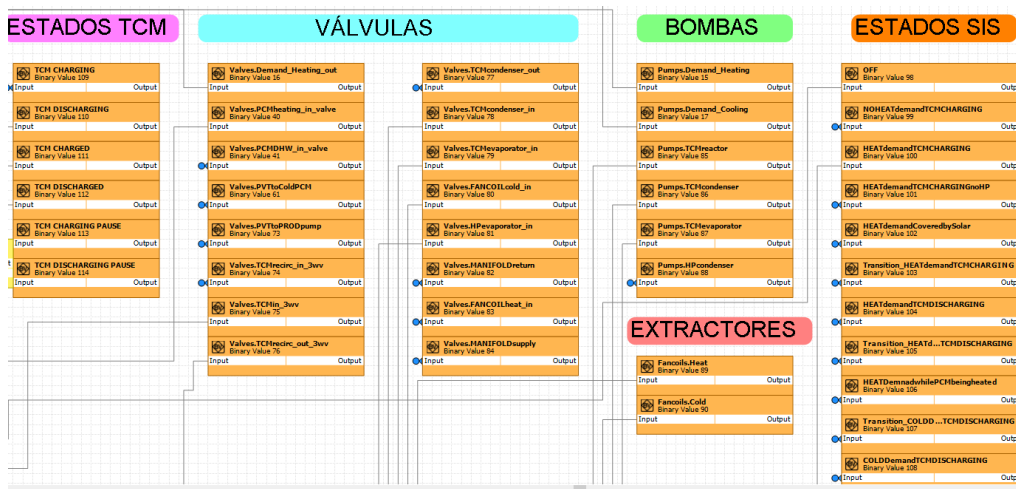


Figura 71 Vista de bloques Internal variable en las salidas



Figura 72 Vista de bloques Internal variable en las salidas

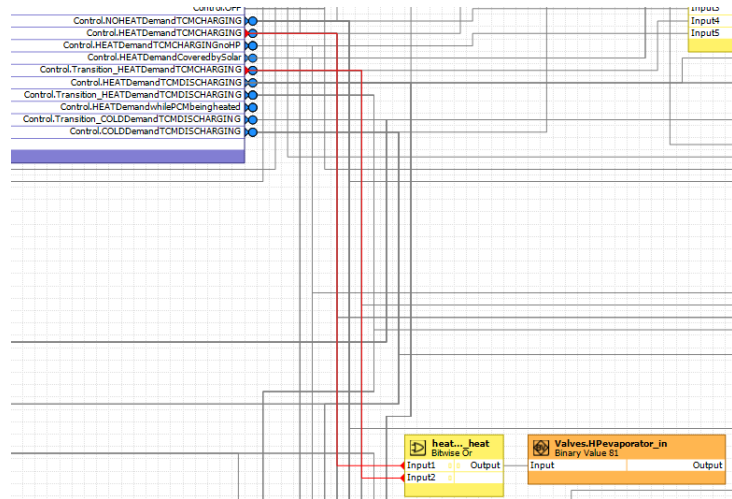


Figura 73: Vista activación de una válvula

Devices

- MD1: ENTRADAS MODBUS
 - Points
 - TCMevaporator_out_T
 - TCMreactor_out_T
 - TCMreactor_heating_call
 - TCMreactor_cooling_call
 - TCMcondenser_T
 - TCMreactor_in_T
 - HP_evaporator_T
 - HPcondenser_out_T
 - PCMcooling_call
 - PCMcold_T
 - PCMcold_in_T
 - PCMheating_heating_call
 - PCMheating_DHW_call
 - PCMheating_T
 - PCMDHW_T
 - Demo_heat_demand
 - Demo_cold_demand
 - WinterMode
 - SummerMode
 - Demo_outdoor_T
 - SolarTank_Ttop

Object name: ENTRADAS MODBUS

Description:

Modbus

Network: TCP/IP

IP address: 192.168.60.76

IP port: 502 [1 ... 65.535]

Address: 1 [1 ... 255]

Heartbeat point: None

Encoding

Int16 byte ordering: Byte Swap

Int32 byte ordering: Byte Swap Word Swap

Int64 byte ordering: Byte Swap Word Swap Double Word Swap

Float byte ordering: Byte Swap Word Swap Double Word Swap

Double byte ordering: Byte Swap Word Swap Double Word Swap

Options

Supports write multiple coils:

Supports write multiple registers:

Figura 74: Configuración del ModbusDevice

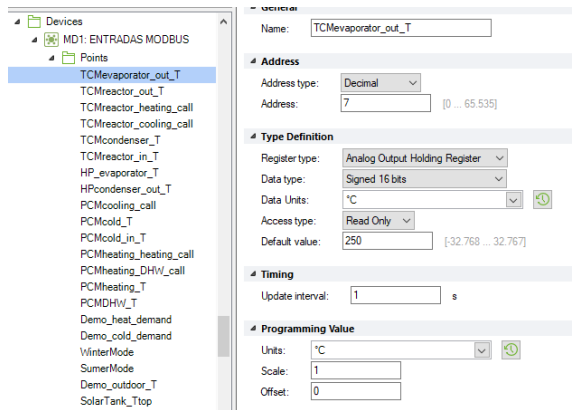


Figura 75: Configuración del registro Modbus

```
from pyModbusTCP.server import ModbusServer
s=ModbusServer("192.168.60.76",502,1,False)
s.start()
```

Figura 76: Captura código Servidor

```
import csv
import time
UNIT = 0x1
# Leemos y mandamos cada 10 seg
TIME = 10
paso = 10

#segmentamos la espera para que lo mande en el tiempo establecido
newtime=TIME/paso

from pyModbusTCP.client import ModbusClient
client=ModbusClient("192.168.60.76", port=502, unit_id=1, auto_open=False)
client.open()

nombre_archivo = "proof_on_csv.csv"
with open(nombre_archivo, "r") as archivo:
    lector = csv.reader(archivo, delimiter=",")
```

Figura 77: 1º Captura del código Cliente


```

for fila in lector:

    i=0

    v3 = int(fila[2])
    v4 = int(fila[3])
    v10= int(fila[9])
    v15= int(fila[14])
    v12= int(fila[11])
    v18 = int(fila[17])
    v19= int(fila[18])
    v20= int(fila[19])
    v21= int(fila[20])
#si es la primera fila que no segmente valores, despues si
if s == 0:
    v1= int(fila[0])*10
    v2= int(fila[1])*10
    v5= int(fila[4])*10
    v6= int(fila[5])*10
    v7 = int(fila[6])*10
    v8= int(fila[7])*10
    v9 = int(fila[8])*10
    v11= int(fila[10])*10
    v13= int(fila[12])*10
    v14= int(fila[13])*10
    v16= int(fila[15])*10
    v17= int(fila[16])*10

    client.write_multiple_registers(1, [v1,v2,v3,v4,v5,v6,v7,v8,v9
    s=1

else:

    #paso para dividir dato de 30 a 50 seria 32, 34,36,38...
    #leamos el actual valor y cogemos el anterior
    actv1= int(fila[0])*10
    actv2= int(fila[1]) *10
    actv5= int(fila[4]) *10

```

Figura 78: 2º Captura del código Cliente

```

else:

    #paso para dividir dato de 30 a 50 seria 32, 34,36,38....

    #leamos el actual valor y cogemos el anterior
    actv1= int(fila[0])*10
    actv2= int(fila[1]) *10
    actv3= int(fila[4]) *10
    actv6= int(fila[5])*10
    actv7 = int(fila[6])*10
    actv8= int(fila[7])*10
    actv9 = int(fila[8])*10
    actv11= int(fila[10])*10
    actv13= int(fila[12])*10
    actv14= int(fila[13])*10
    actv16= int(fila[15])*10
    actv17= int(fila[16])*10

    vant1= v1
    vant2= v2
    vant5= v5
    vant6= v6
    vant7= v7
    vant8= v8
    vant9= v9
    vant11= v11
    vant13= v13
    vant14= v14
    vant16= v16
    vant17= v17

    #bucle para mandar los valores segmentados
    for i in range(paso):

        v1= vant1 +(((actv1-vant1)/paso)*(i+1))
        v1= int (v1)
        v2= vant2 +(((actv2-vant2)/paso)*(i+1))

#bucle para mandar los valores segmentados
for i in range(paso):

    v1= vant1 +(((actv1-vant1)/paso)*(i+1))
    v1= int (v1)
    v2= vant2 +(((actv2-vant2)/paso)*(i+1))
    v2= int (v2)
    v5= vant5 +(((actv5-vant5)/paso)*(i+1))
    v5= int (v5)
    v6= vant6 +(((actv6-vant6)/paso)*(i+1))
    v6= int (v6)
    v7= vant7 +(((actv7-vant7)/paso)*(i+1))
    v7= int (v7)
    v8= vant8 +(((actv8-vant8)/paso)*(i+1))
    v8= int (v8)
    v9= vant9 +(((actv9-vant9)/paso)*(i+1))
    v9= int (v9)
    v11= vant11 +(((actv11-vant11)/paso)*(i+1))
    v11= int (v11)
    v13= vant13 +(((actv13-vant13)/paso)*(i+1))
    v13= int (v13)
    v14= vant14 +(((actv14-vant14)/paso)*(i+1))
    v14= int (v14)
    v16= vant16 +(((actv16-vant16)/paso)*(i+1))
    v16= int (v16)
    v17= vant17 +(((actv17-vant17)/paso)*(i+1))
    v17= int (v17)
    client.write_multiple_registers(1, [v1,v2,v3,v4,v5,v
time.sleep(newtime)

```

Figura 79: 3º Captura del código Cliente

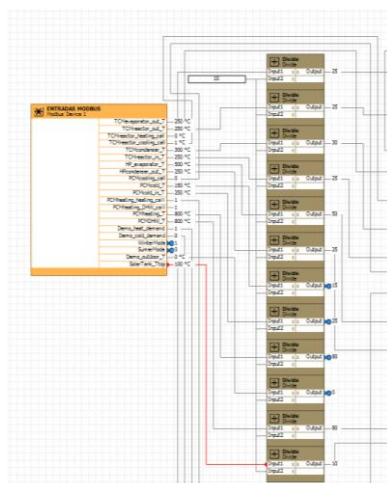


Figura 80:Vista conexión Modbus programada

| NUMERO | MODO | ENTRADA/S MODIFICADA /s | ESTADO ESPERADO |
|--------|------|---|--|
| 1 | INV | Solartank_Ttop:40->65 TCMcondenser_T:30->90 TCMreactor_heating_call:0->1 | NOHEATDemandTCMCHARGING |
| 2 | INV | PCMheating_heating_call:0->1 PCMheating_T:70->80 | HEATDemandCoveredbyTCMCHARGINGno HP |
| 3 | INV | TCMcondenser_T:40->30 Demo_heating_demand:1->0 Demo_cooling_demand:0->1 | TransitionHEATDemandCoveredbyTCM CHARGING |
| 4 | INV | TCMreactor_in_T:25->83 TCMreactor_out_T:25->80 HPcondenser_out_T:25->90 Demo_cooling_demand:1->0 | HEATDemandCoveredbyTCMCHARGING |
| 5 | INV | TCMreactor_in_T:83->25 TCMreactor_out_T:80->25 TCMreactor_heating_call:1->0 TCMreactor_cooling_call:0->1 Demo_heating_demand:0->1 Demo_cooling_demand:0->1 | Transition_HEATDemandCoveredbyTC MDISCHARGING |
| 6 | INV | TCMreactor_in_T:25->70 TCMreactor_out_T:25->70 TCMreactor_cooling_call:1->0 | HEATDemandCoveredbyTCMDISCHARGIN G |
| 7 | INV | Solartank_Ttop:65->50 Demo_cooling_demand:1->0 | OFF |
| 8 | INV | Solartank_Ttop:50->40 | OFF |

| | | | |
|----|-----|--|--|
| | | | |
| 9 | INV | Solartank_Ttop:40->60 TCMreactor_heating_call:0->1 PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 | TransitionHEATDemandCoveredbyTCM CHARGING |
| 10 | INV | TCMreactor_in_T:25->83 TCMreactor_out_T:25->80 HPcondenser_out_T:25->90 | HEATDemandCoveredbyTCMCHARGING |
| 11 | INV | Solartank_Ttop:60->80 TCMreactor_heating_call:1->0 TCMreactor_in_T:83->25 TCMreactor_out_T:80->25 HPcondenser_out_T:90->25 | HEATDemandCoveredbySOLAR |
| 12 | INV | PCMDHW_heating_call:1->0 PCMDHW_T:80->70 | OFF |
| 13 | INV | Solartank_Ttop:80->50 TCMreactor_cooling_call:0->1 PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 | Transition_HEATDemandCoveredbyTC MDISCHARGING |
| 14 | INV | PCMDHW_heating_call:1->0 PCMDHW_T:80->70 PCMcold_T:20->10 Demo_outdoor_T:10->0 | HEATDemandwhileCOLDPCMbeingheate d |
| 15 | INV | Solartank_Ttop:50->10 TCMreactor_cooling_call:1->0 PCMcold_T:10->15 | OFF |
| 16 | INV | TCMreactor_cooling_call:0->1 PCMheating_heating_call:0->1 PCMheating_T:70->80 PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 | Transition_HEATDemandCoveredbyTC MDISCHARGING |
| 17 | INV | TCMreactor_in_T:25->83 TCMreactor_out_T:25->80 HPcondenser_out_T:25->90 | HEATDemandCoveredbyTCMDISCHARGIN G |
| 18 | INV | TCMreactor_cooling_call:1->0 PCMheating_heating_call:1->0 PCMheating_T:80->70 PCMDHW_heating_call:1->0 PCMDHW_T:80->70 | OFF |
| 19 | INV | Solartank_Ttop:10->40 TCMreactor_heating_call:1->0 TCMreactor_in_T:83->25 TCMreactor_out_T:80->25 HPcondenser_out_T:90->25 PCMcold_T:15->20 Demo_outdoor_T:0->10 | OFF |
| 20 | INV | Solartank_Ttop:40->60 TCMreactor_heating_call:0->1 PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 | TransitionHEATDemandCoveredbyTCM CHARGING |

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| 21 | INV | TCMcondenser_T:30->40 | HEATDemandCoveredbyTCMCHARGINGno HP |
| 22 | INV | PCMDHW_heating_call:1->0 PCMDHW_T:80->70 | NOHEATDemandTCMCHARGING |
| 23 | INV | TCMcondenser_T:40->24 Demo_outdoor_T:10->20 | OFF |
| 24 | INV | TCMcondenser_T:24->30 Demo_outdoor_T:20->10 PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 | TransitionHEATDemandCoveredbyTCM CHARGING |
| 25 | INV | TCMreactor_in_T:25->83 HPcondenser_out_T:25->90 | HEATDemandCoveredbyTCMCHARGING |
| 26 | INV | PCMDHW_heating_call: 1->0 PCMcold_T:20->15 Demo_outdoor_T:10->3 | HEATDemandwhileCOLDPCMbeingheate d |
| 27 | INV | TCMreactor_cooling_call:0->1 PCMcold_T:15->20 HPcondenser_out_T:90->80 | Transition_HEATDemandCoveredbyTC MDISCHARGING |
| 28 | INV | PCMDHW_heating_call:1->0 PCMDHW_T:80->70 | OFF |
| 29 | INV | TCMreactor_out_T:25->80 HPcondenser_out_T:80->90 PCMcold_T:20->10 | HEATDemandwhileCOLDPCMbeingheate d |
| 30 | INV | PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 PCMcold_T:10->20 | Transition_HEATDemandCoveredbyTC MDISCHARGING |
| 31 | INV | | HEATDemandCoveredbyTCMDISCHARGIN G |
| 32 | INV | Solartank_Ttop:40->60 TCMreactor_cooling_call:1->0 PCMDHW_heating_call:1->0 PCMDHW_T:80->70 | OFF |
| 33 | INV | TCMreactor_in_T:83->25 TCMreactor_out_T:80->25 HPcondenser_out_T:90->25 | OFF |
| 34 | INV | Solartank_Ttop:40->60 TCMreactor_heating_call:0->1 | NOHEATDemandTCMCHARGING |
| 35 | INV | PCMheating_heating_call:0->1 PCMheating_T:70->80 | TransitionHEATDemandCoveredbyTCM CHARGING |
| 36 | INV | TCMreactor_in_T:25->83 TCMreactor_out_T:25->80 HPcondenser_out_T:25->90 | HEATDemandCoveredbyTCMCHARGING |
| 37 | INV | TCMcondenser_T:30->40 | HEATDemandCoveredbyTCMCHARGINGno HP |
| 38 | INV | TCMcondenser_T:40->30 TCMreactor_in_T:83->25 TCMreactor_out_T:80->25 | TransitionHEATDemandCoveredbyTCM CHARGING |

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| | | HPcondenser_out_T:90->25 | |
| 39 | INV | TCMreactor_in_T:25->83 TCMreactor_out_T:25->80 HPcondenser_out_T:25->90 | HEATDemandCoveredbyTCMCHARGING |
| 40 | INV | PCMheating_heating_call:1->0 PCMheating_T:80->70 | NOHEATDemandTCMCHARGING |
| 41 | INV | TCMreactor_heating_call:1->0 | OFF |
| 42 | INV | Solartank_Ttop:60->50 PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 TCMreactor_cooling_call:0->1 TCMreactor_in_T:83->25 TCMreactor_out_T:80->25 HPcondenser_out_T:90->25 | Transition_HEATDemandCoveredbyTCMDISCHARGING |
| 43 | INV | Solartank_Ttop:50->60 TCMreactor_in_T:25->70 TCMreactor_out_T:25->70 HPcondenser_out_T:25->90 PCMDHW_heating_call:1->0 PCMDHW_T:80->70 PCMheating_heating_call:0->1 PCMheating_T:70->80 | HEATDemandCoveredbyTCMDISCHARGING |
| 44 | INV | Solartank_Ttop:60->50 TCMreactor_cooling_call:1->0 | OFF |
| 45 | INV | Solartank_Ttop:50->40 TCMreactor_in_T:70->25 TCMreactor_out_T:70->25 HPcondenser_out_T:90->25 | OFF |
| 46 | INV | Solartank_Ttop:40->60 TCMreactor_heating_call:0->1 PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 | TransitionHEATDemandCoveredbyTCMCHARGING |
| 47 | INV | Solartank_Ttop:60->80 TCMreactor_in_T:25->70 TCMreactor_out_T:25->70 HPcondenser_out_T:25->90 | HEATDemandCoveredbyTCMCHARGING |
| 48 | INV | TCMreactor_heating_call:1->0 TCMreactor_in_T:83->25 TCMreactor_out_T:80->25 | HEATDemandCoveredbySOLAR |
| 49 | INV | Solartank_Ttop:80->70 TCMreactor_cooling_call:0->1 HPcondenser_out_T:90->25 | Transition_HEATDemandCoveredbyTCMDISCHARGING |
| 50 | INV | TCMreactor_cooling_call:1->0 PCMDHW_T:80->65 | HEATDemandCoveredbySOLAR |
| 51 | INV | Solartank_Ttop:70->80 PCMDHW_heating_call:1->0 PCMDHW_T:65->70 | OFF |

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| 52 | INV | PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 | HEATDemandCoveredbySOLAR |
| 53 | INV | PCMDHW_heating_call:1->0 PCMDHW_T:80->70 | OFF |
| 54 | INV | PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 Solartank_Ttop:80->50 TCMreactor_cooling_call:1->0 | Transition_HEATDemandCoveredbyTC MDISCHARGING |
| 55 | INV | Solartank_Ttop:50->60 TCMreactor_in_T:25->70 TCMreactor_out_T:25->70 HPcondenser_out_T:25->90 PCMDHW_heating_call:1->0 PCMDHW_T:80->70 PCMheating_heating_call:0->1 PCMheating_T:70->80 | HEATDemandCoveredbyTCMDISCHARGIN G |
| 56 | INV | Solartank_Ttop:60->50 TCMreactor_cooling_call:1->0 | OFF |
| 57 | VER | Solartank_Ttop:50->40 TCMreactor_in_T:70->25 TCMreactor_out_T:70->25 HPcondenser_out_T:90->25 PCMheating_heating_call:1->0 PCMheating_T:80->70 Demo_outdoor_T:10->30 MCFcold_in_T:25->20 Demo_heating_demand:1->0 Demo_cooling_demand:0->1 | OFF |
| 58 | VER | Solartank_Ttop:40->60 TCMreactor_heating_call:0->1 Demo_outdoor_T:30->20 | NODemandTCMCHARGING |
| 59 | VER | PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 -Parametro: Allow_SummerHeatDemand_ withHPandTCM=1 | TransitionHEATDemandCoveredbyTCM CHARGING |
| 60 | VER | HPcondenser_out_T:25->86 | HEATDemandCoveredbyTCMCHARGING |
| 61 | VER | Solartank_Ttop:60->90 PCMDHW_heating_call:1->0 | HEATDemandCoveredbySOLAR |
| 62 | VER | Solartank_Ttop:90->70 TCMreactor_cooling_call:0->1 TCMevaporator_T:25->10 MCFcold_in_T:20->14 Demo_outdoor_T:20->25 | Transition_COLDDemandCoveredbyTC MDISCHARGING |
| 63 | VER | TCMevaporator_T:10->3 MCFcold_in_T:14->20 Demo_outdoor_T:25->20 | COLDDemandCoveredbyTCMDISCHARGIN G |
| 64 | VER | Solartank_Ttop:70->50 | OFF |

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| | | TCMreactor_cooling_call:1->0 | |
| 65 | VER | Solartank_Ttop:50->40 TCMreactor_cooling_call:1->0 HPcondenser_out_T:86->25 TCMevaporator_T:3->10 Demo_outdoor_T:20->30 PCMcold_T:20->26 PCMDHW_heating_call:1->0 PCMDHW_T:80->70 Demo_cooling_demand:1->0 -Parametro: Allow_SummerHeatDemand withTCM =1 | OFF |
| 66 | VER | Solartank_Ttop:40->60 TCMreactor_heating_call:0->1 PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 | TransitionHEATDemandCoveredByTCM CHARGING |
| 67 | VER | TCMcondenser_T:30->40 | HEATDemandCoveredByTCMCHARGINGno HP |
| 68 | VER | TCMcondenser_T:40->30 | TransitionHEATDemandCoveredByTCM CHARGING |
| 69 | VER | TCMreactor_heating_call:1->0 TCMreactor_cooling_call:0->1 TCMevaporator_T:10->20 | Transition_COLDDemandCoveredByTC MDISCHARGING |
| 70 | VER | Demo_outdoor_T:30->36 | OFF |
| 71 | VER | Solartank_Ttop:60->40 PCMDHW_heating_call:1->0 PCMDHW_T:80->70 Demo_outdoor_T:36->28 MCFcold_cooling_call:0->1 | Transition_COLDDemandCoveredByTC MDISCHARGING |
| 72 | VER | Solartank_Ttop:40->90 PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 MCFcold_cooling_call:1->0 | HEATDemandCoveredBySOLAR |
| 73 | VER | PCMDHW_heating_call:1->0 PCMDHW_T:80->70 PCMcold_T:26->20 | OFF |
| 74 | VER | Solartank_Ttop:90->40 MCFcold_cooling_call:0->1 PCMcold_T:20->26 | Transition_COLDDemandCoveredByTC MDISCHARGING |
| 75 | VER | Solartank_Ttop:40->70 PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 MCFcold_cooling_call:1->0 PCMcold_T:26->20 TCMevaporator_T:20->3 Demo_outdoor_T:28->20 HPcondenser_out_T:25->86 | COLDDemandCoveredByTCMDISCHARGIN G |
| 76 | VER | Solartank_Ttop:70->50 TCMreactor_cooling_call:1->0 | OFF |

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| 77 | VER | Solartank_Ttop:70->50 PCMDHW_heating_call:1->0 PCMDHW_T:80->70 HPcondenser_out_T:86->25 TCMeaporator_T:3->25 Demo_outdoor_T:20->30 | OFF |
| 78 | VER | Solartank_Ttop:40->60 TCMreactor_heating_call:0->1 Demo_outdoor_T:30->20 TCMcondenser_T:30->40 | NODemandTCMCHARGING |
| 79 | VER | PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 -Parametro: Allow_SummerHeatDemand_ withTCM =1 | HEATDemandCoveredbyTCMCHARGINGno HP |
| 80 | VER | -Parametro: Allow_SummerHeatDemand_ withHPandTCM=0 | OFF |
| 81 | VER | PCMDHW_heating_call:1->0 PCMDHW_T:80->70 TCMcondenser_T:40->30 | NODemandTCMCHARGING |
| 82 | VER | TCMreactor_heating_call:1->0 | OFF |
| 83 | VER | TCMreactor_heating_call:0->1 PCMDHW_heating_call: 0->1 PCMDHW_T:70->60 | HEATDemandCoveredbySOLAR |
| 84 | VER | Solartank_Ttop:60->90 PCMDHW_heating_call:1->0 PCMDHW_T:60->70 TCMreactor_heating_call:1->0 TCMreactor_cooling_call:0->1 TCMeaporator_T:25->20 Demo_outdoor_T:20->24 | OFF |
| 85 | VER | Solartank_Ttop:90->40 MFCcold_cooling_call:0->1 Demo_outdoor_T:24->28 PCMcold_T:20->26 | Transition_COLDDemandCoveredbyTC MDISCHARGING |
| 86 | VER | PCMcold_T:26->20 Solartank_Ttop:40->70 HPcondenser_out_T:25->86 TCMeaporator_T:20->3 Demo_outdoor_T:28->20 PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 | COLDDemandCoveredbyTCMDISCHARGIN G |
| 87 | VER | Solartank_Ttop:70->50 MFCcold_cooling_call:1->0 | OFF |
| 88 | VER | Solartank_Ttop:50->40 HPcondenser_out_T:86->25 TCMeaporator_T:3->25 PCMDHW_heating_call:1->0 | OFF |

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| | | PCMDHW_T:80->70 Demo_outdoor_T:20->30 | |
| 89 | VER | Solartank_Ttop:40->60 TCMreactor_heating_call:0->1 PCMDHW_heating_call: 0->1 PCMDHW_T:70->80 Demo_outdoor_T:30->20 | TransitionHEATDemandCoveredbyTCM CHARGING |
| 90 | VER | HPcondenser_out_T:25->86 | HEATDemandCoveredbyTCMCHARGING |
| 91 | VER | TCMcondenser_T:30->40 | HEATDemandCoveredbyTCMCHARGINGno HP |
| 92 | VER | -Parametro: Allow_SummerHeatDemand_ withHPandTCM=0 | OFF |

Tabla 1: Batería de pruebas del modelo