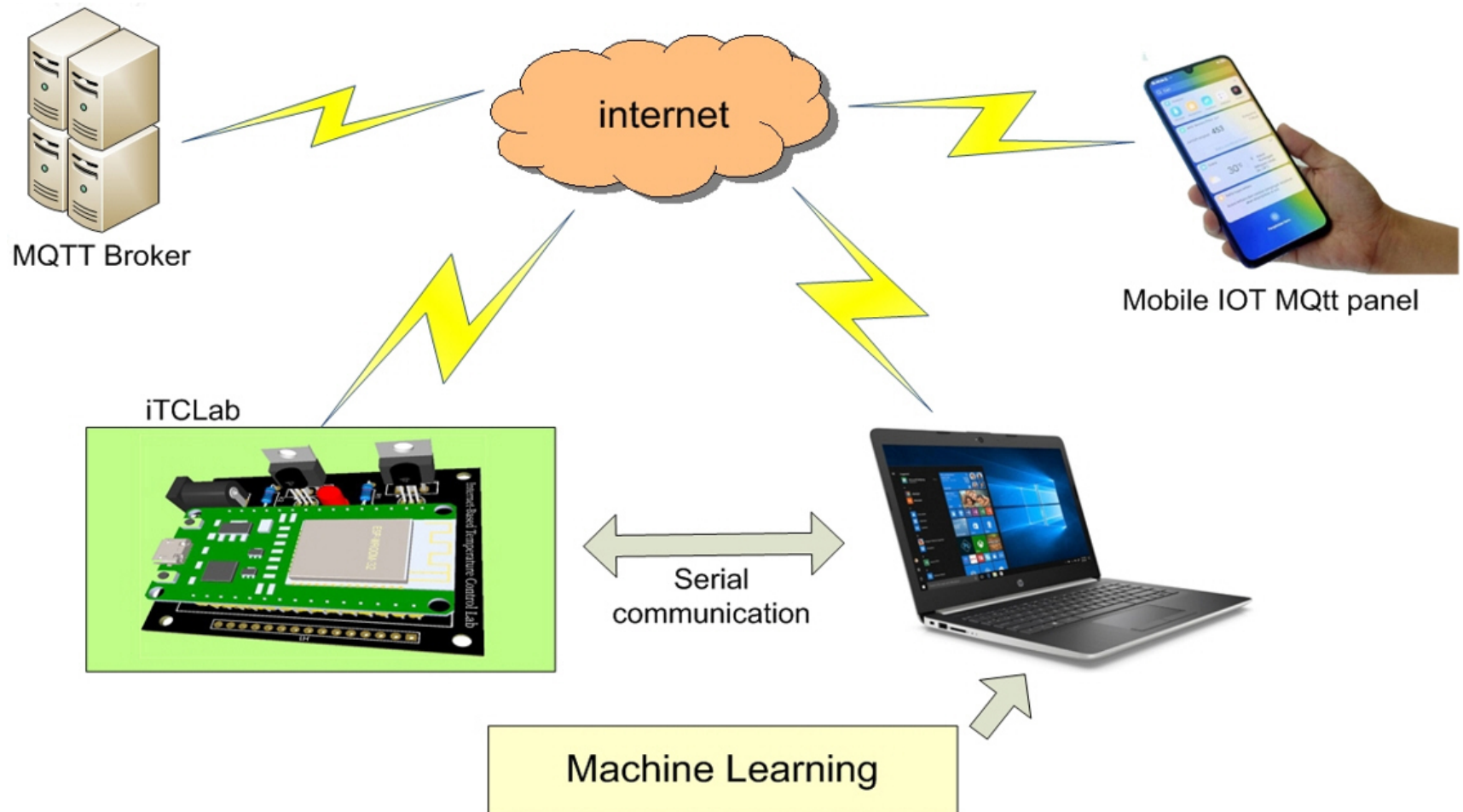


# Penalaan Parameter PID Menggunakan Deep Learning pada Kit iTCLab dan Pemantauannya Menggunakan Internet of Things (IoT)

Oleh: Tim IO-T.NET (<https://io-t.net/itclab>)



Proses penalaan nilai  $K_c$ ,  $\tau_I$  dan  $\tau_D$  pada pengendali PID menggunakan Deep Learning pada Kit iTCLab dan Pemantauannya Menggunakan Internet of Things (IoT)

```
In [1]: import itclab
import numpy as np
import time
import matplotlib.pyplot as plt
from scipy.integrate import odeint
import random
from paho.mqtt import client as mqtt_client
```

```
In [2]: # Machine Learning - Building Datasets and Model
# Impor `Sequential` dari `keras.models`
from keras.models import Sequential

# Impor `Dense` dari `keras.layers`
from keras.layers import Dense

# Inisialisasi konstruktor
model = Sequential()

# Tambahkan Lapisan masukan
model.add(Dense(2, activation='sigmoid', input_shape=(2,)))

# Tambahkan satu Lapisan tersembunyi
model.add(Dense(3, activation='sigmoid'))

# Tambahkan Lapisan keluaran
model.add(Dense(3, activation='sigmoid'))

# Data Latih.
X = np.array([
    [1, 1],
    [0.4, 1.2],
    [1.2, 0.1],
    [1, 0.1]
])

# Label untuk Data Latih.
y = np.array([
    [0.25, 4.31, 0.20],
    [0.2, 4.1, 0.1],
    [0.1, 4.0, 0],
    [0.1, 4.0, 0]
])

# Bentuk keluaran model
model.output_shape

# Ringkasan model
model.summary()

# Konfigurasi model
```

```
model.get_config()

# Buat daftar semua tensor bobot
model.get_weights()
```

```
-----
dense_1 (Dense)                (None, 3)                9
-----
dense_2 (Dense)                (None, 3)                12
=====
Total params: 27
Trainable params: 27
Non-trainable params: 0
-----
```

```
Out[2]: [array([[ -1.047825 , -1.111195 ],
                [-0.5602793, -1.0093   ]], dtype=float32),
         array([0., 0.], dtype=float32),
         array([[ 0.49625528, -1.045764 ,  0.7800678 ],
                [ 0.49991798, -0.22290719, -0.15202206]], dtype=float32),
         array([0., 0., 0.], dtype=float32),
         array([[ -0.34835267, -0.97555804, -0.24375486],
                [-0.35620403,  0.97434473,  0.93942237],
                [-0.23832917, -0.05082703,  0.06857944]], dtype=float32),
         array([0., 0., 0.], dtype=float32)]
```



```
In [3]: model.compile(loss='binary_crossentropy',
                    optimizer='adam',
                    metrics=['accuracy'])

model.fit(X, y, epochs=100, batch_size=1, verbose=1)
Epoch 92/100
4/4 [=====] - 0s 2ms/step - loss: -0.6907 - accuracy: 1.0000
Epoch 93/100
4/4 [=====] - 0s 2ms/step - loss: -0.7070 - accuracy: 1.0000
Epoch 94/100
4/4 [=====] - 0s 3ms/step - loss: -0.7234 - accuracy: 1.0000
Epoch 95/100
4/4 [=====] - 0s 3ms/step - loss: -0.7397 - accuracy: 1.0000
Epoch 96/100
4/4 [=====] - 0s 3ms/step - loss: -0.7560 - accuracy: 1.0000
Epoch 97/100
4/4 [=====] - 0s 2ms/step - loss: -0.7723 - accuracy: 1.0000
Epoch 98/100
4/4 [=====] - 0s 3ms/step - loss: -0.7887 - accuracy: 1.0000
Epoch 99/100
4/4 [=====] - 0s 2ms/step - loss: -0.8050 - accuracy: 1.0000
Epoch 100/100
4/4 [=====] - 0s 2ms/step - loss: -0.8213 - accuracy: 1.0000
```

```
Out[3]: <keras.callbacks.History at 0x25e79546ac0>
```

```

In [4]: #####
# Use this script for evaluating model predictions #
# and PID controller performance for the TCLab #
# Adjust only PID and model sections #
#####

#####
# PID Controller #
#####

# inputs -----
# sp = setpoint
# pv = current temperature
# pv_last = prior temperature
# ierr = integral error
# dt = time increment between measurements
# outputs -----
# op = output of the PID controller
# P = proportional contribution
# I = integral contribution
# D = derivative contribution
def pid(sp,pv,pv_last,ierr,dt):
    Kc = 10.0 # K/%Heater
    tauI = 50.0 # sec
    tauD = 1.0 # sec
    # Parameters in terms of PID coefficients
    KP = Kc
    KI = Kc/tauI
    KD = Kc*tauD
    # ubias for controller (initial heater)
    op0 = 0
    # upper and lower bounds on heater level
    ophi = 100
    oplo = 0
    # calculate the error
    error = sp-pv
    # calculate the integral error
    ierr = ierr + KI * error * dt
    # calculate the measurement derivative
    dpv = (pv - pv_last) / dt
    # calculate the PID output
    P = KP * error
    I = ierr

```

```
D = -KD * dpv
op = op0 + P + I + D
# implement anti-reset windup
if op < oplo or op > ophi:
    I = I - KI * error * dt
    # clip output
    op = max(oplo,min(ophi,op))
# return the controller output and PID terms
return [op,P,I,D]
```

```

In [5]: #####
# PID Controller using Deep Learning #
#####
# inputs -----
# sp = setpoint
# pv = current temperature
# pv_last = prior temperature
# ierr = integral error
# dt = time increment between measurements
# outputs -----
# op = output of the PID controller
# P = proportional contribution
# I = integral contribution
# D = derivative contribution

def pid_dl(sp,pv,pv_last,ierr,dt):

    # calculate the error
    error = sp-pv
    d_error = sp-pv_last
    delta_error = (error - d_error)

    outDL = model.predict(np.array([[error,delta_error]]))

    Kc = outDL[0,0]
    tauI = outDL[0,1]
    tauD = outDL[0,2]

    # Parameters in terms of PID coefficients
    KP = Kc
    KI = Kc/tauI
    KD = Kc*tauD
    # ubias for controller (initial heater)
    op0 = 0
    # upper and lower bounds on heater Level
    ophi = 100
    oplo = 0

    # calculate the integral error
    ierr = ierr + KI * error * dt
    # calculate the measurement derivative
    dpv = (pv - pv_last) / dt

```

```
# calculate the PID output
P = KP * error
I = ierr
D = -KD * dpv
op = op0 + P + I + D
# implement anti-reset windup
if op < oplo or op > ophi:
    I = I - KI * error * dt
    # clip output
    op = max(oplo, min(ophi, op))
# return the controller output and PID terms
return [op, P, I, D]
```

```

In [6]: #####
# FOPDT model #
#####
Kp = 0.5 # degC/%
tauP = 120.0 # seconds
thetaP = 10 # seconds (integer)
Tss = 23 # degC (ambient temperature)
Qss = 0 # % heater

#####
# Energy balance model #
#####
def heat(x,t,Q):
    # Parameters
    Ta = 23 + 273.15 # K
    U = 10.0 # W/m^2-K
    m = 4.0/1000.0 # kg
    Cp = 0.5 * 1000.0 # J/kg-K
    A = 12.0 / 100.0**2 # Area in m^2
    alpha = 0.01 # W / % heater
    eps = 0.9 # Emissivity
    sigma = 5.67e-8 # Stefan-Boltzman

    # Temperature State
    T = x[0]

    # Nonlinear Energy Balance
    dTdt = (1.0/(m*Cp))*(U*A*(Ta-T) \
        + eps * sigma * A * (Ta**4 - T**4) \
        + alpha*Q)
    return dTdt

```

```
In [7]: # Connect to MQTT Broker for Monitoring
broker = 'broker.hivemq.com'
port = 1883
client_id = f'python-mqtt-{random.randint(0, 1000)}'

def connect_mqtt():
    def on_connect(client, userdata, flags, rc):
        if rc == 0:
            print("Connected to MQTT Broker!")
        else:
            print("Failed to connect, return code %d\n", rc)

    client = mqtt_client.Client(client_id)
    client.on_connect = on_connect
    client.connect(broker, port)
    return client

client = connect_mqtt()
client.loop_start()
```

Connected to MQTT Broker!

```

In [11]: #####
# Do not adjust anything below this point      #
#####

# Connect to Arduino
a = itclab.iTCLab()
#a.encode('utf-8').strip()#modification error
# Turn LED on
print('LED On')
a.LED(100)

# Run time in minutes
run_time = 15.0

# Number of cycles
loops = int(60.0*run_time)
tm = np.zeros(loops)

# Temperature
# set point (degC)
Tsp1 = np.ones(loops) * 25.0
Tsp1[60:] = 45.0
Tsp1[360:] = 30.0
Tsp1[660:] = 35.0
T1 = np.ones(loops) * a.T1 # measured T (degC)
error_sp = np.zeros(loops)

Tsp2 = np.ones(loops) * 23.0 # set point (degC)
T2 = np.ones(loops) * a.T2 # measured T (degC)

# Predictions
Tp = np.ones(loops) * a.T1
error_eb = np.zeros(loops)
Tp1 = np.ones(loops) * a.T1
error_fopdt = np.zeros(loops)

# impulse tests (0 - 100%)
Q1 = np.ones(loops) * 0.0
Q2 = np.ones(loops) * 0.0

print('Running Main Loop. Ctrl-C to end.')
print('  Time      SP      PV      Q1  =  P  +  I  +  D')

```



```

print('{:6.1f} {:6.2f} {:6.2f} ' + \
      '{:6.2f} {:6.2f} {:6.2f} {:6.2f}').format( \
      tm[0],Tsp1[0],T1[0], \
      Q1[0],0.0,0.0,0.0))

# Create plot
plt.figure(figsize=(10,7))
plt.ion()
plt.show()

# Main Loop
start_time = time.time()
prev_time = start_time
# Integral error
ierr = 0.0
try:
    for i in range(1,loops):
        # Sleep time
        sleep_max = 1.0
        sleep = sleep_max - (time.time() - prev_time)
        if sleep>=0.01:
            time.sleep(sleep-0.01)
        else:
            time.sleep(0.01)

        # Record time and change in time
        t = time.time()
        dt = t - prev_time
        prev_time = t
        tm[i] = t - start_time

        # Read temperatures in Kelvin
        T1[i] = a.T1
        T2[i] = a.T2

        # Simulate one time step with Energy Balance
        Tnext = odeint(heat,Tp[i-1]+273.15,[0,dt],args=(Q1[i-1],))
        Tp[i] = Tnext[1]-273.15

        # Simulate one time step with Linear FOPDT model
        z = np.exp(-dt/tauP)
        Tpl[i] = (Tpl[i-1]-Tss) * z \
                + (Q1[max(0,i-int(thetaP)-1)]-Qss)*(1-z)*Kp \

```

```

+ Tss

# Calculate PID Output (Choose one of them)
# 1. Manually Chosen
# [Q1[i],P,ierr,D] = pid(Tsp1[i],T1[i],T1[i-1],ierr,dt)

# 2. Based on Deep Learning Result
[Q1[i],P,ierr,D] = pid_dl(Tsp1[i],T1[i],T1[i-1],ierr,dt)

# Start setpoint error accumulation after 1 minute (60 seconds)
if i>=60:
    error_eb[i] = error_eb[i-1] + abs(Tp[i]-T1[i])
    error_fopdt[i] = error_fopdt[i-1] + abs(Tpl[i]-T1[i])
    error_sp[i] = error_sp[i-1] + abs(Tsp1[i]-T1[i])

# Write output (0-100)
a.Q1(Q1[i])
a.Q2(0.0)

# Print line of data
print('{:6.1f} {:6.2f} {:6.2f} ' + \
      '{:6.2f} {:6.2f} {:6.2f} {:6.2f}').format( \
      tm[i],Tsp1[i],T1[i], \
      Q1[i],P,ierr,D))

# Publish data to MQTT Broker
pub_sp = client.publish('SetPoint', Tsp1[i])
pub_pv1 = client.publish('suhu1', T1[i])
pub_op = client.publish('Nilai_op', Q1[i])

# Plot
plt.clf()
ax=plt.subplot(4,1,1)
ax.grid()
plt.plot(tm[0:i],T1[0:i],'r.',label=r'$T_1$ measured')
plt.plot(tm[0:i],Tsp1[0:i],'k--',label=r'$T_1$ set point')
plt.ylabel('Temperature (degC)')
plt.legend(loc=2)
ax=plt.subplot(4,1,2)
ax.grid()
plt.plot(tm[0:i],Q1[0:i],'b-',label=r'$Q_1$')
plt.ylabel('Heater')
plt.legend(loc='best')

```

```
ax=plt.subplot(4,1,3)
ax.grid()
plt.plot(tm[0:i],T1[0:i], 'r.',label=r'$T_1$ measured')
plt.plot(tm[0:i],Tp[0:i], 'k-',label=r'$T_1$ energy balance')
plt.plot(tm[0:i],Tpl[0:i], 'g-',label=r'$T_1$ linear model')
plt.ylabel('Temperature (degC)')
plt.legend(loc=2)
ax=plt.subplot(4,1,4)
ax.grid()
plt.plot(tm[0:i],error_sp[0:i], 'r-',label='Set Point Error')
plt.plot(tm[0:i],error_eb[0:i], 'k-',label='Energy Balance Error')
plt.plot(tm[0:i],error_fopdt[0:i], 'g-',label='Linear Model Error')
plt.ylabel('Cumulative Error')
plt.legend(loc='best')
plt.xlabel('Time (sec)')
plt.draw()
plt.pause(0.05)

# Turn off heaters
a.Q1(0)
a.Q2(0)
# Save figure
plt.savefig('test_PID_d1.png')

# Allow user to end loop with Ctrl-C
except KeyboardInterrupt:
    # Disconnect from Arduino
    a.Q1(0)
    a.Q2(0)
    print('Shutting down')
    a.close()
    plt.savefig('test_PID_d1.png')

# Make sure serial connection still closes when there's an error
except:
    # Disconnect from Arduino
    a.Q1(0)
    a.Q2(0)
    print('Error: Shutting down')
    a.close()
    plt.savefig('test_PID_d1.png')
    raise
```

```
a.close()
```

Opening connection

iTCLab connected via Arduino on port COM3

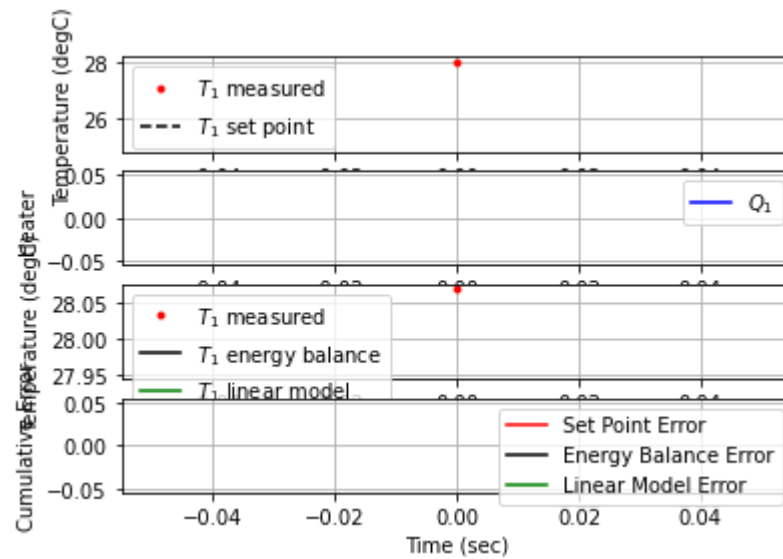
LED On

Running Main Loop. Ctrl-C to end.

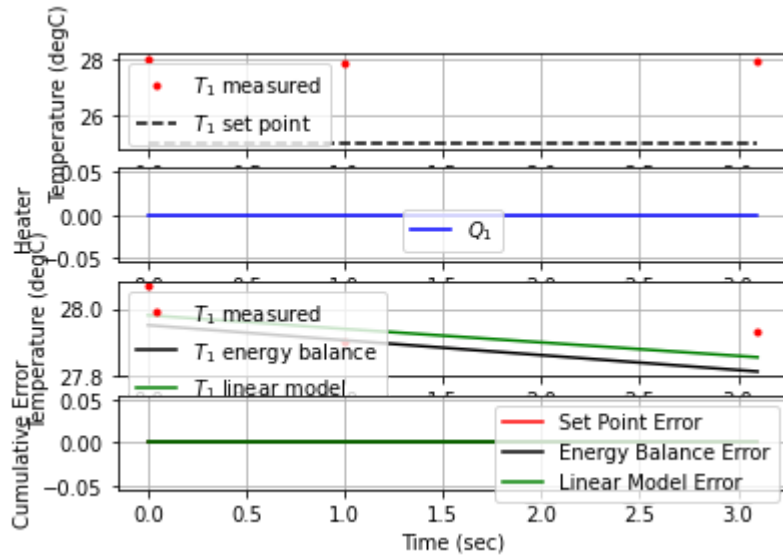
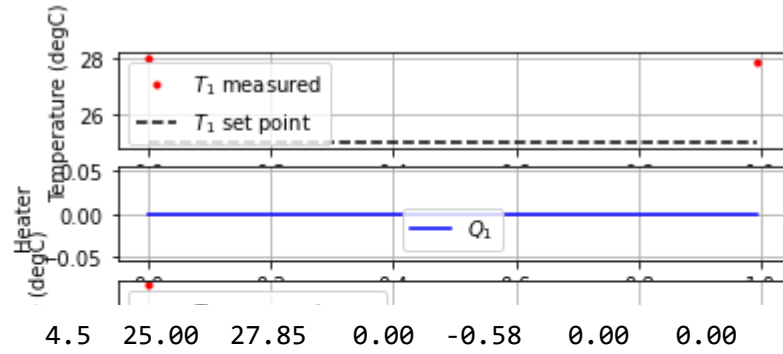
Time	SP	PV	Q1	= P	+ I	+ D
0.0	25.00	28.07	0.00	0.00	0.00	0.00

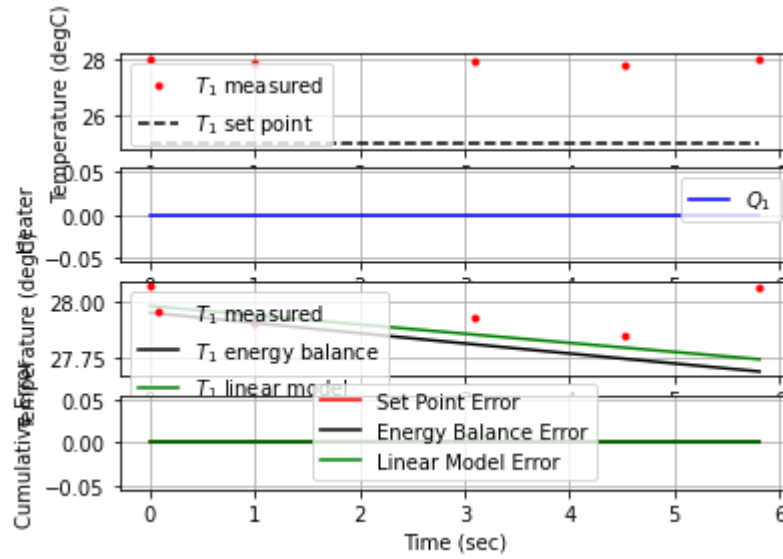
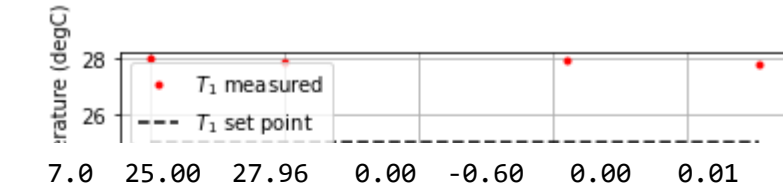
<Figure size 720x504 with 0 Axes>

1.0	25.00	27.90	0.00	-0.59	0.00	0.01
-----	-------	-------	------	-------	------	------

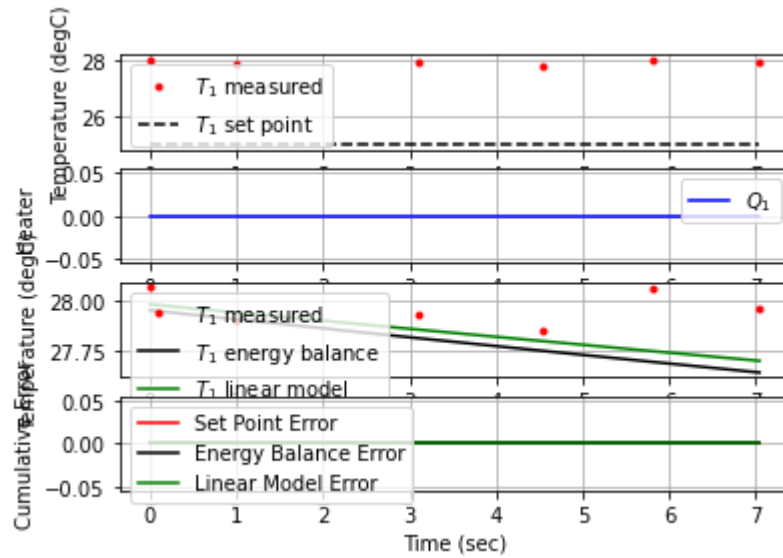


3.1	25.00	27.93	0.00	-0.59	0.00	-0.00
-----	-------	-------	------	-------	------	-------

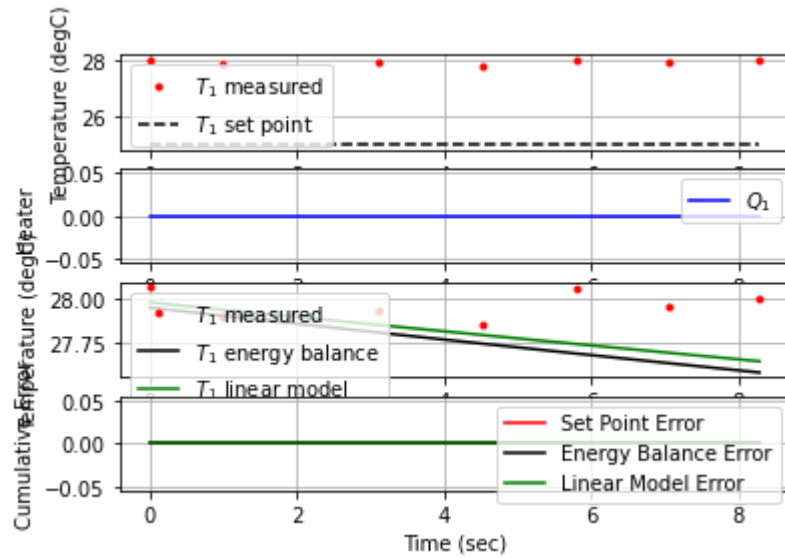




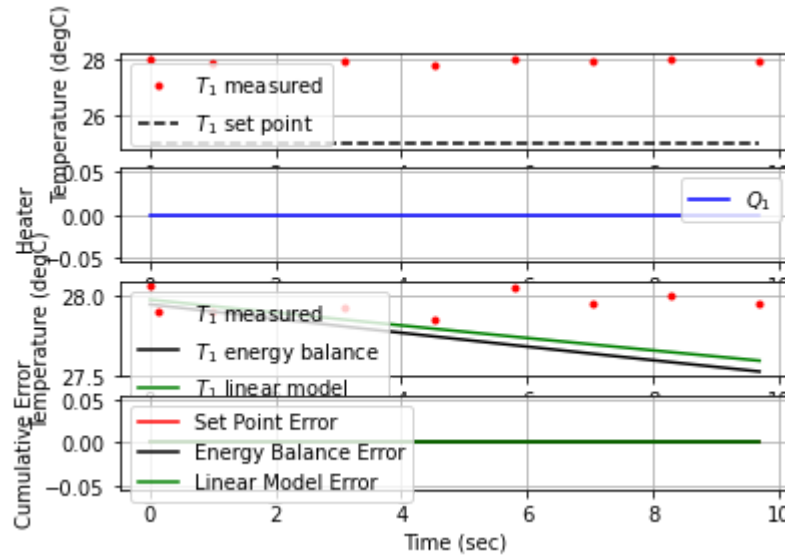
8.3 25.00 28.00 0.00 -0.61 0.00 -0.00



9.7 25.00 27.96 0.00 -0.60 0.00 0.00

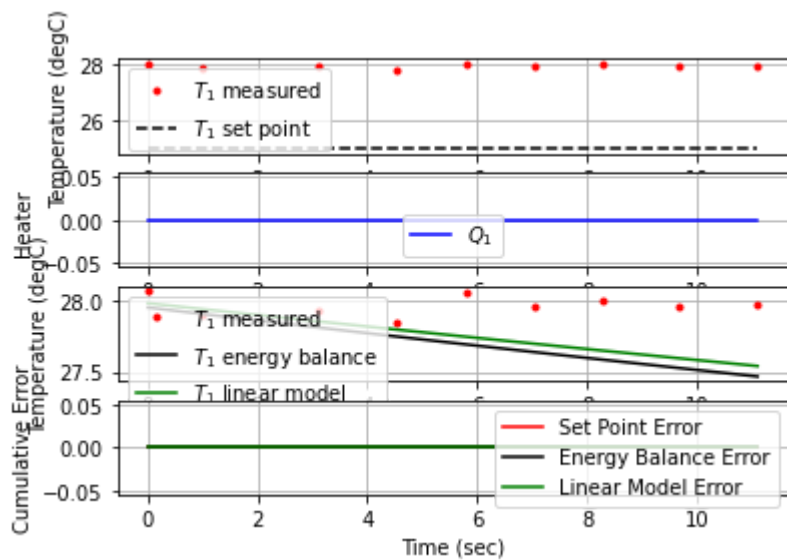


11.1 25.00 27.97 0.00 -0.60 0.00 -0.00

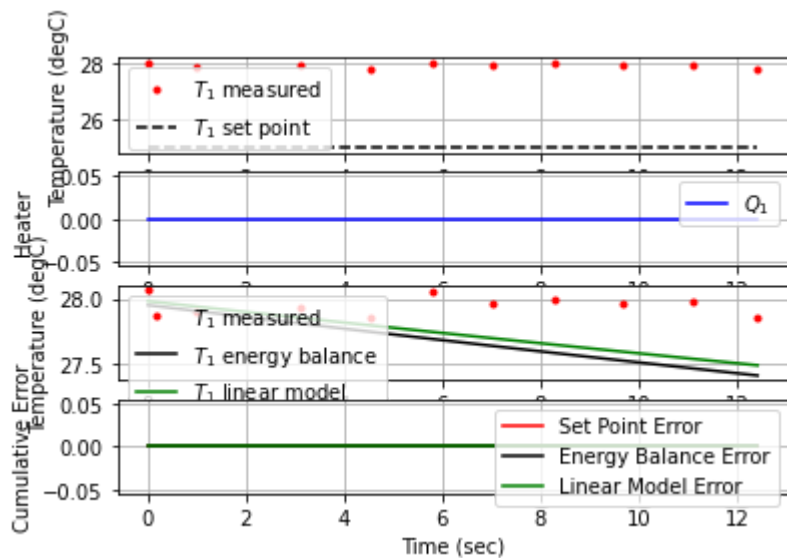




12.4 25.00 27.85 0.00 -0.58 0.00 0.01

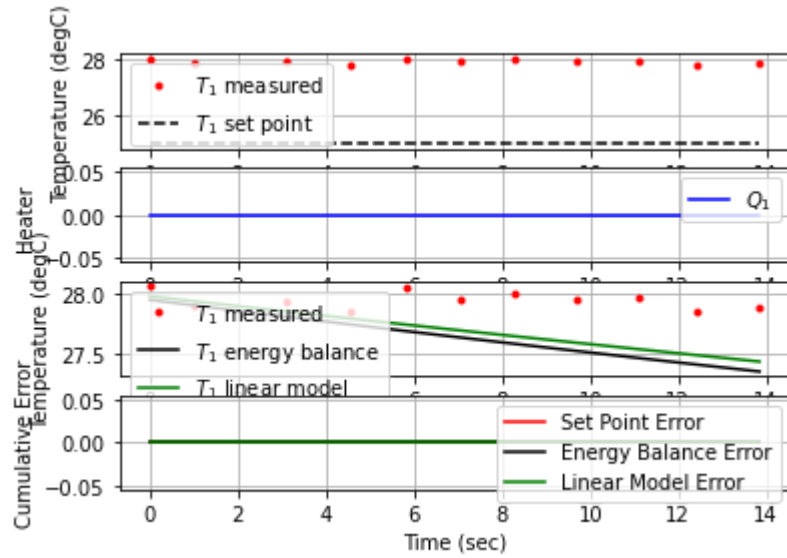


13.8 25.00 27.89 0.00 -0.58 0.00 -0.00

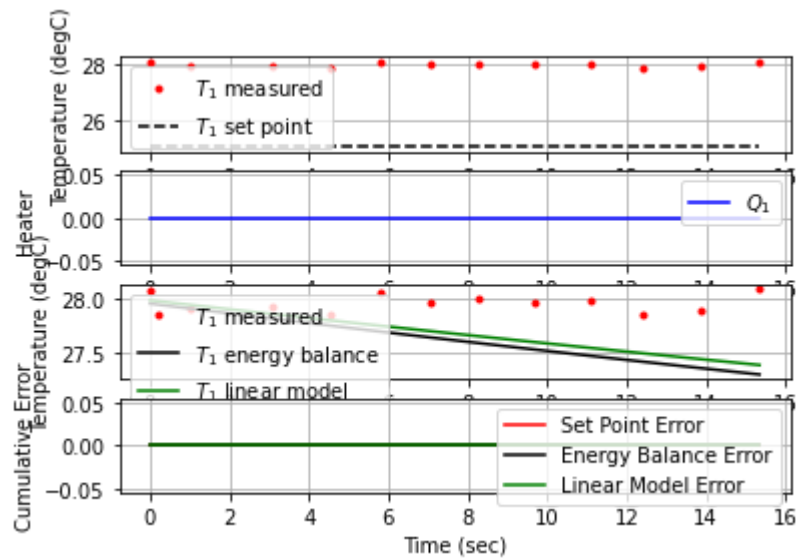




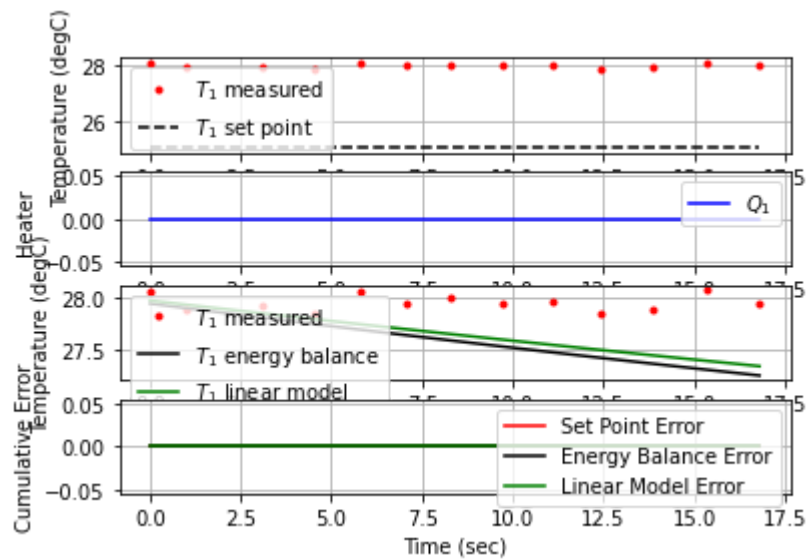
15.3 25.00 28.09 0.00 -0.62 0.00 -0.01



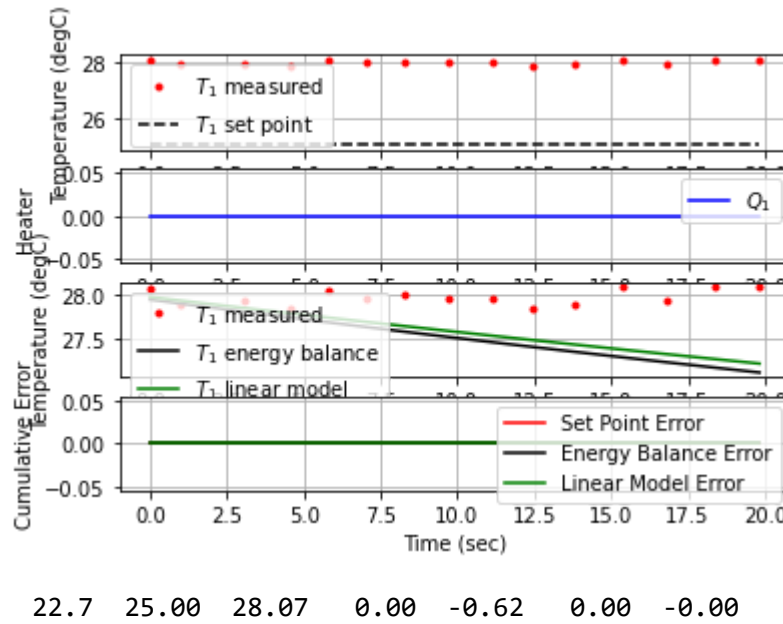
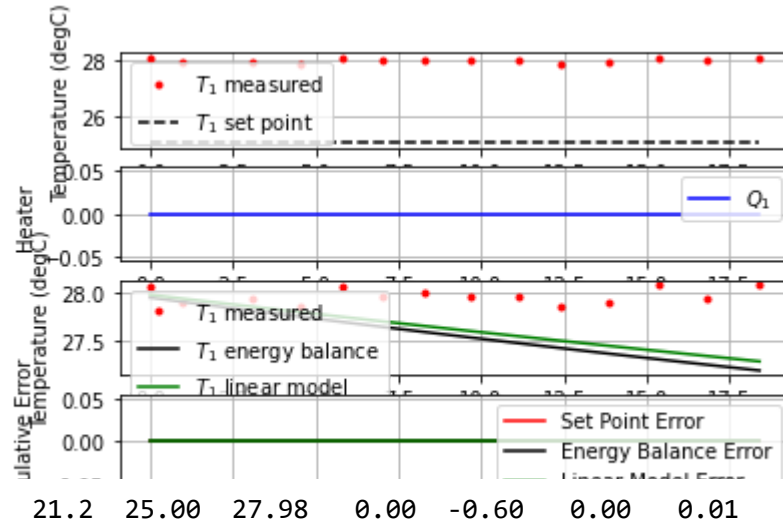
16.8 25.00 27.95 0.00 -0.60 0.00 0.01

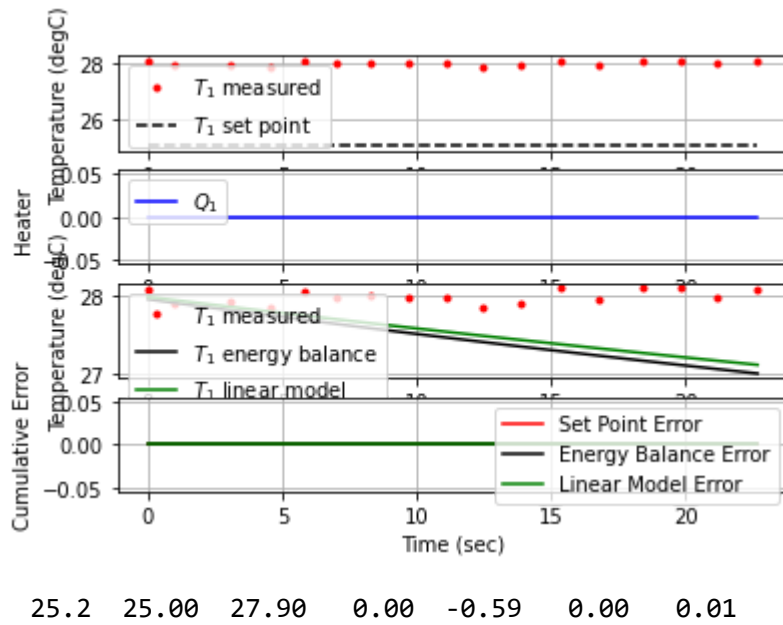
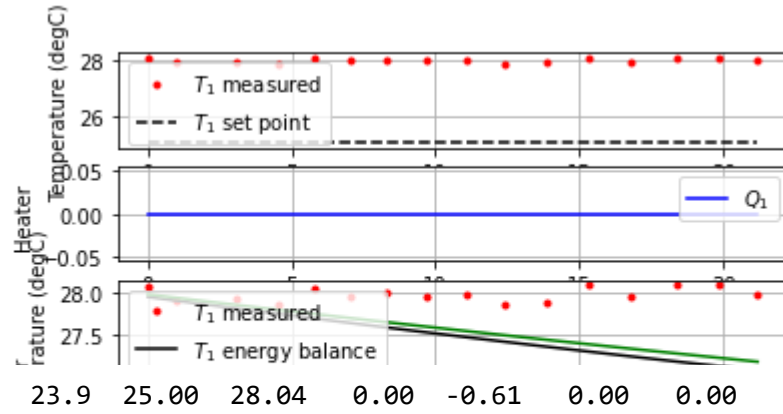


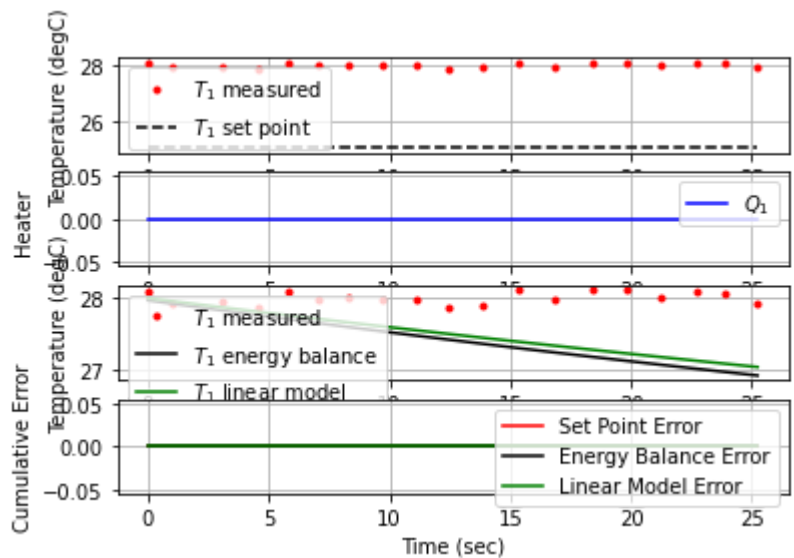
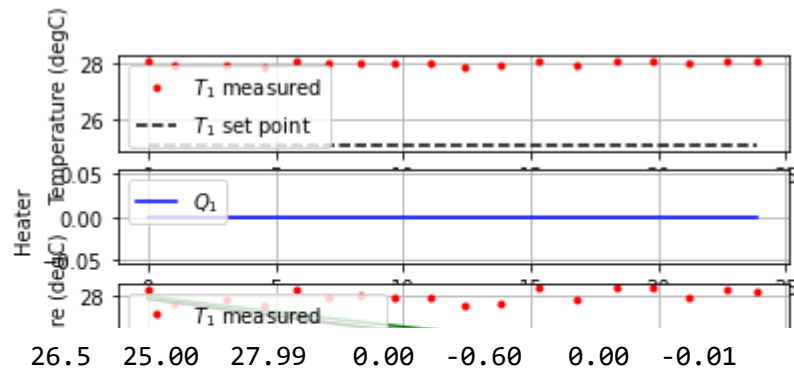
18.4 25.00 28.09 0.00 -0.62 0.00 -0.01

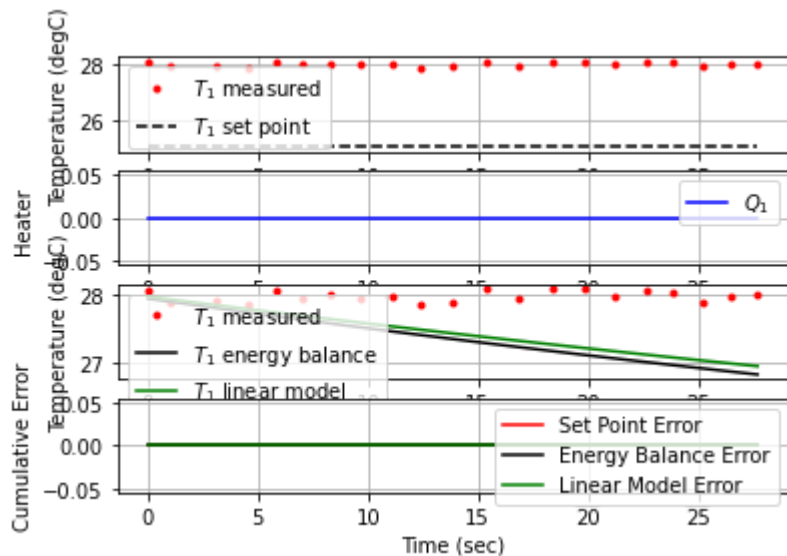
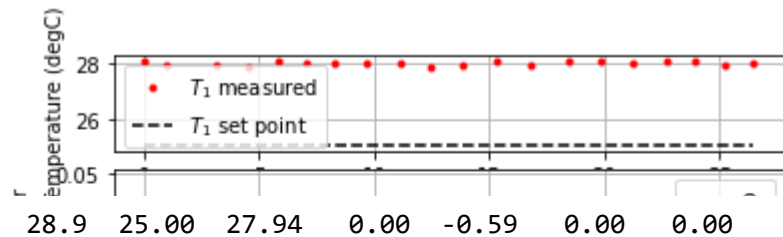


19.8 25.00 28.10 0.00 -0.63 0.00 -0.00

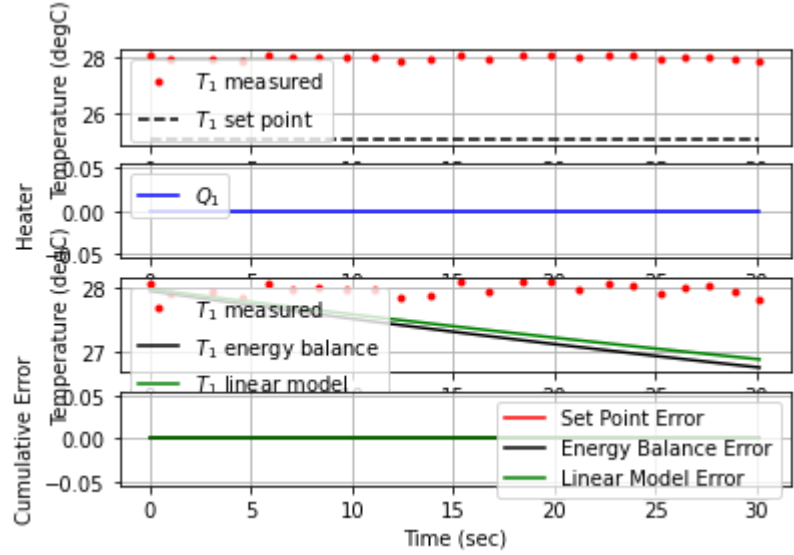




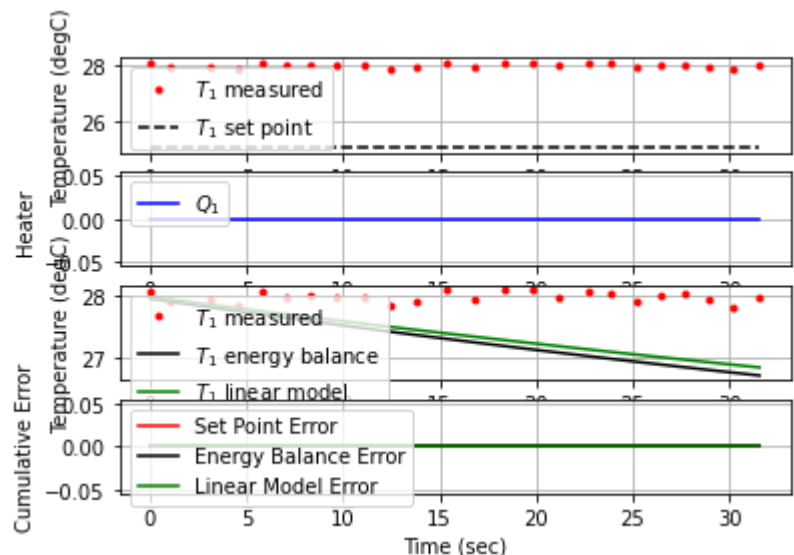




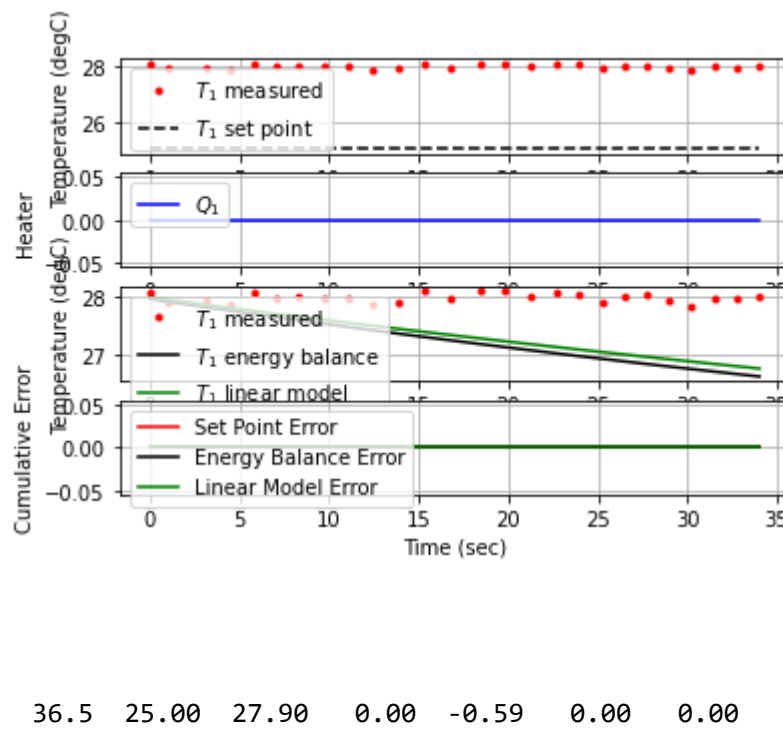
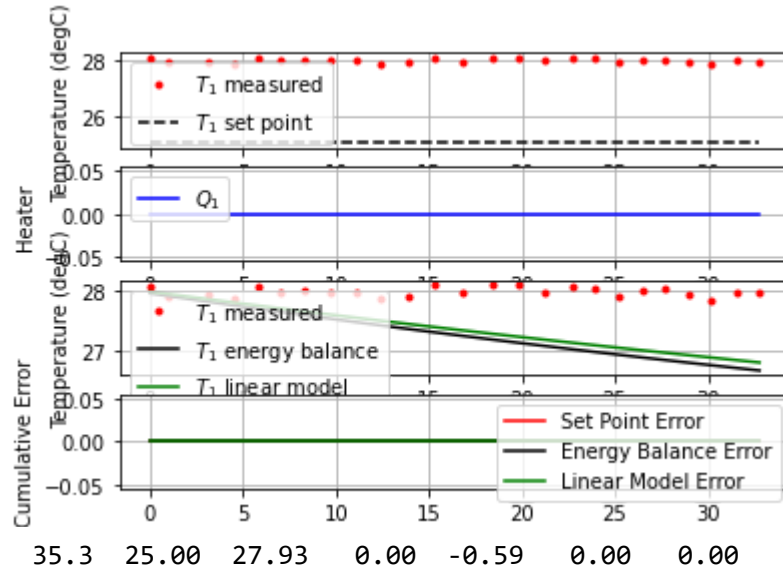
31.6 25.00 27.97 0.00 -0.60 0.00 -0.01



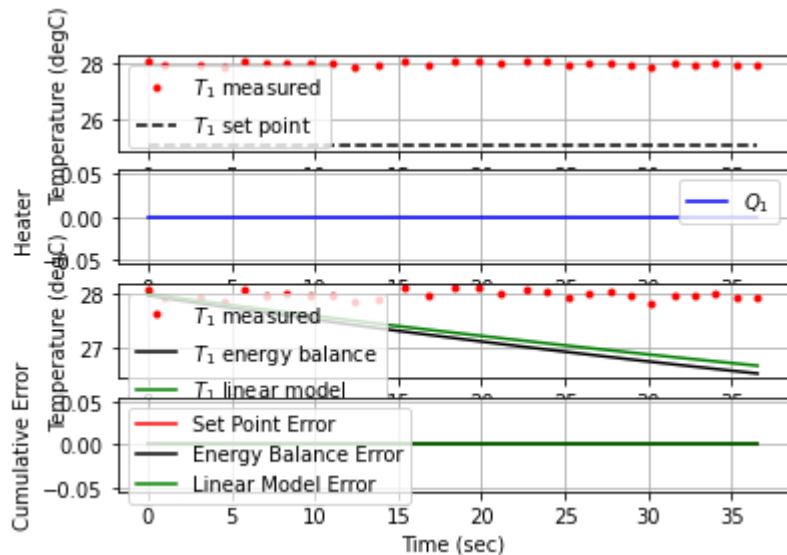
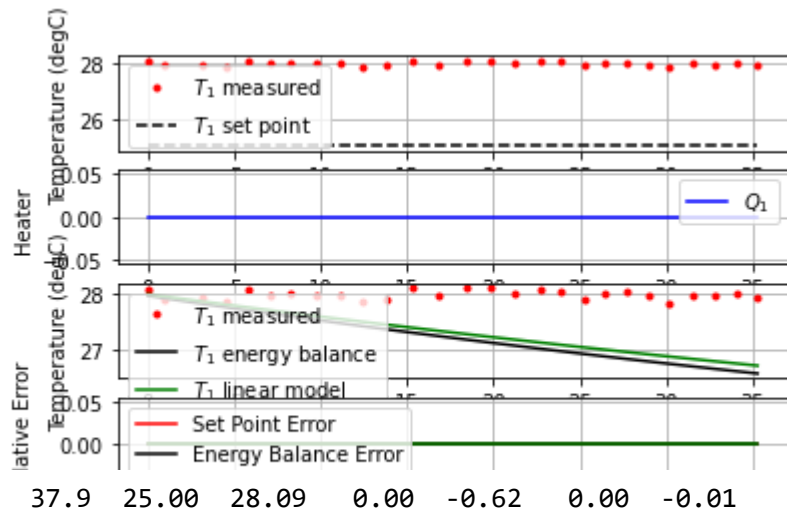
32.8 25.00 27.95 0.00 -0.60 0.00 0.00

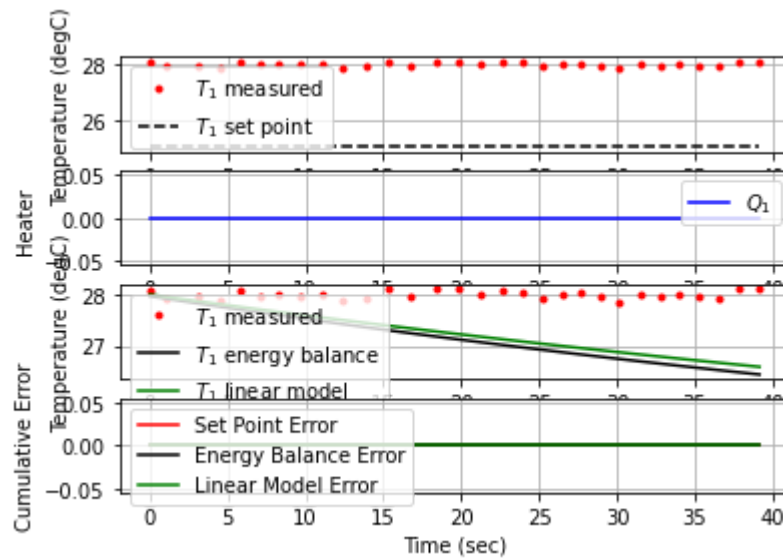
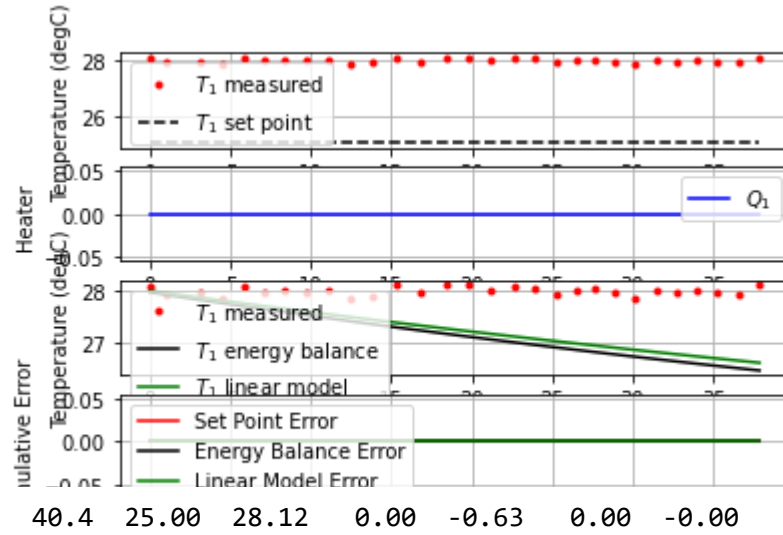


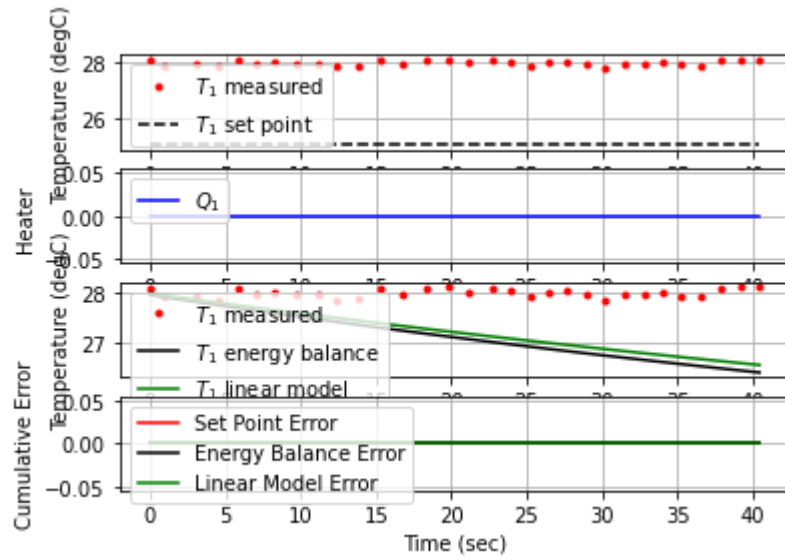
34.0 25.00 27.99 0.00 -0.60 0.00 -0.00



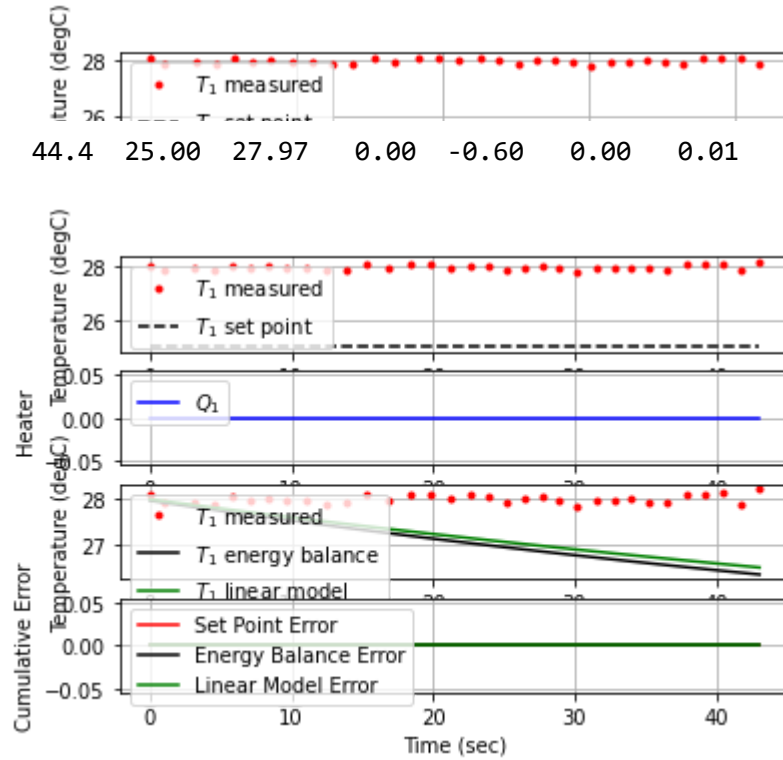




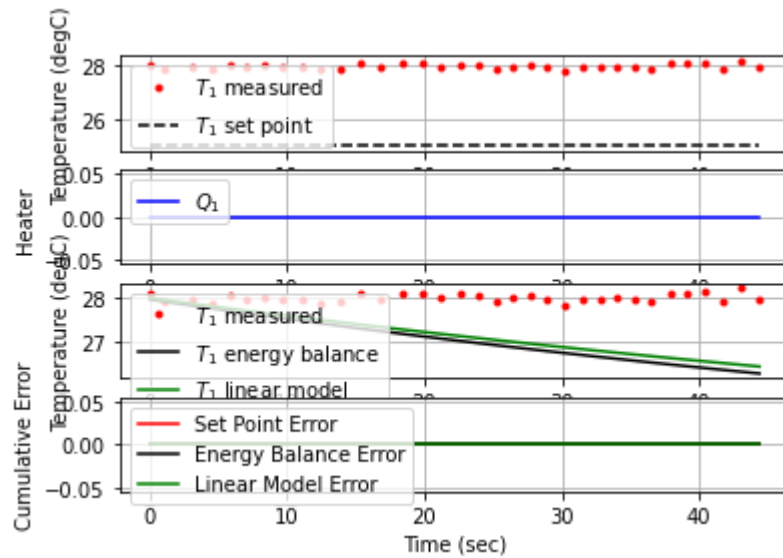




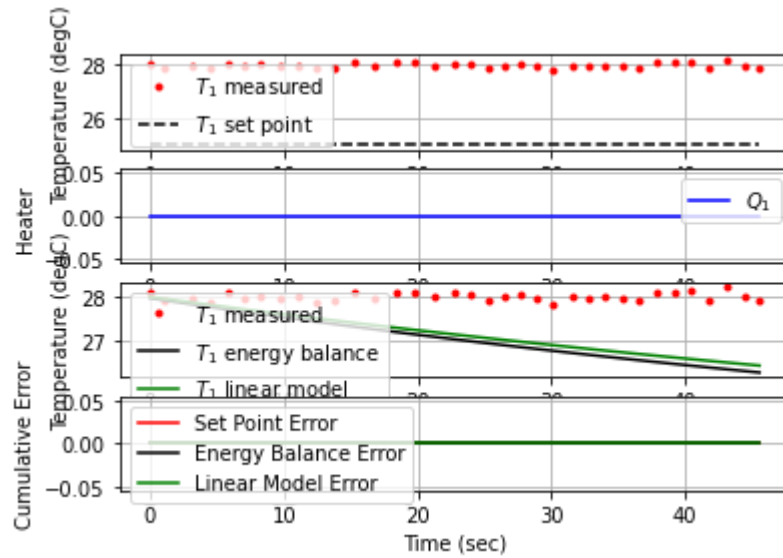
43.1 25.00 28.22 0.00 -0.65 0.00 -0.02



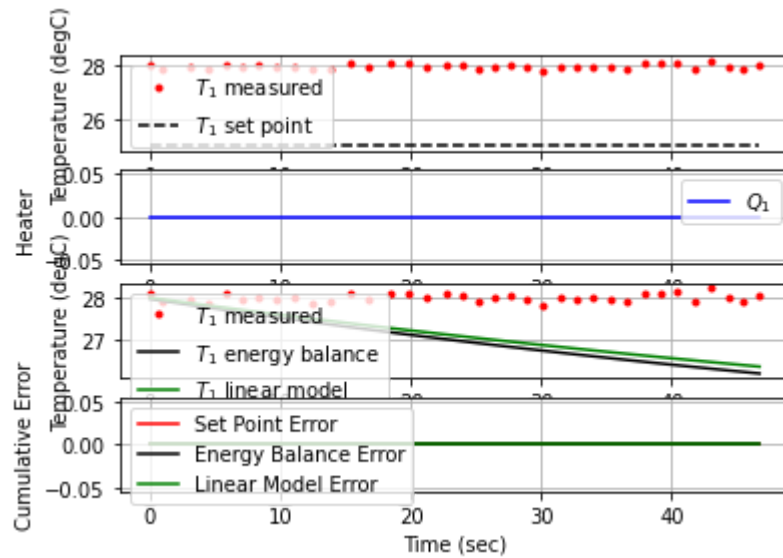
45.5 25.00 27.90 0.00 -0.59 0.00 0.00



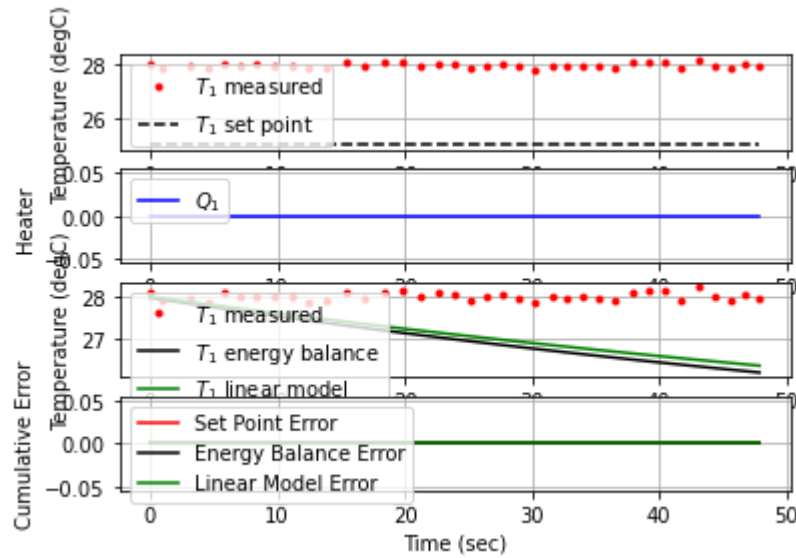
46.7 25.00 28.05 0.00 -0.62 0.00 -0.01



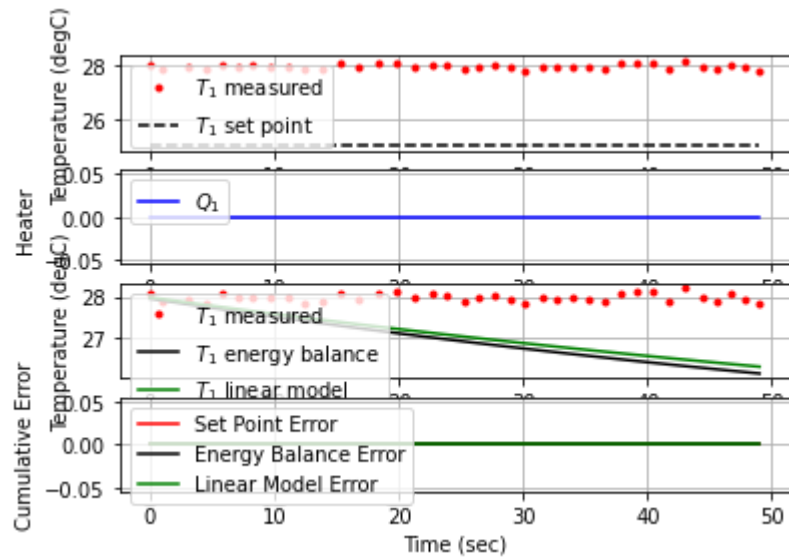
47.9 25.00 27.95 0.00 -0.60 0.00 0.01



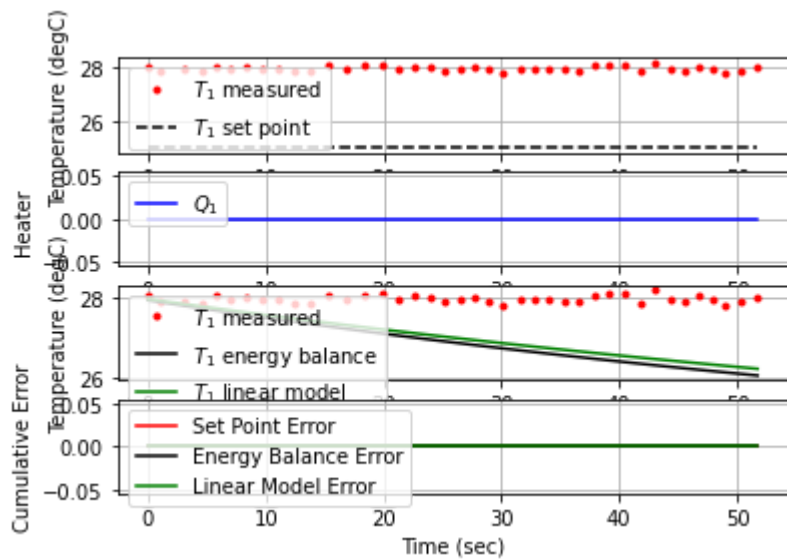
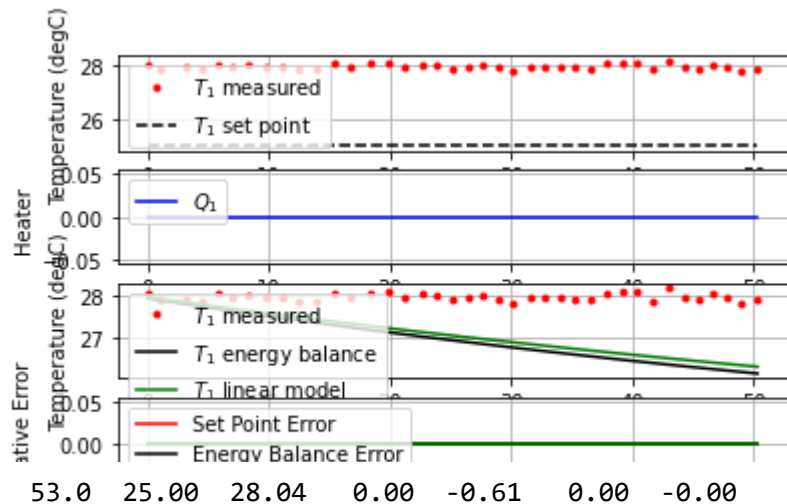
49.0 25.00 27.84 0.00 -0.57 0.00 0.01



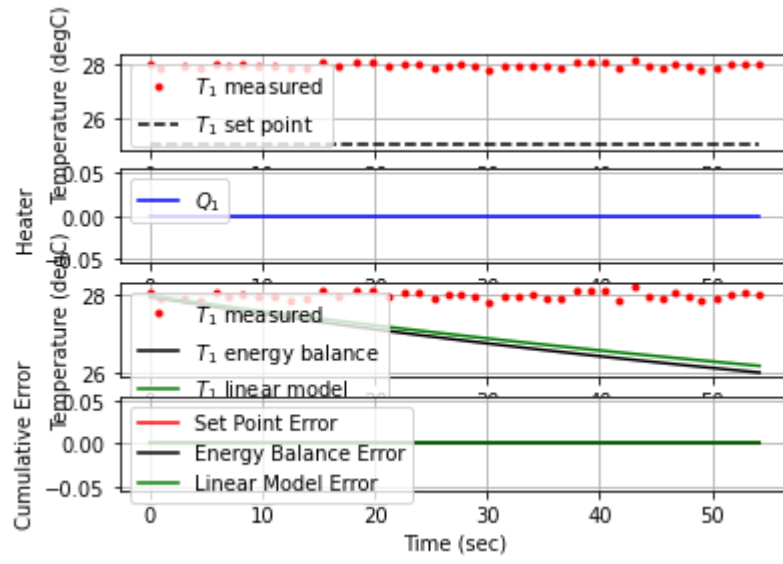
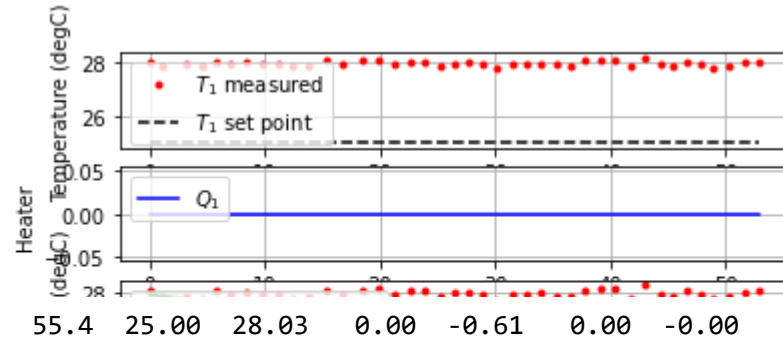
50.4 25.00 27.90 0.00 -0.59 0.00 -0.00



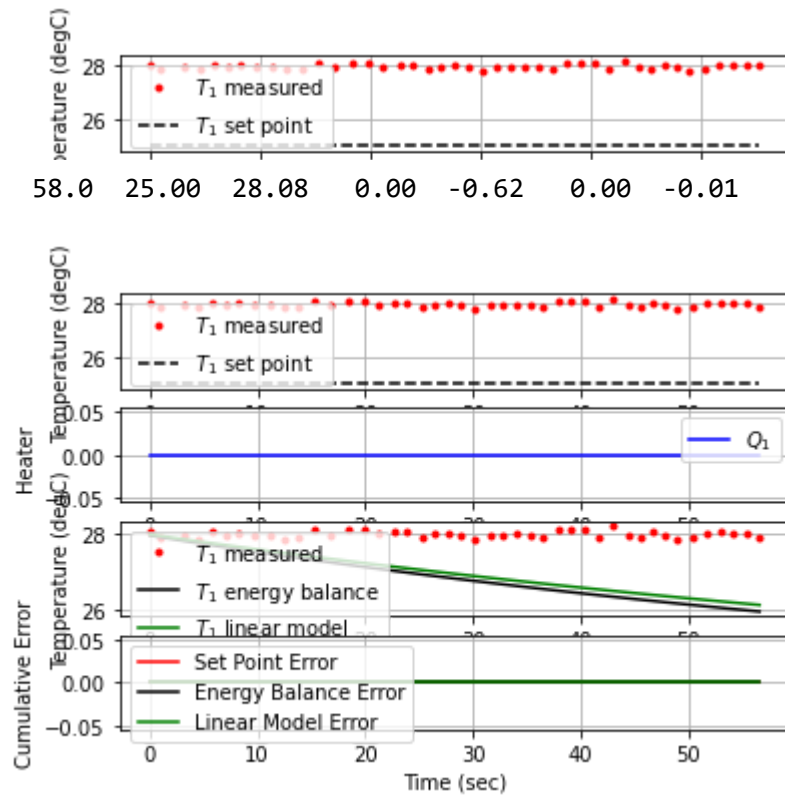
51.7 25.00 28.01 0.00 -0.61 0.00 -0.01



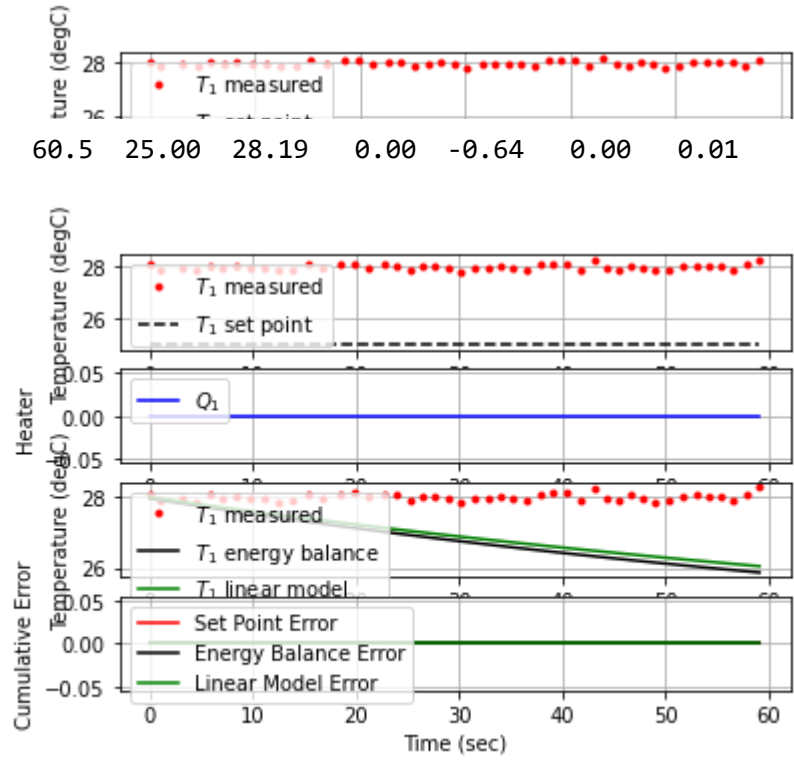
54.2 25.00 28.01 0.00 -0.61 0.00 0.00



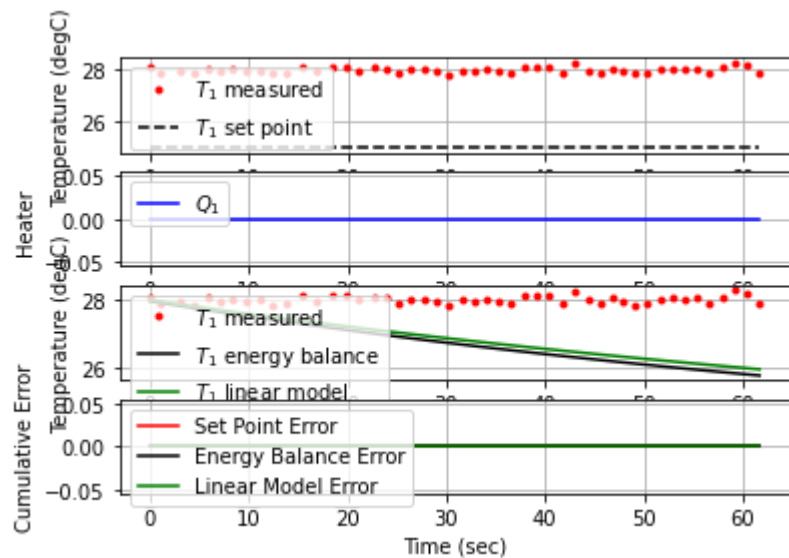
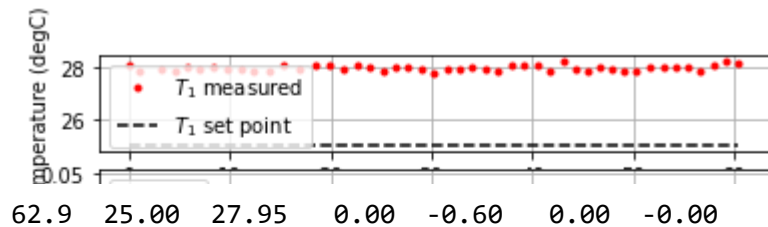




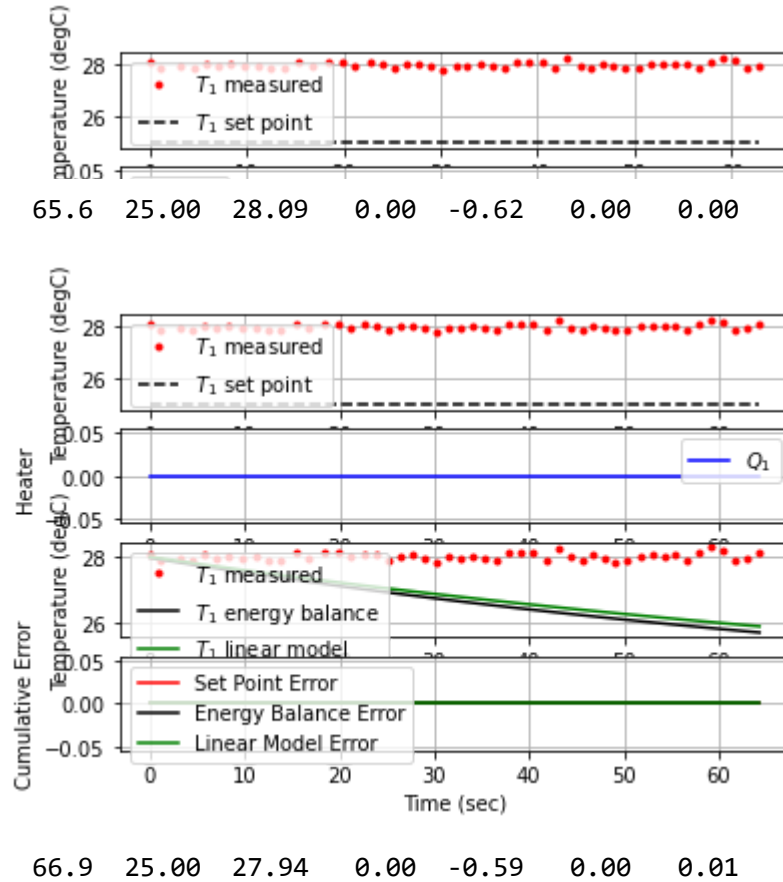
59.1 25.00 28.29 0.00 -0.66 0.00 -0.01

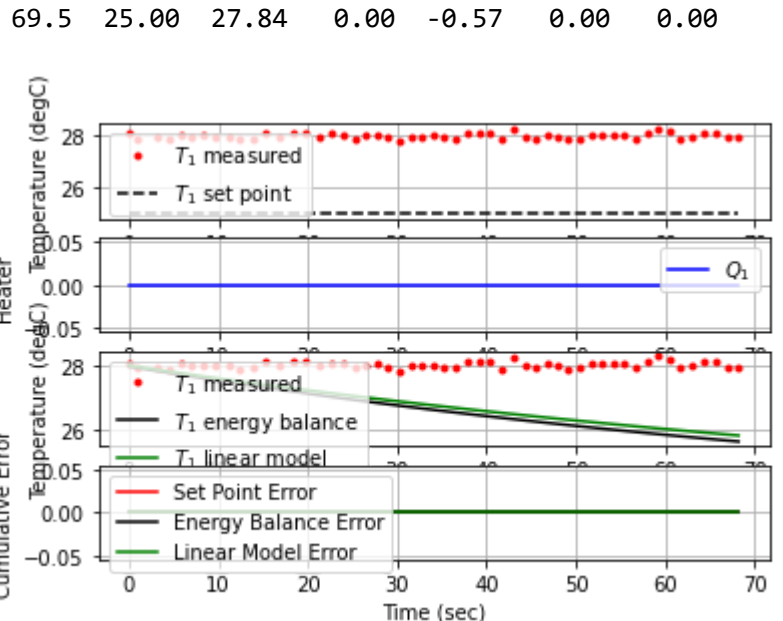
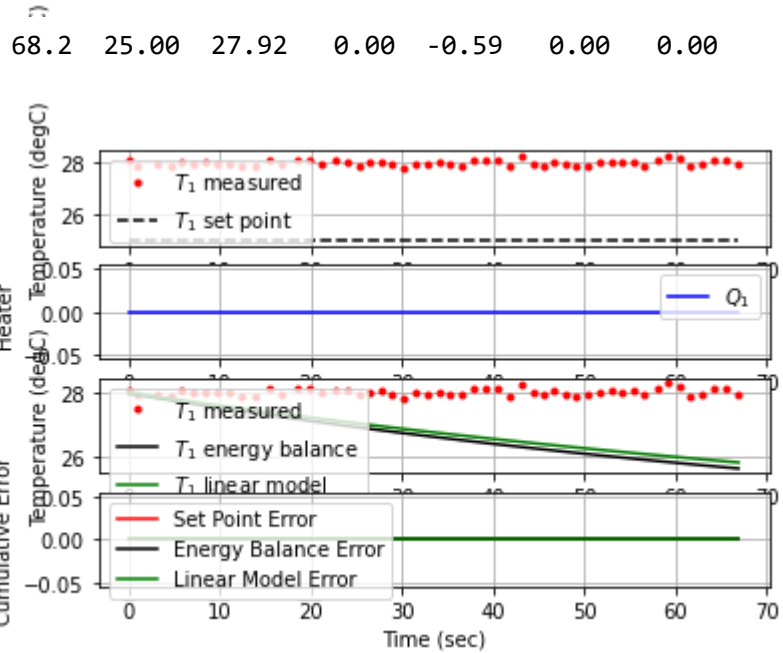


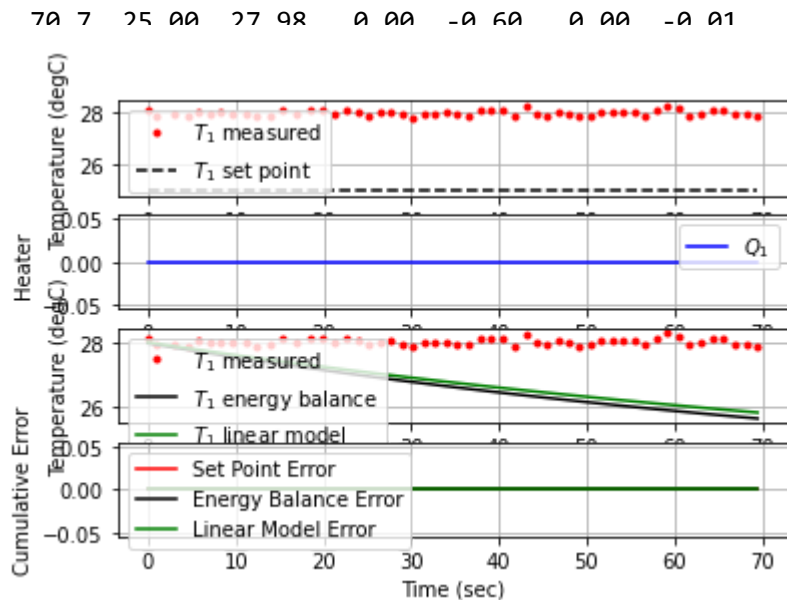
61.7 25.00 27.89 0.00 -0.58 0.00 0.02



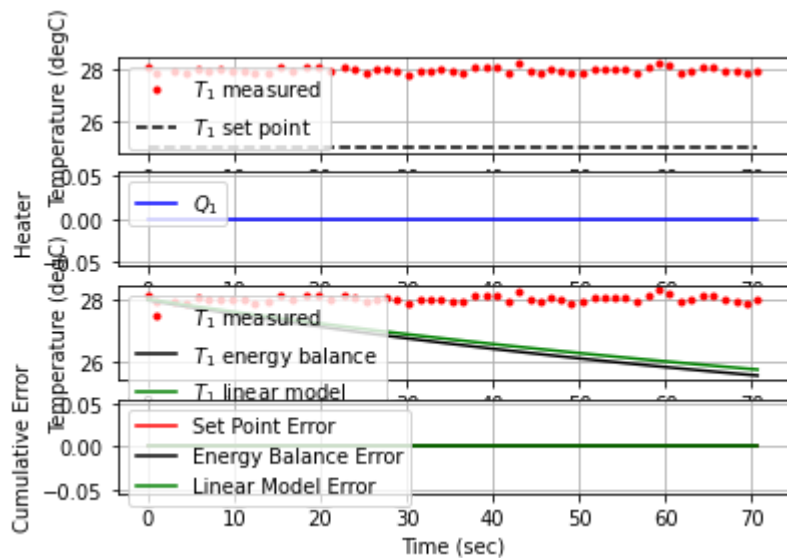
64.3 25.00 28.10 0.00 -0.63 0.00 -0.01



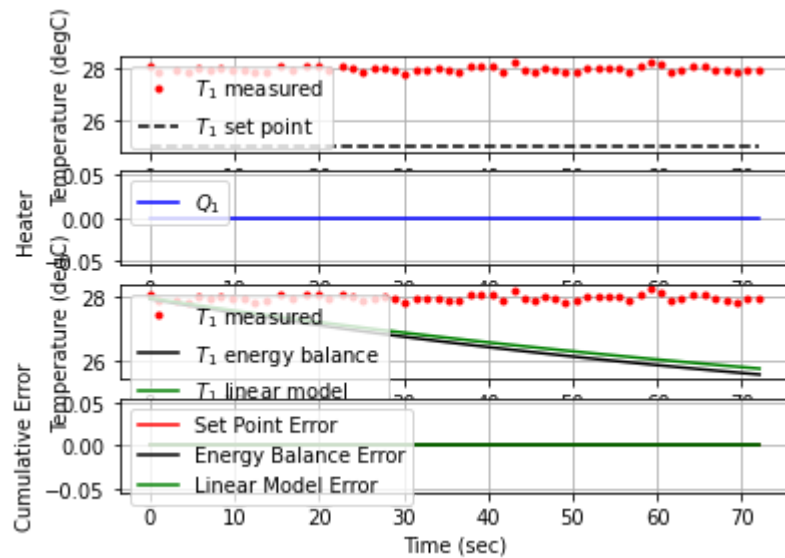




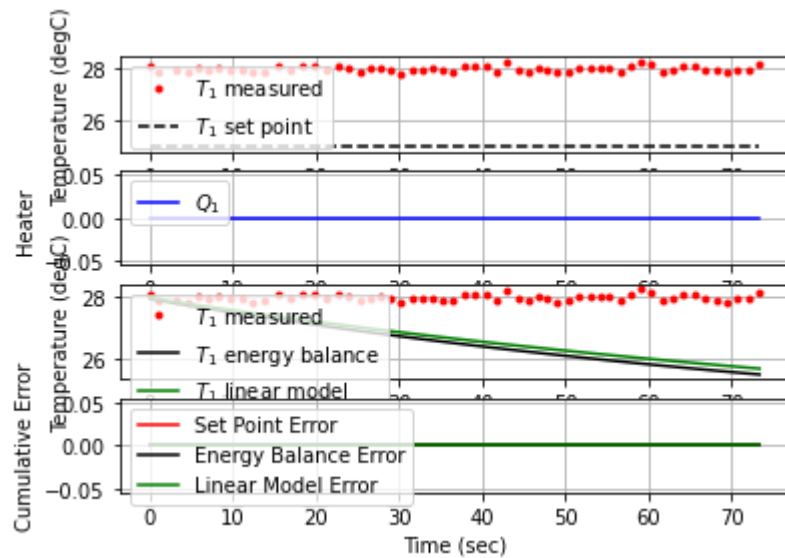
72.1 25.00 27.95 0.00 -0.60 0.00 0.00



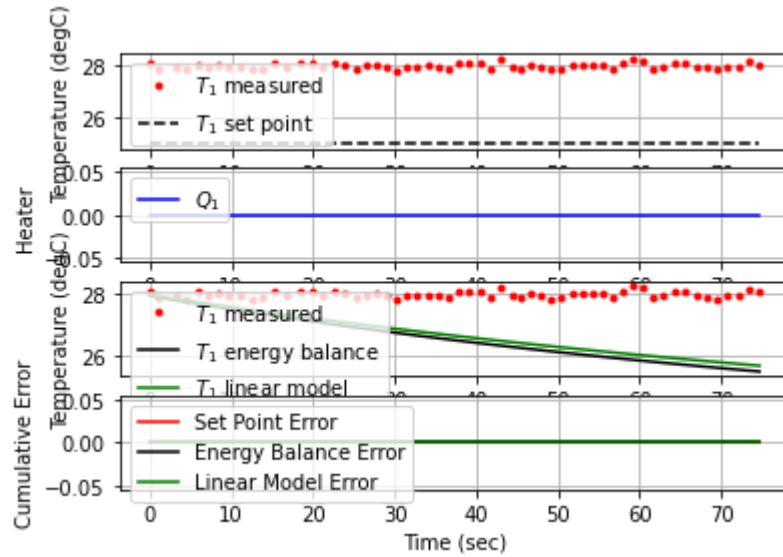
73.4 25.00 28.14 0.00 -0.63 0.00 -0.01



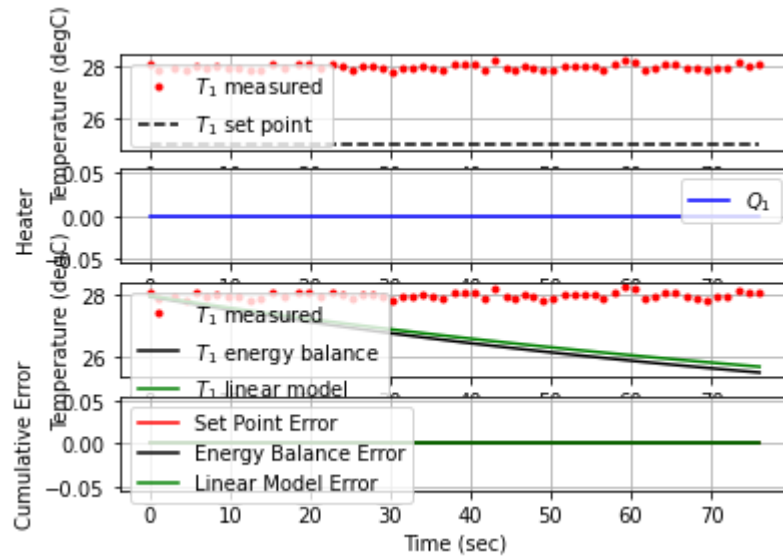
74.7 25.00 28.06 0.00 -0.62 0.00 0.00



76.1 25.00 28.08 0.00 -0.62 0.00 -0.00

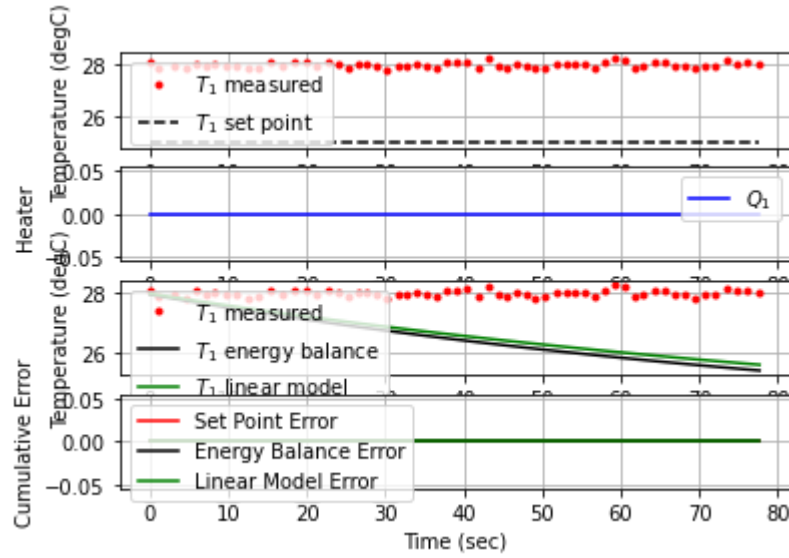


77.7 25.00 27.99 0.00 -0.60 0.00 0.00

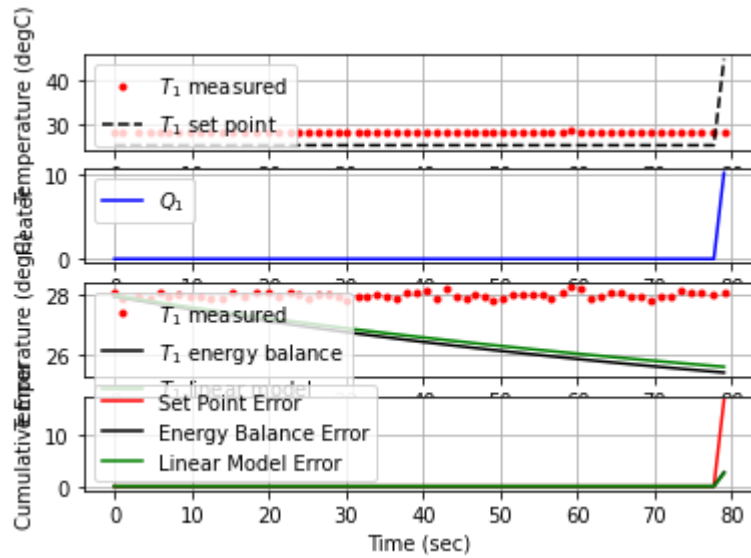


79.0 45.00 28.10 10.11 3.74 6.37 -0.01

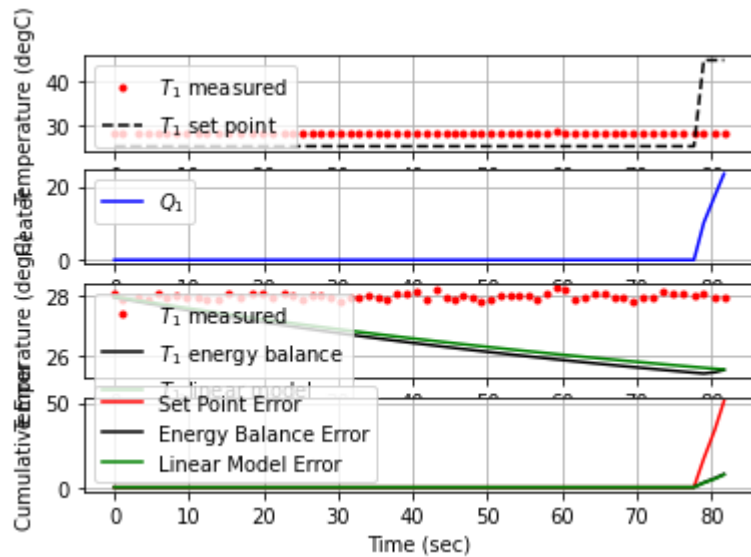
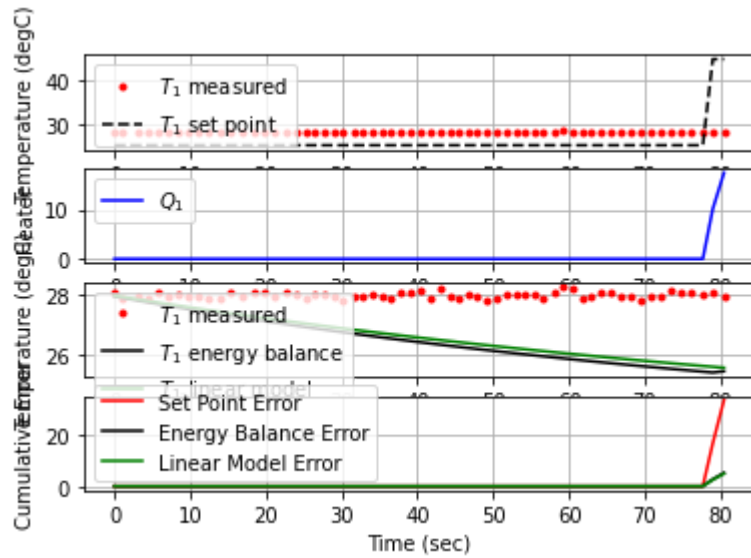


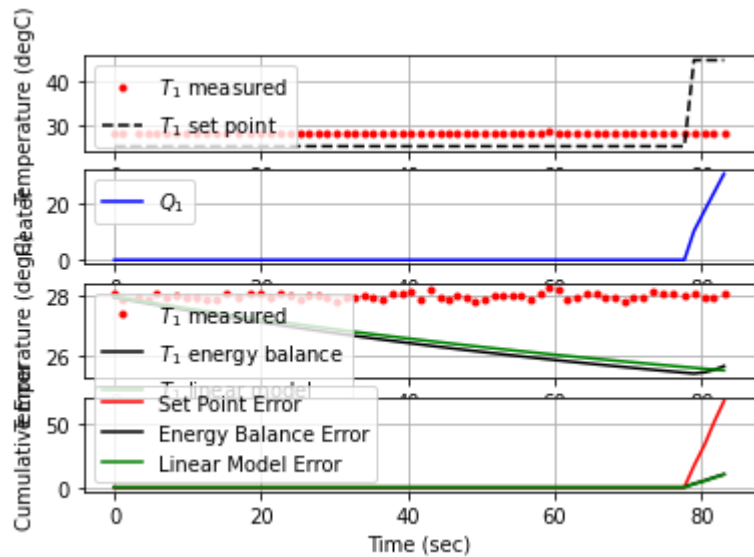


80.5 45.00 27.95 17.41 3.78 13.62 0.01

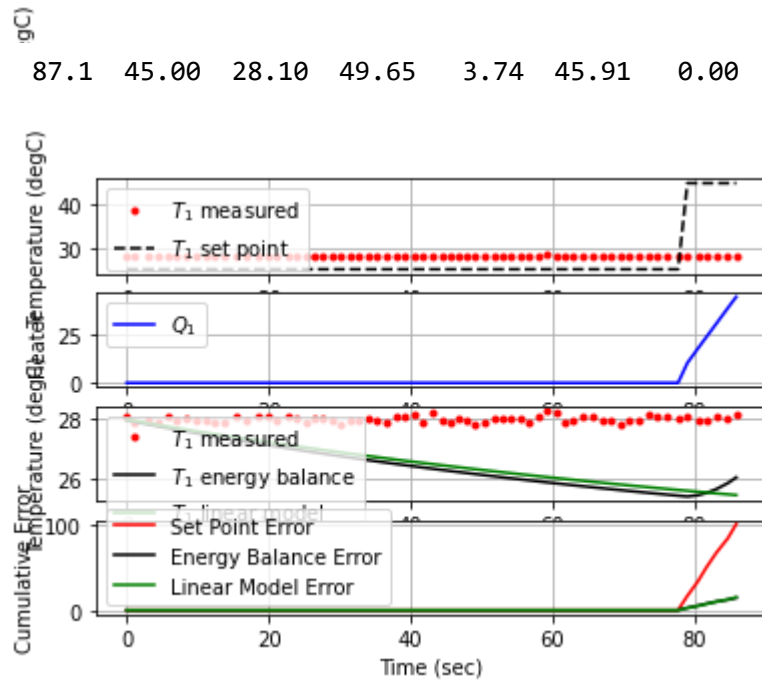


81.7 45.00 27.97 23.42 3.77 19.65 -0.00

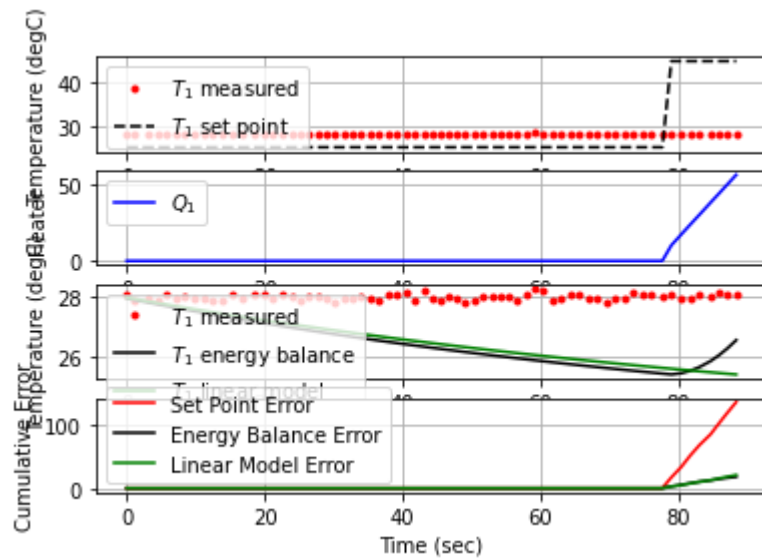
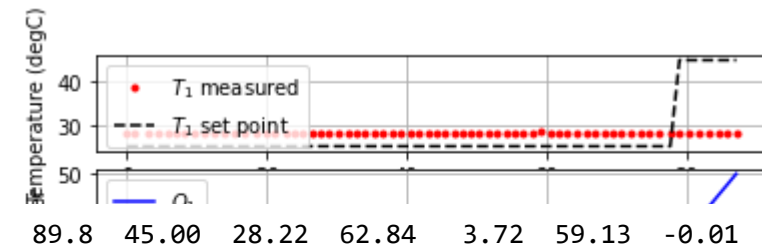


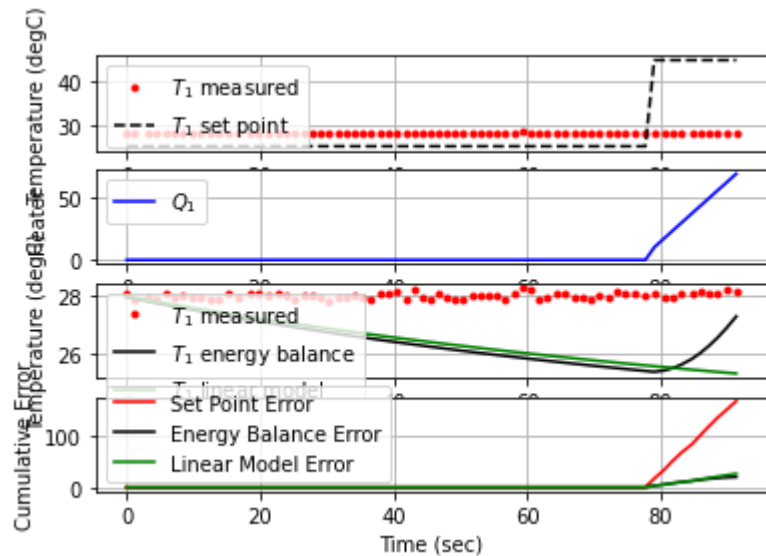
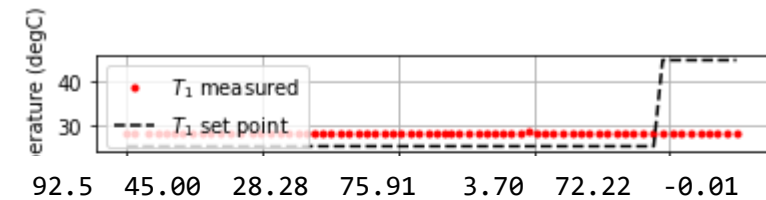


85.9 45.00 28.16 43.63 3.73 39.91 -0.01

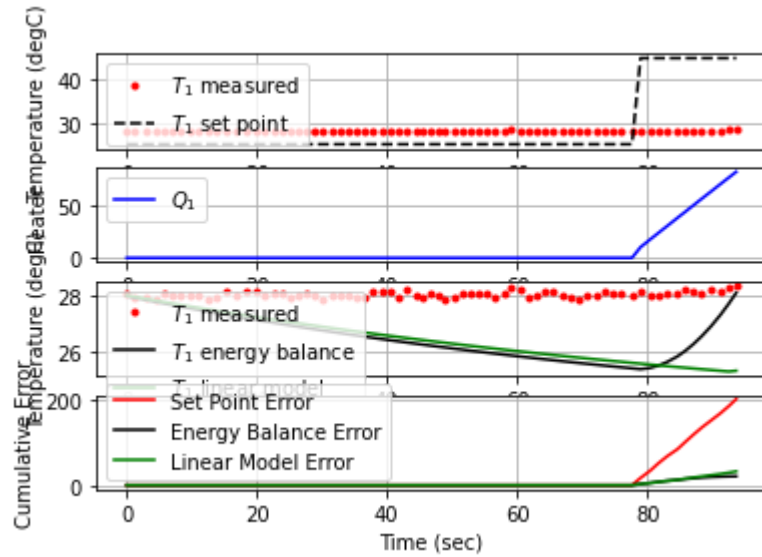
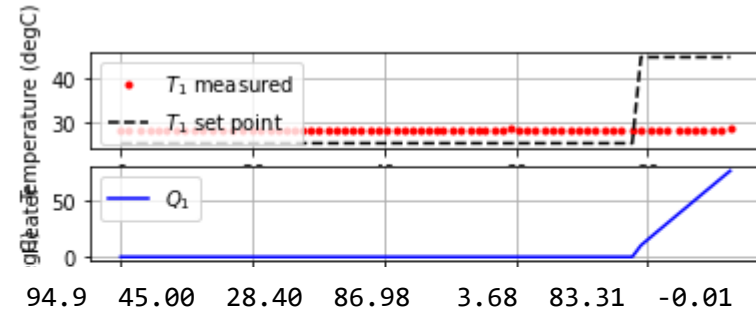


88.4 45.00 28.07 55.95 3.75 52.20 0.00

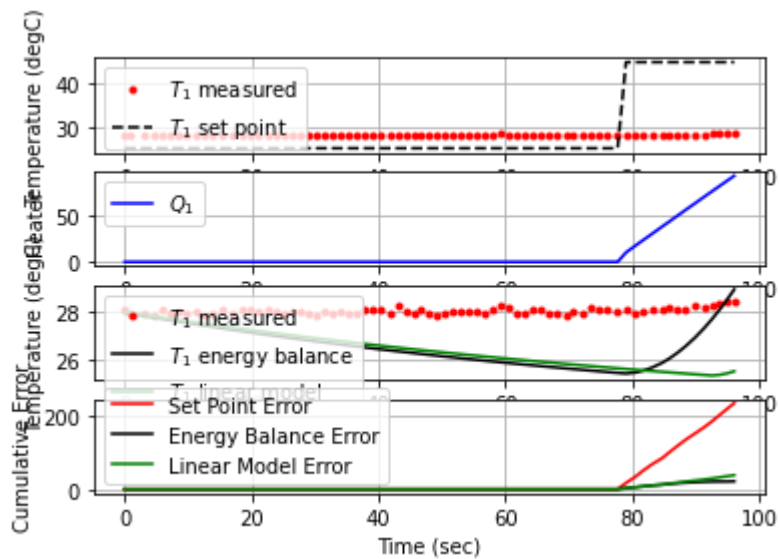
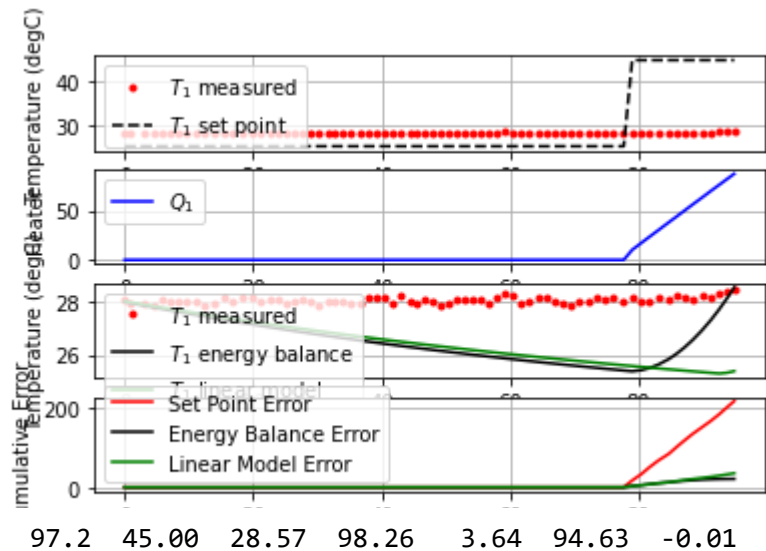




93.7 45.00 28.33 81.42 3.69 77.73 -0.00

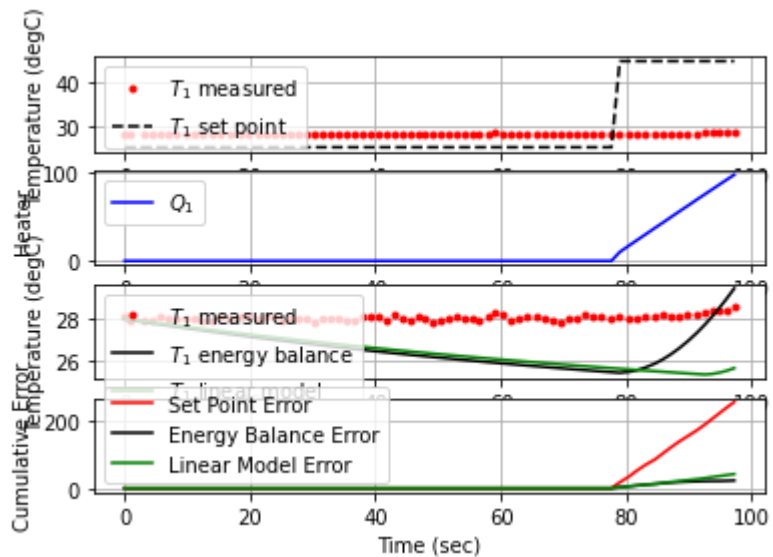


96.0 45.00 28.39 92.57 3.68 88.89 0.00

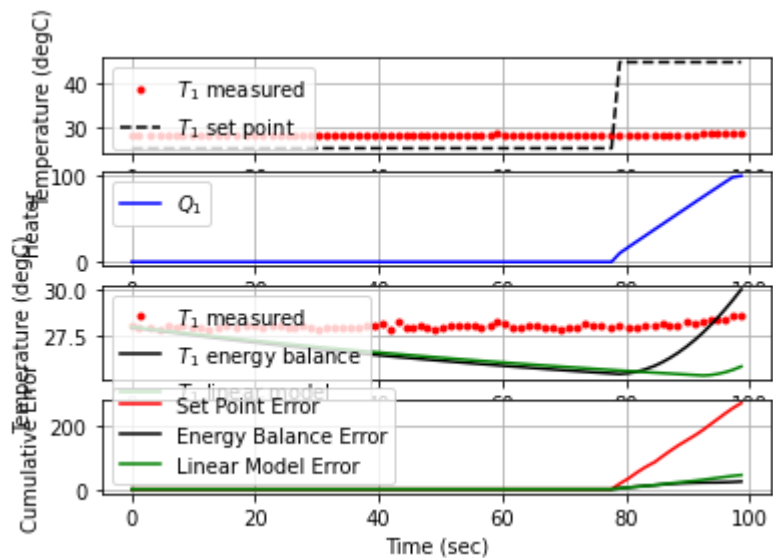




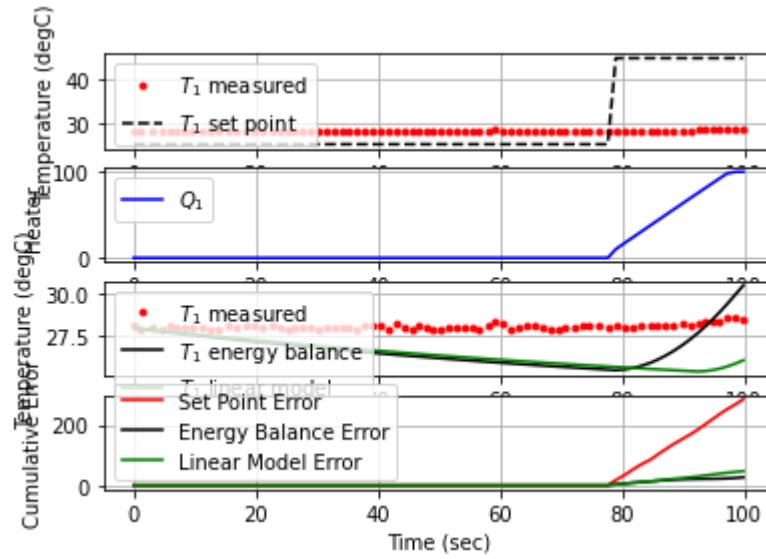
98.7 45.00 28.55 100.00 3.64 94.63 0.00



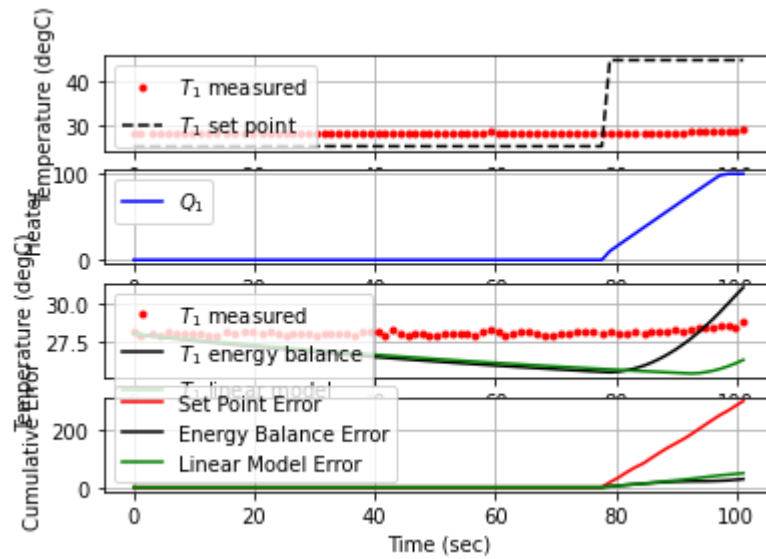
99.9 45.00 28.44 100.00 3.67 94.63 0.01



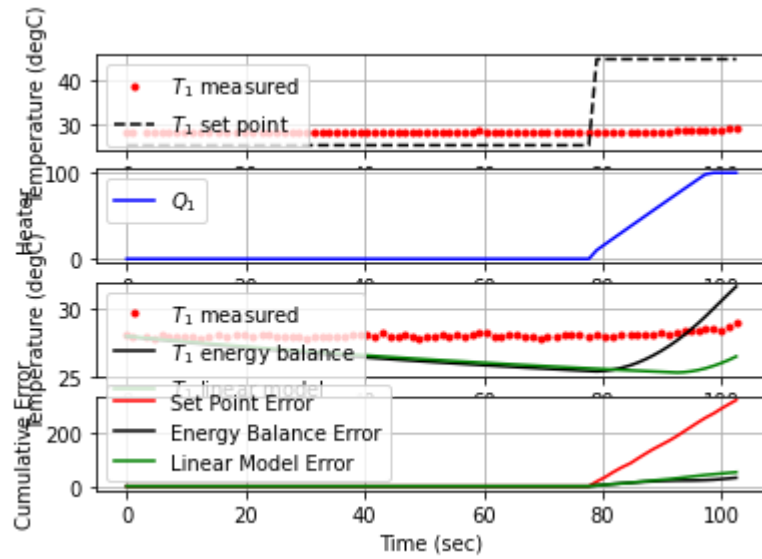
101.1 45.00 28.73 100.00 3.60 94.63 -0.02



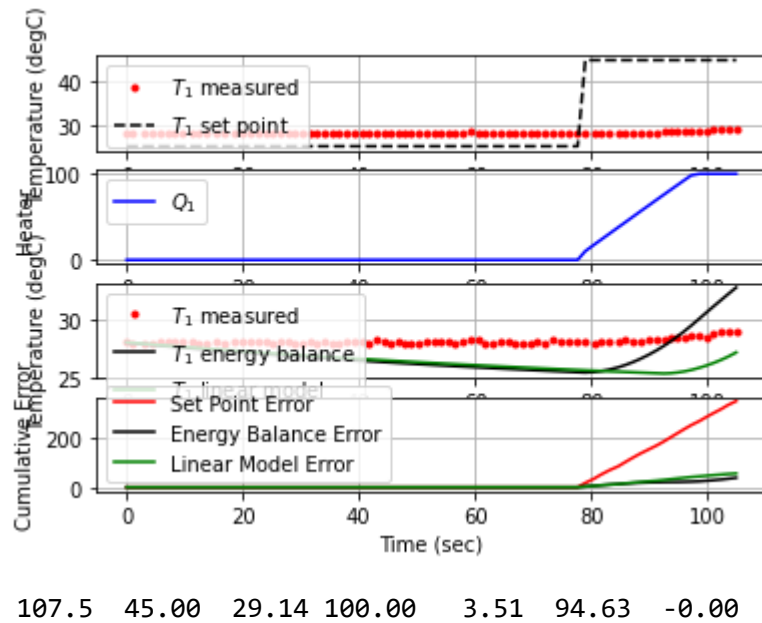
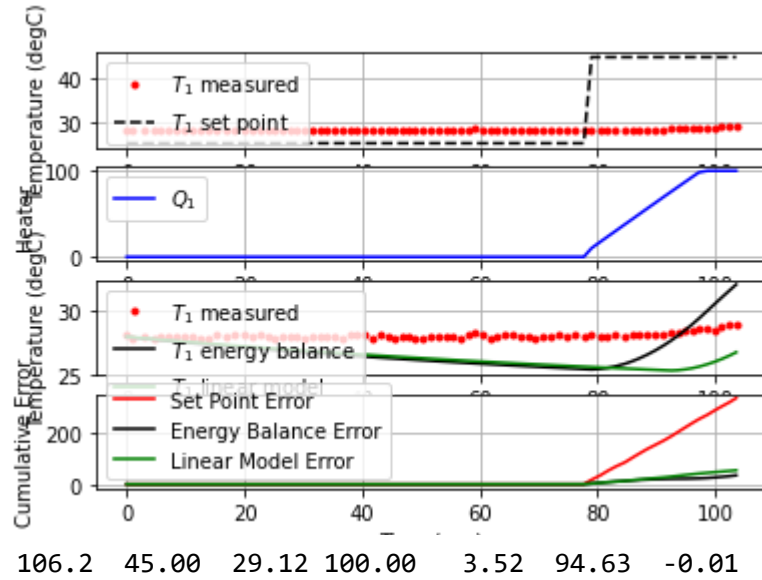
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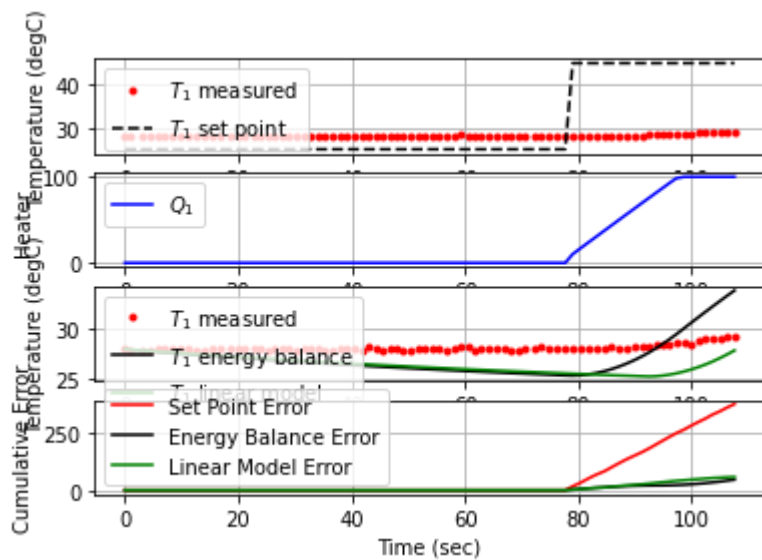
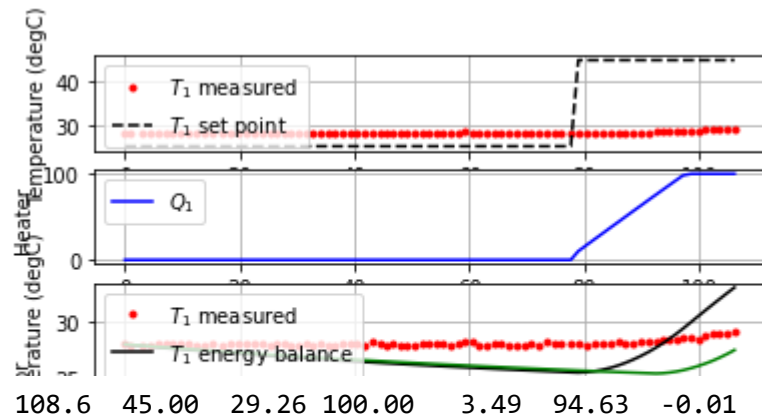


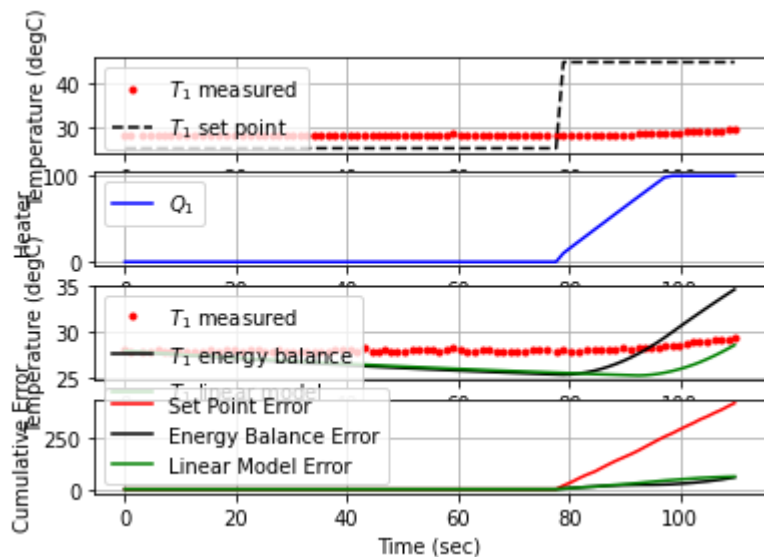
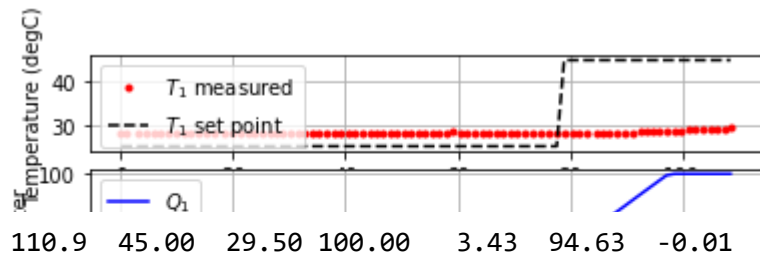
103.6 45.00 28.98 100.00 3.55 94.63 -0.00

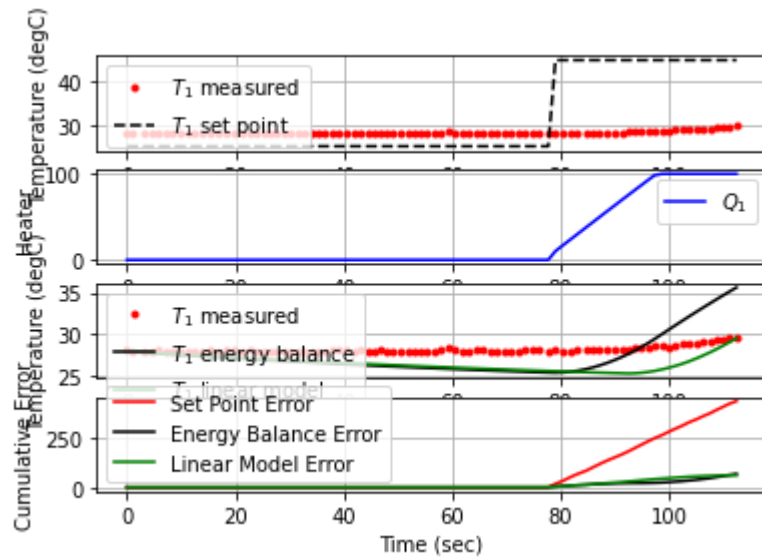
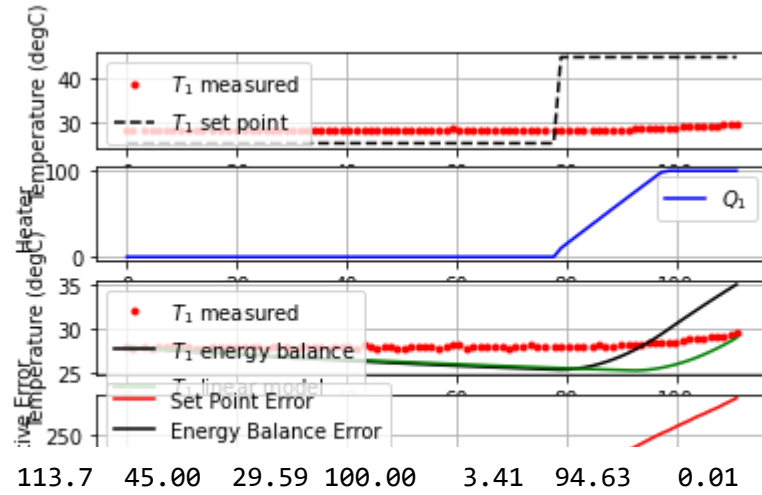


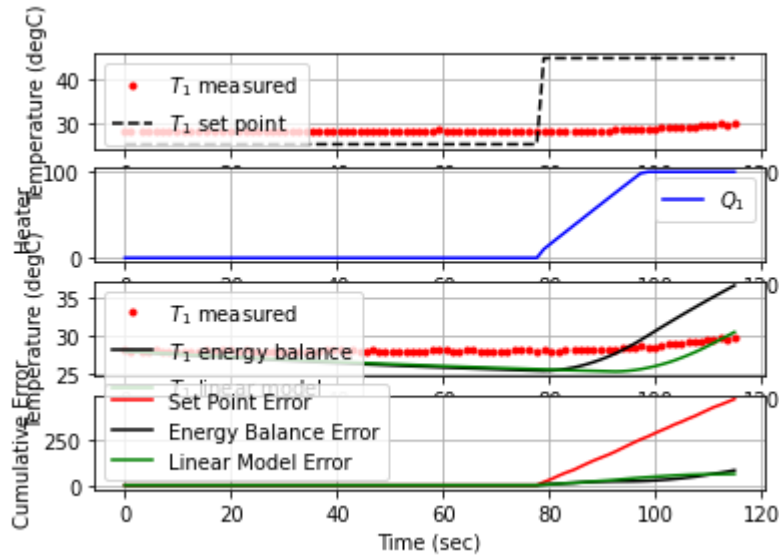
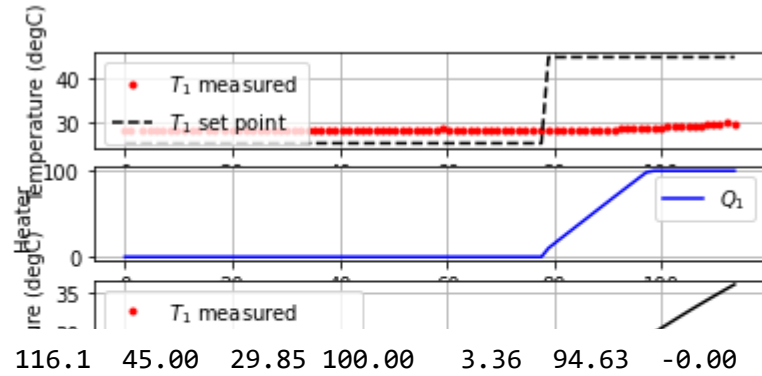
105.0 45.00 28.94 100.00 3.56 94.63 0.00





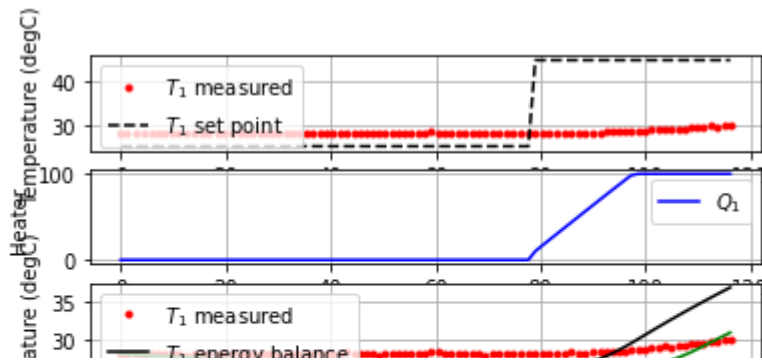




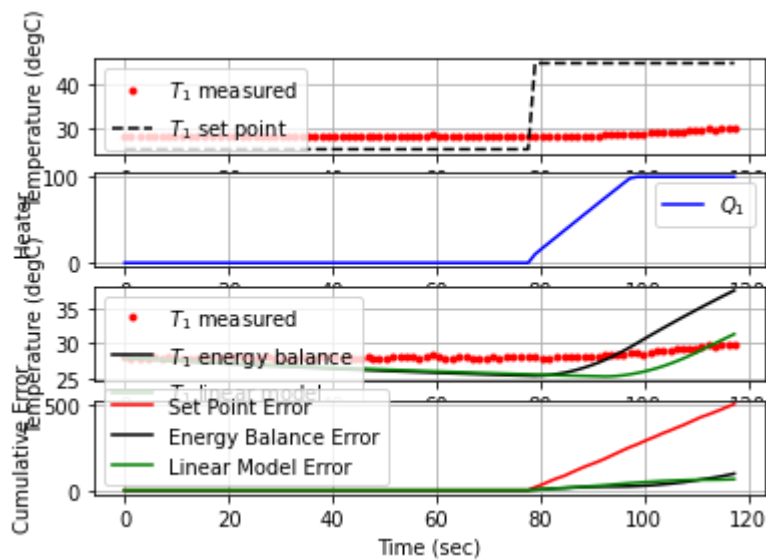


117.3 45.00 29.77 100.00 3.37 94.63 0.01

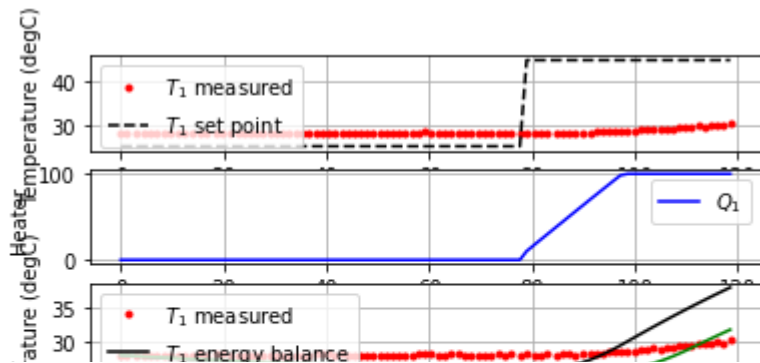




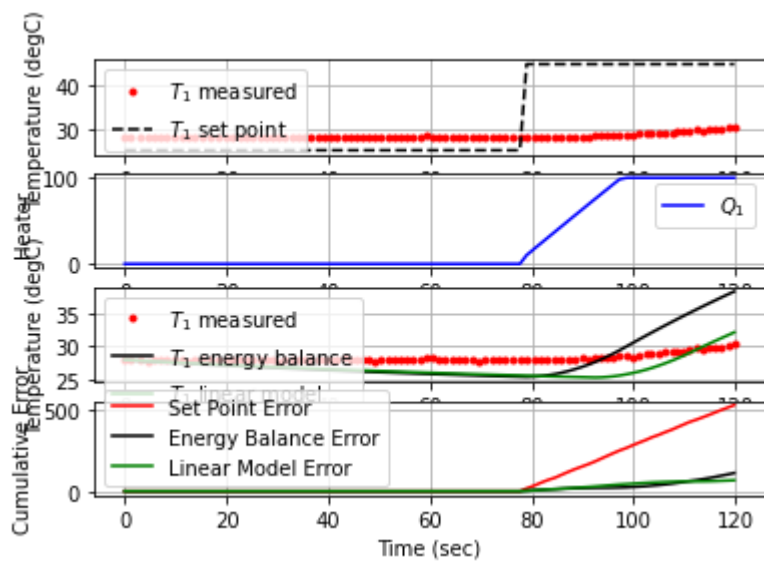
118.6 45.00 30.13 100.00 3.29 94.63 -0.02



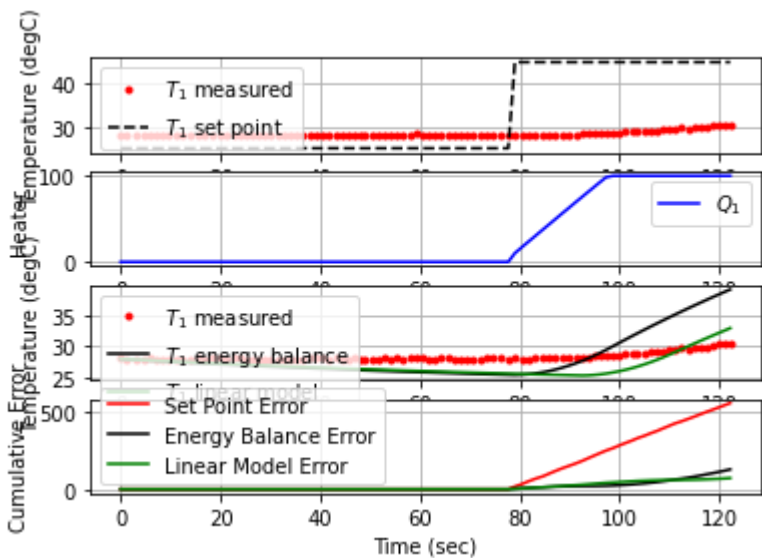
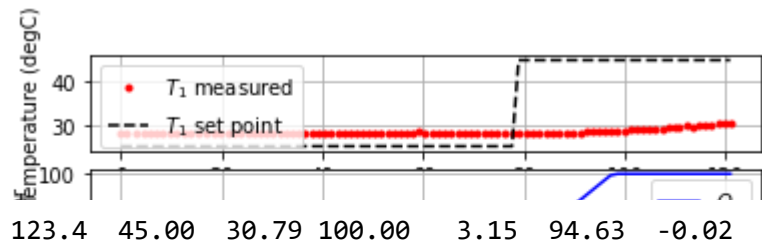
119.8 45.00 30.44 100.00 3.22 94.63 -0.02



121.0 45.00 30.42 100.00 3.23 94.63 0.00

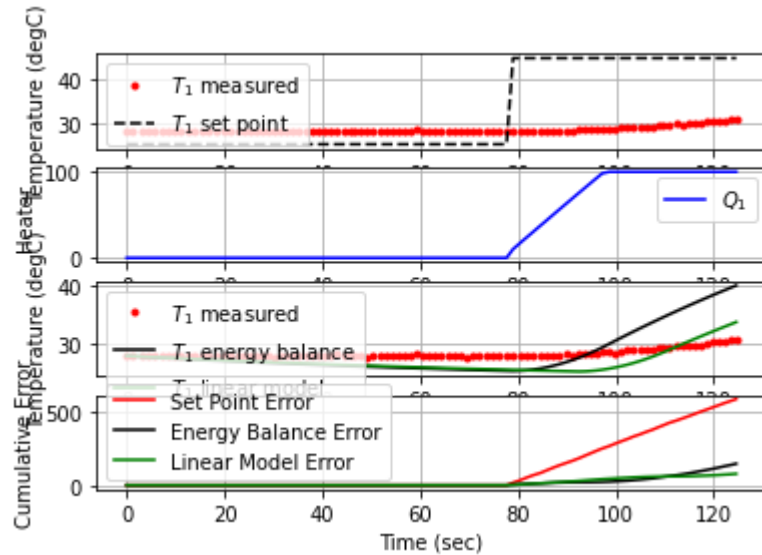


122.1 45.00 30.43 100.00 3.23 94.63 -0.00

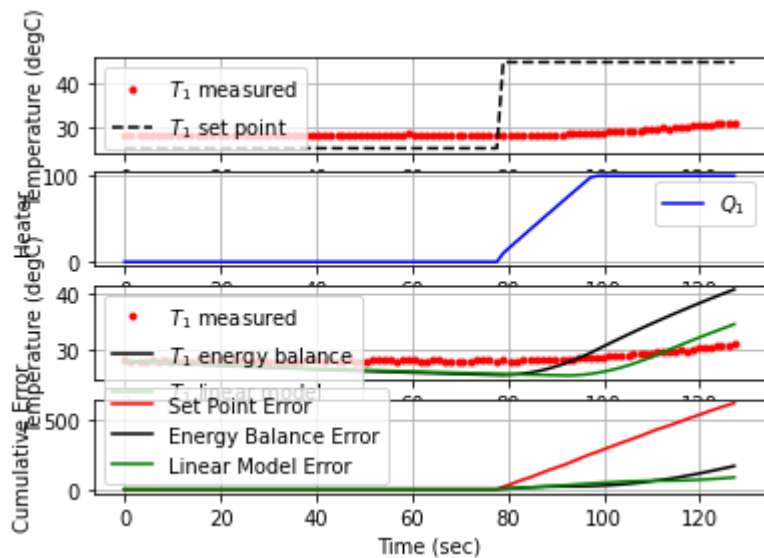
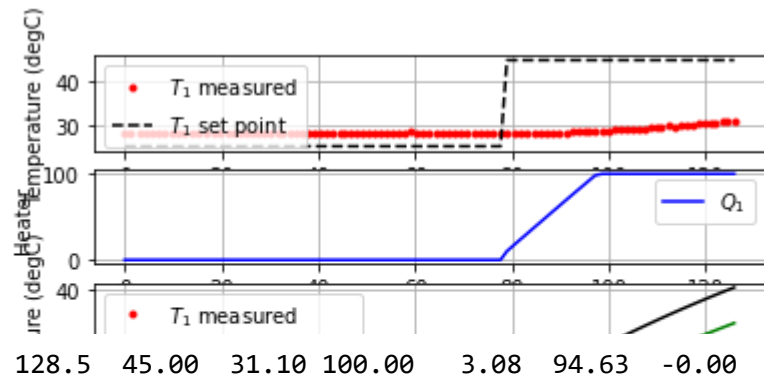


124.6 45.00 30.88 100.00 3.13 94.63 -0.01

126.0 45.00 30.84 100.00 3.14 94.63 0.00

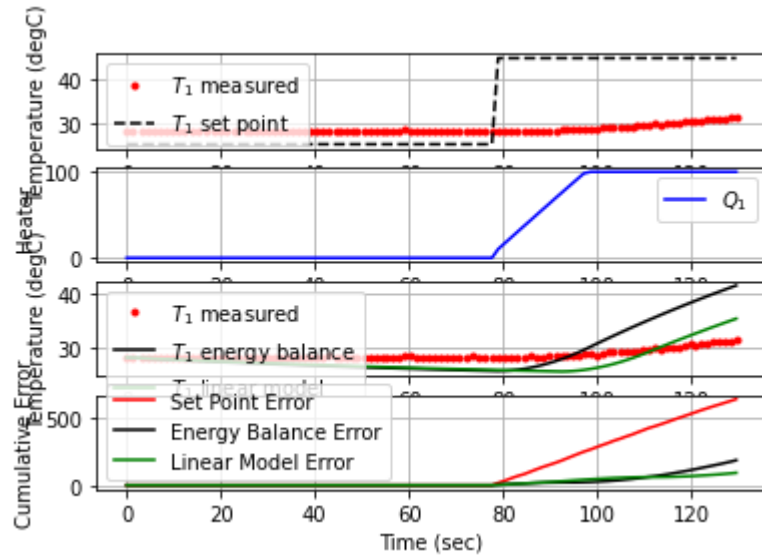
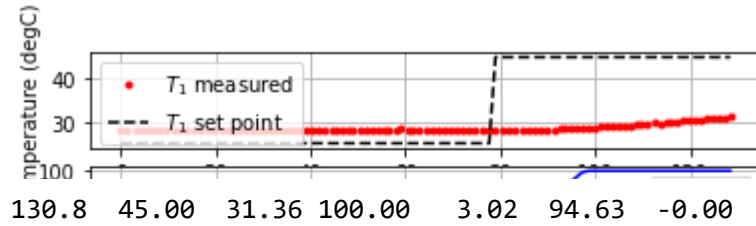


127.2 45.00 31.03 100.00 3.09 94.63 -0.01

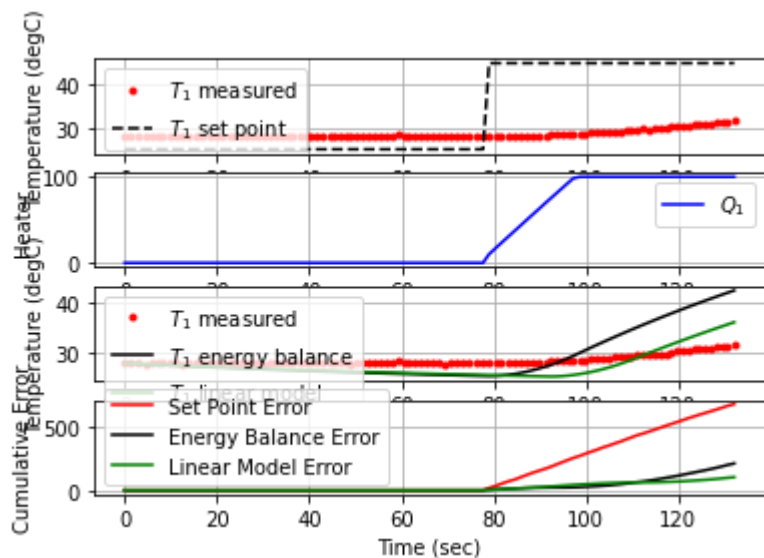


129.6 45.00 31.30 100.00 3.03 94.63 -0.01

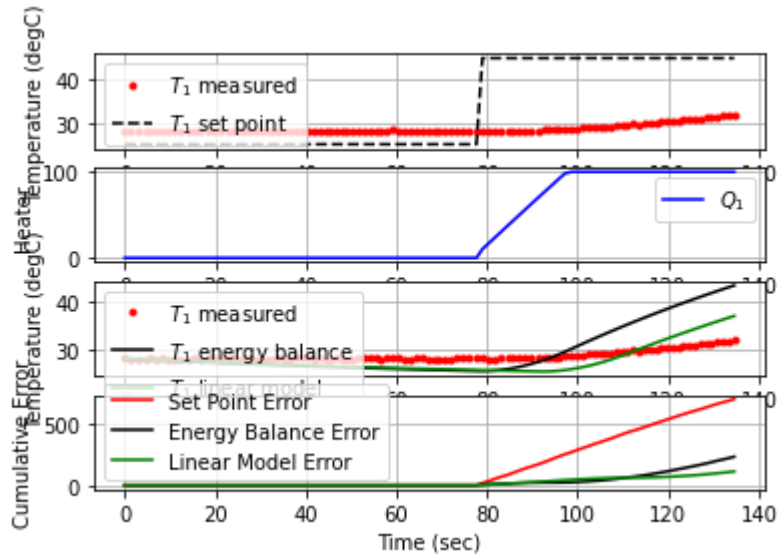
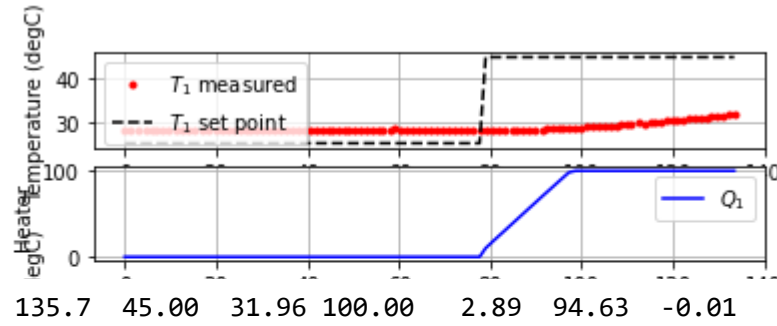




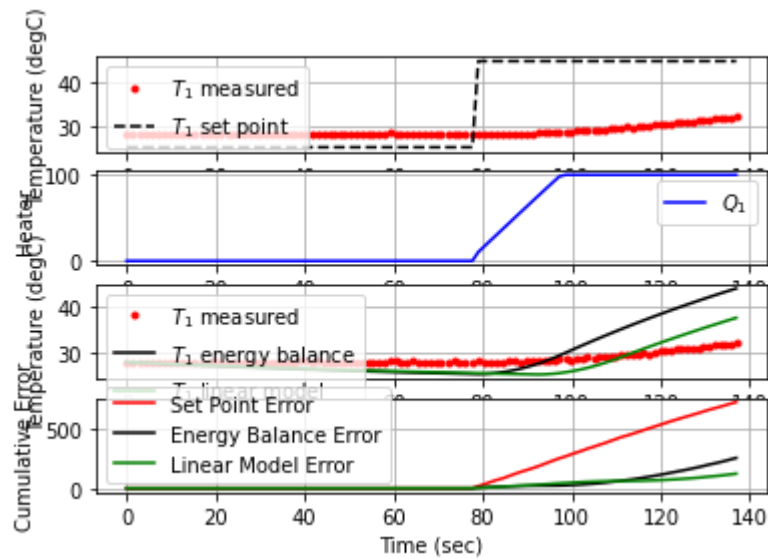
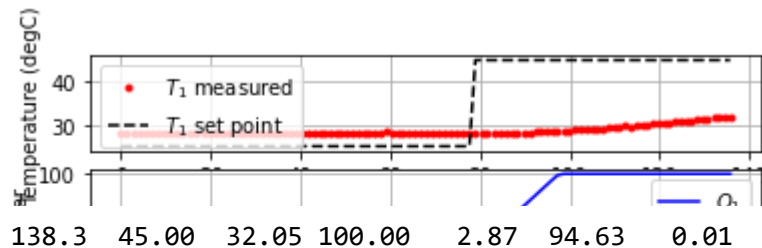
133.4 45.00 31.70 100.00 2.95 94.63 -0.01



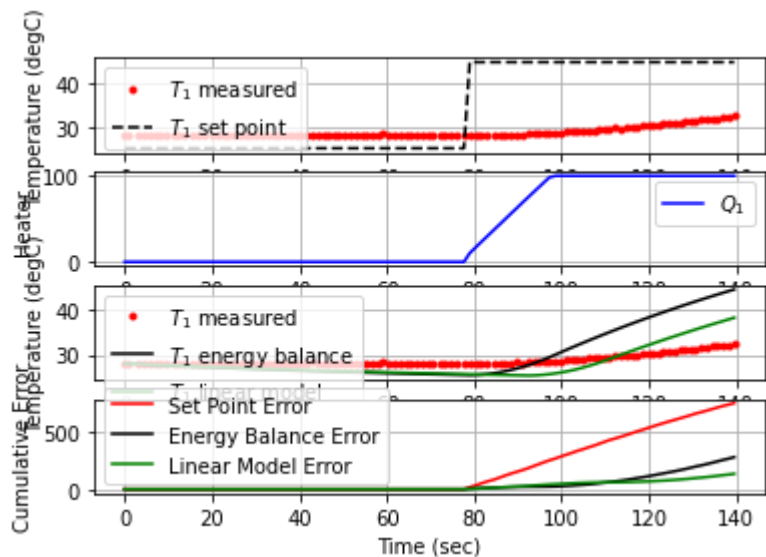
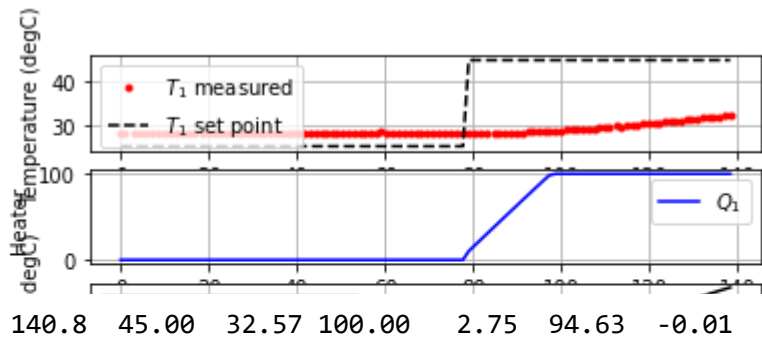
134.6 45.00 31.88 100.00 2.91 94.63 -0.01

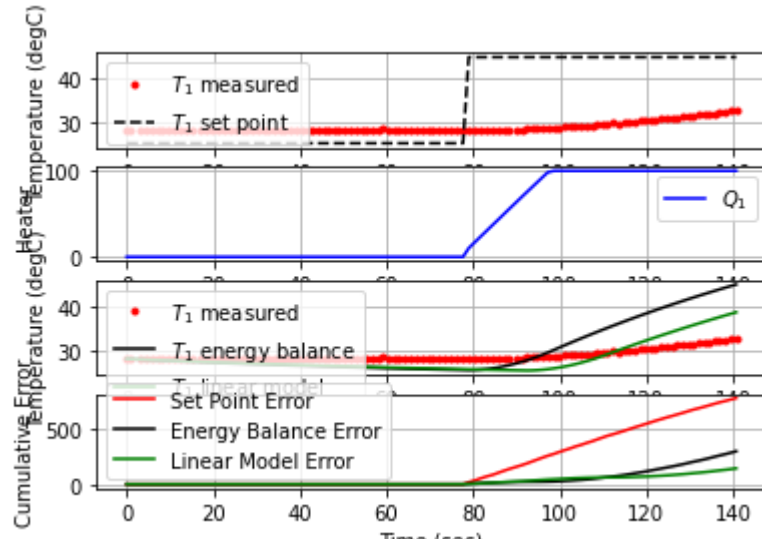




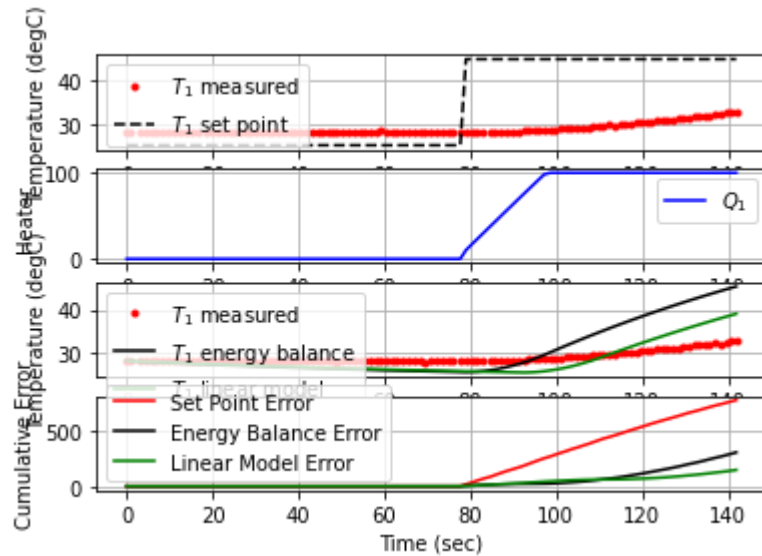


139.5 45.00 32.44 100.00 2.78 94.63 -0.03

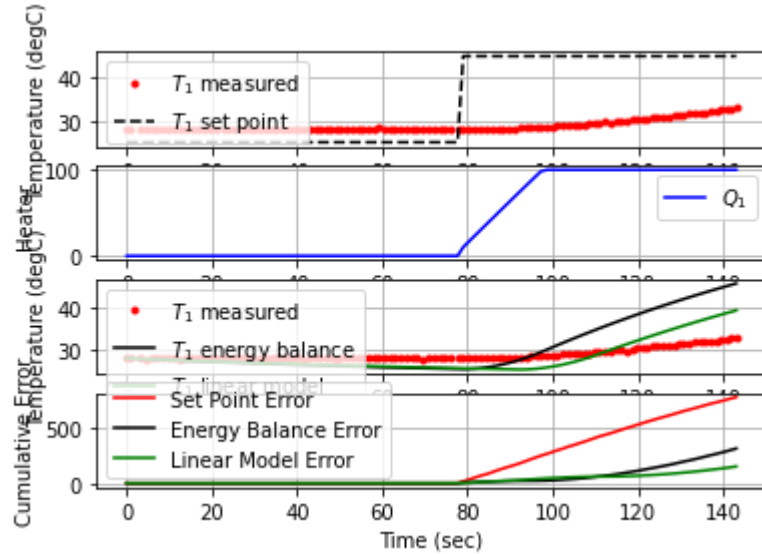




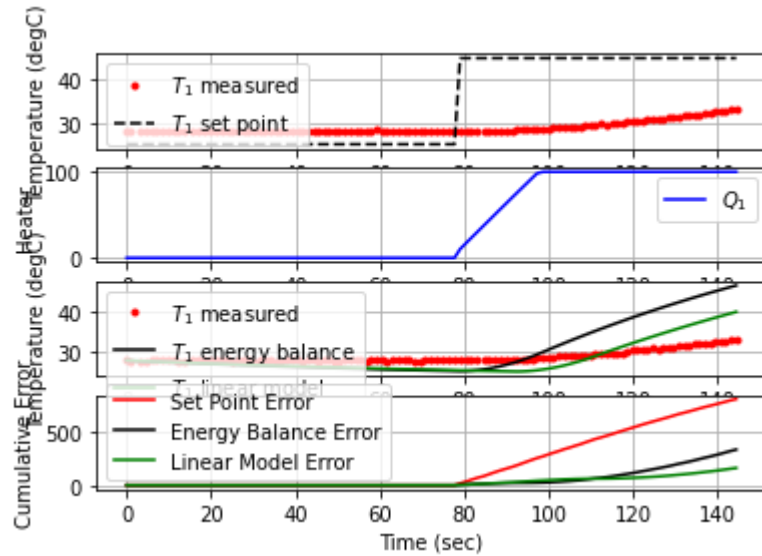
143.1 45.00 32.95 100.00 2.67 94.63 -0.02



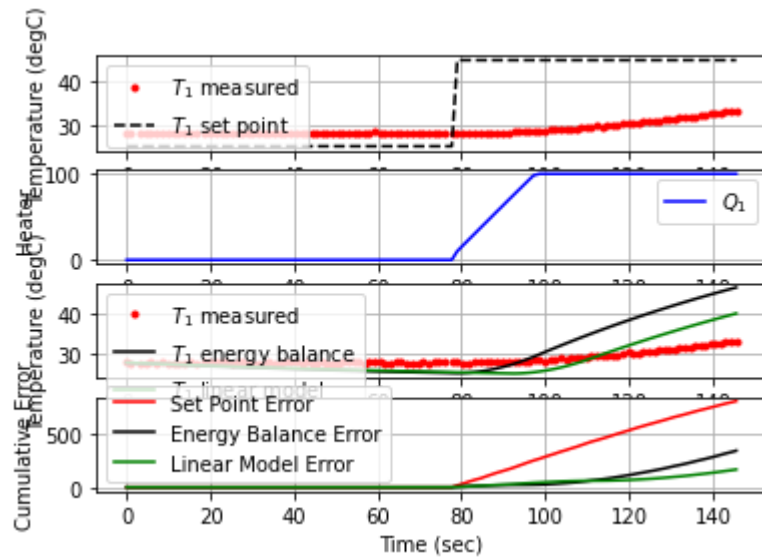
144.4 45.00 32.92 100.00 2.68 94.63 0.00



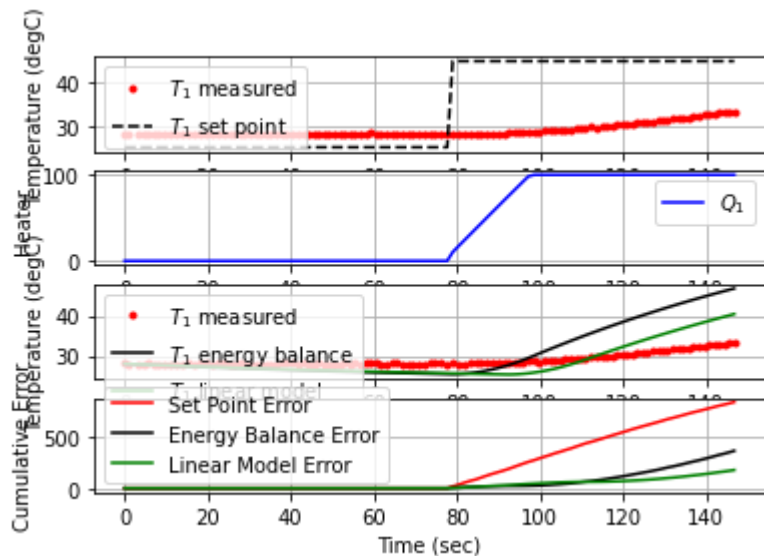
145.6 45.00 33.17 100.00 2.62 94.63 -0.02



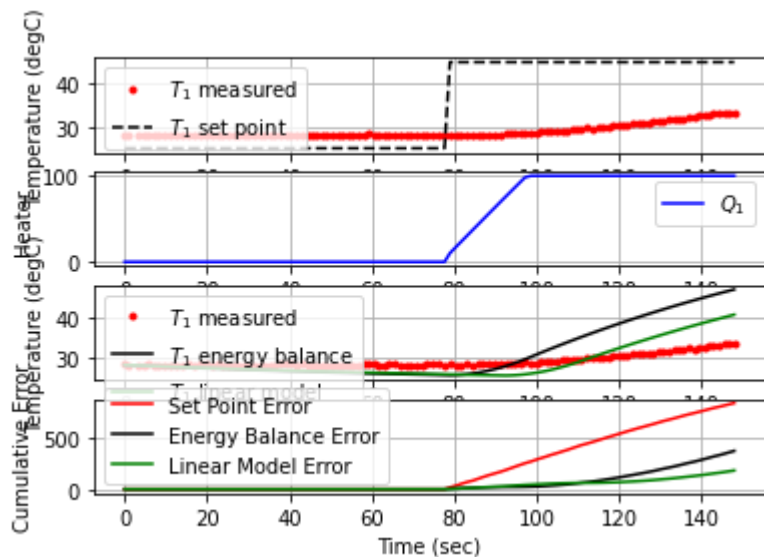
146.8 45.00 33.23 100.00 2.61 94.63 -0.00



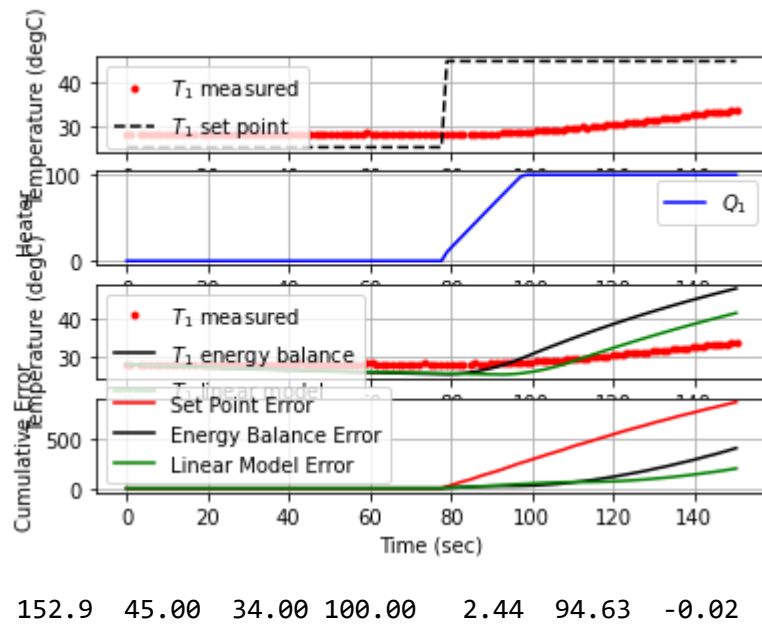
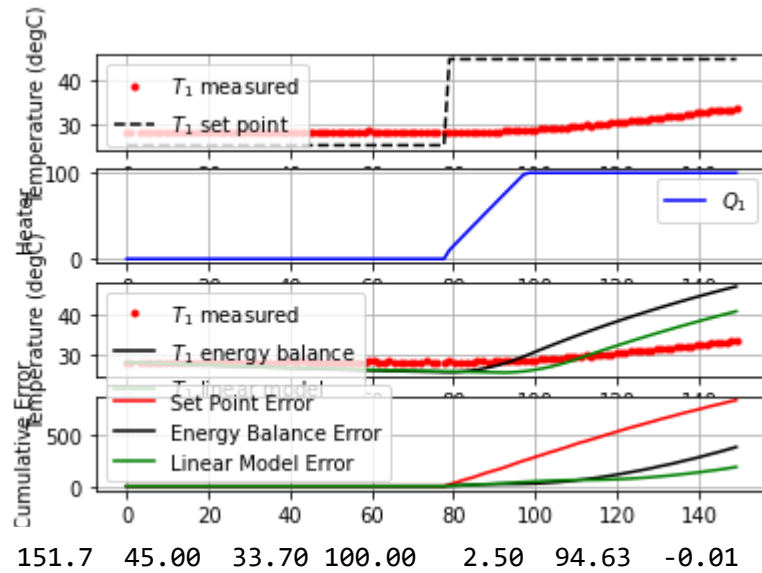
148.0 45.00 33.30 100.00 2.59 94.63 -0.00

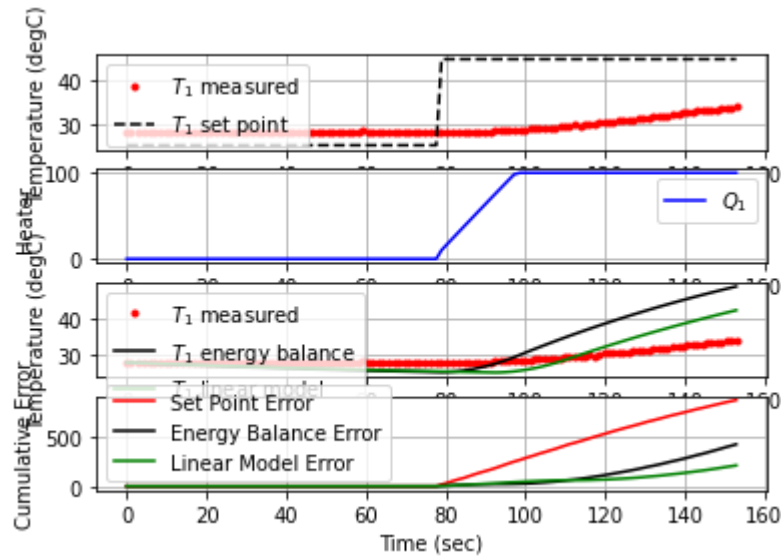
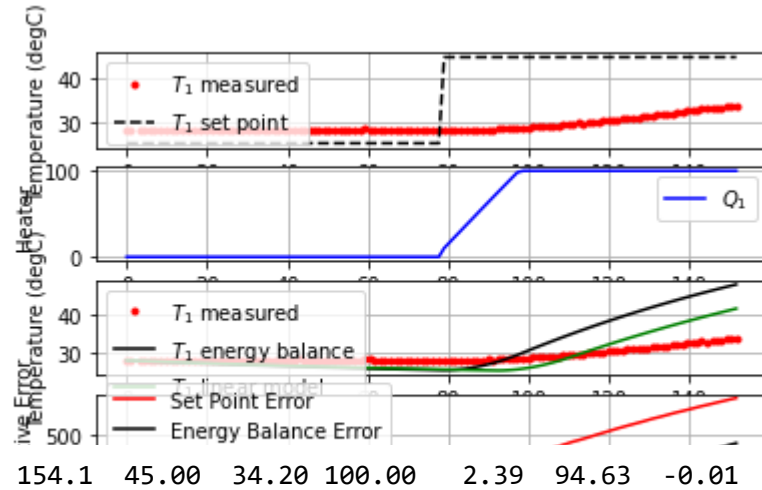


149.2 45.00 33.54 100.00 2.54 94.63 -0.02

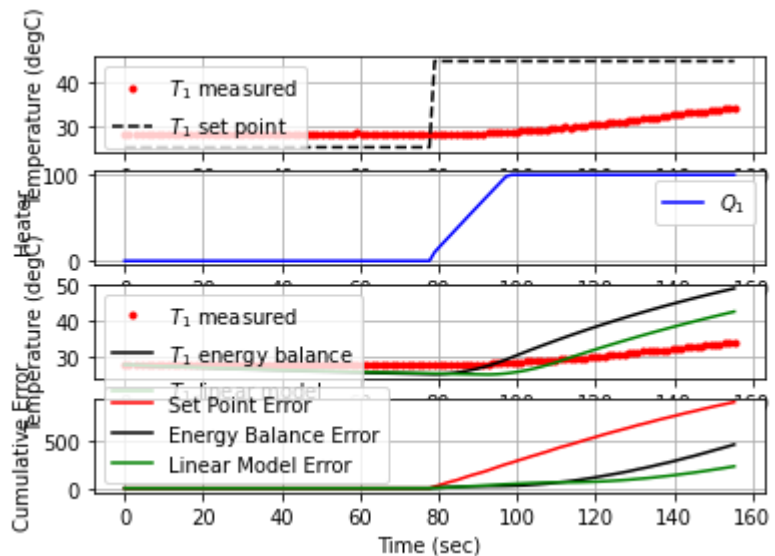
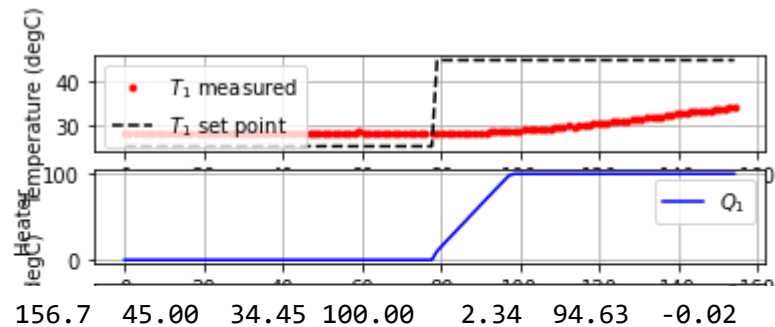


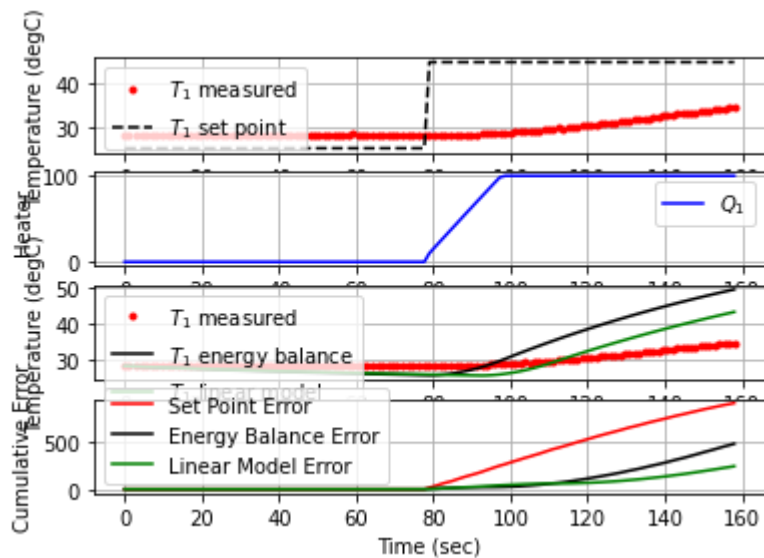
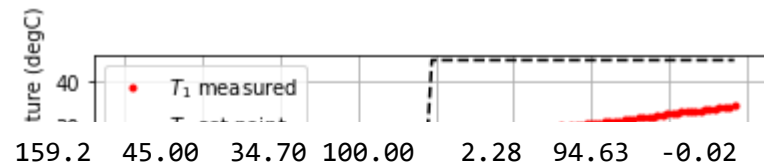
150.4 45.00 33.62 100.00 2.52 94.63 -0.01



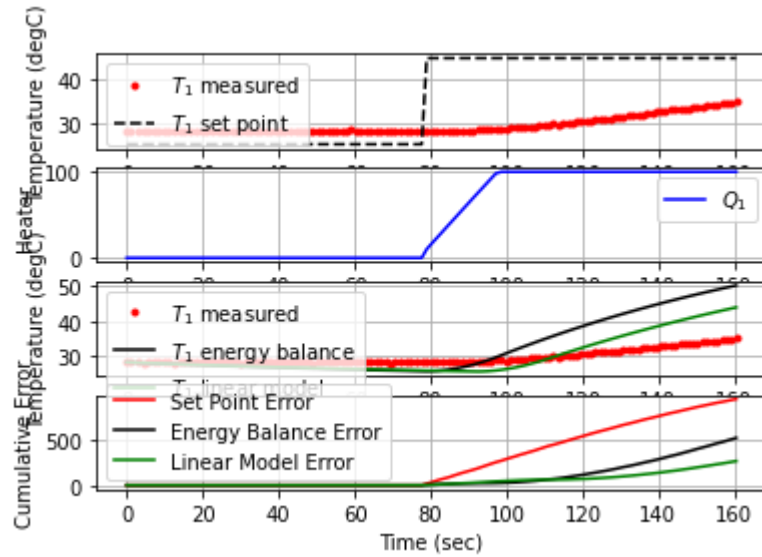
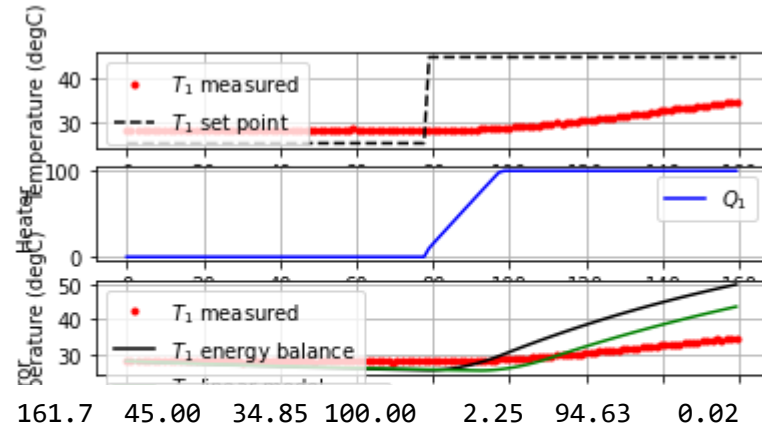


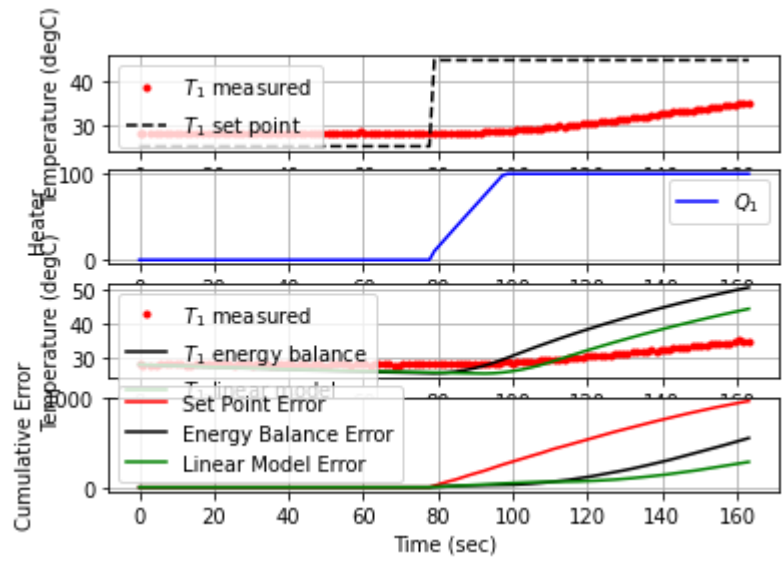
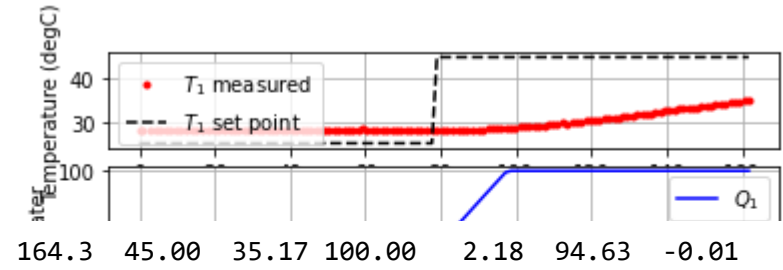


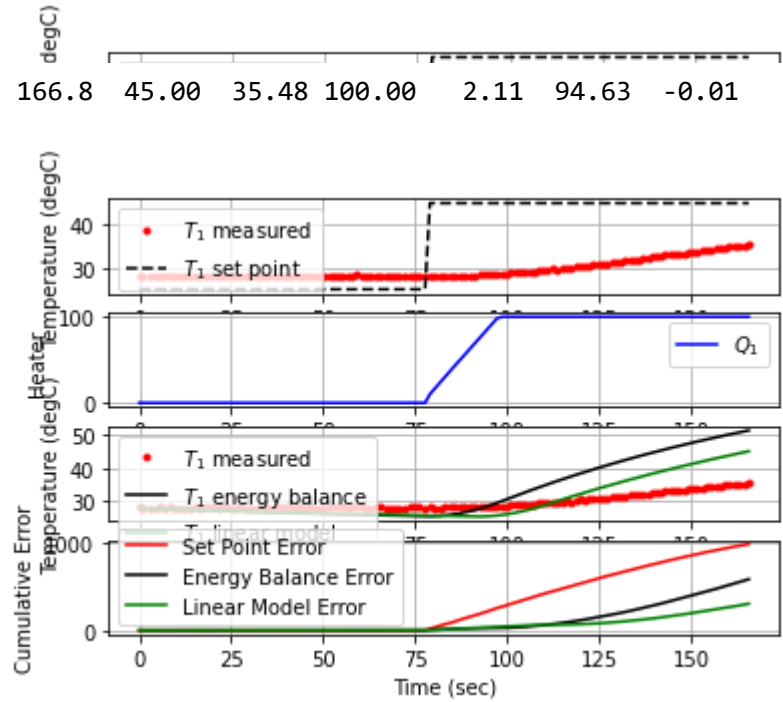


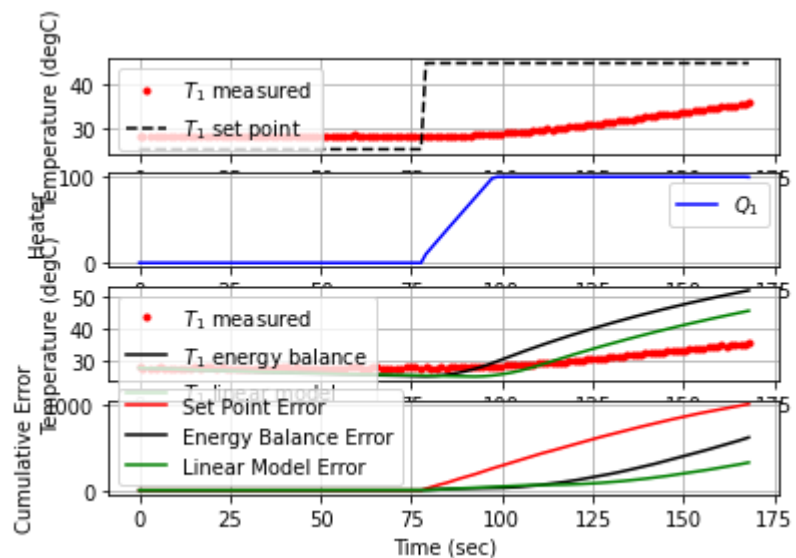
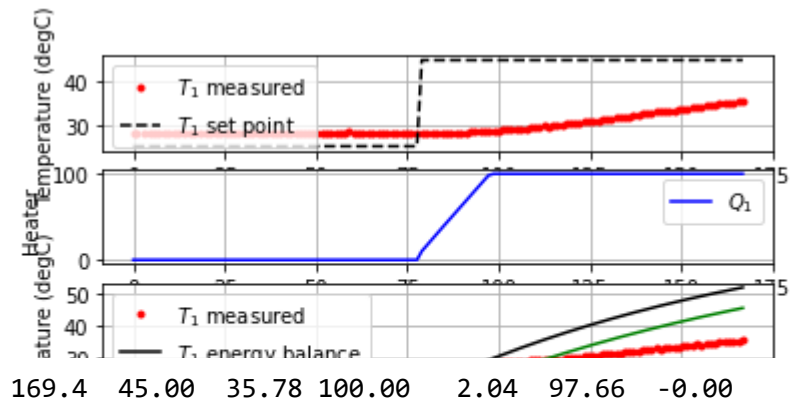


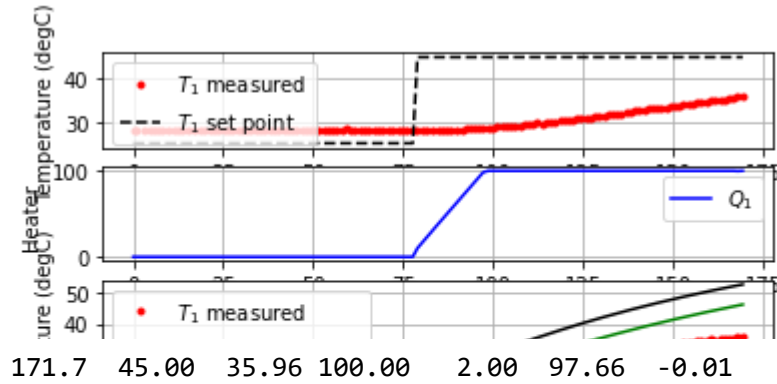
160.5 45.00 35.09 100.00 2.19 94.63 -0.03



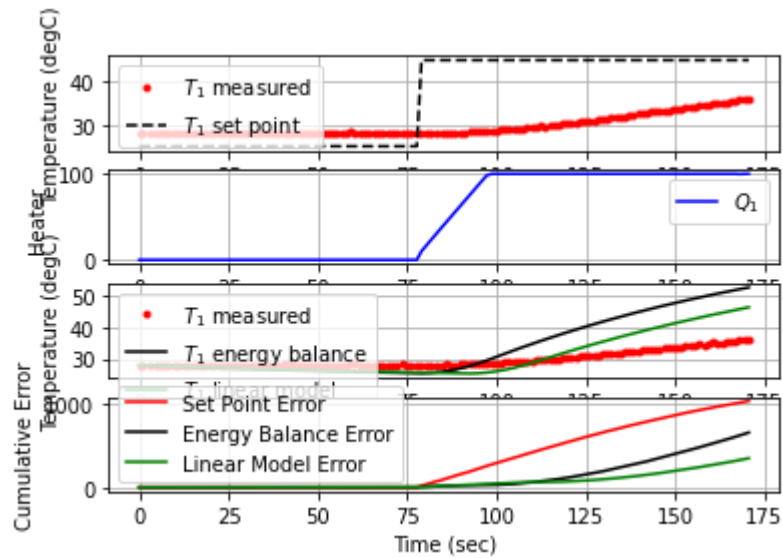




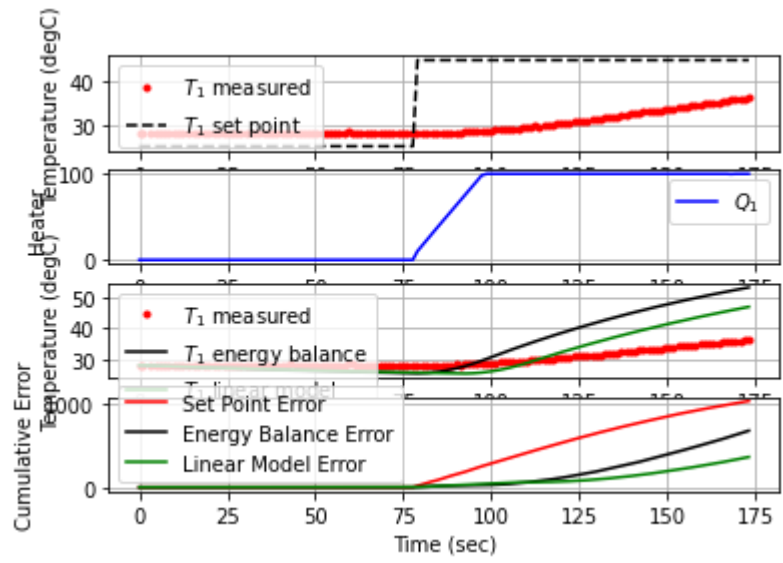
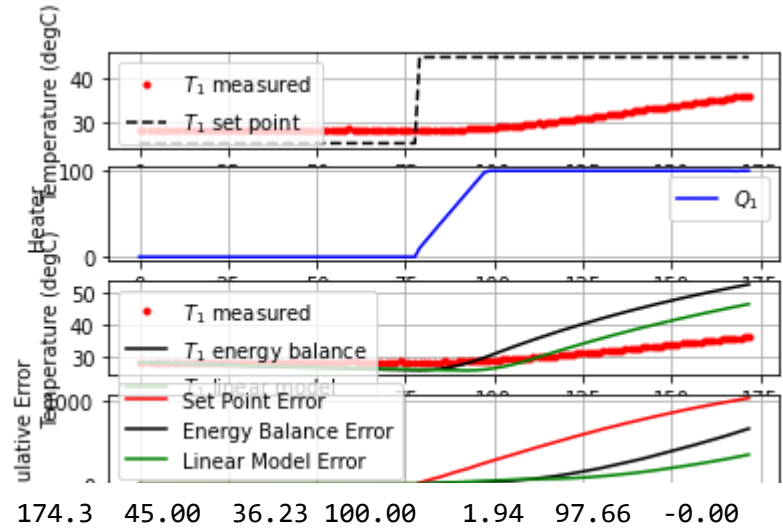




171.7 45.00 35.96 100.00 2.00 97.66 -0.01

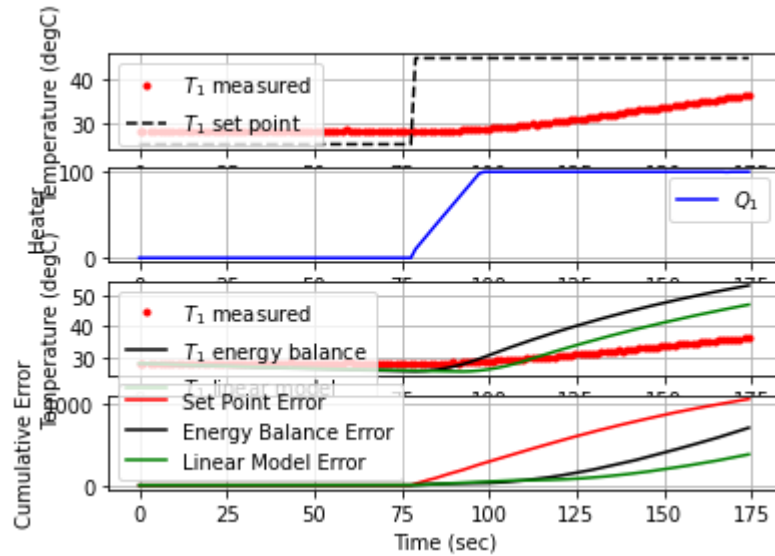


173.0 45.00 36.17 100.00 1.96 97.66 -0.01

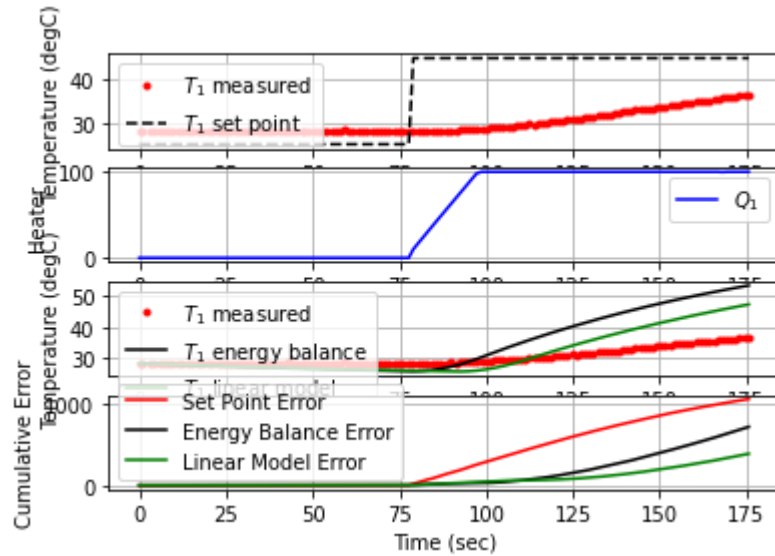




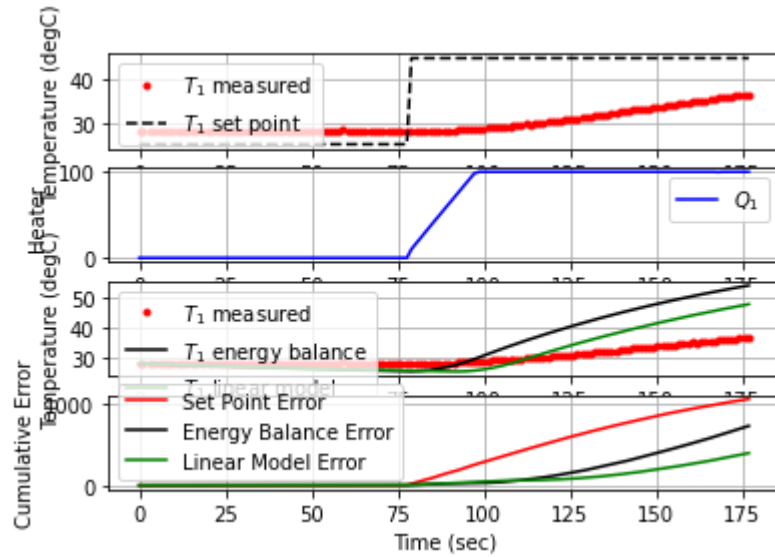
175.6 45.00 36.51 100.00 1.88 97.66 -0.02



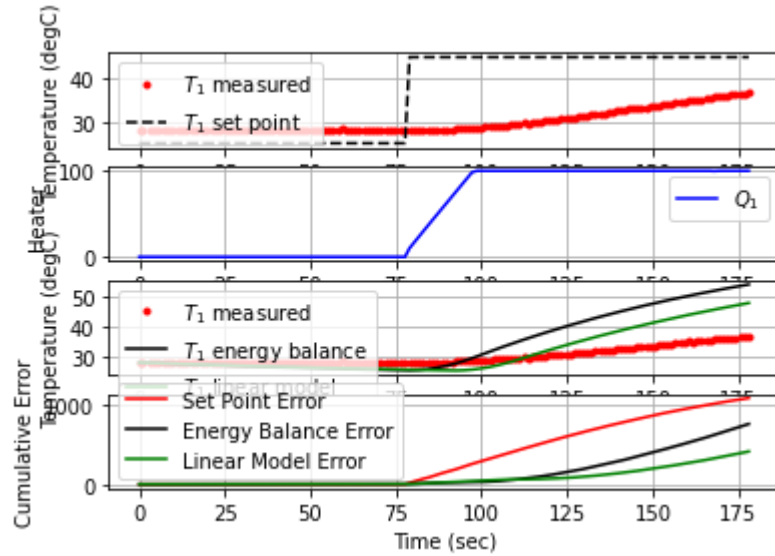
176.9 45.00 36.57 100.00 1.87 97.66 -0.00



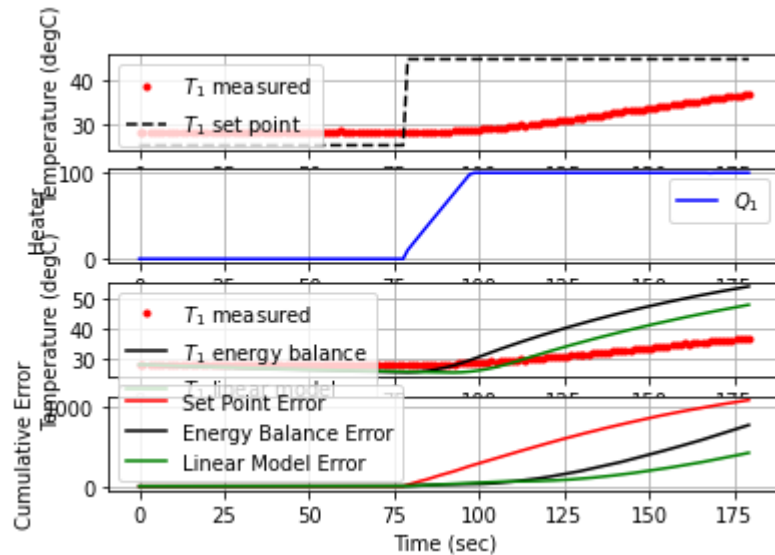
178.1 45.00 36.78 100.00 1.82 97.66 -0.01



179.3 45.00 36.77 100.00 1.82 97.66 0.00

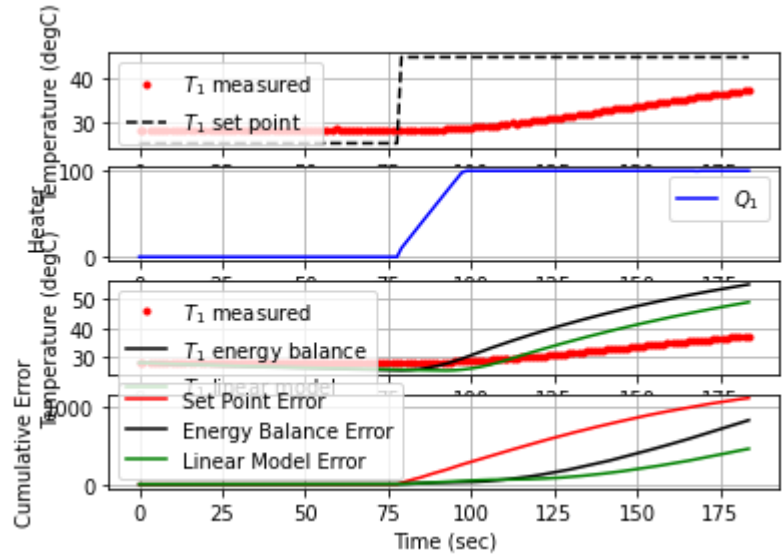


180.7 45.00 36.85 100.00 1.81 97.66 -0.01

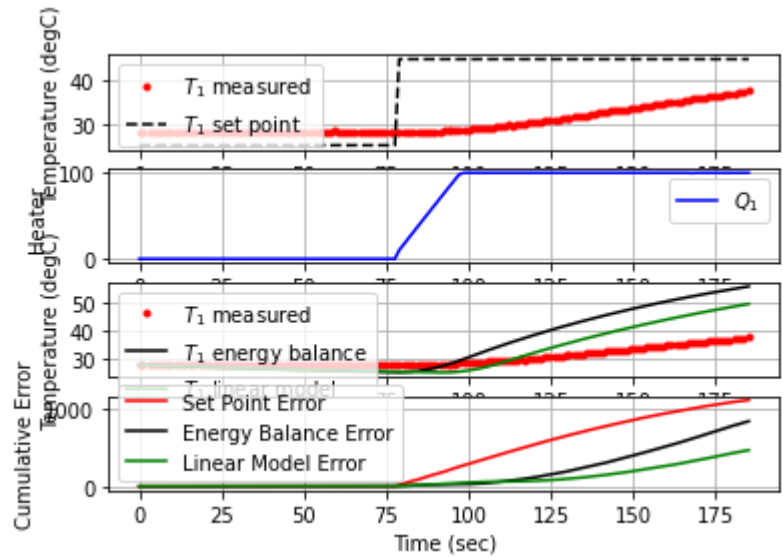


182.3 45.00 37.21 100.00 1.73 97.66 -0.02

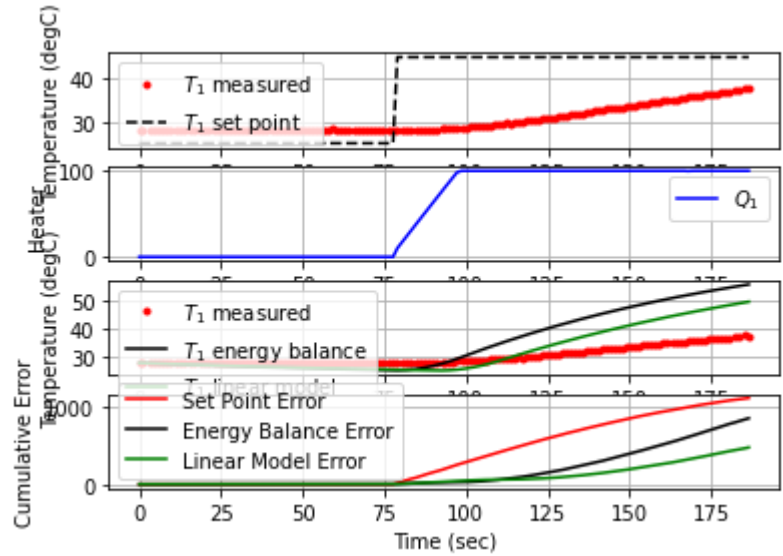




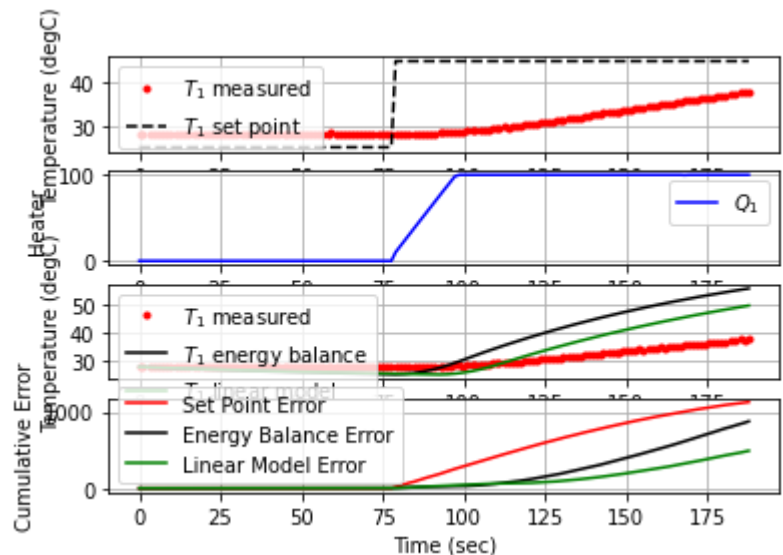
186.5 45.00 37.58 100.00 1.64 97.66 0.01



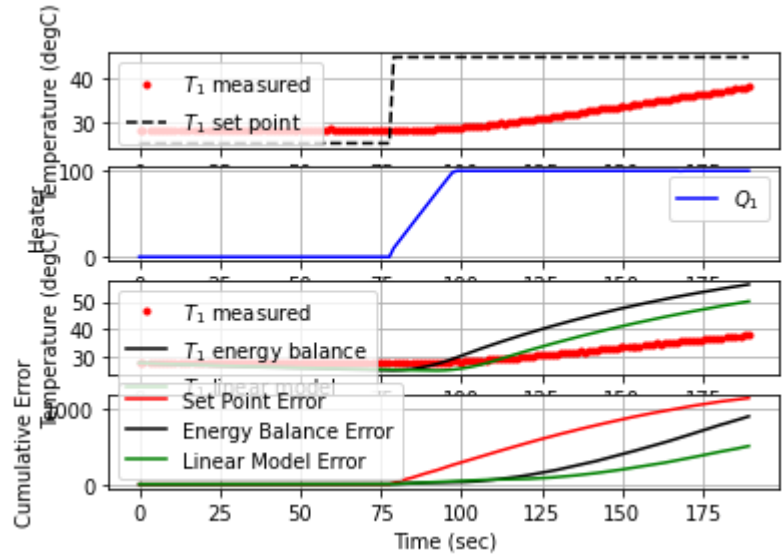
187.8 45.00 37.89 100.00 1.57 97.66 -0.02



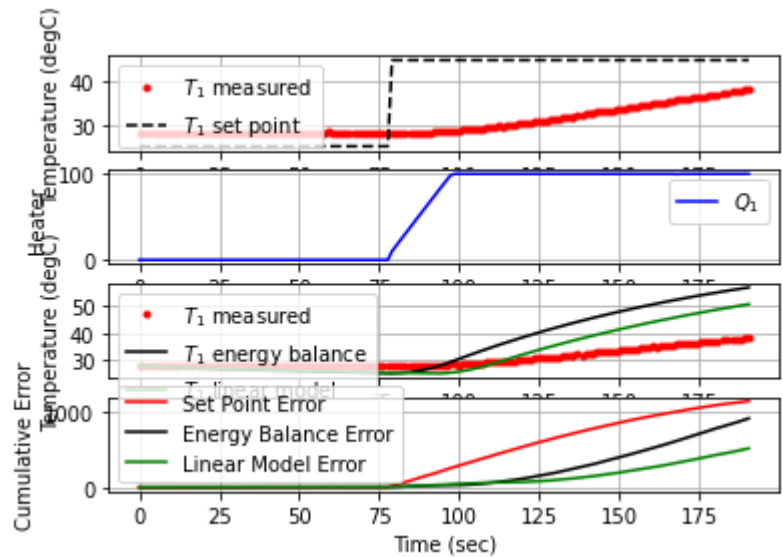
189.2 45.00 38.12 100.00 1.52 97.66 -0.01



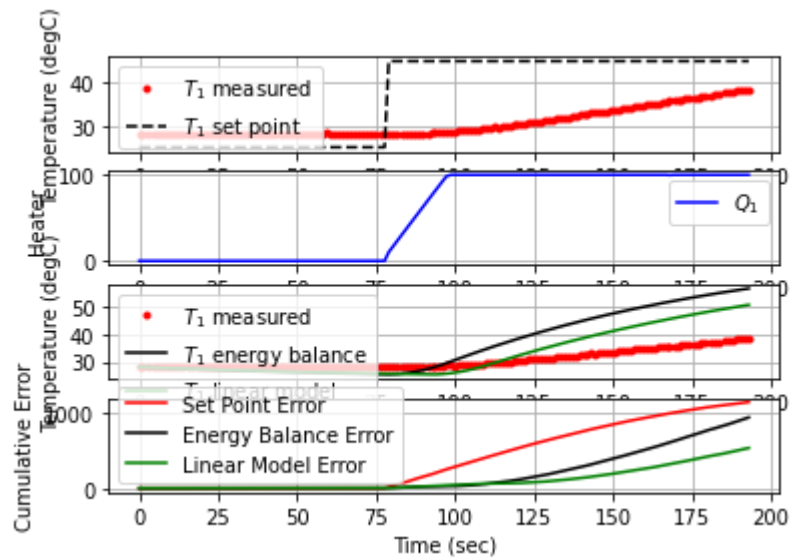
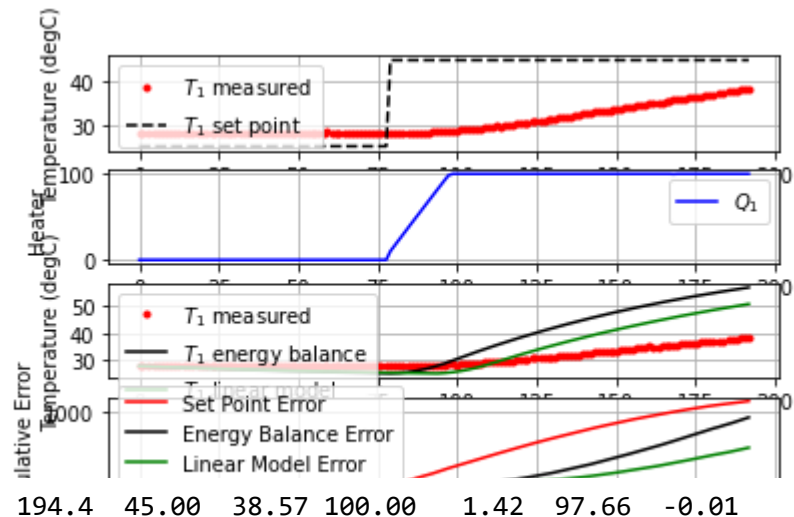
190.4 45.00 38.08 100.00 1.53 97.66 0.00



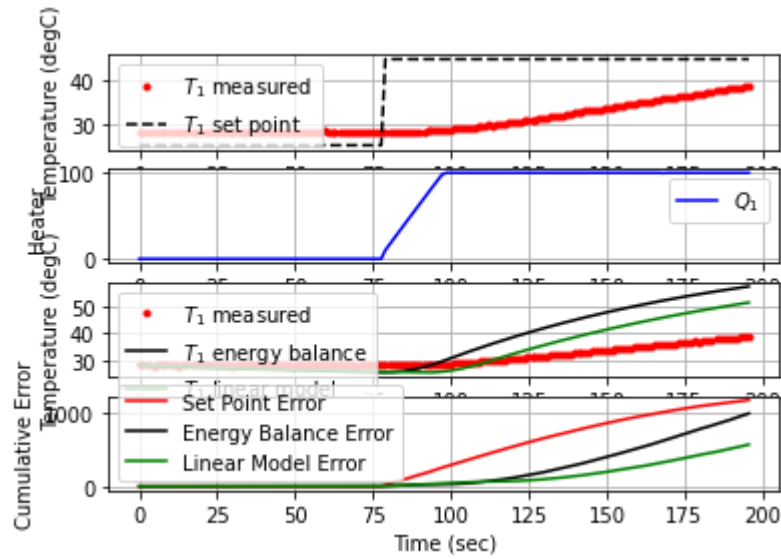
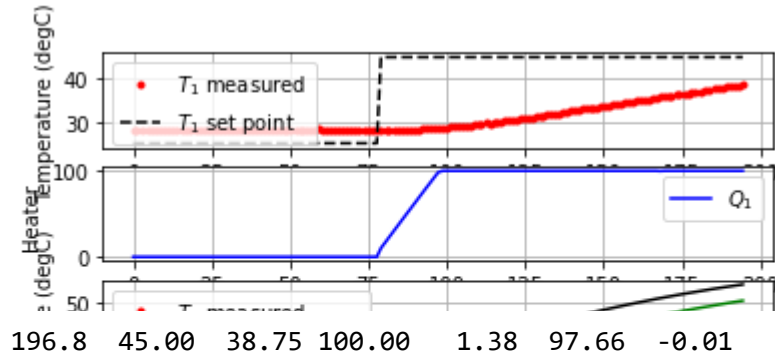
191.7 45.00 38.25 100.00 1.49 97.66 -0.01

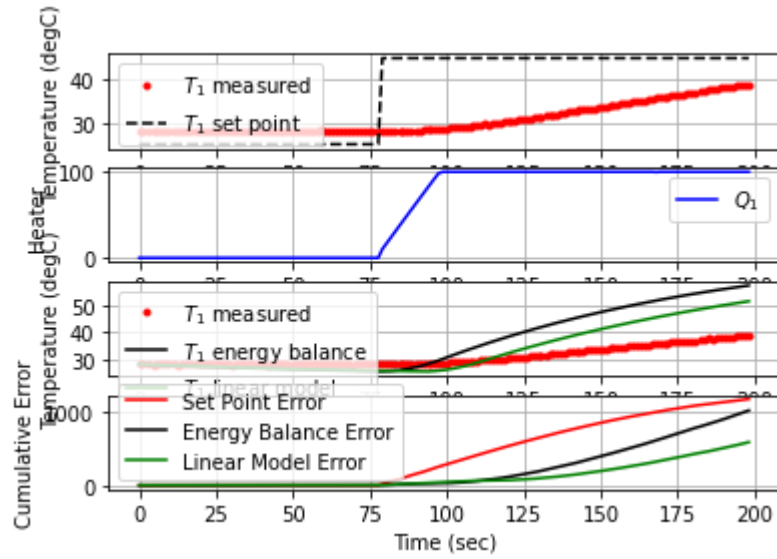
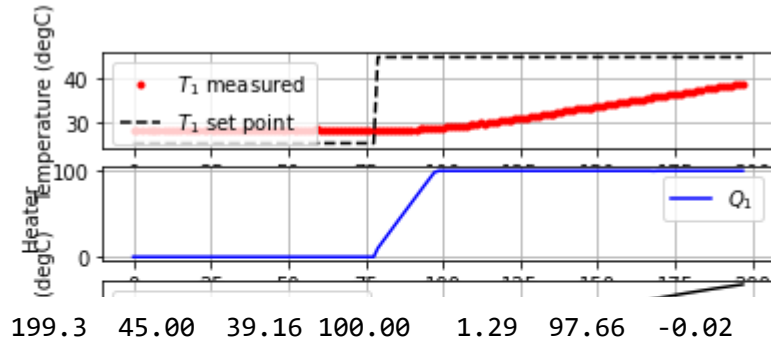


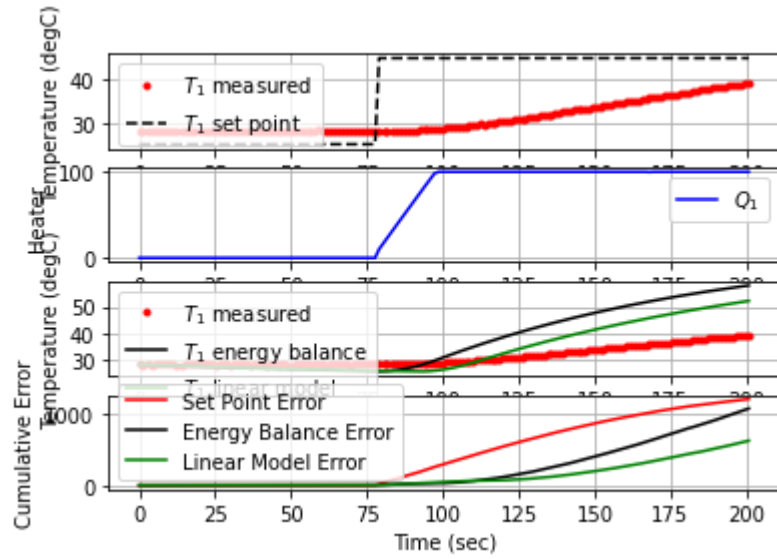
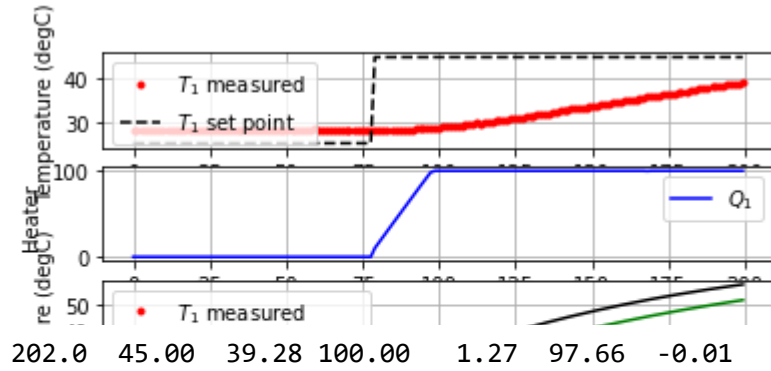
193.0 45.00 38.38 100.00 1.47 97.66 -0.01

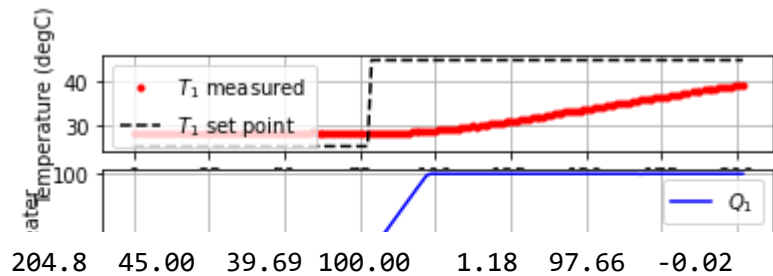




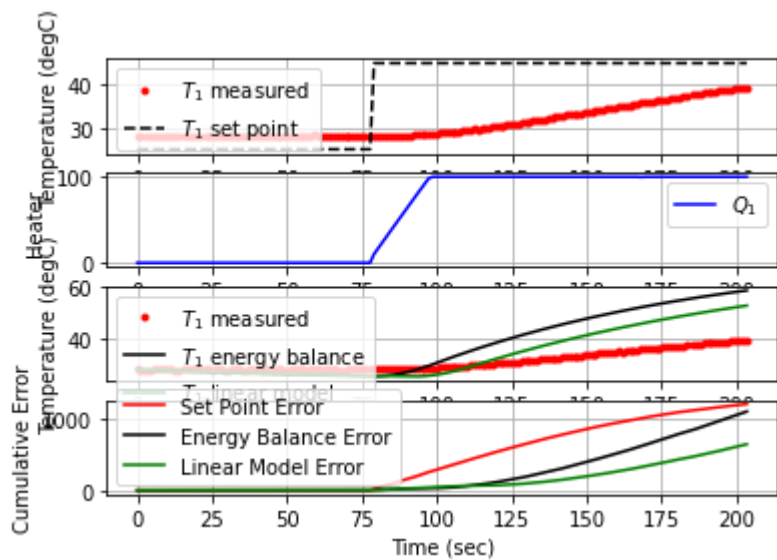




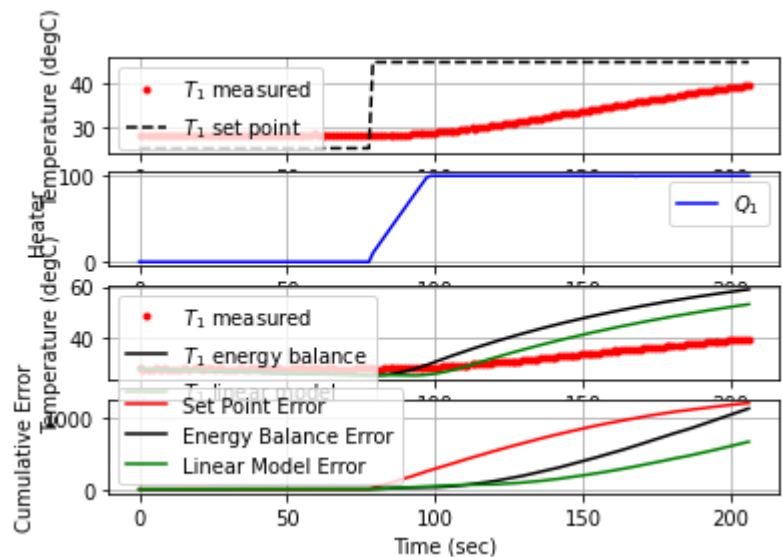
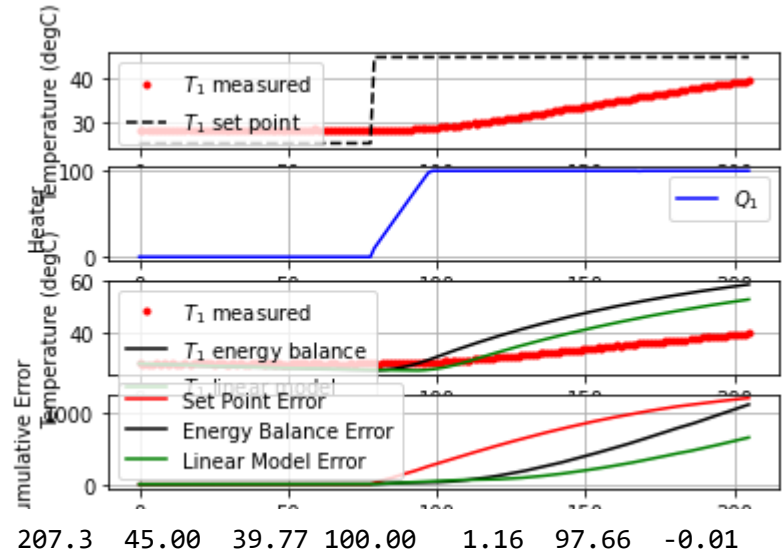


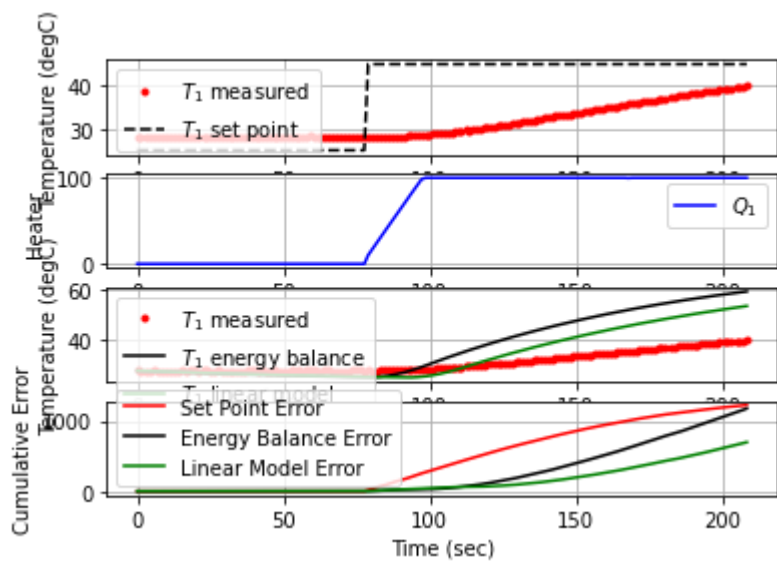
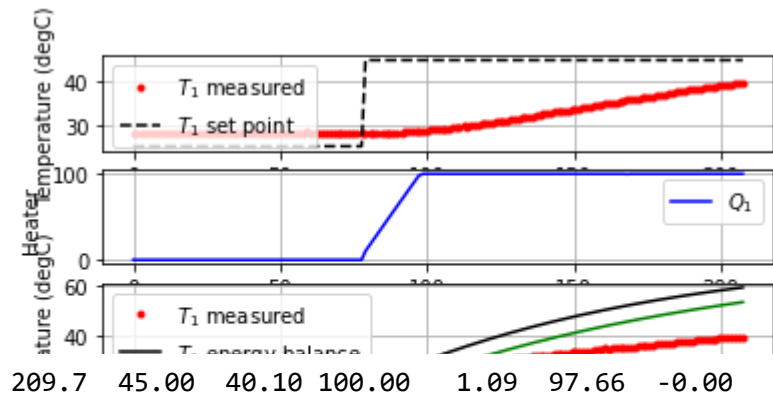


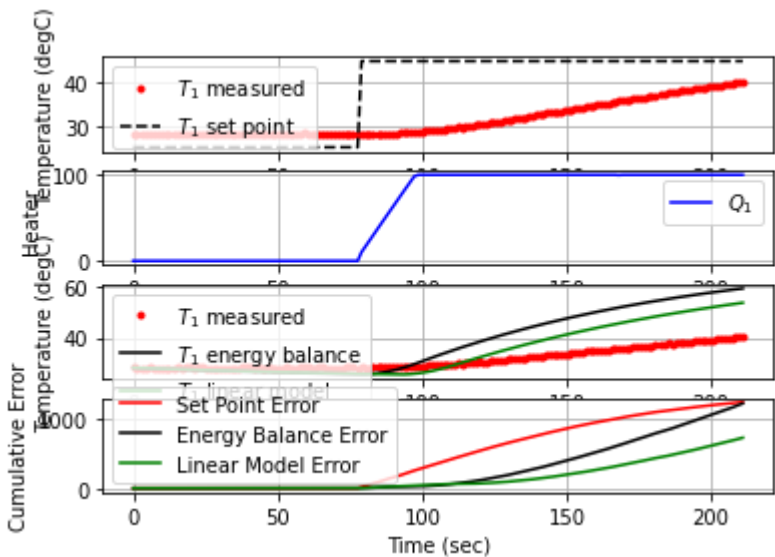
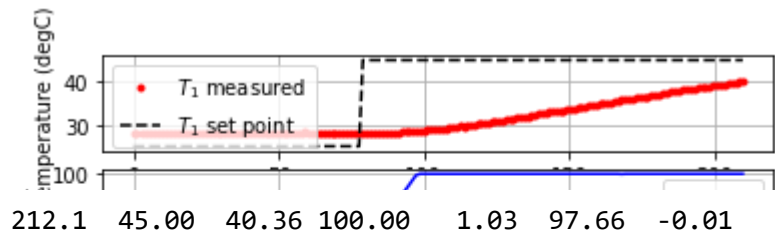
204.8 45.00 39.69 100.00 1.18 97.66 -0.02



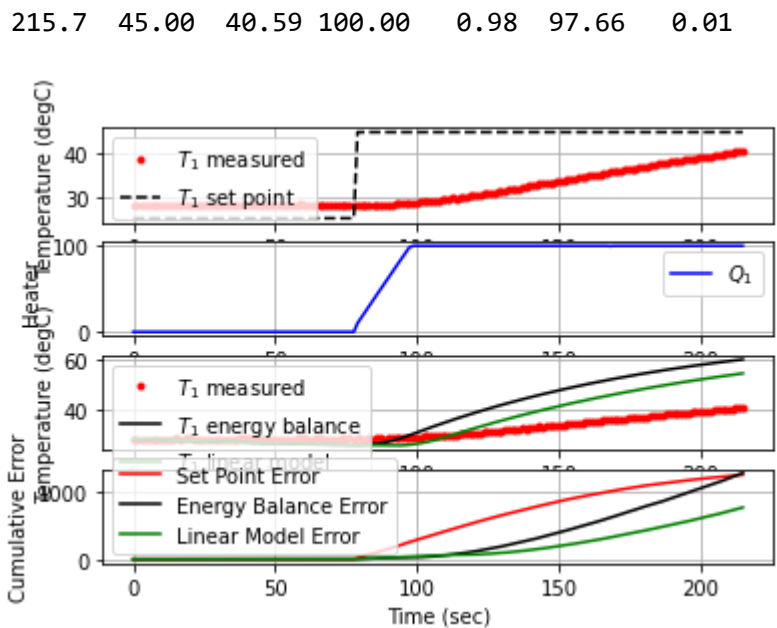
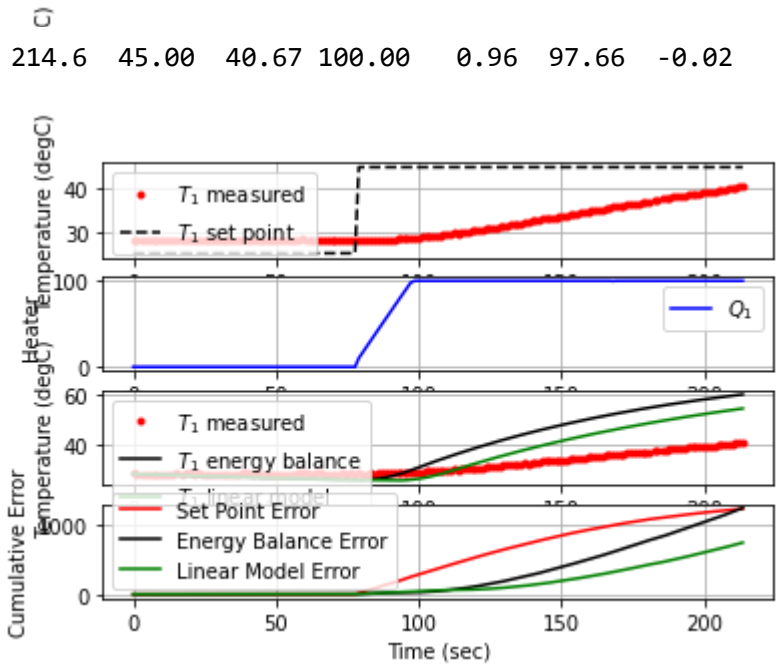
206.1 45.00 39.67 100.00 1.18 97.66 0.00





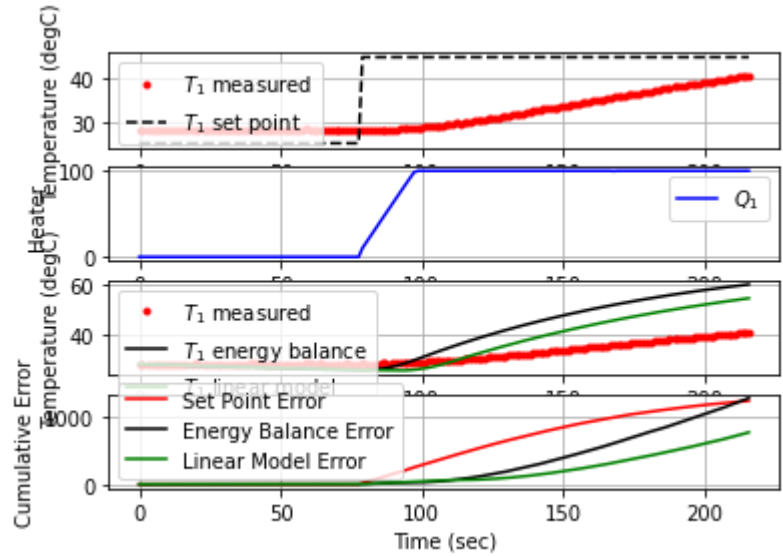


213.4 45.00 40.44 100.00 1.01 97.66 -0.01

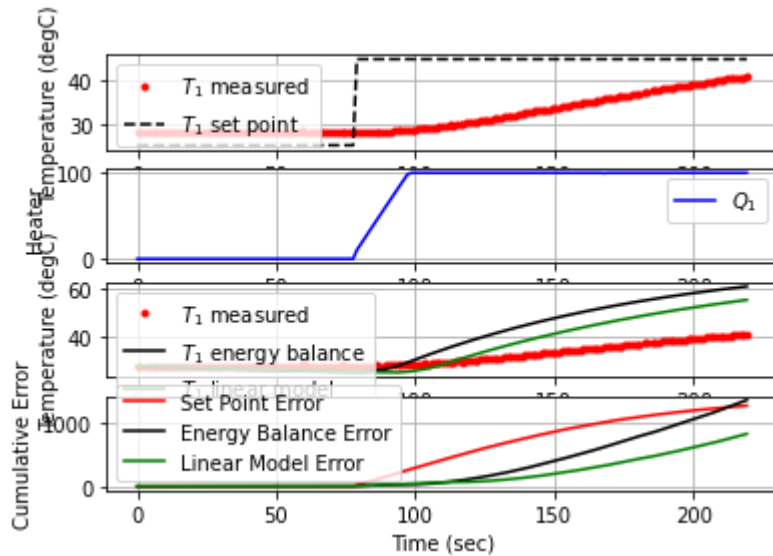
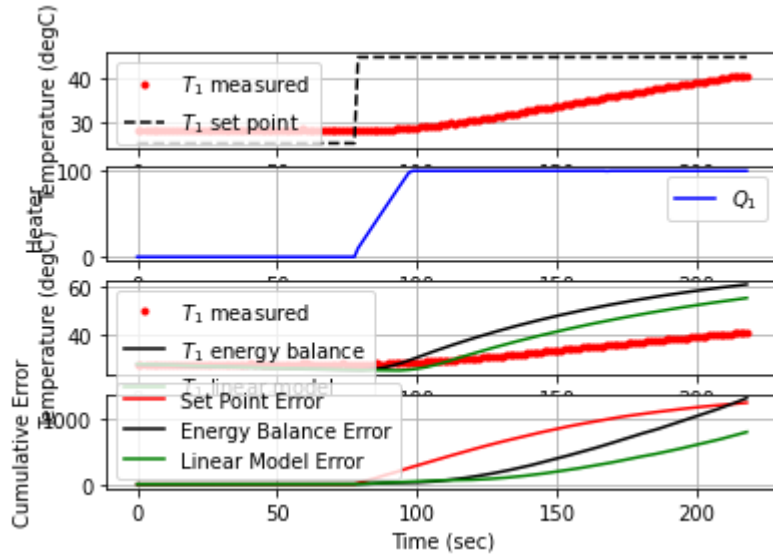
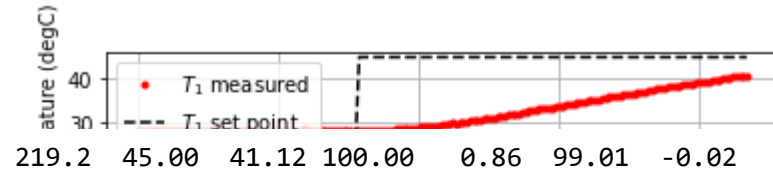


216.9 45.00 40.75 100.00 0.94 97.66 -0.01

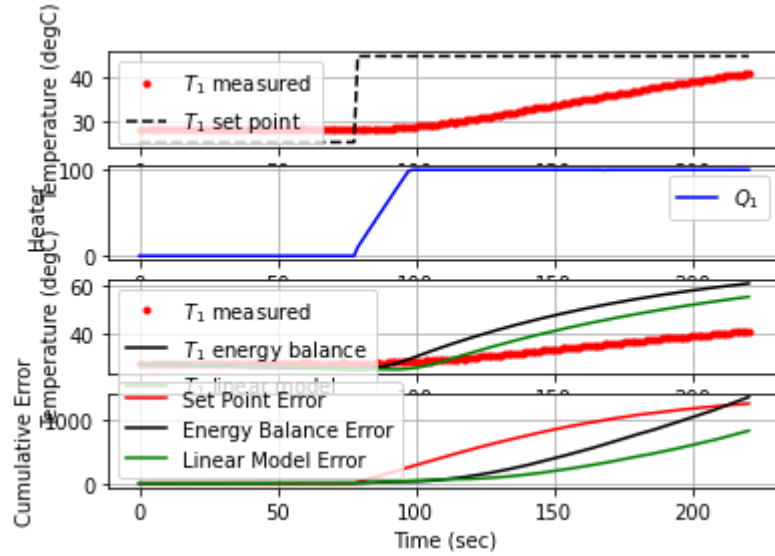




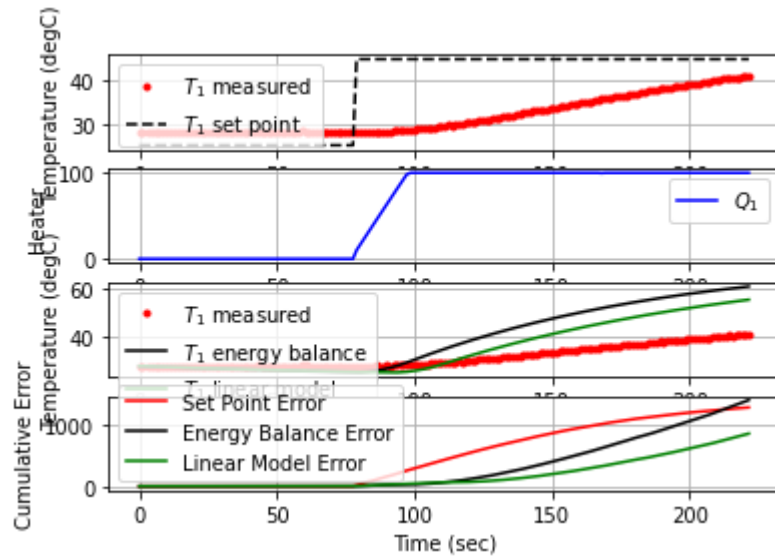
218.0 45.00 40.77 99.94 0.94 99.01 -0.00



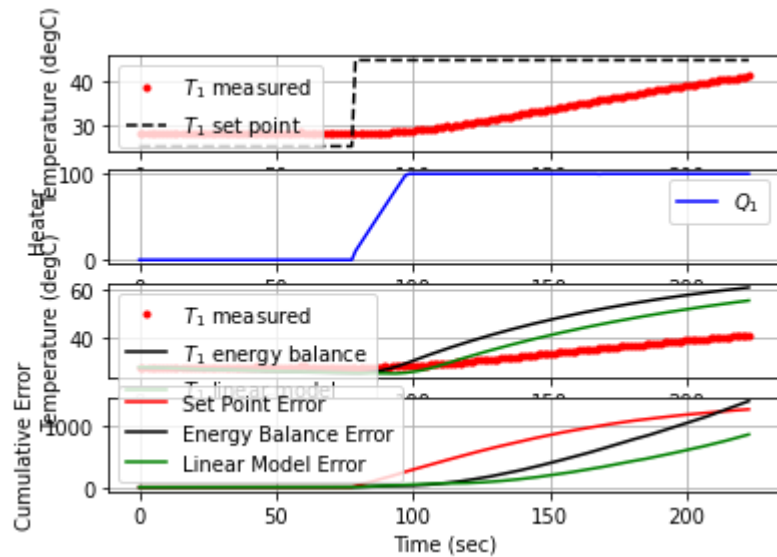
221.5 45.00 41.14 100.00 0.85 99.01 0.00



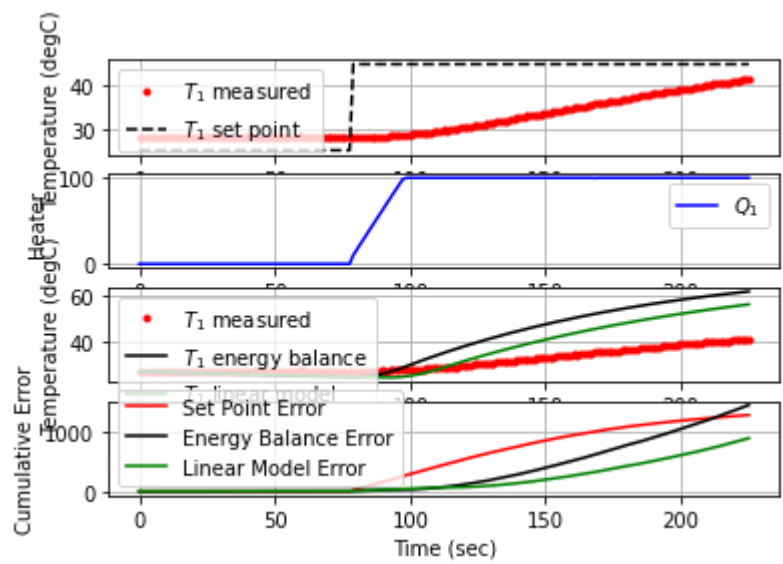
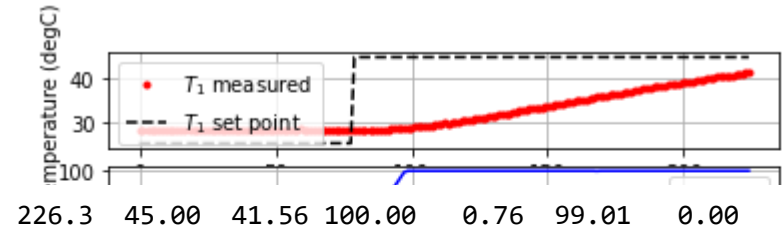
222.7 45.00 41.36 100.00 0.81 99.01 -0.02

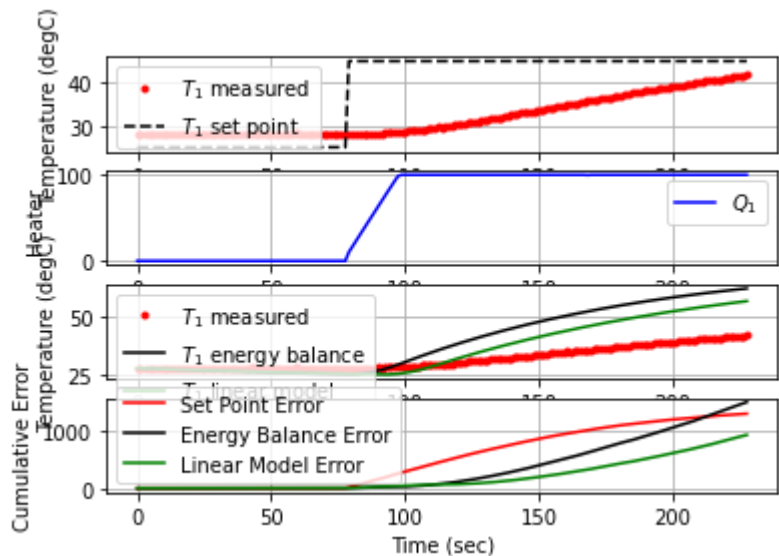
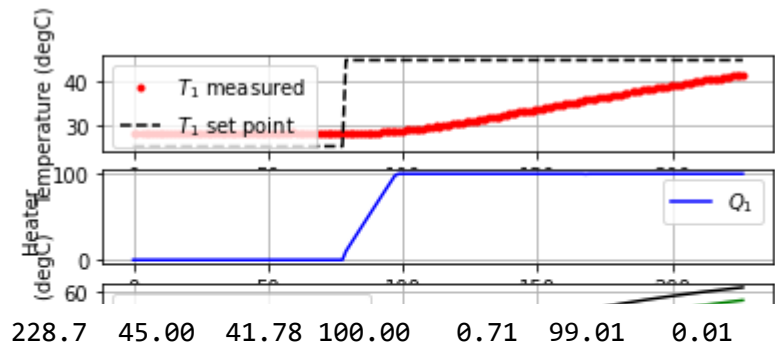


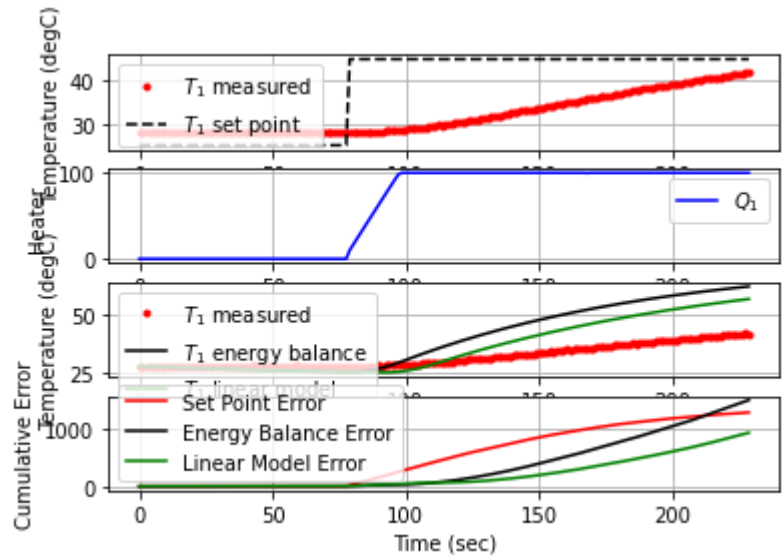
223.8 45.00 41.55 100.00 0.76 99.01 -0.01



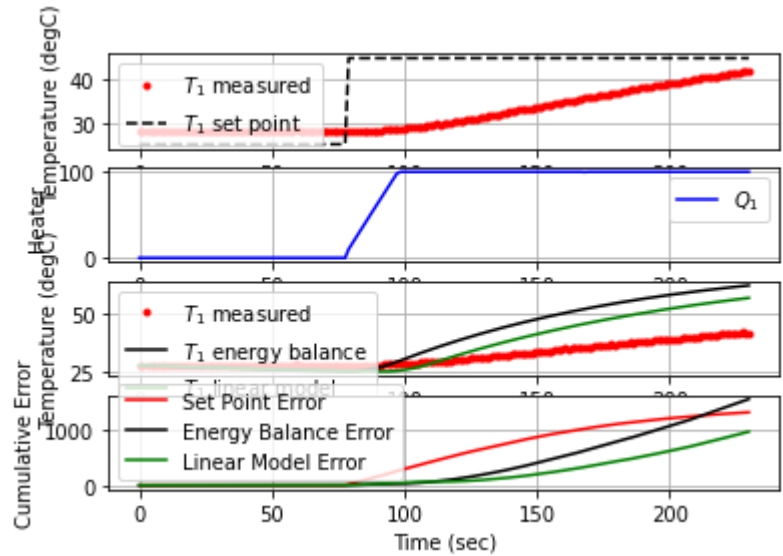
225.0 45.00 41.61 100.00 0.75 99.01 -0.00



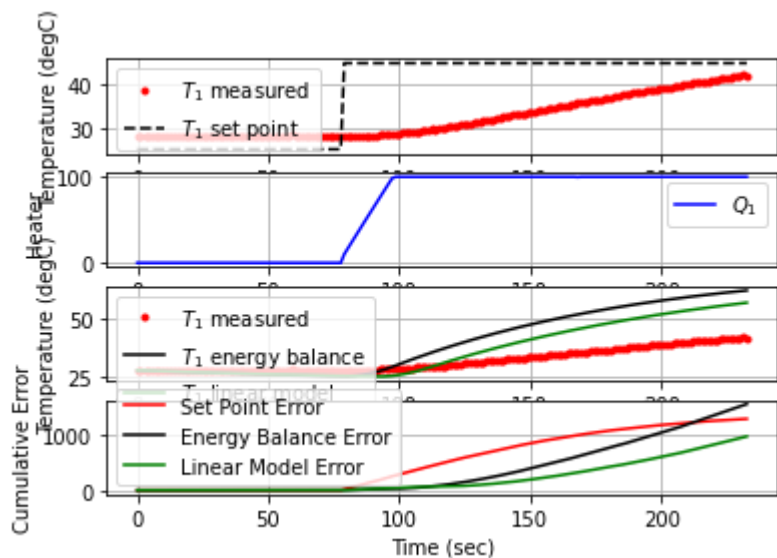
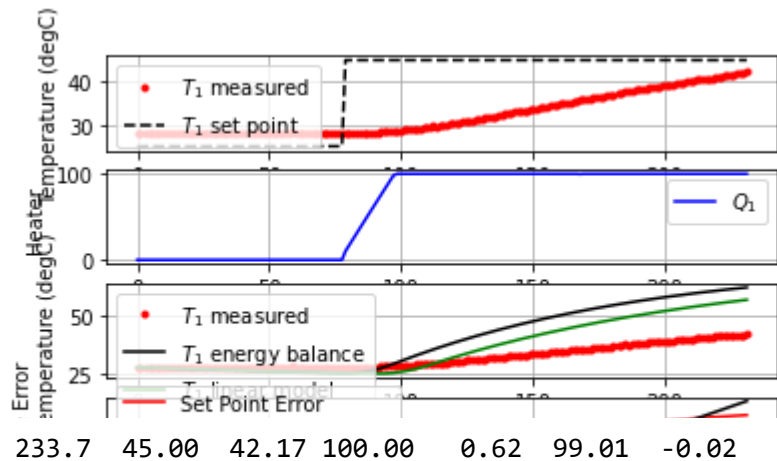




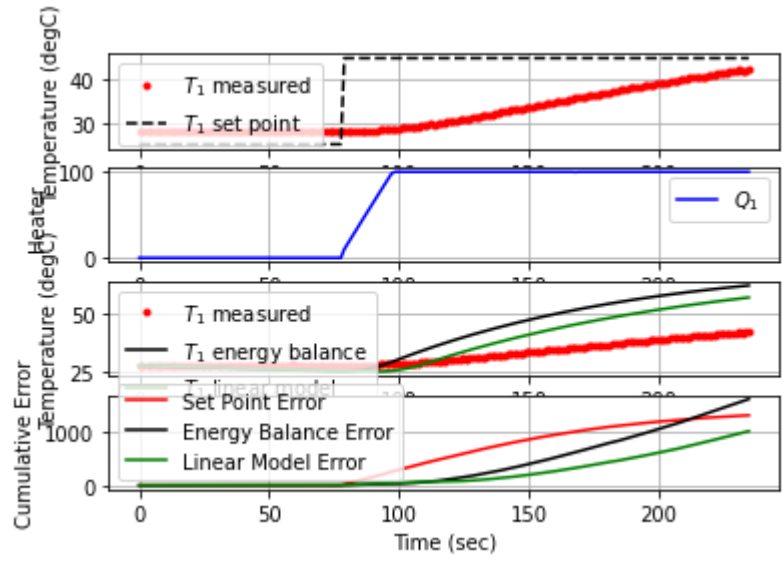
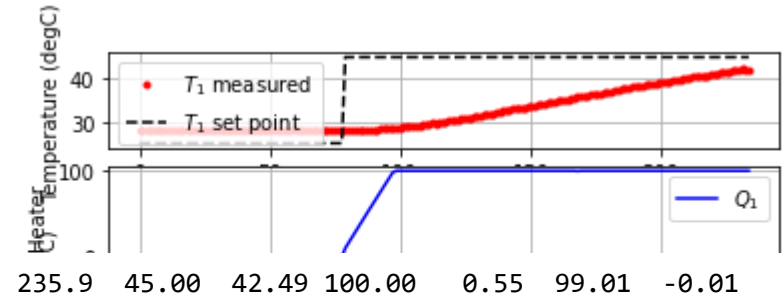
231.2 45.00 42.23 100.00 0.61 99.01 -0.03



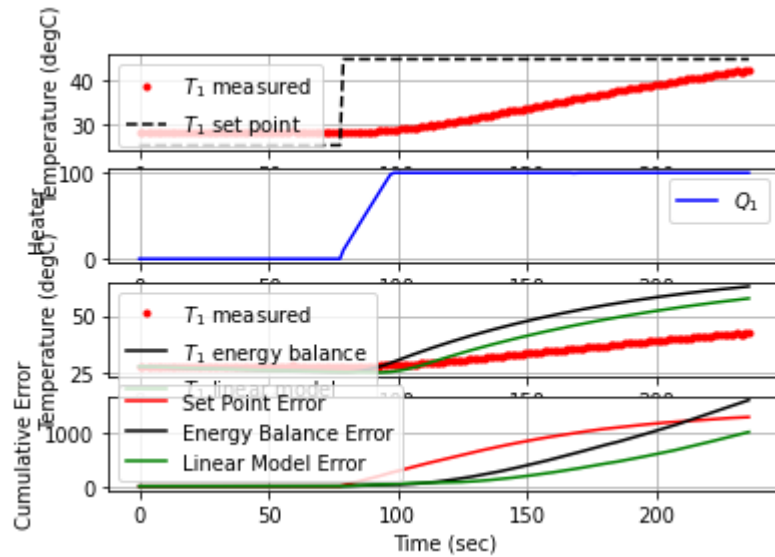
232.6 45.00 41.92 100.00 0.68 99.01 0.02



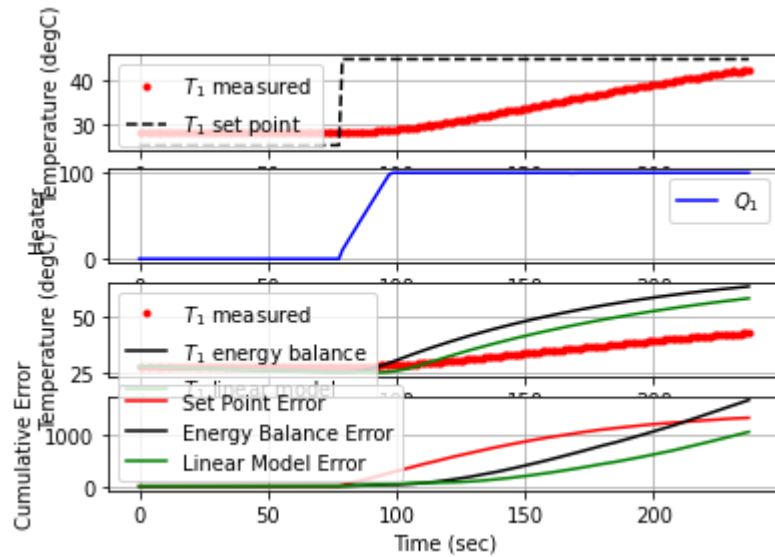




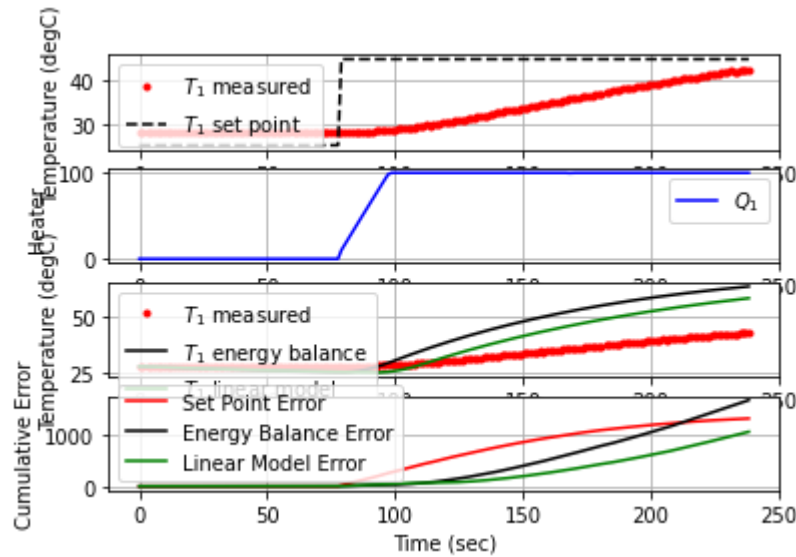
237.1 45.00 42.39 100.00 0.58 99.01 0.01



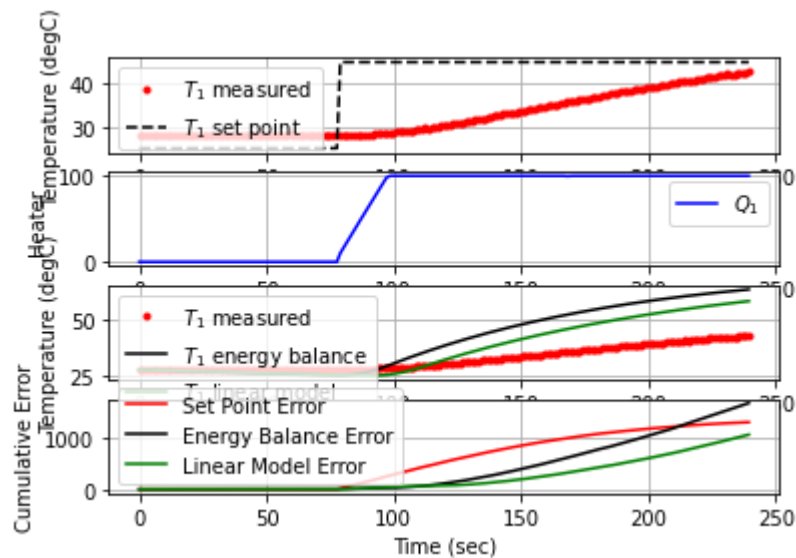
238.2 45.00 42.46 100.00 0.56 99.01 -0.01



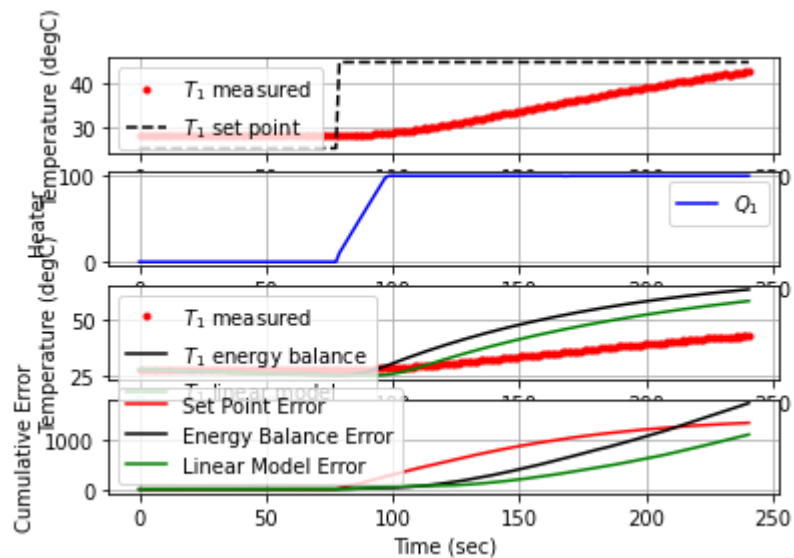
239.5 45.00 42.73 100.00 0.50 99.01 -0.02



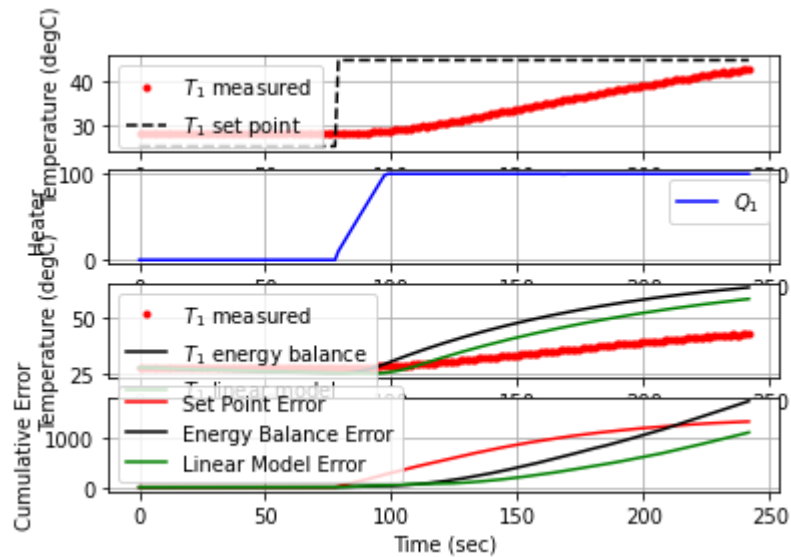
240.6 45.00 42.85 100.00 0.47 99.01 -0.01



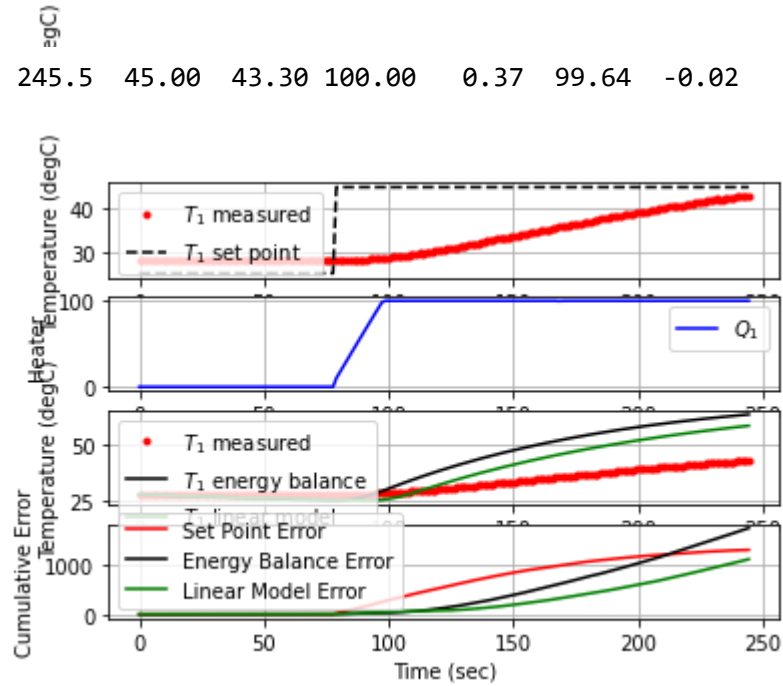
241.8 45.00 42.93 100.00 0.46 99.01 -0.01



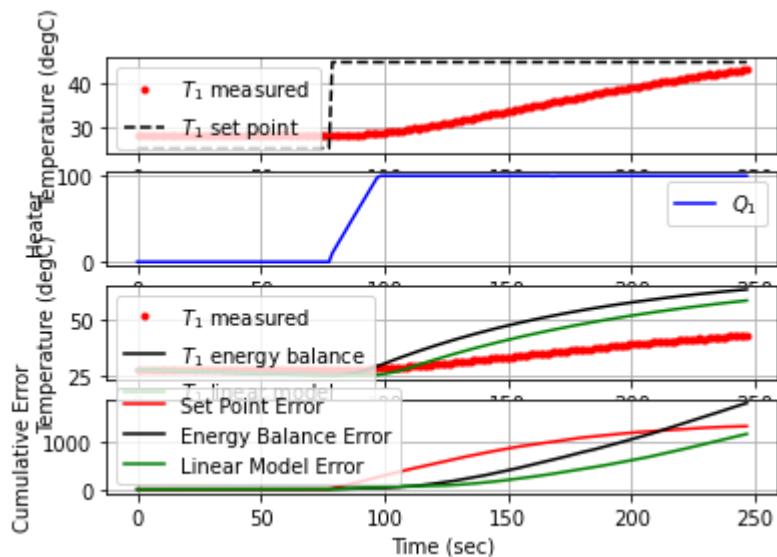
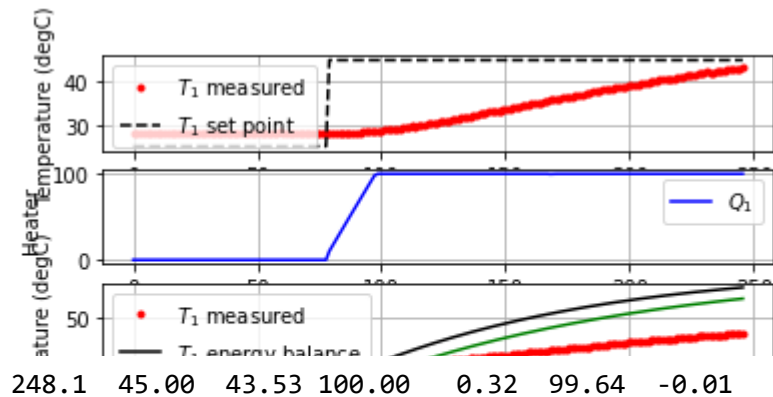
243.0 45.00 42.97 100.00 0.45 99.01 -0.00

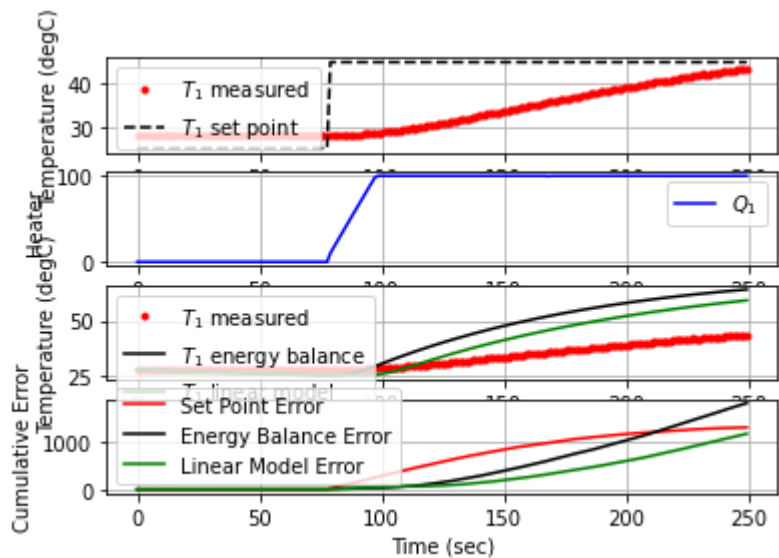
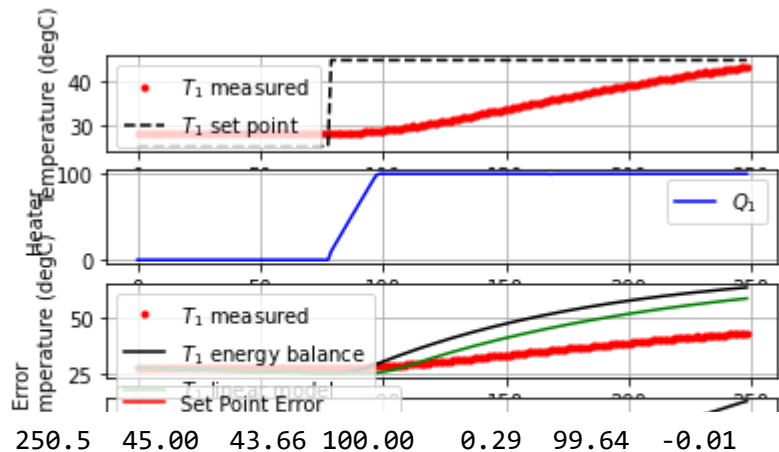


244.2 45.00 43.01 100.00 0.44 99.01 -0.00



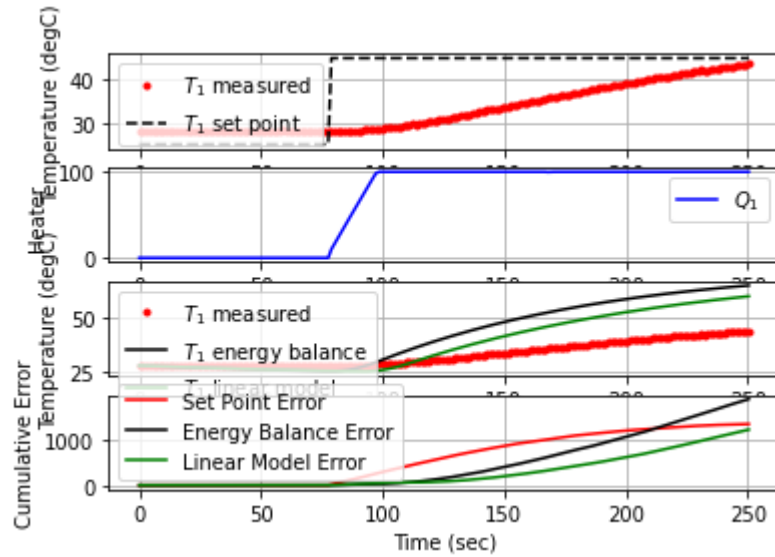
246.8 45.00 43.41 100.00 0.35 99.64 -0.01



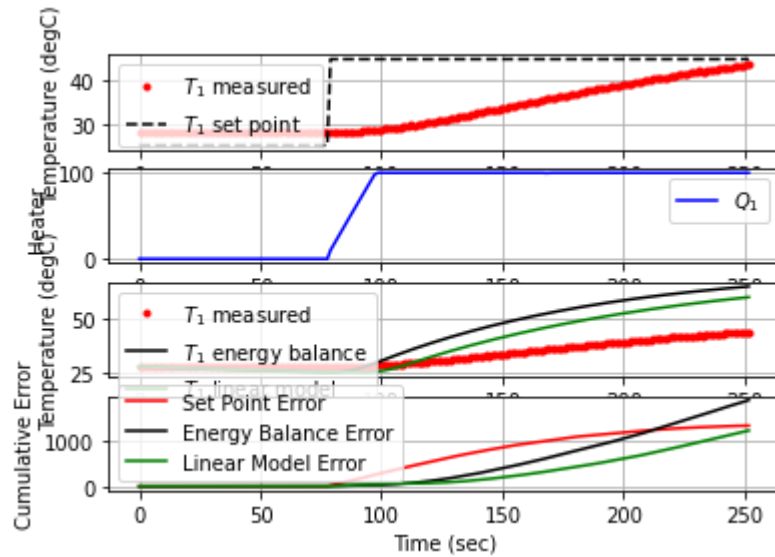




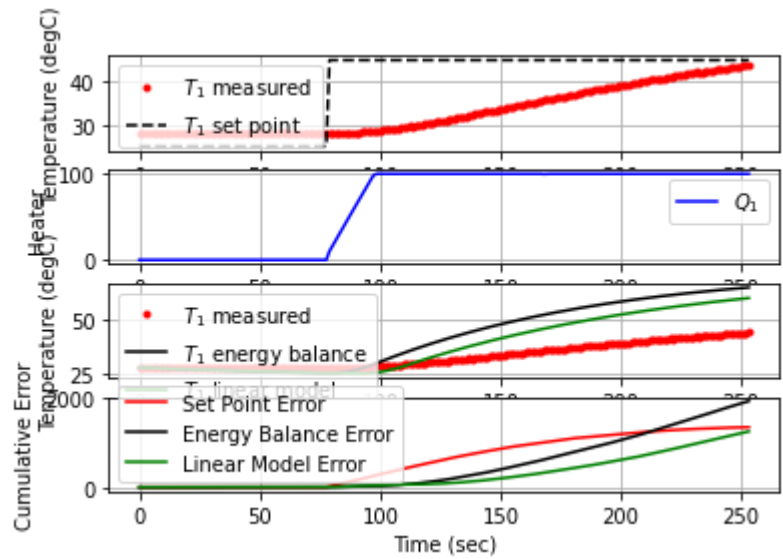
251.7 45.00 43.69 100.00 0.29 99.64 -0.00



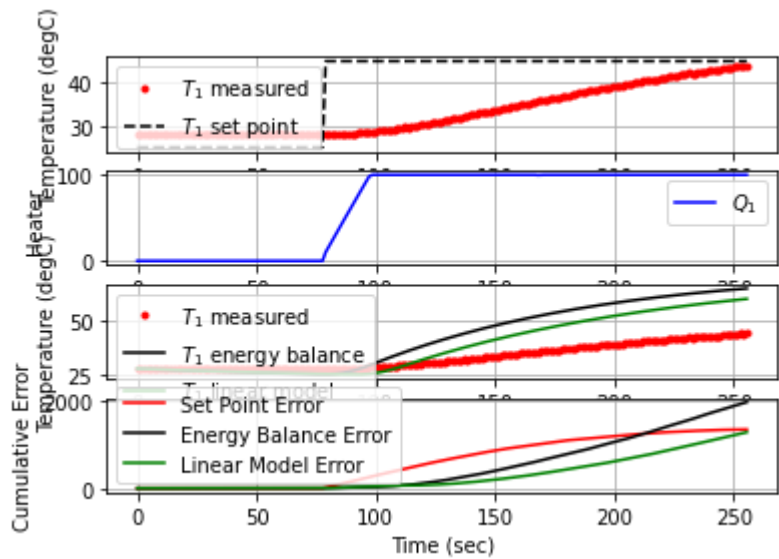
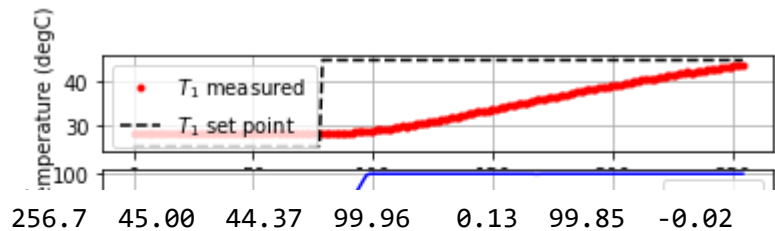
253.1 45.00 44.03 100.00 0.21 99.64 -0.02

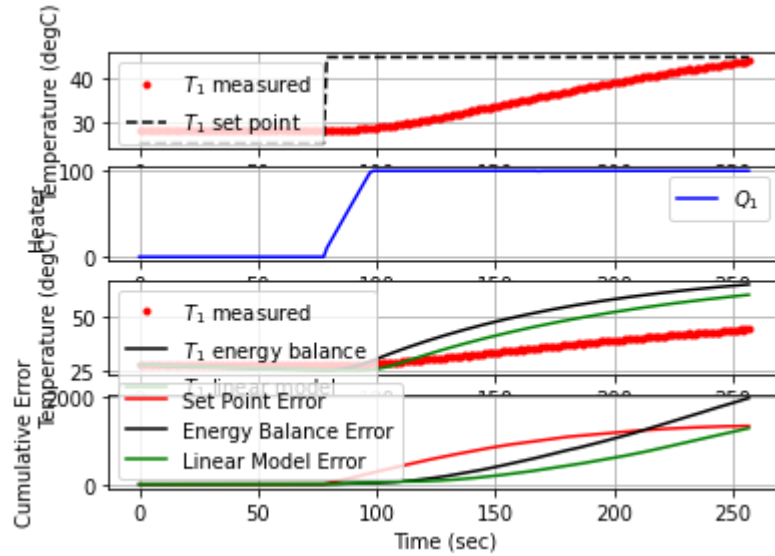


254.3 45.00 43.91 100.00 0.24 99.64 0.01

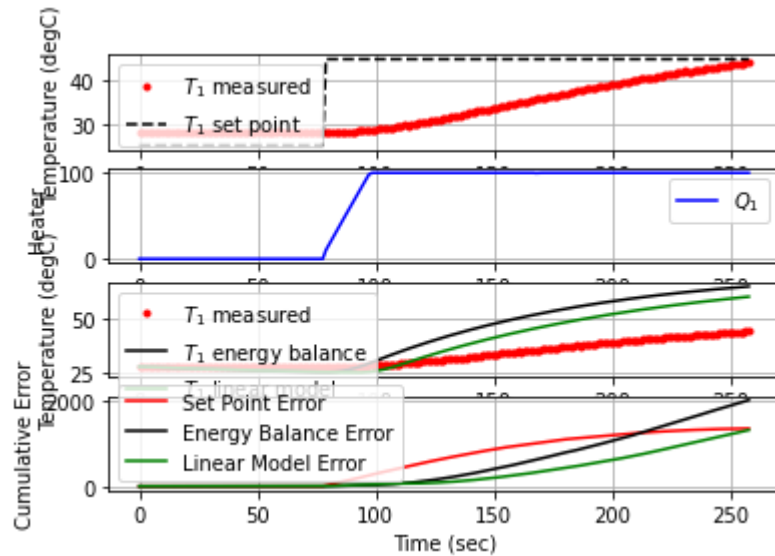


255.5 45.00 44.03 100.00 0.21 99.64 -0.01

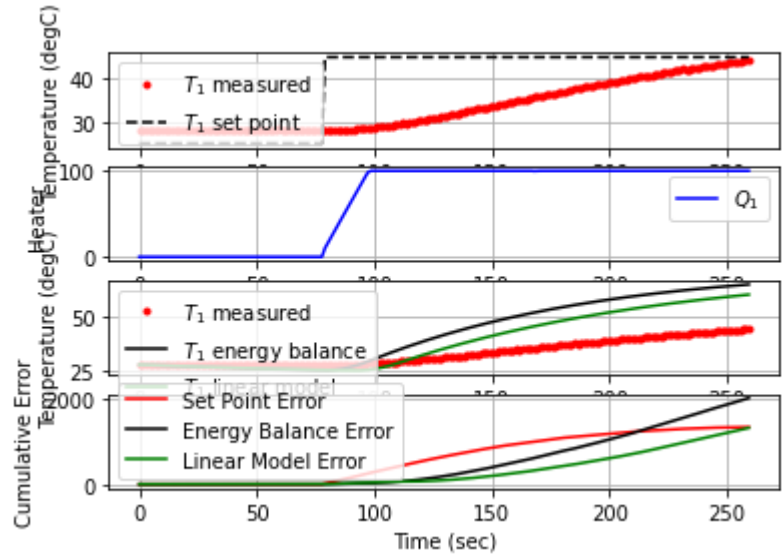




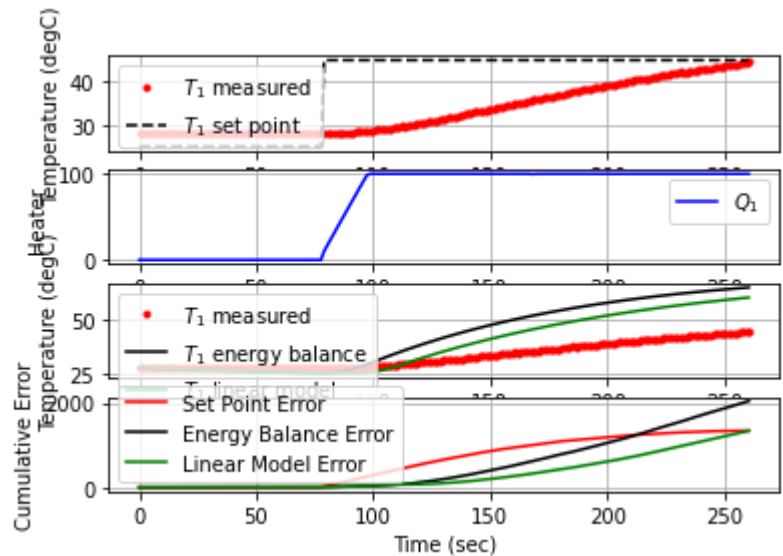
259.2 45.00 44.48 100.00 0.11 99.85 -0.01



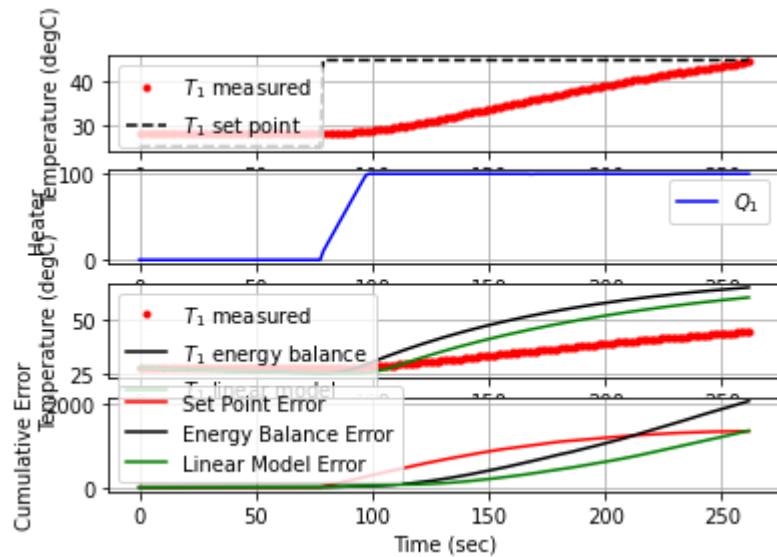
260.4 45.00 44.56 100.00 0.09 99.85 -0.01



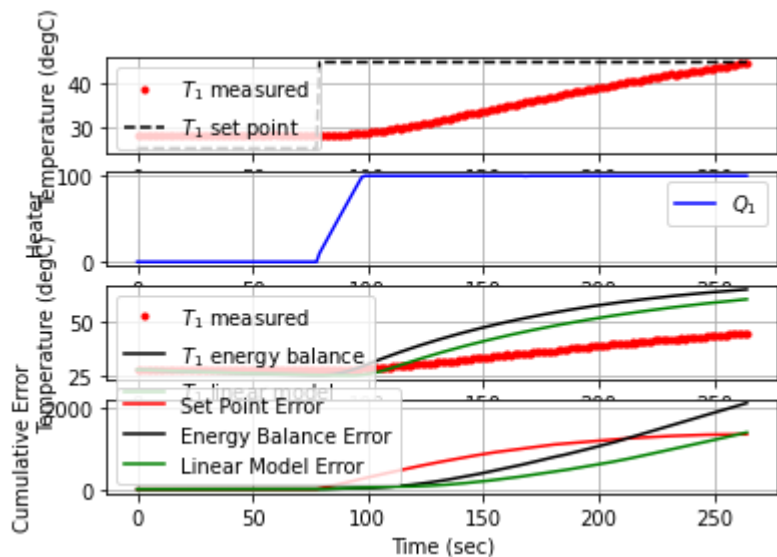
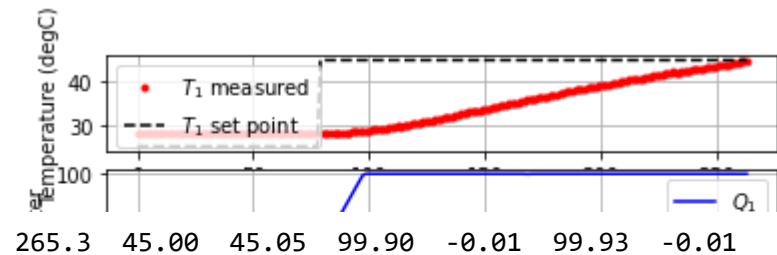
261.6 45.00 44.72 99.99 0.06 99.94 -0.01



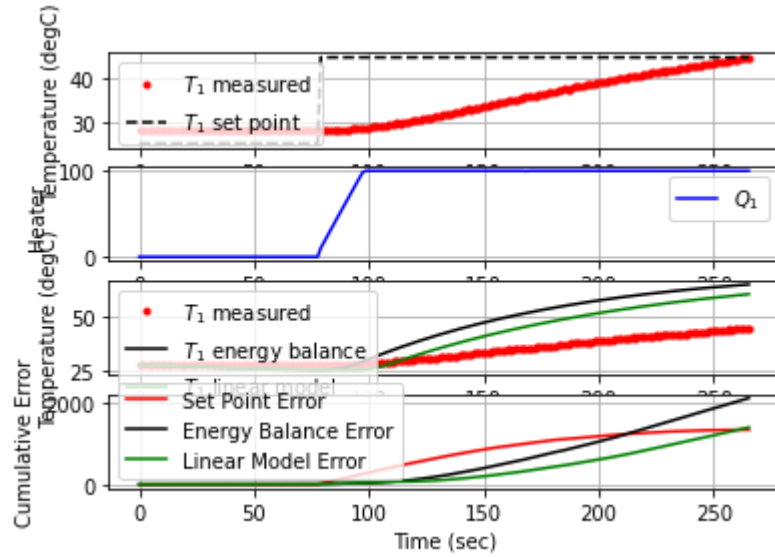
262.9 45.00 44.75 100.00 0.05 99.94 -0.00



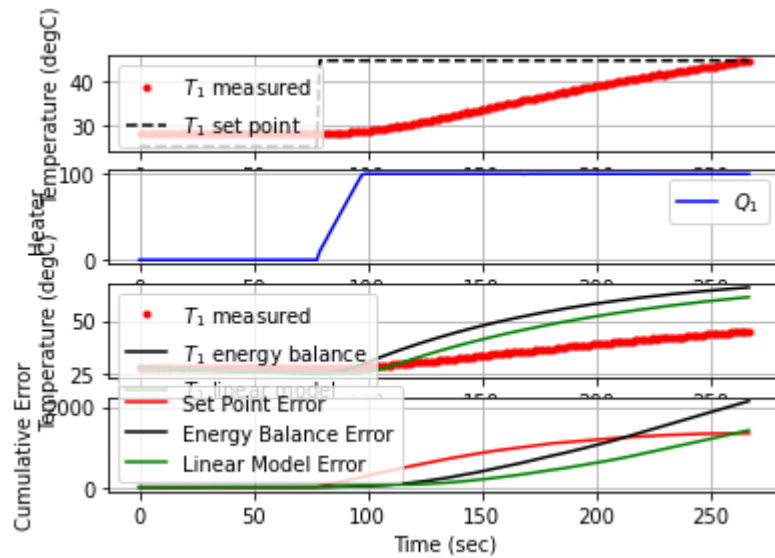
264.1 45.00 44.84 100.00 0.03 99.94 -0.01



266.6 45.00 45.10 99.87 -0.02 99.89 -0.00

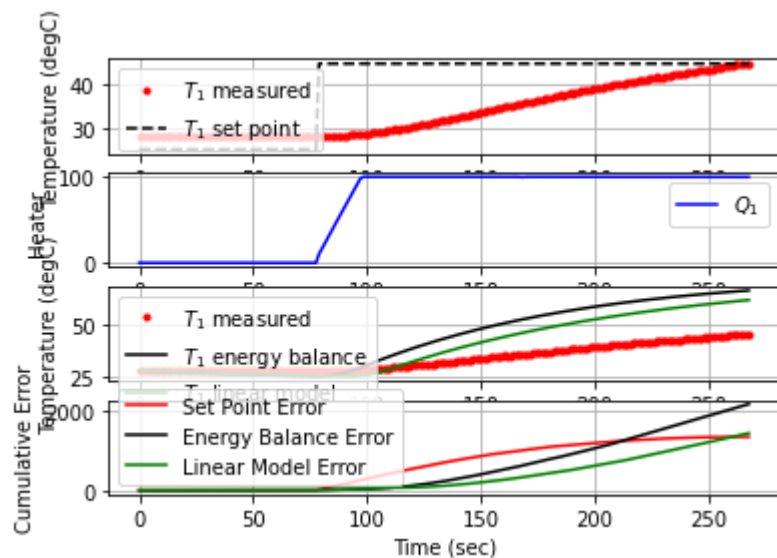


267.8 45.00 45.12 99.83 -0.03 99.85 -0.00

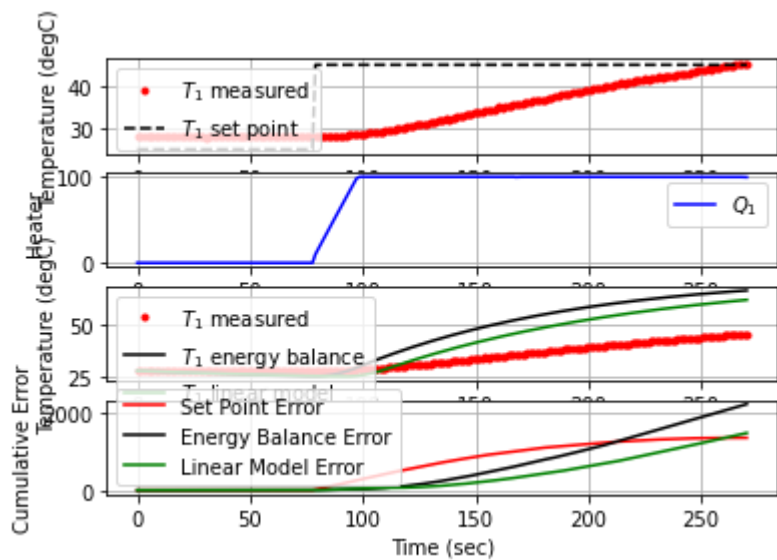
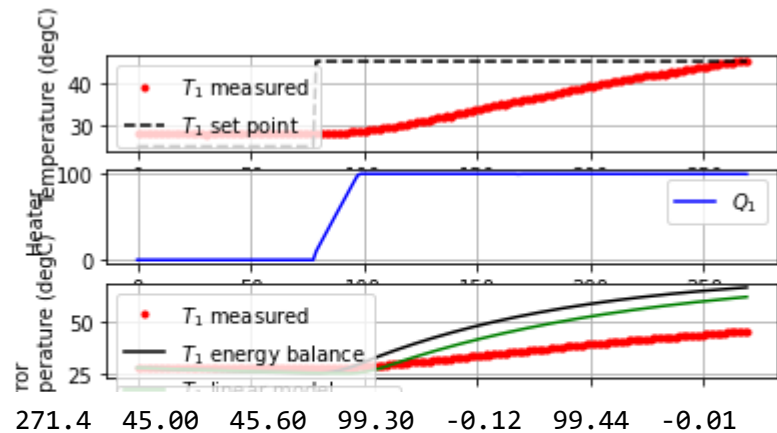


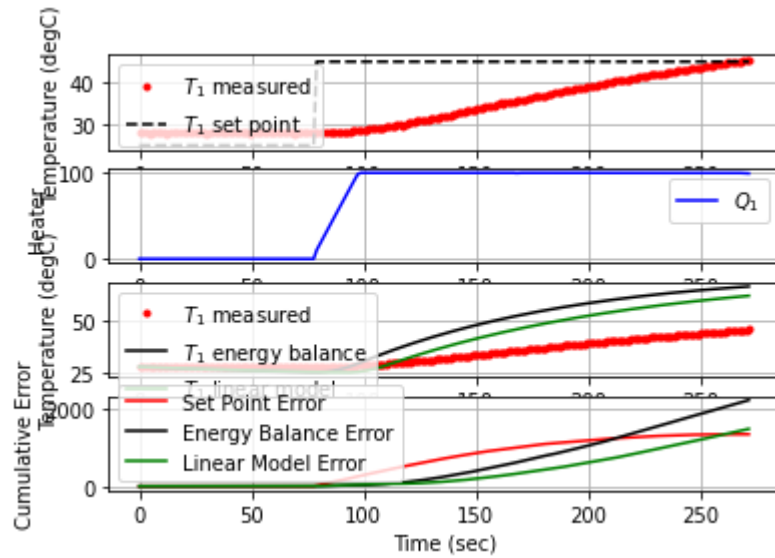


269.0 45.00 45.27 99.70 -0.06 99.76 -0.01

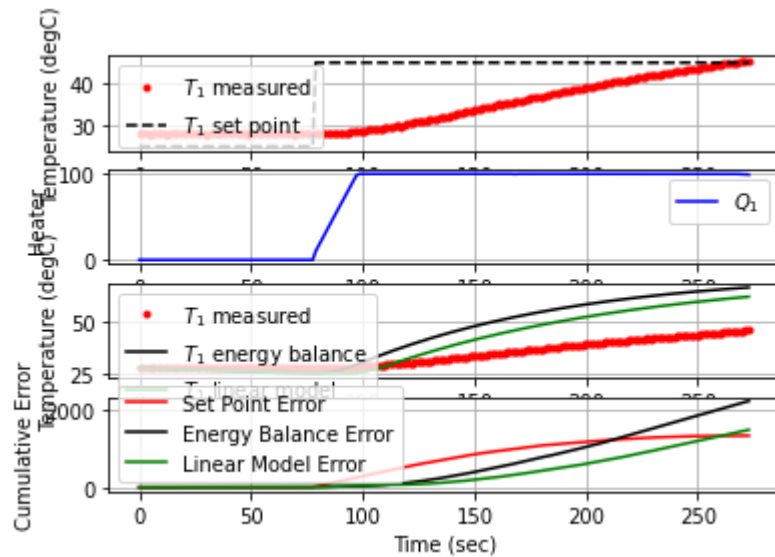


270.2 45.00 45.40 99.55 -0.08 99.64 -0.01

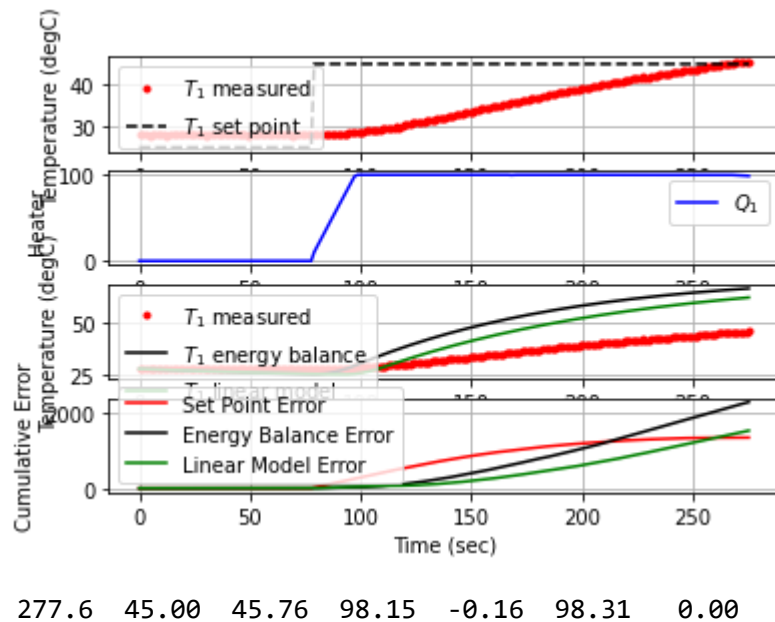
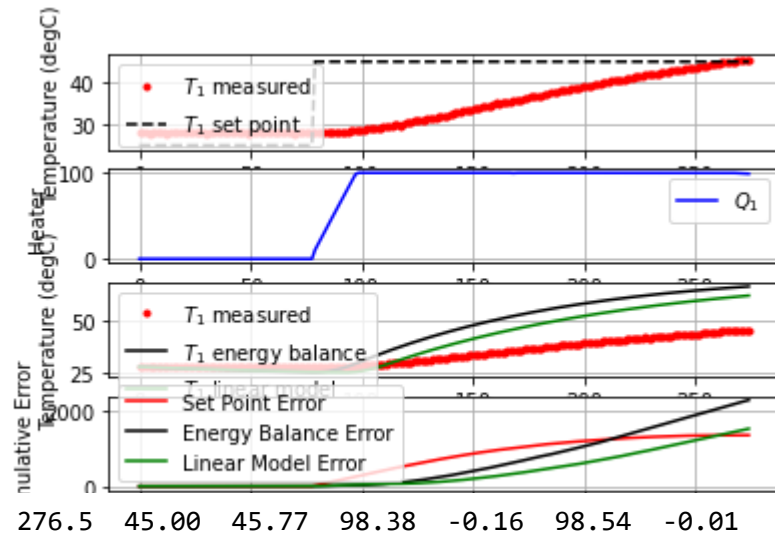


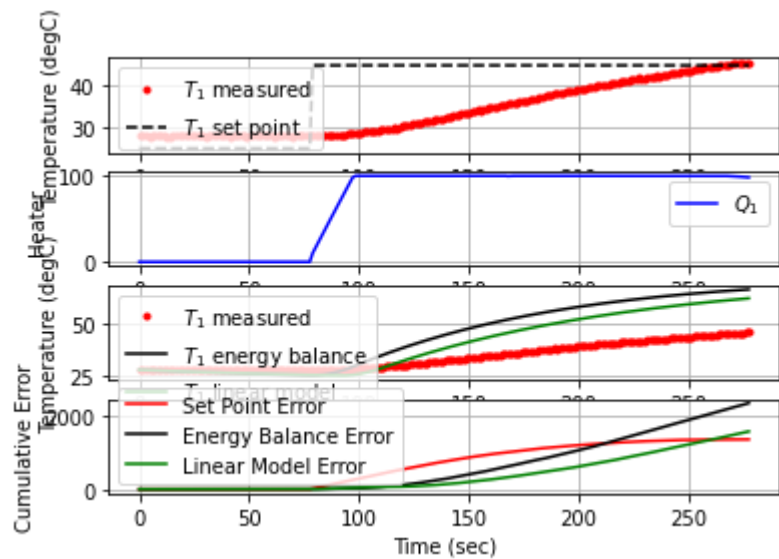
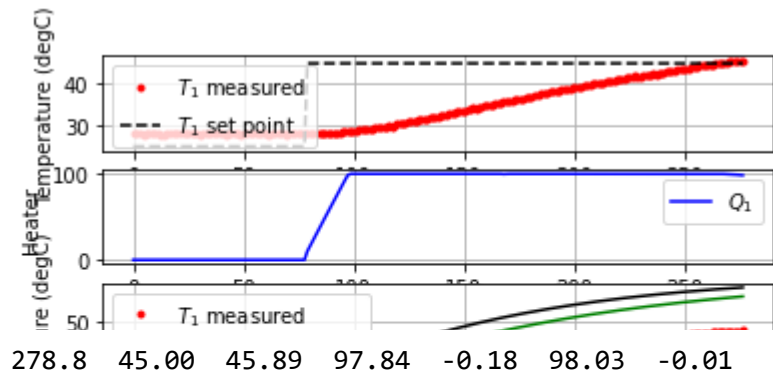


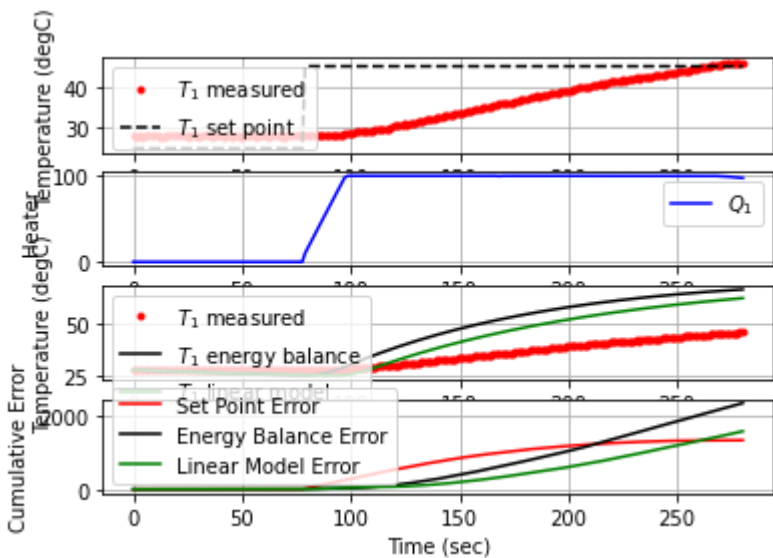
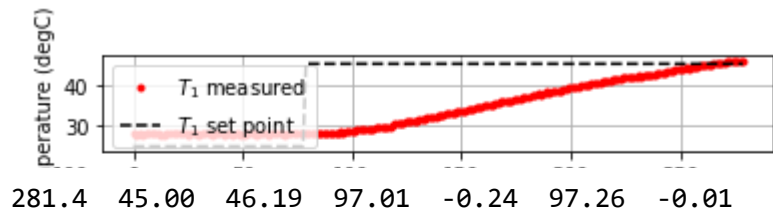
274.1 45.00 45.56 98.90 -0.12 99.02 0.00



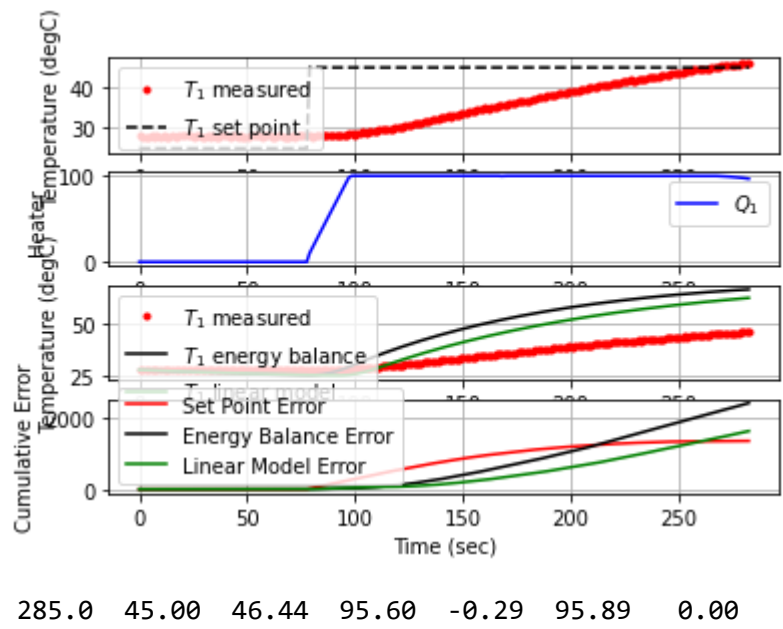
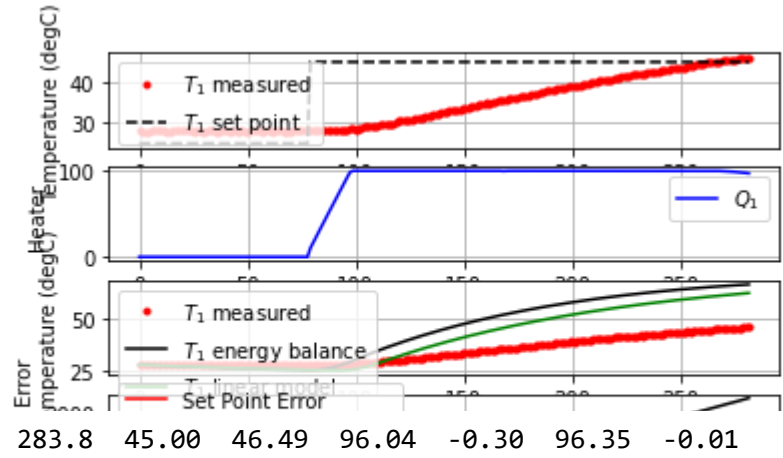
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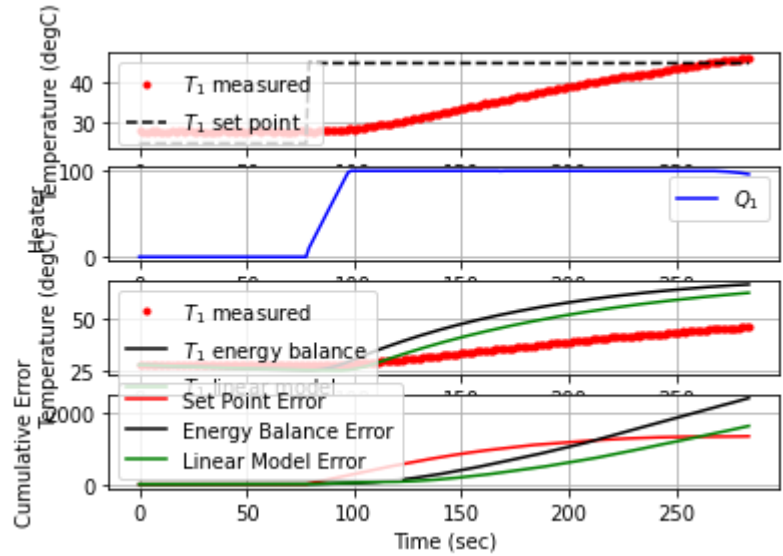




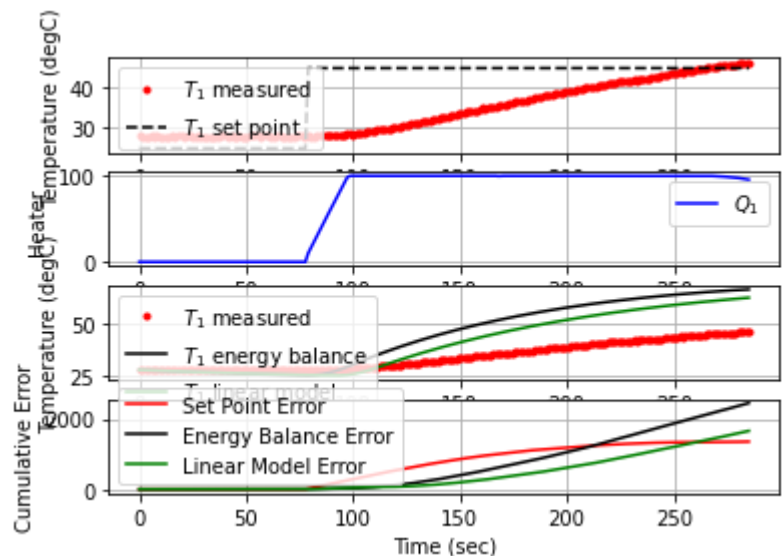


282.6 45.00 46.33 96.53 -0.27 96.81 -0.01



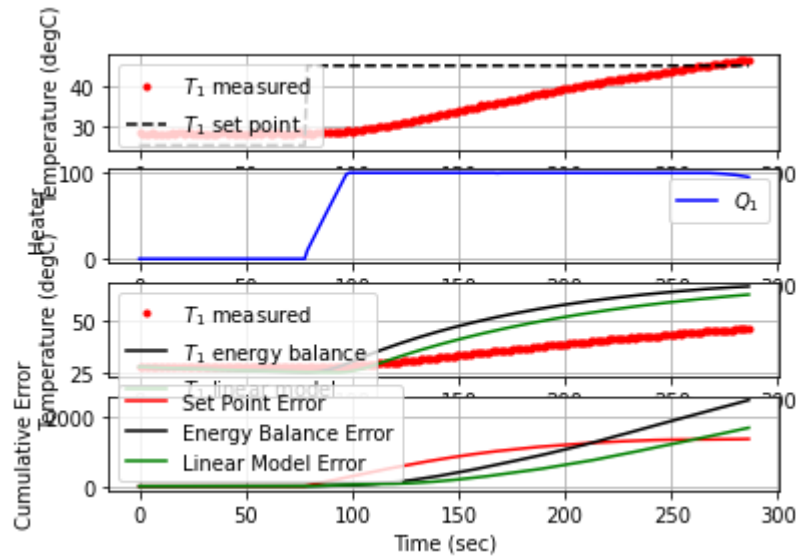


286.3 45.00 46.64 94.95 -0.33 95.30 -0.01

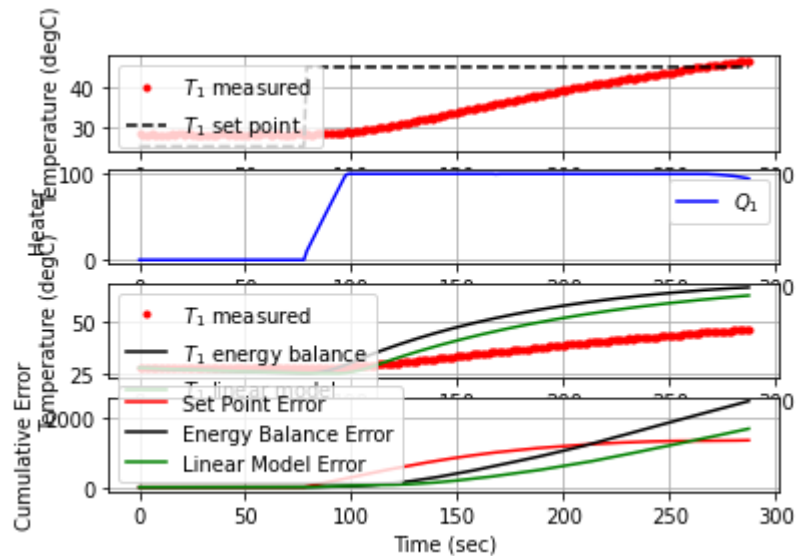




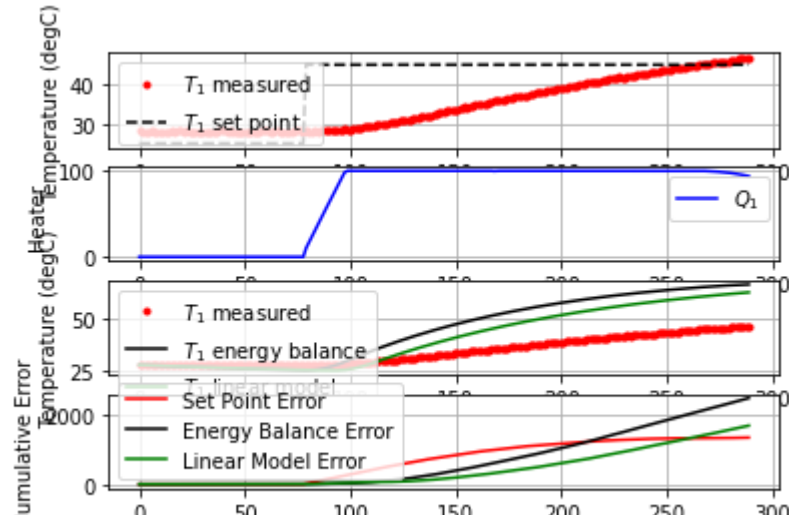
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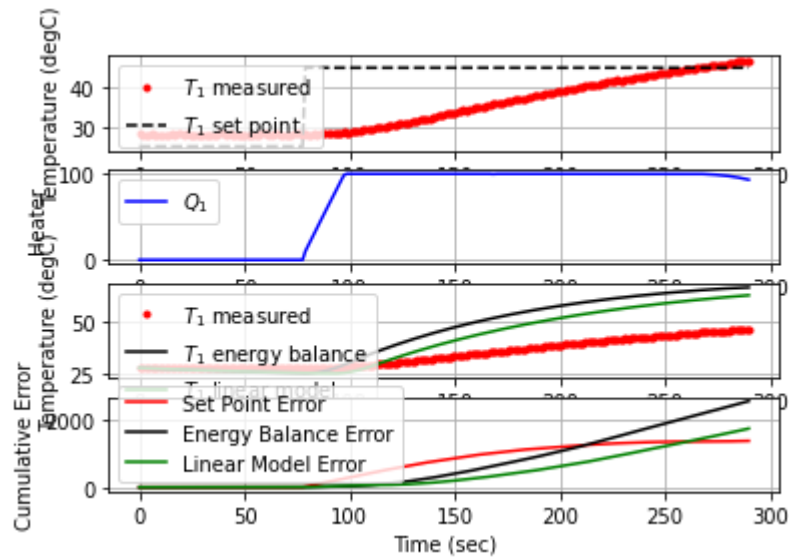
288.6 45.00 46.94 93.74 -0.39 94.14 -0.01



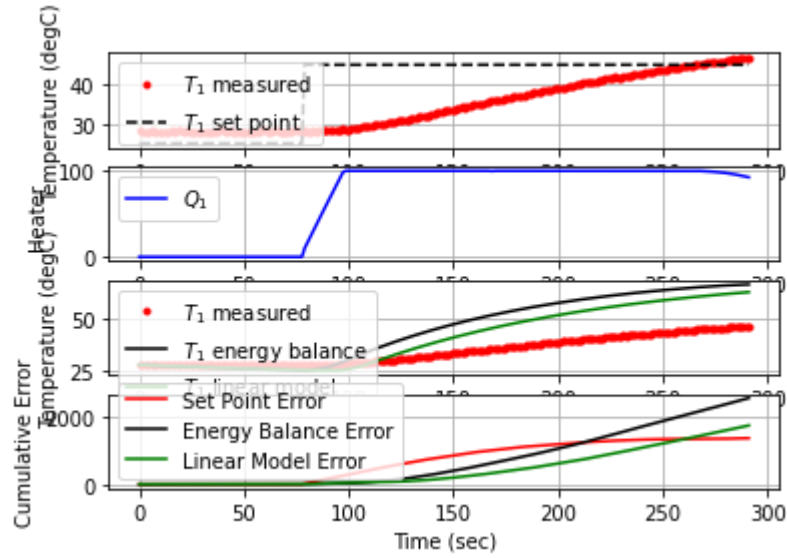
289.8 45.00 46.93 93.14 -0.39 93.53 0.00



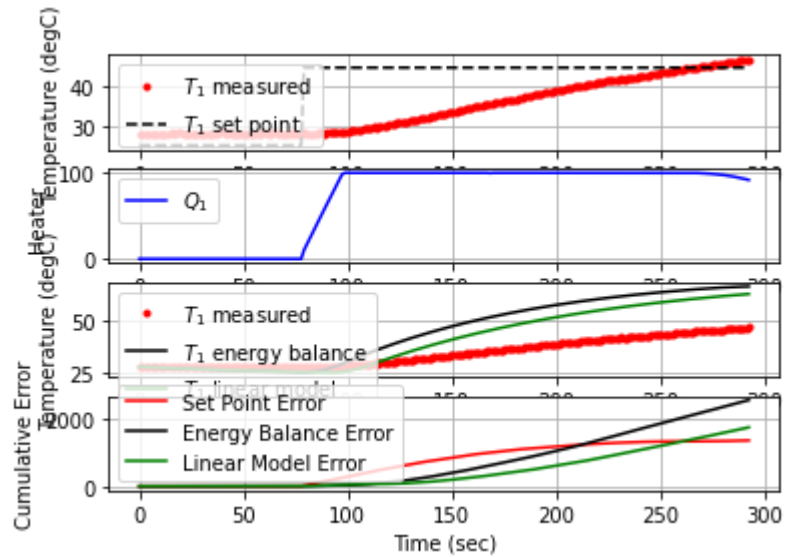
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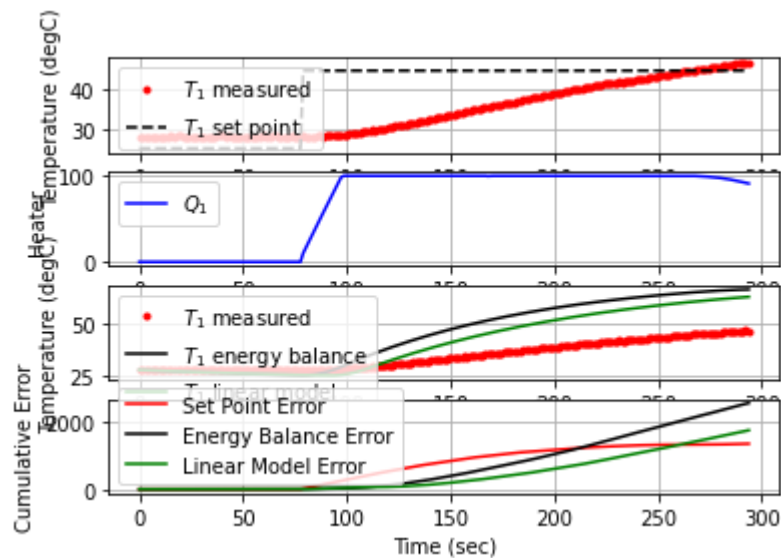
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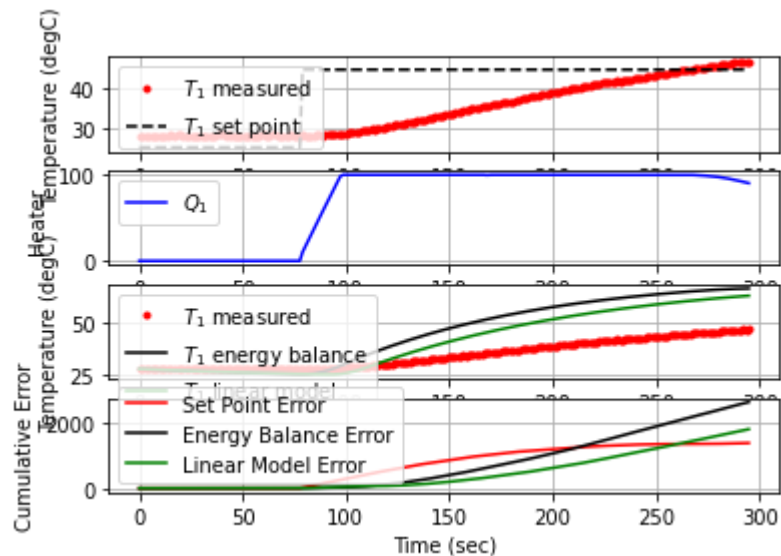
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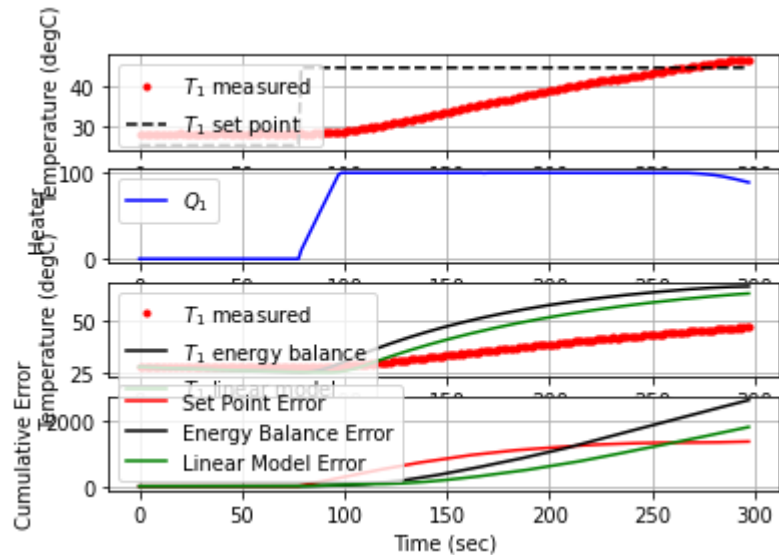
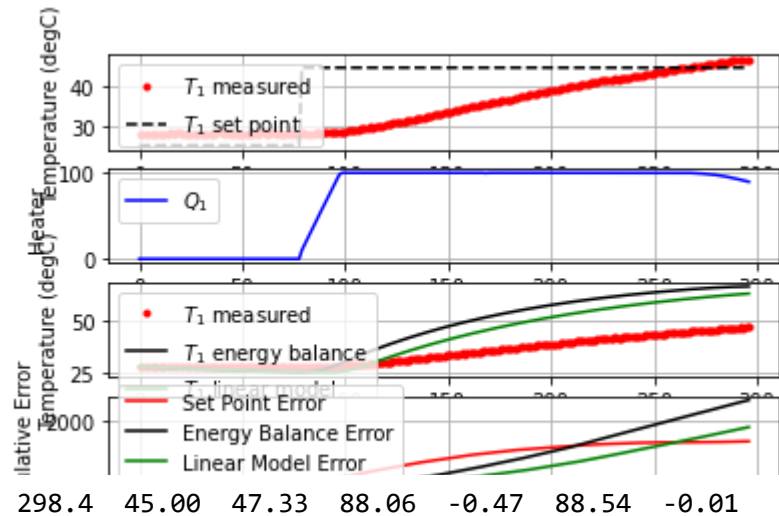
294.8 45.00 47.13 90.27 -0.43 90.71 -0.01

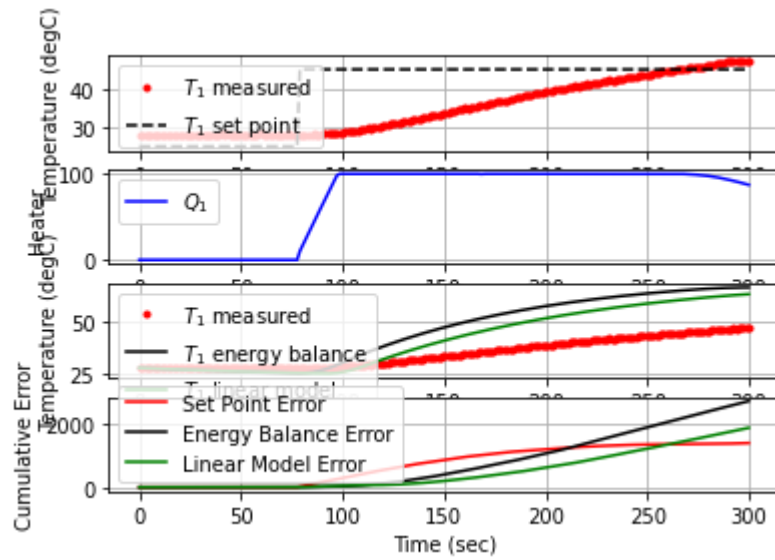
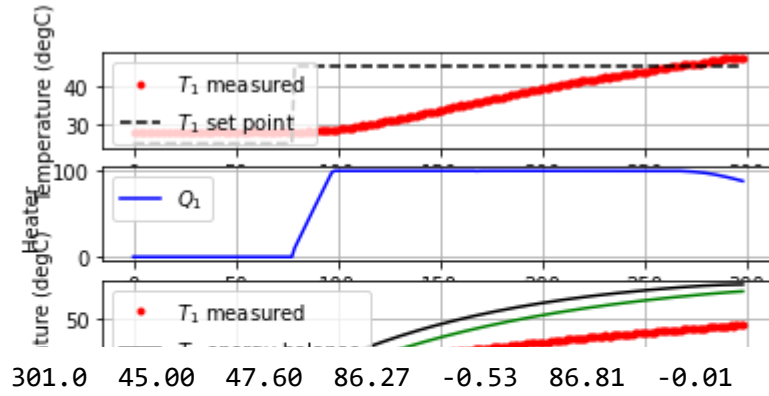


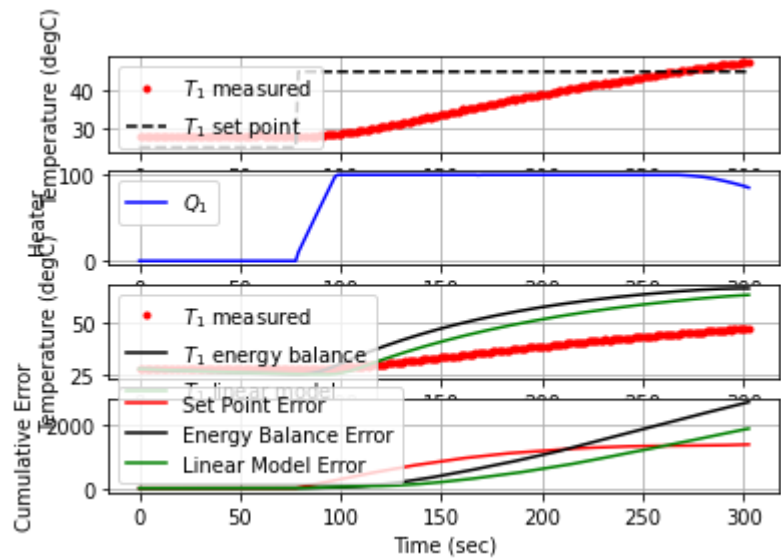
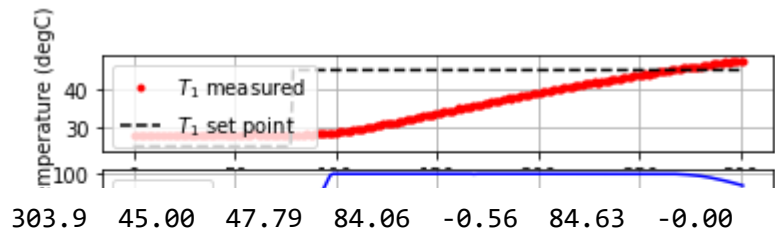
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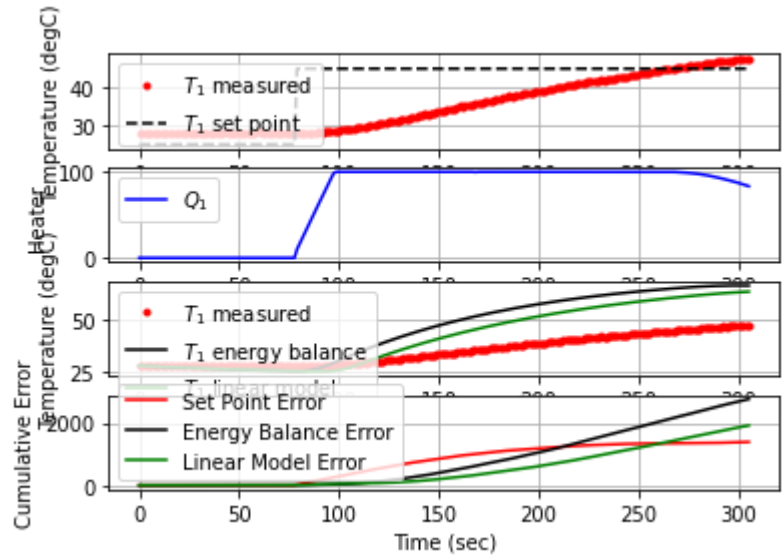
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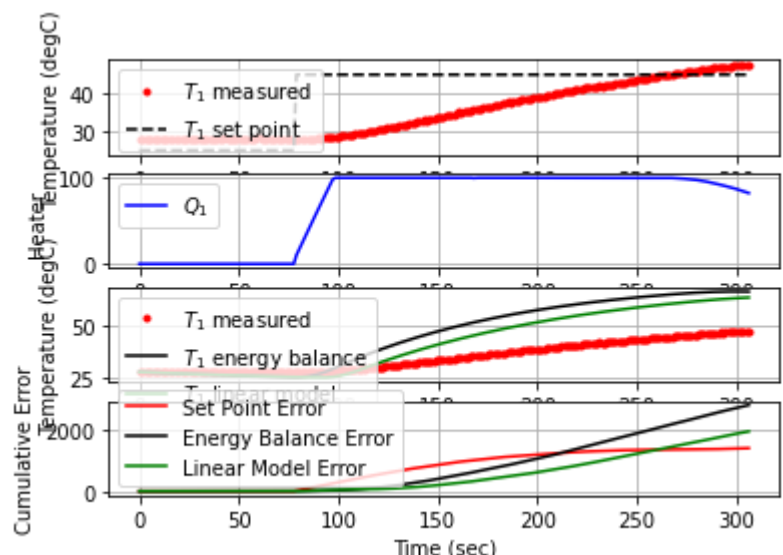




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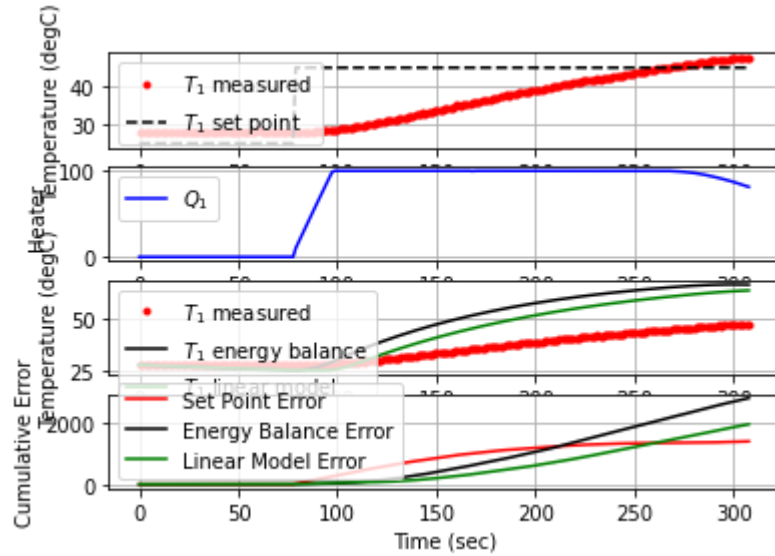


307.7 45.00 47.73 81.28 -0.55 81.83 0.00

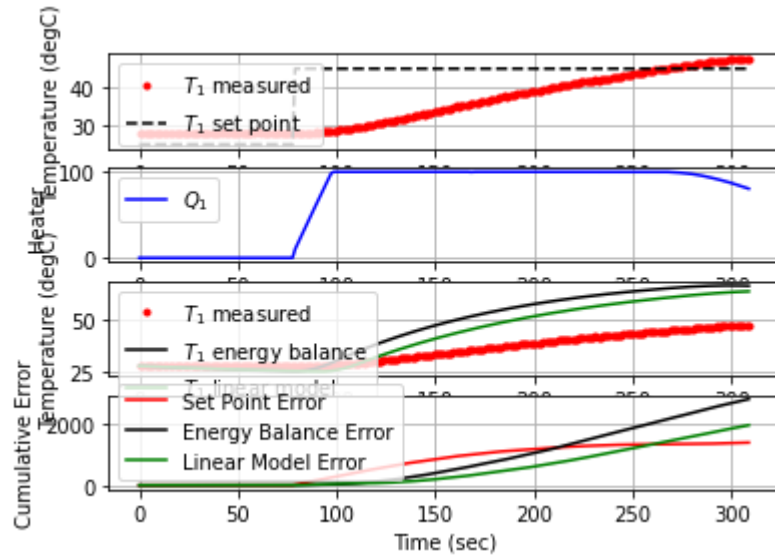


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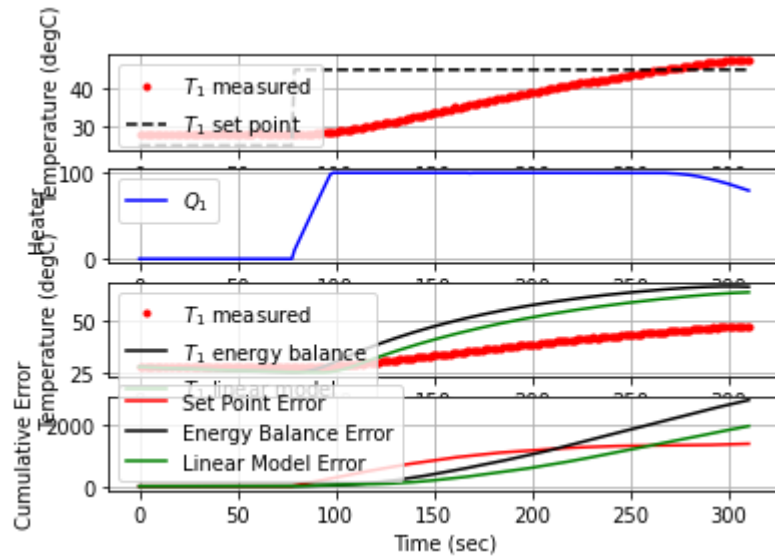




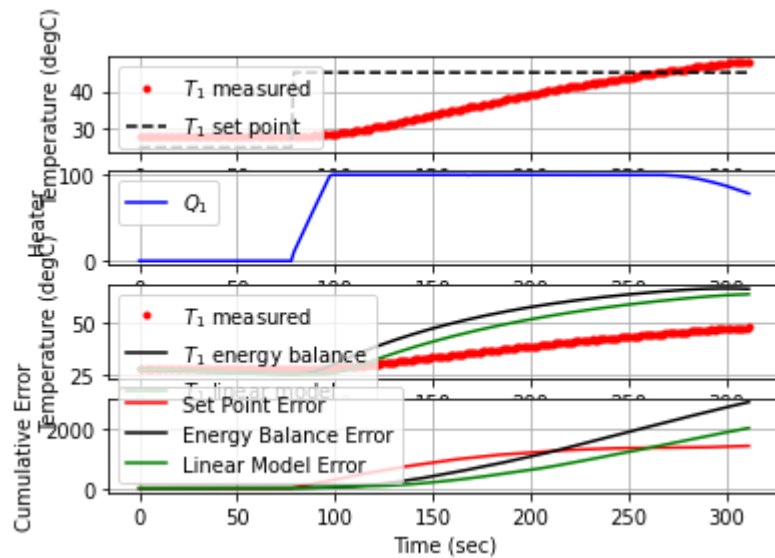
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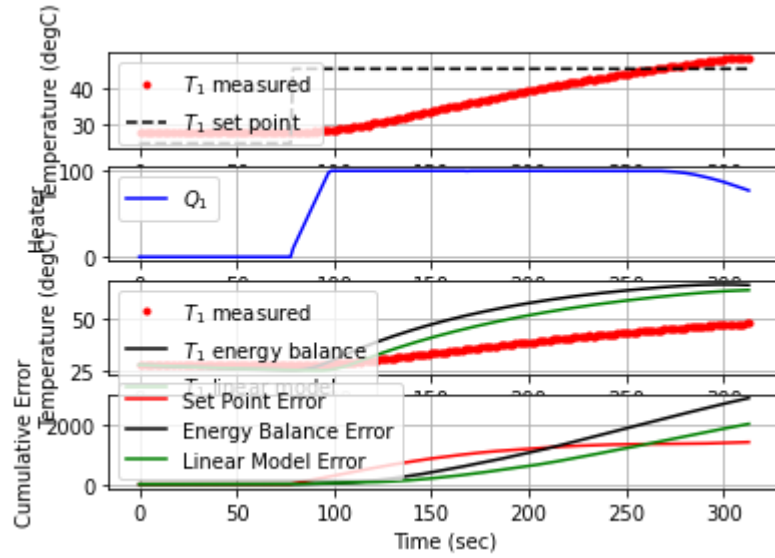
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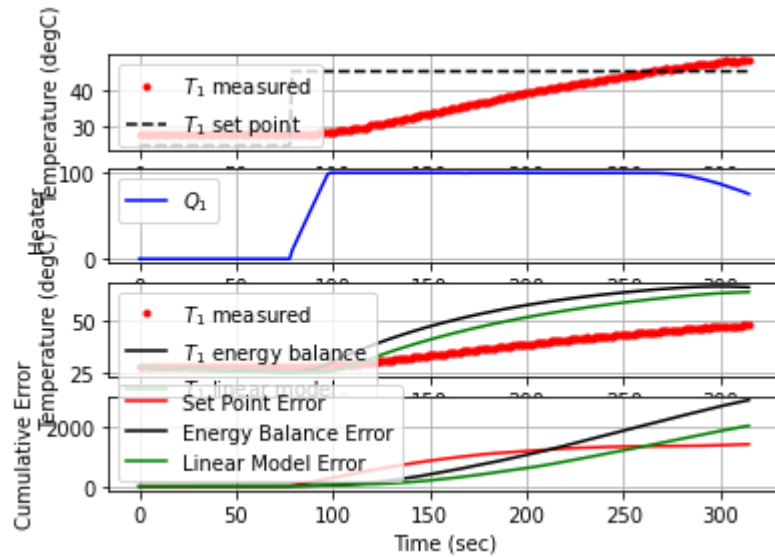
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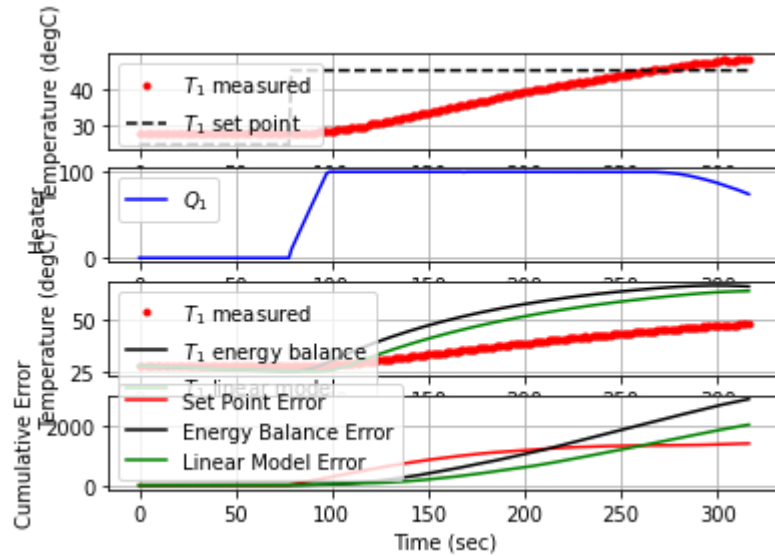
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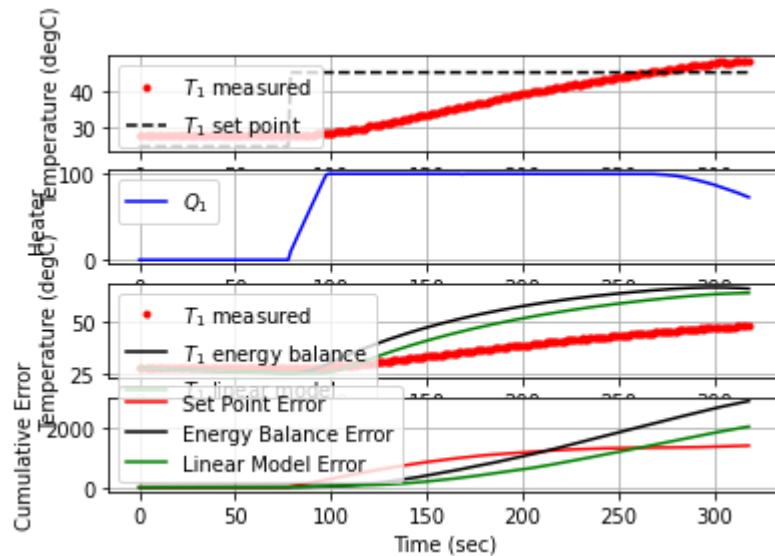
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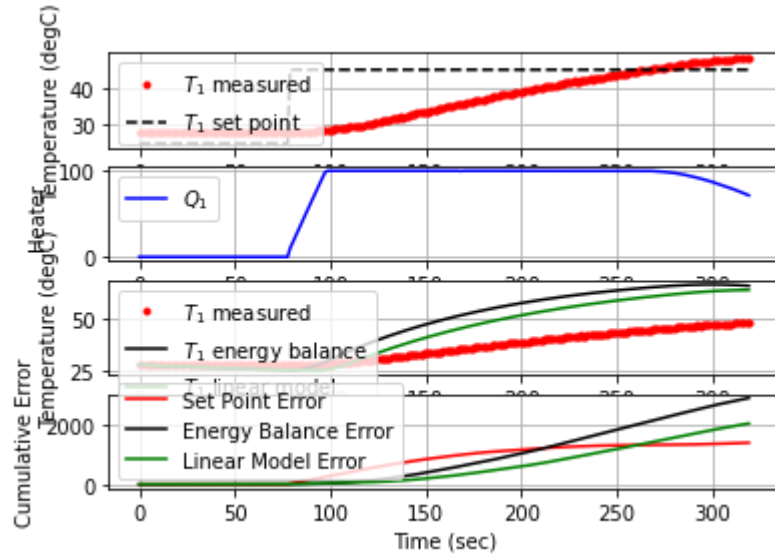
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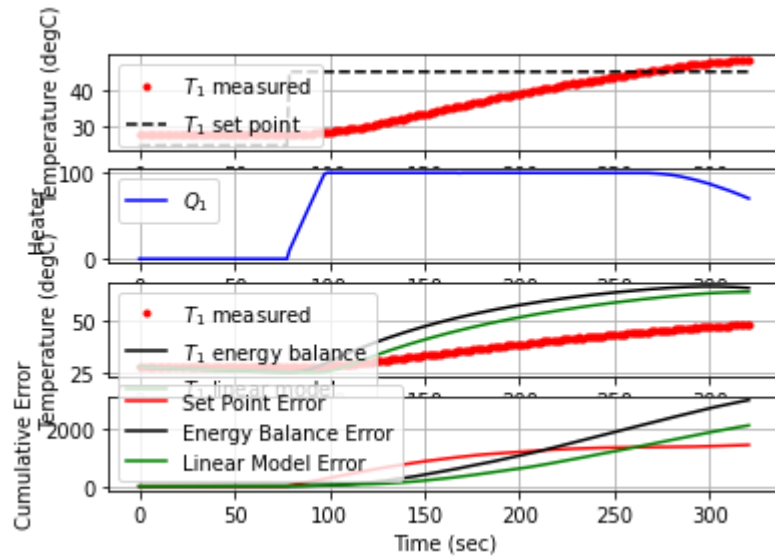
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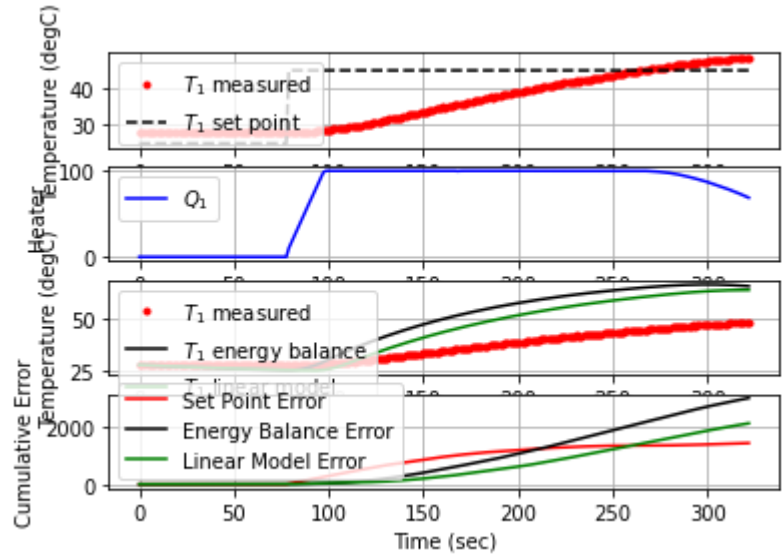
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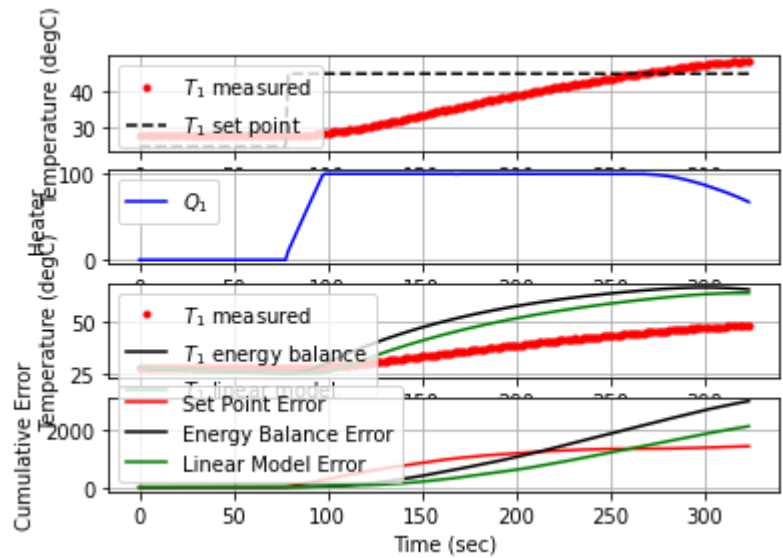
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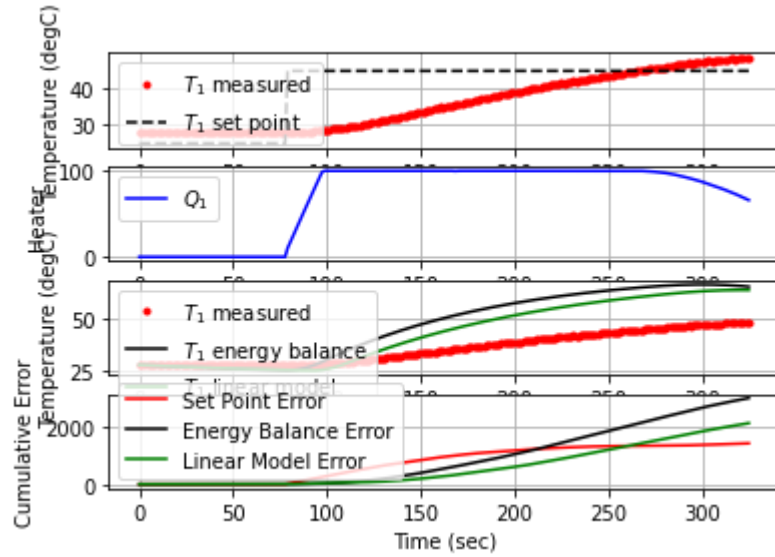
323.3 45.00 48.74 67.25 -0.76 68.01 -0.01



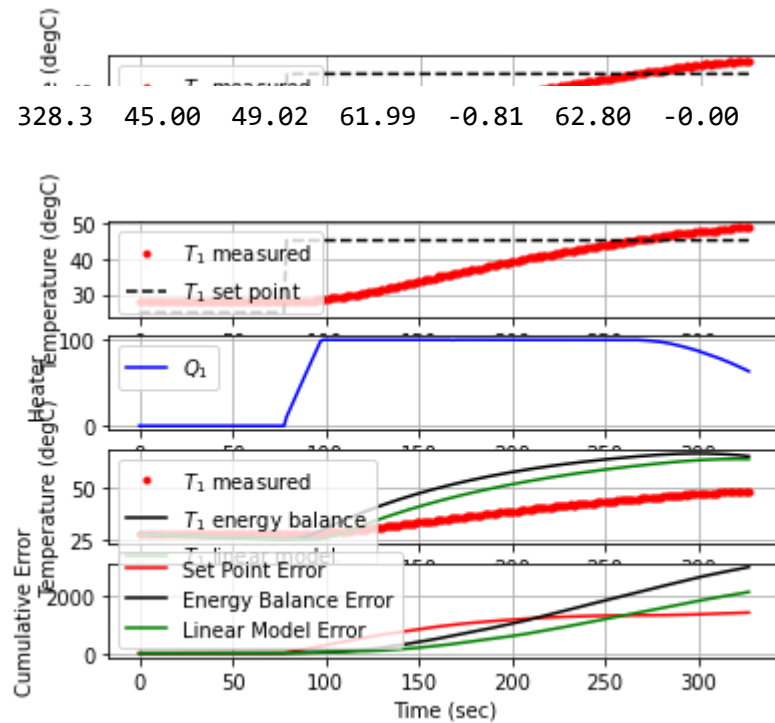
324.6 45.00 48.80 65.96 -0.77 66.73 -0.00



325.8 45.00 48.76 64.72 -0.76 65.48 0.00

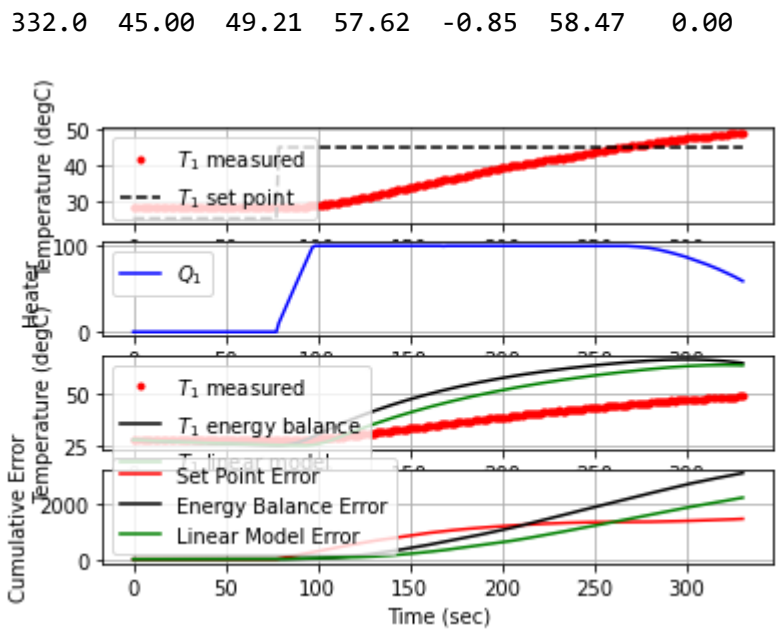
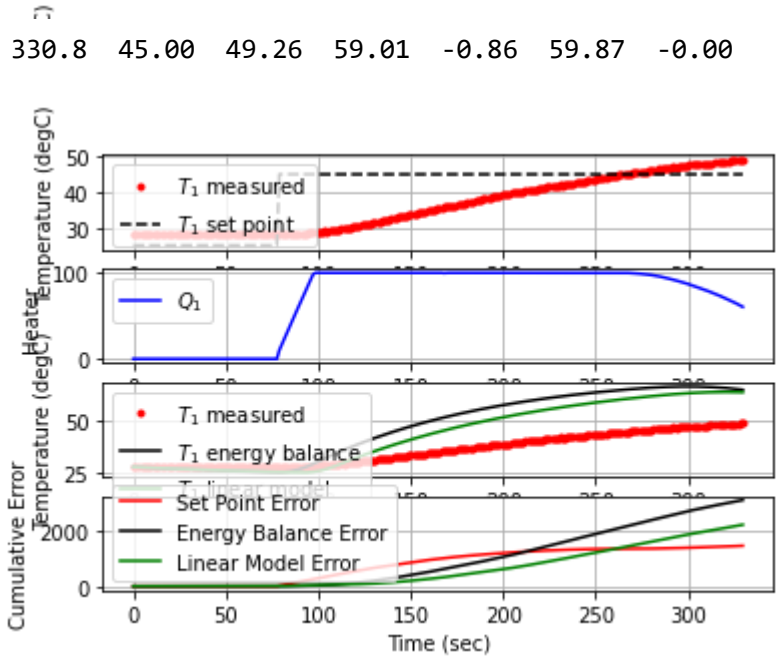


327.0 45.00 48.95 63.35 -0.80 64.16 -0.01

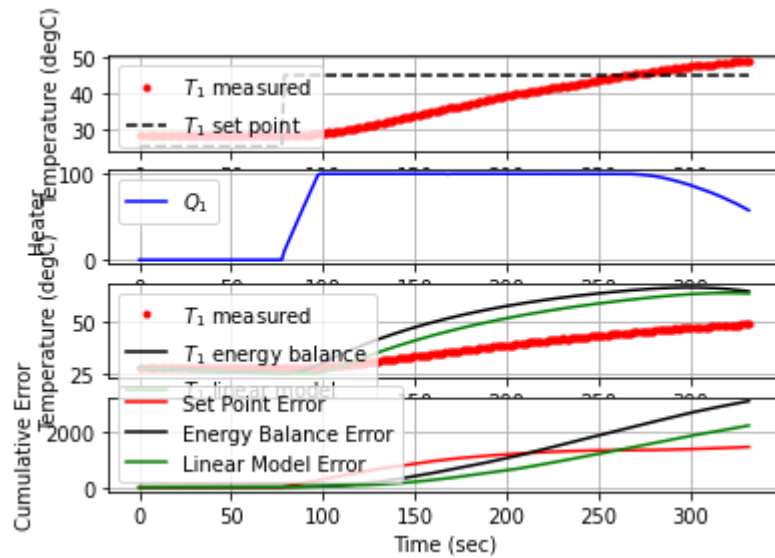


329.6 45.00 49.26 60.42 -0.86 61.29 -0.01

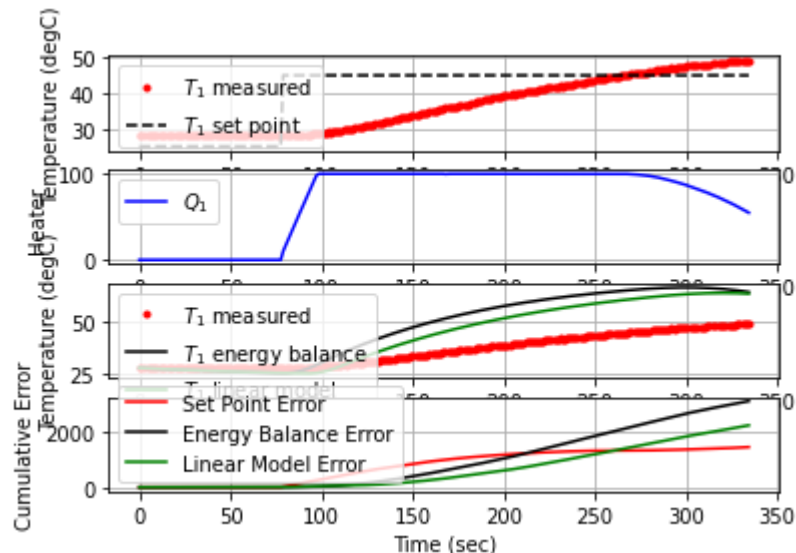
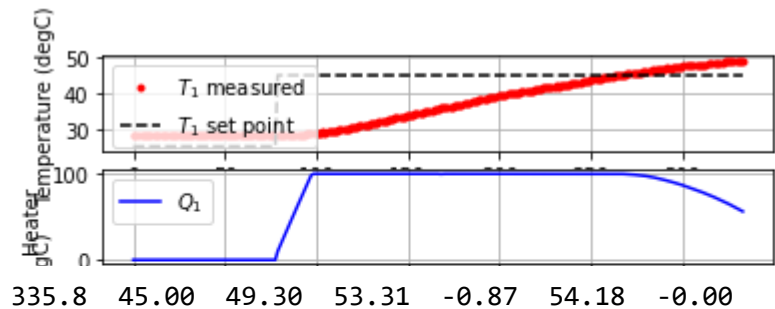


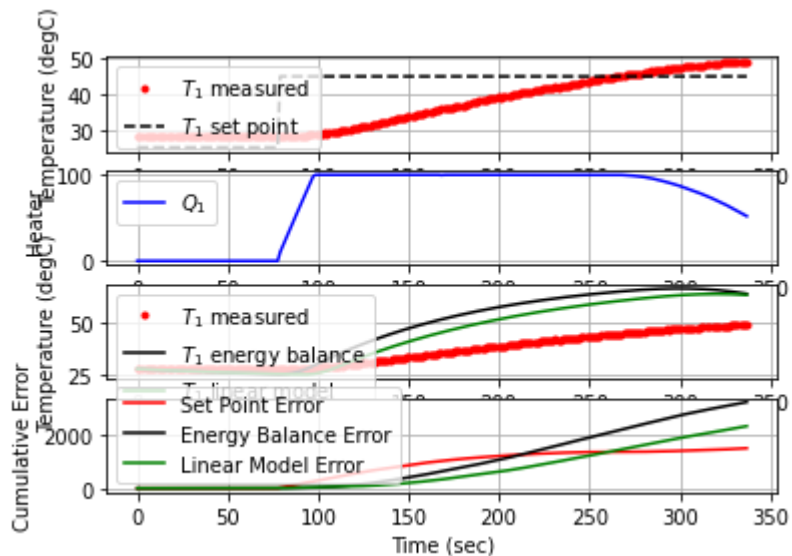
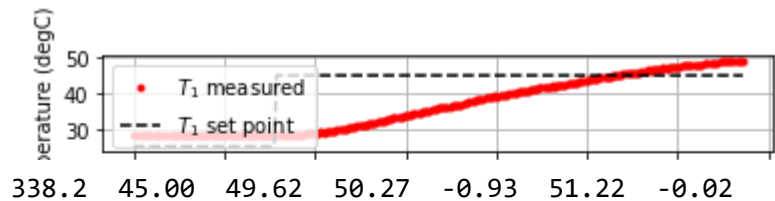


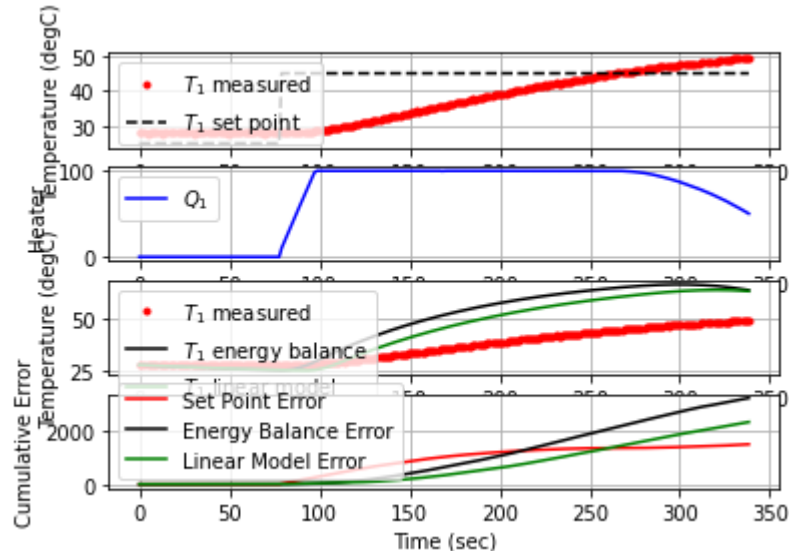
333.2 45.00 49.16 56.29 -0.84 57.13 0.00



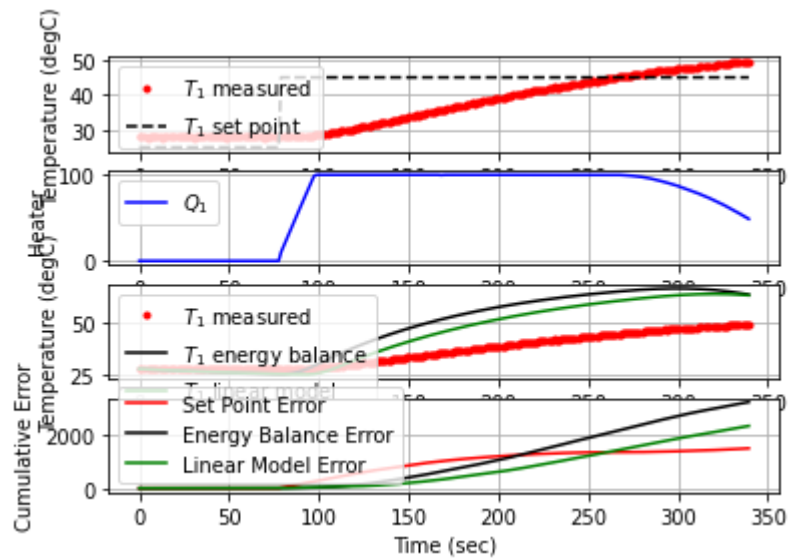
334.5 45.00 49.28 54.83 -0.86 55.71 -0.01



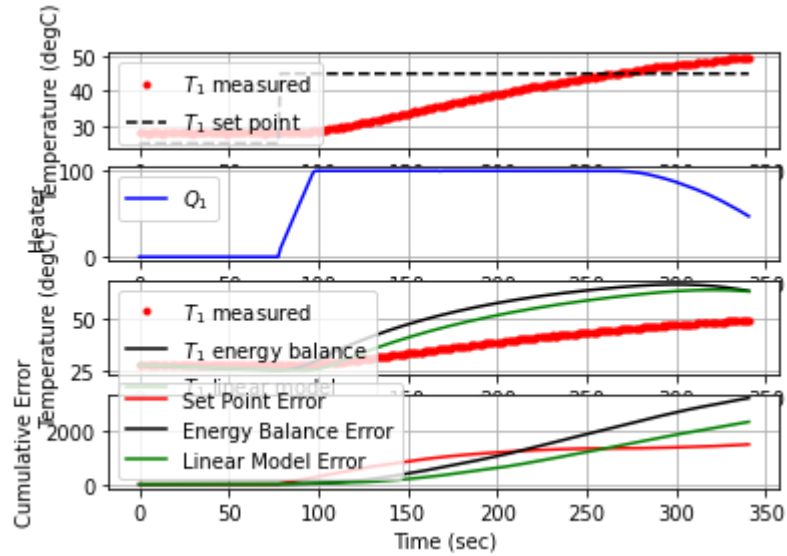




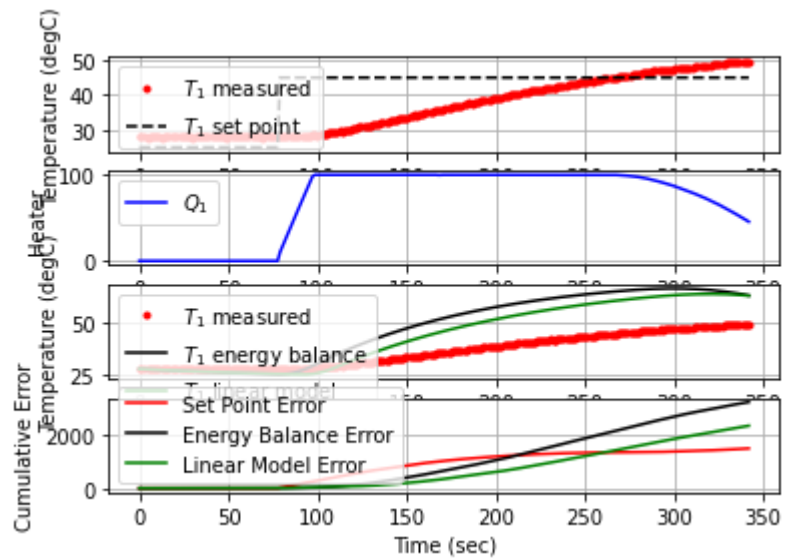
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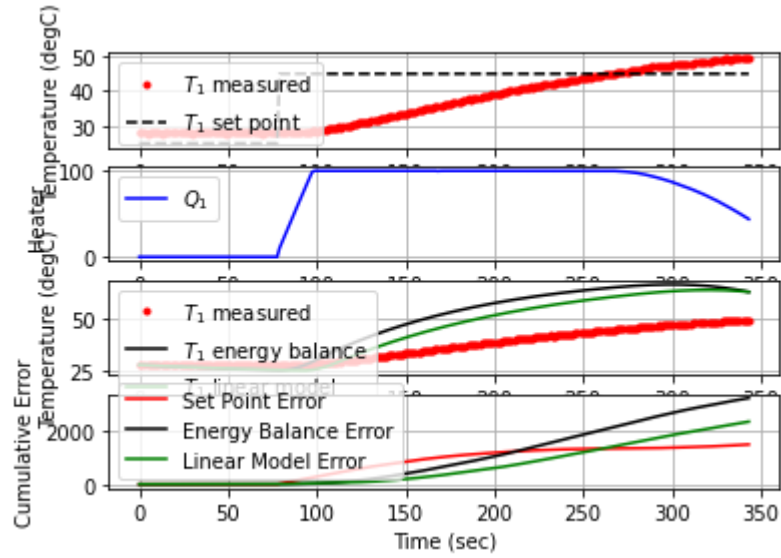
342.0 45.00 49.64 45.50 -0.94 46.43 0.00



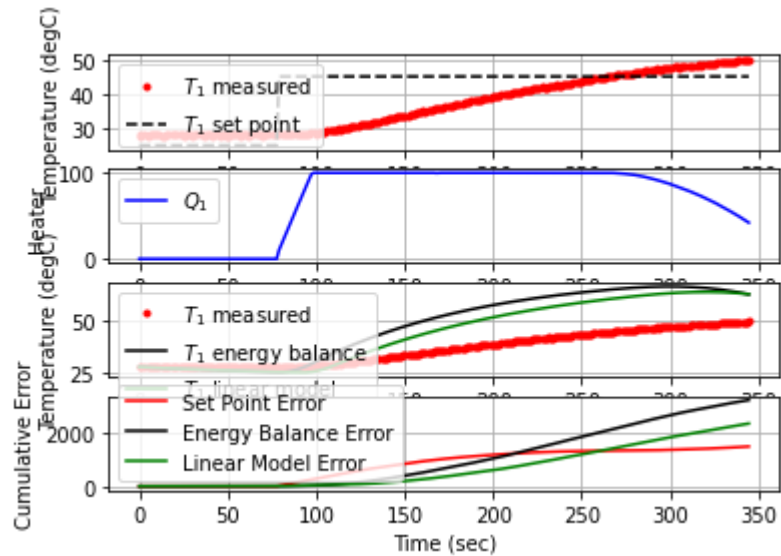
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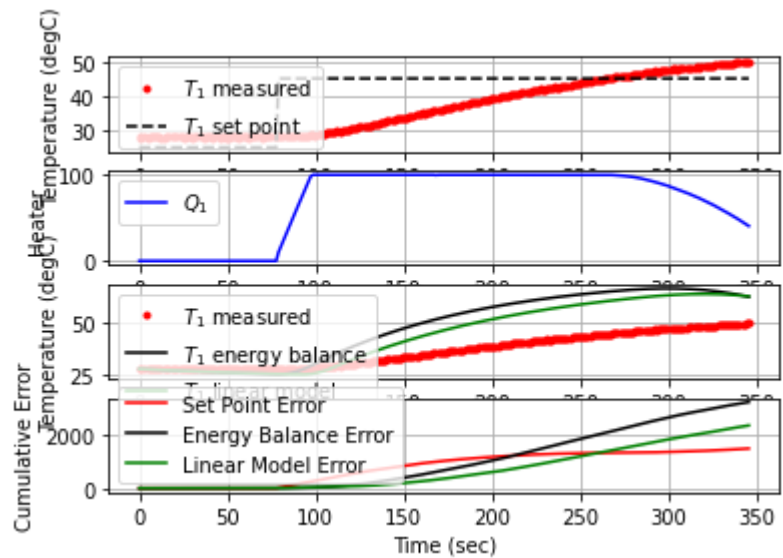
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345.7 45.00 49.98 40.51 -1.01 41.52 0.00

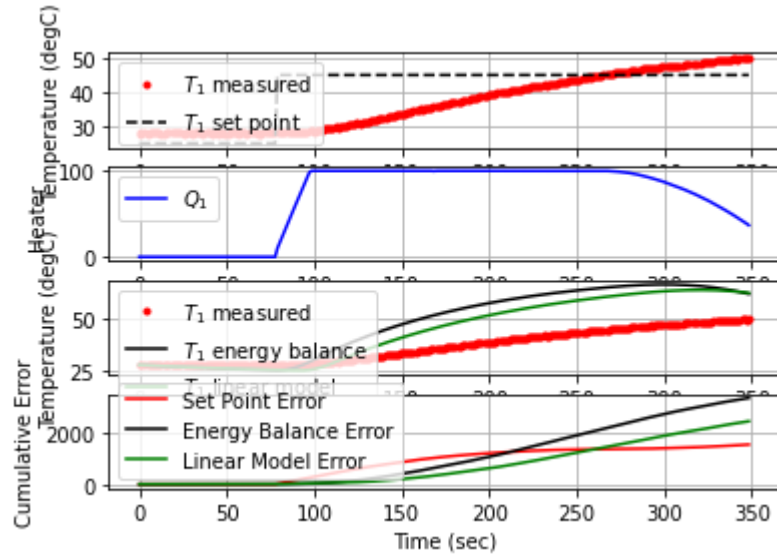
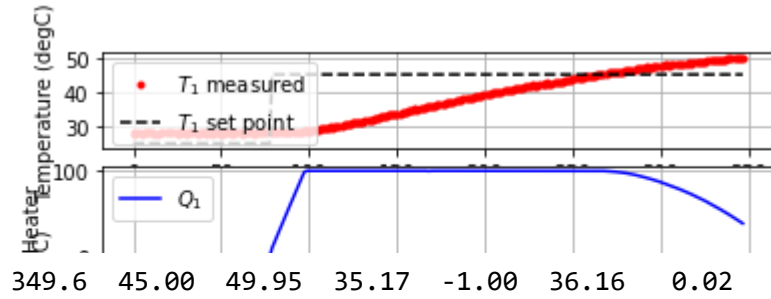


347.0 45.00 49.93 38.86 -1.00 39.85 0.00

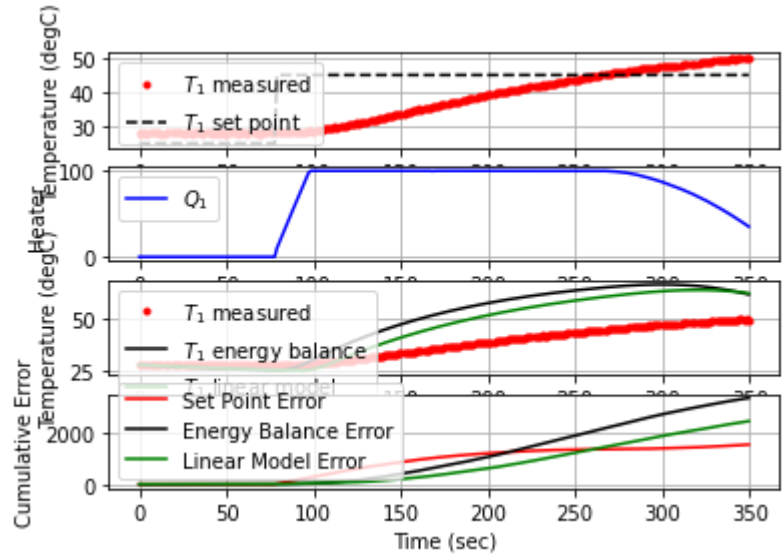


348.4 45.00 50.23 36.80 -1.06 37.87 -0.01

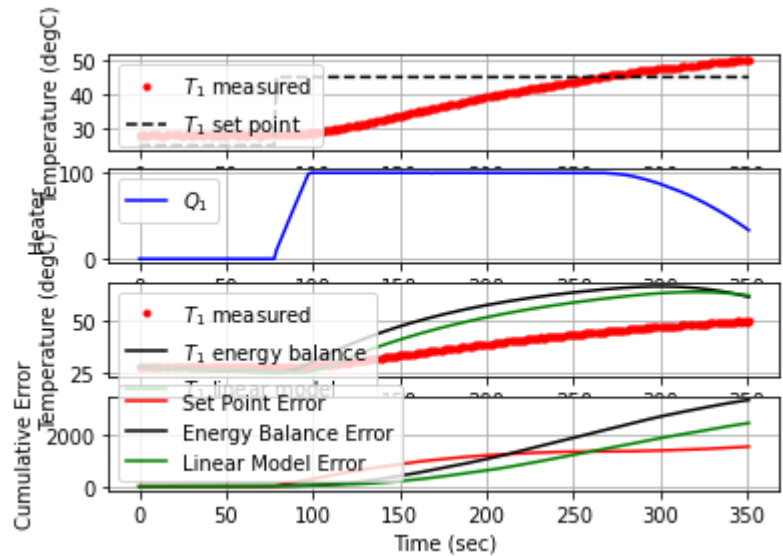




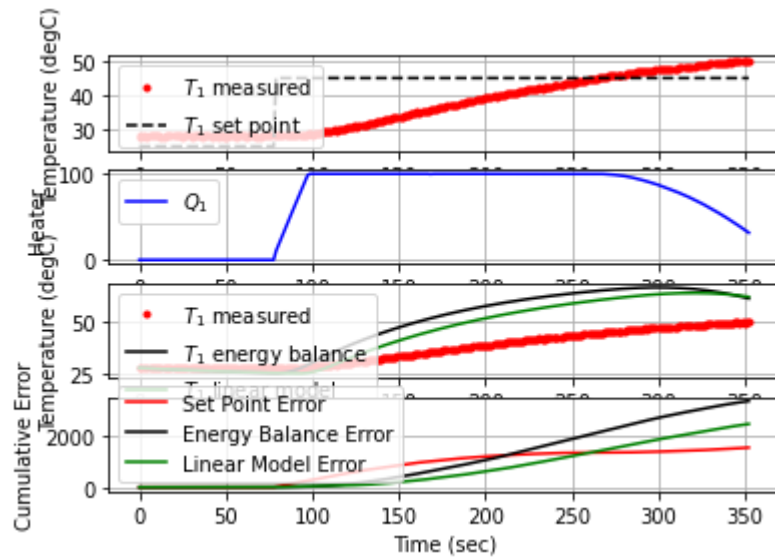
350.9 45.00 50.25 33.29 -1.06 34.37 -0.02



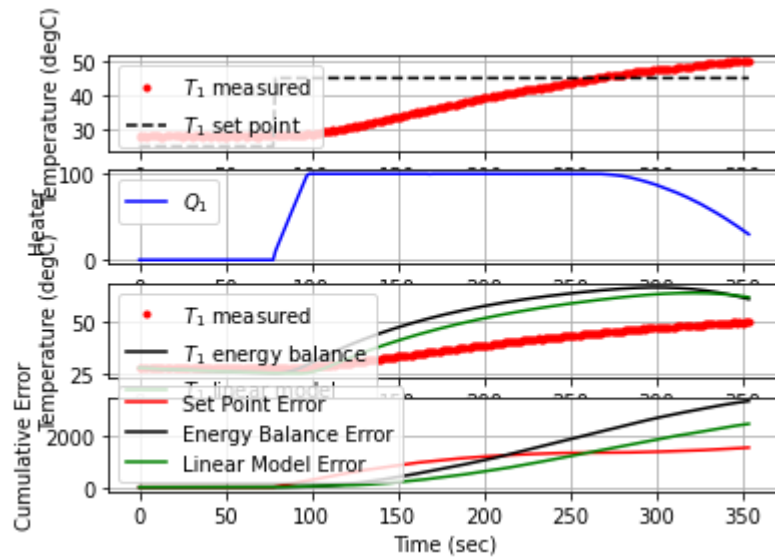
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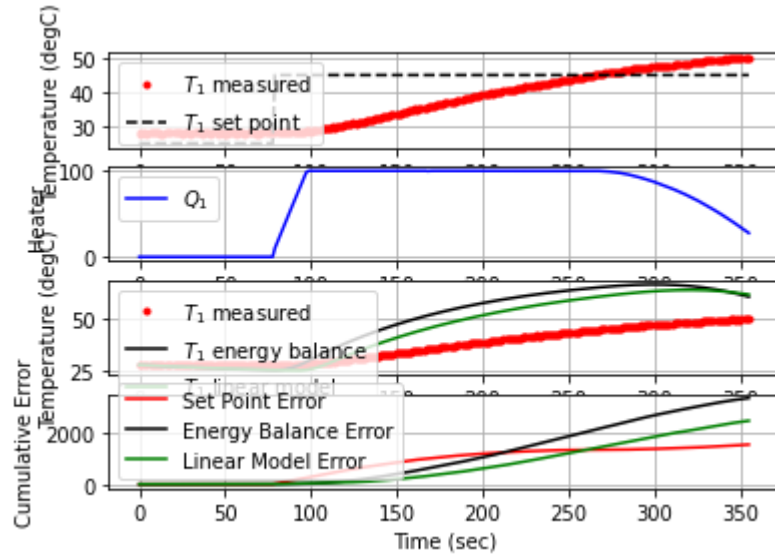
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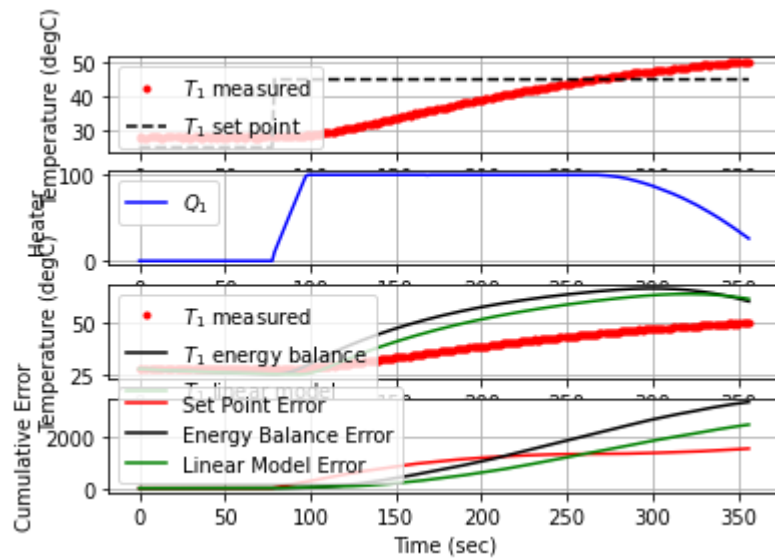
354.9 45.00 50.18 27.76 -1.05 28.81 -0.00



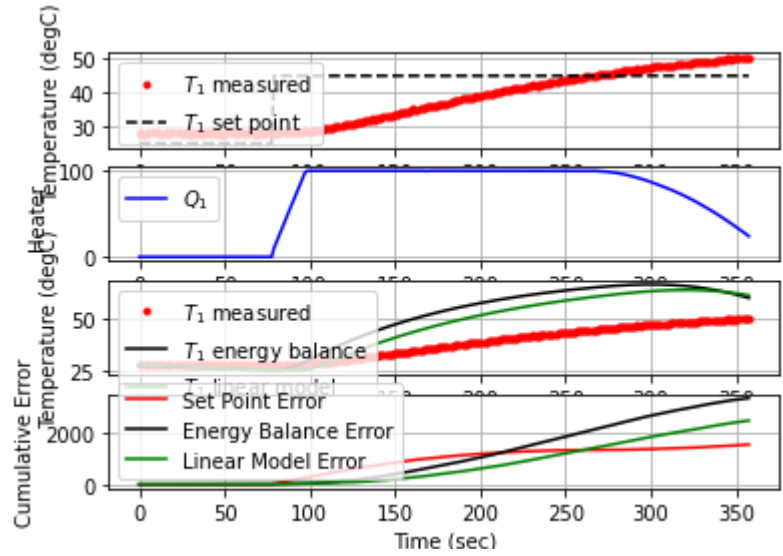
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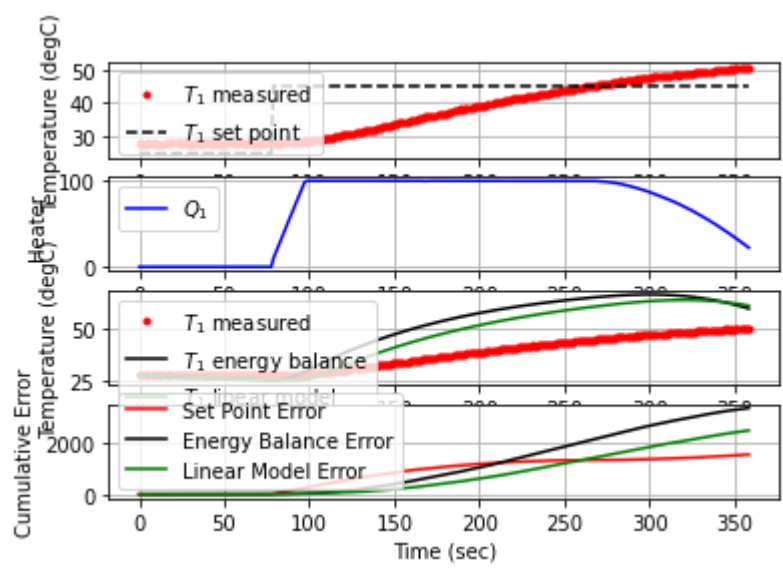
357.3 45.00 50.53 24.05 -1.12 25.18 -0.01



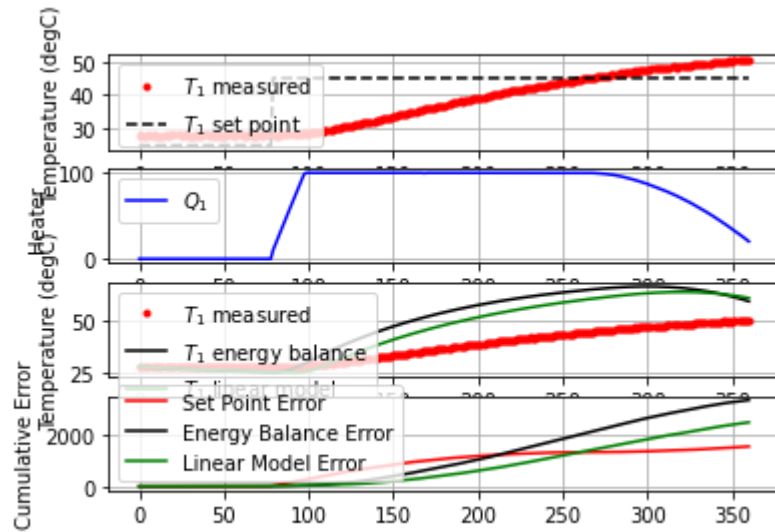
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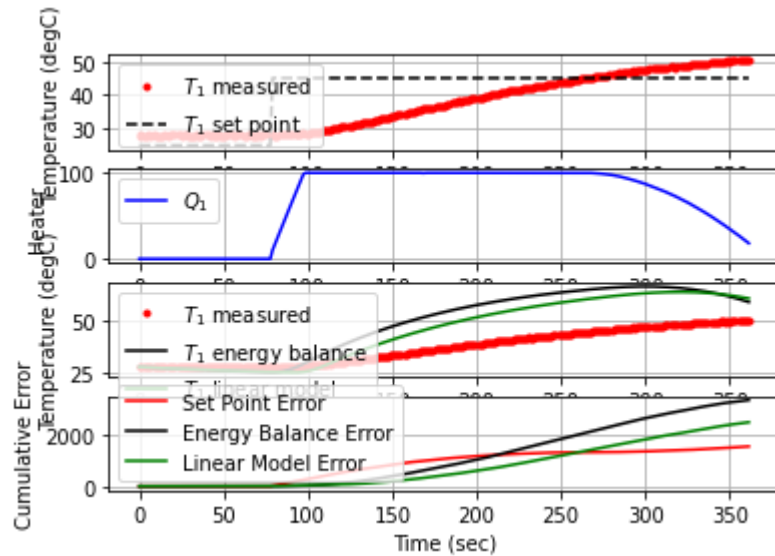
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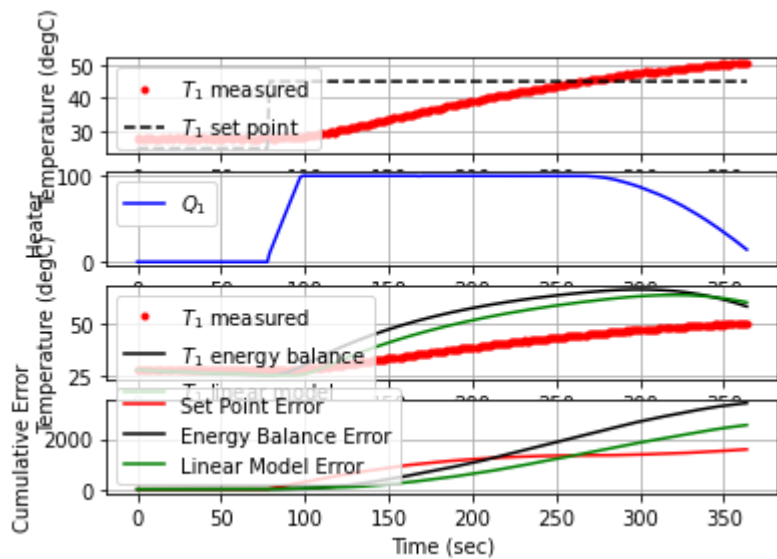
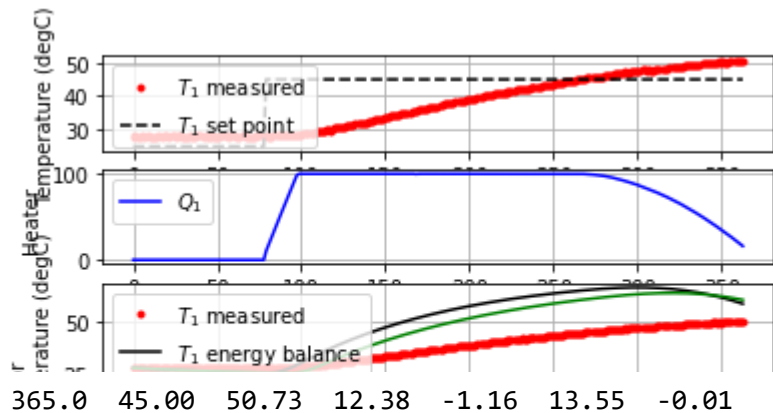
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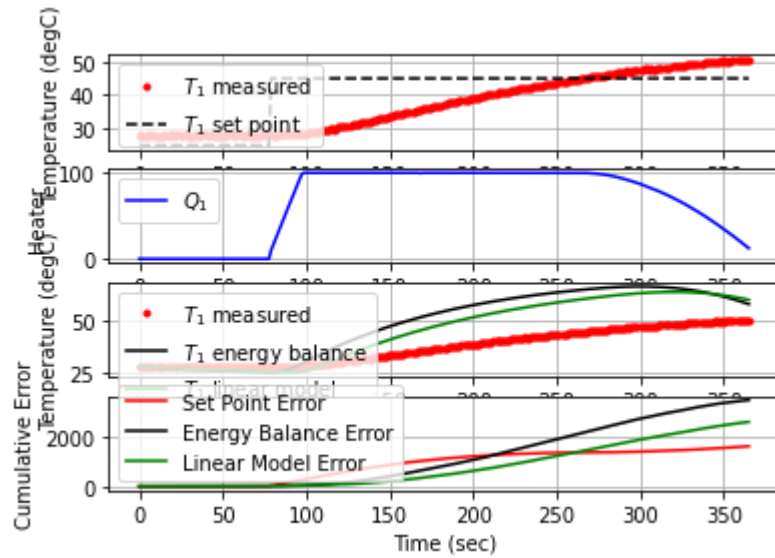


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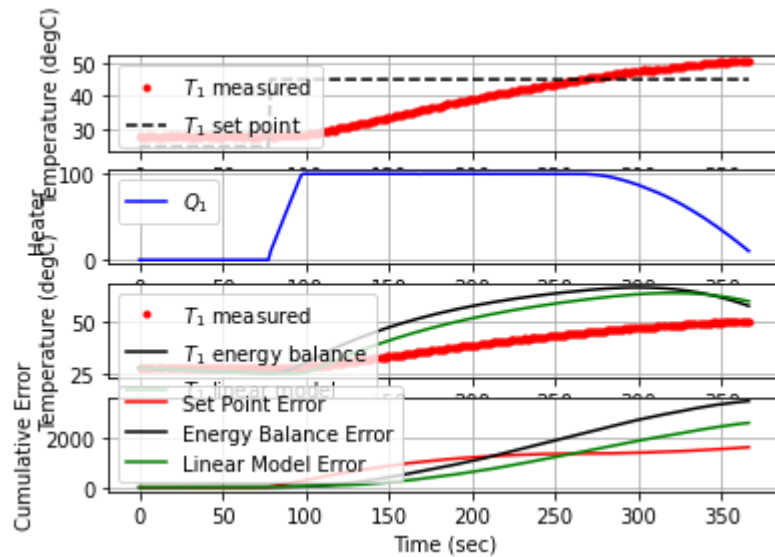


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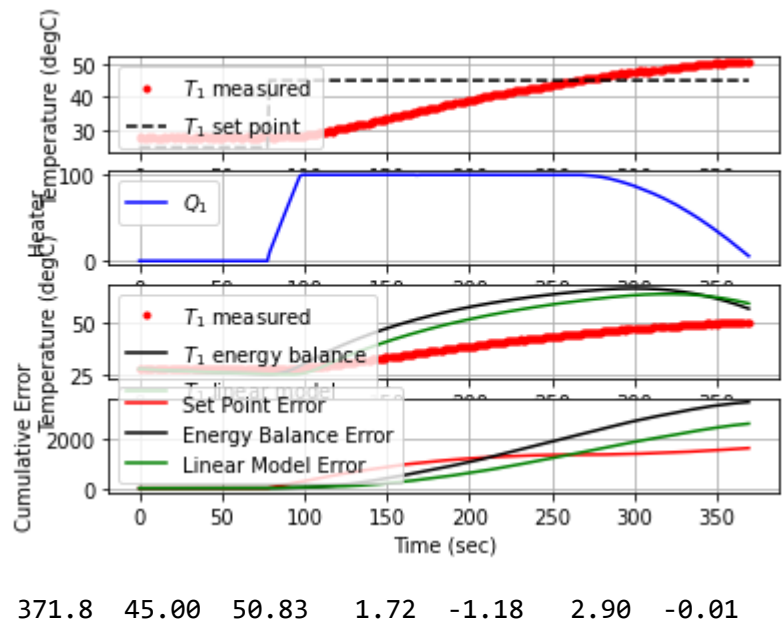
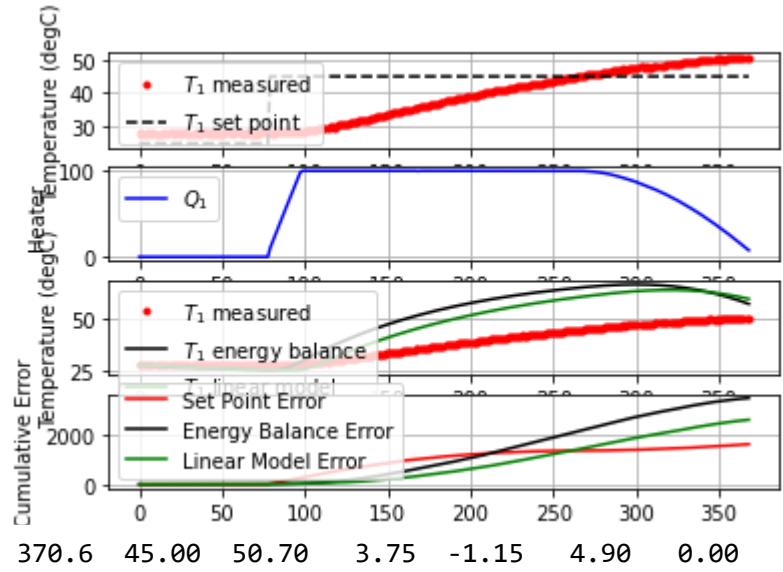


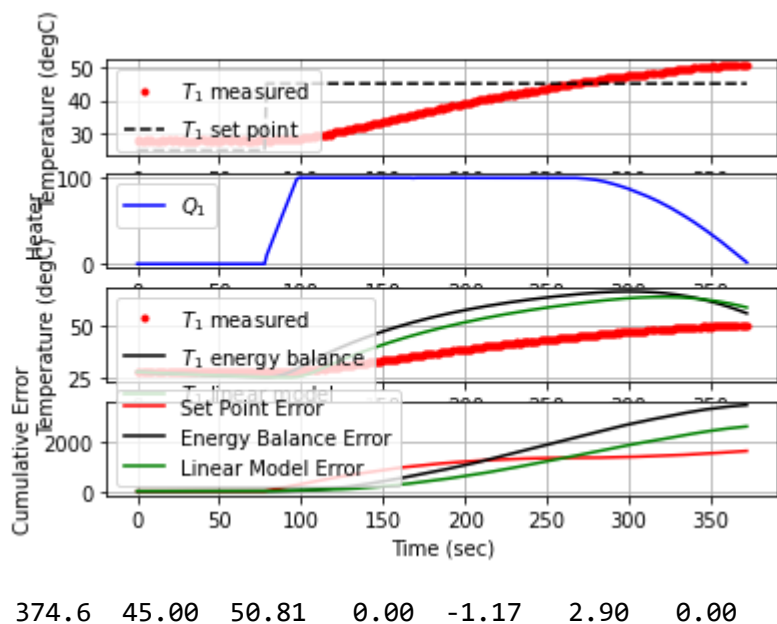
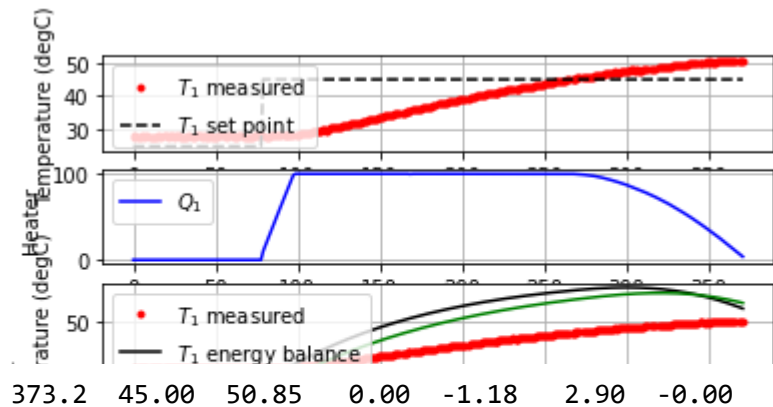
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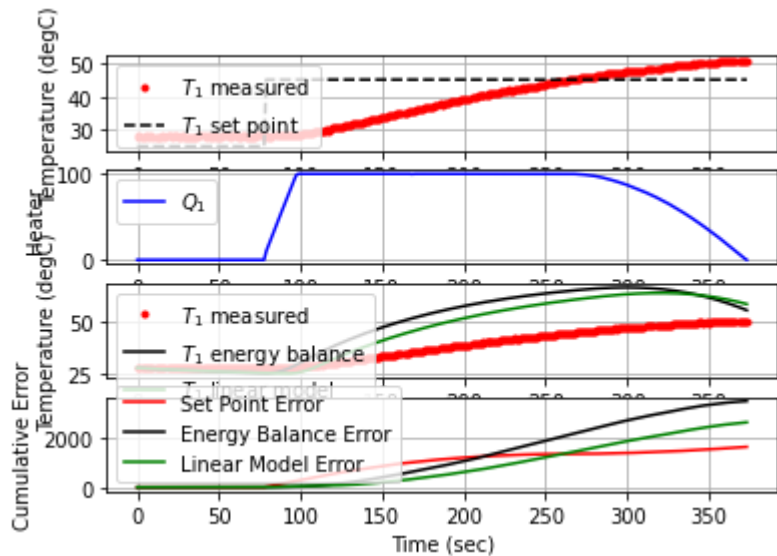


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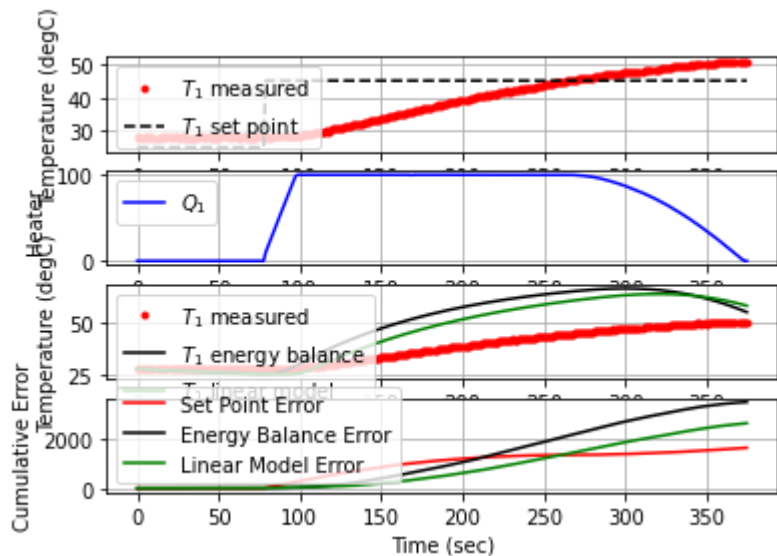




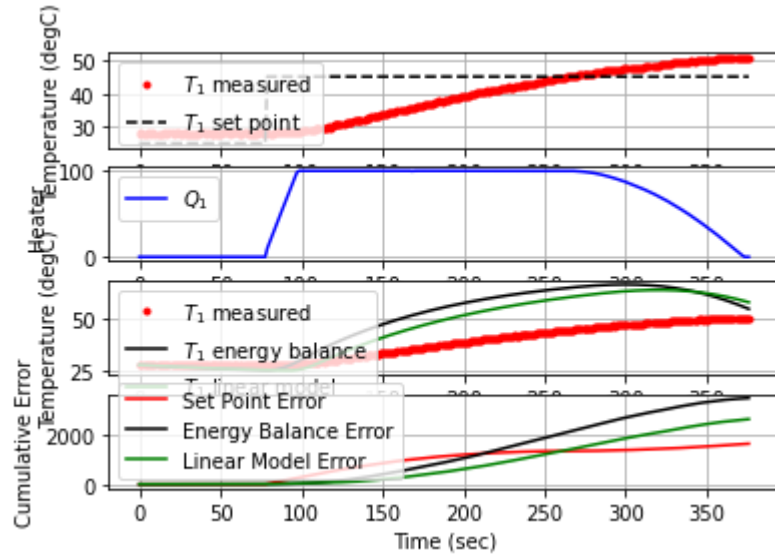




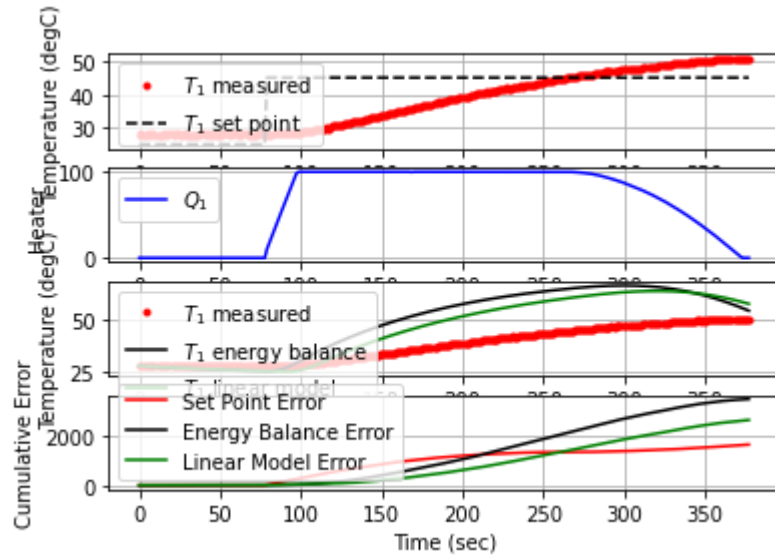
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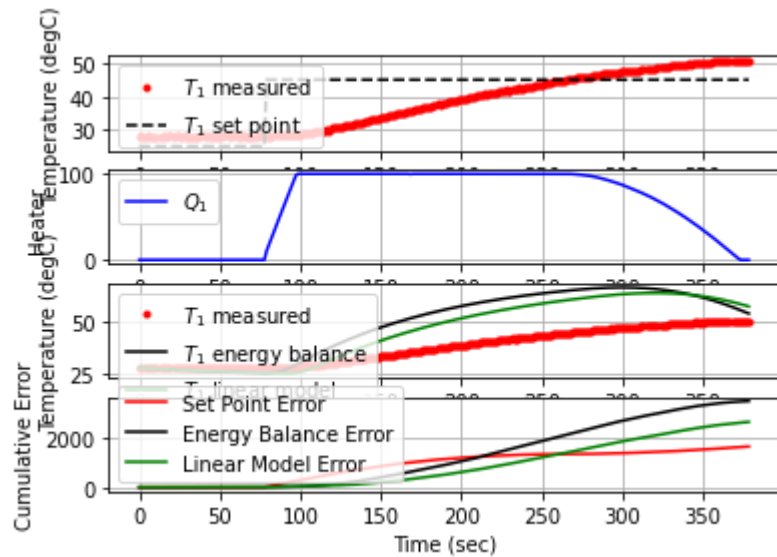
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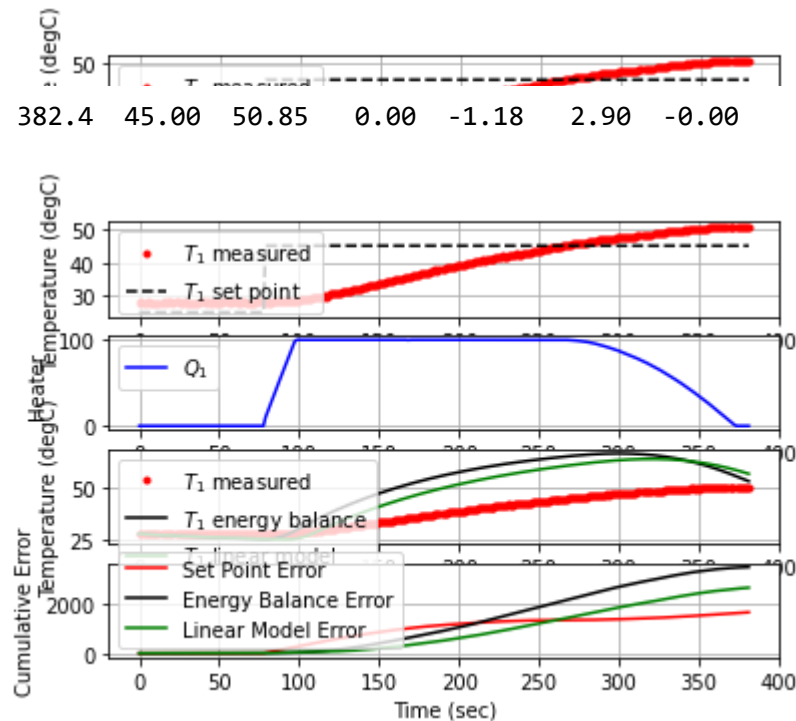
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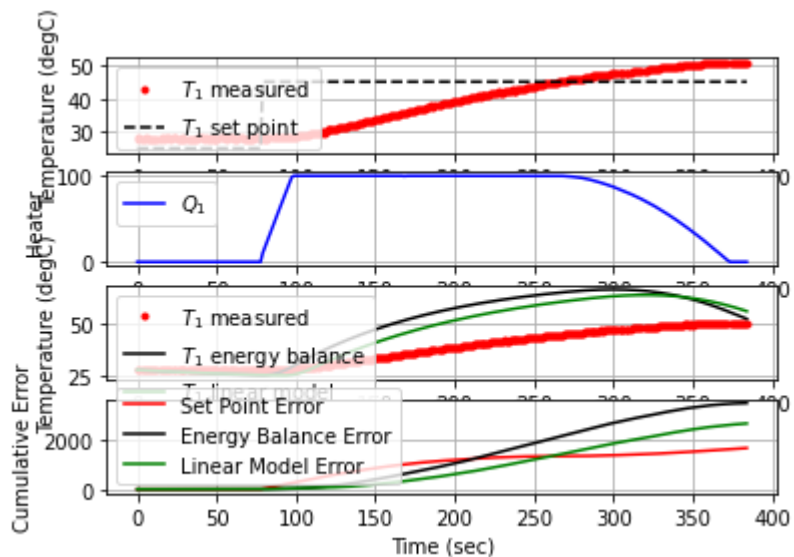
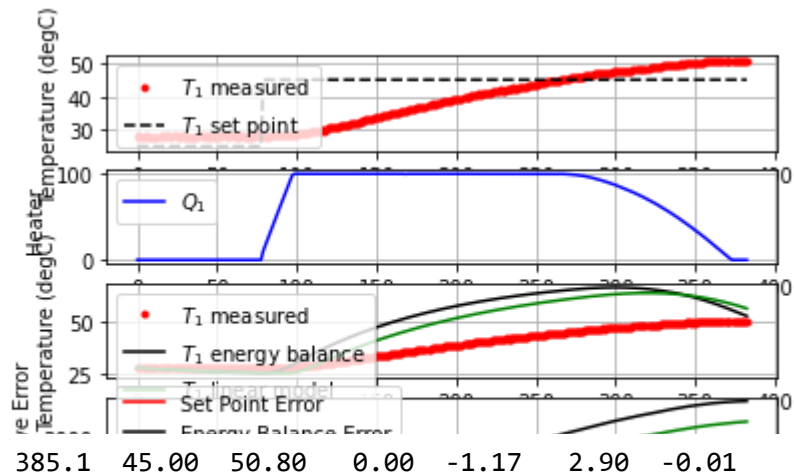
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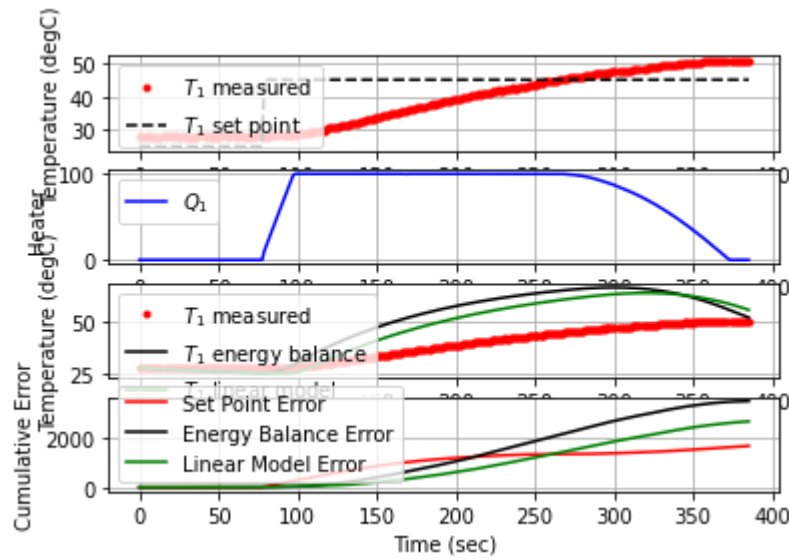
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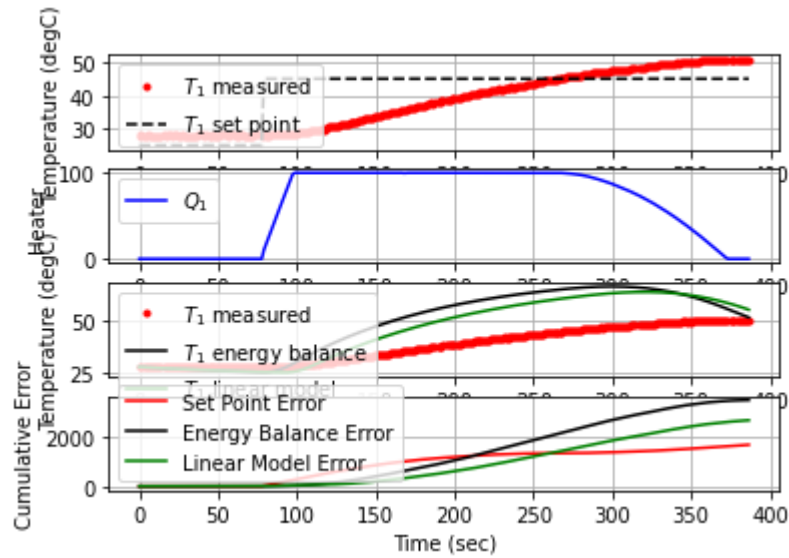
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386.5 45.00 50.65 0.00 -1.14 2.90 0.01

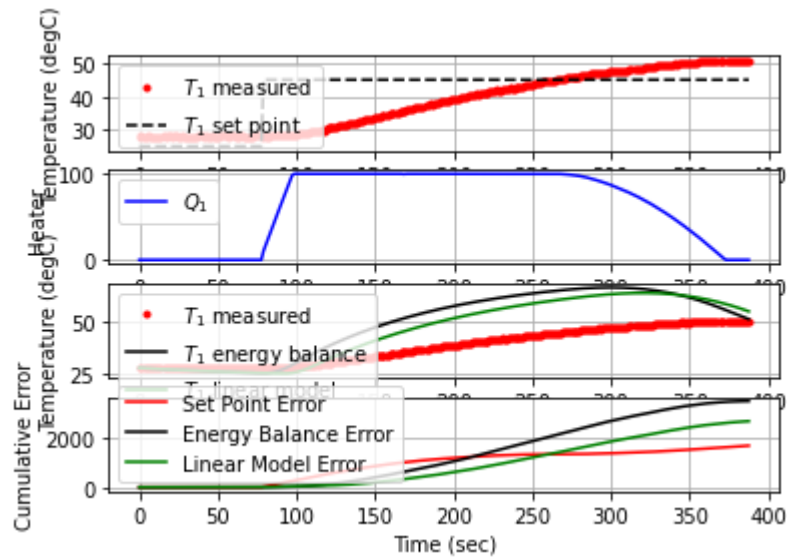


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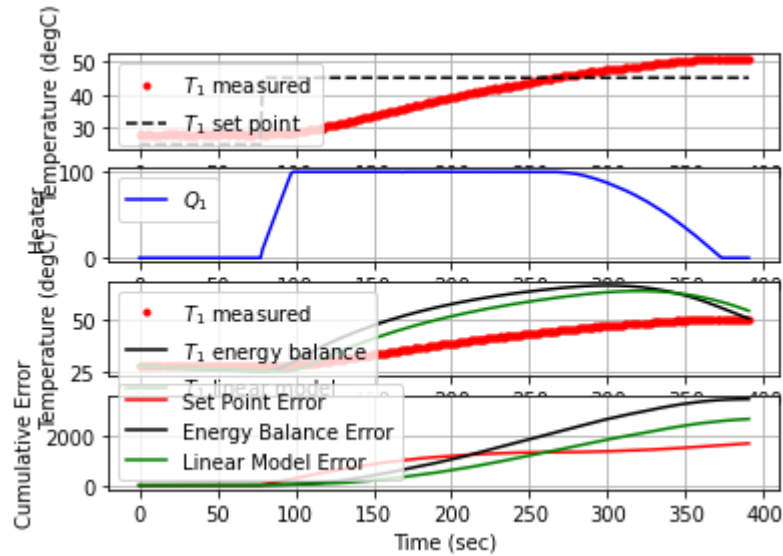
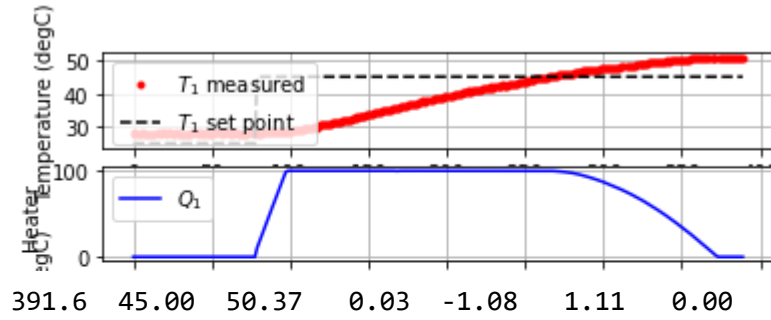


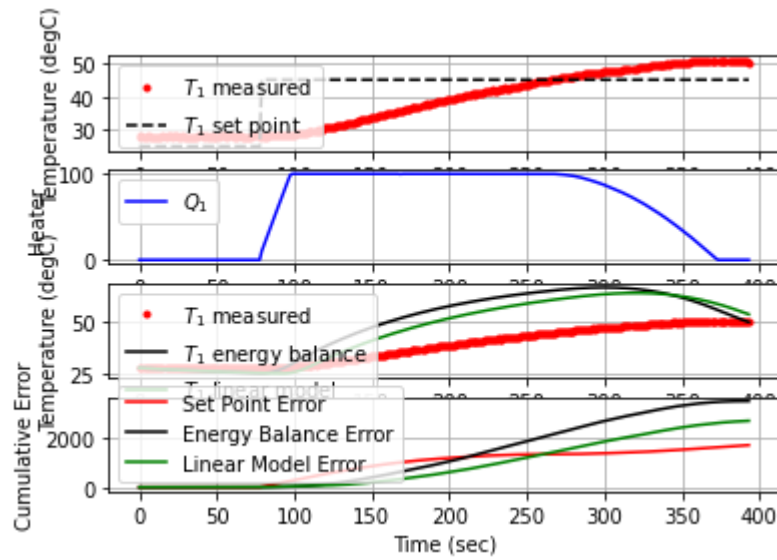
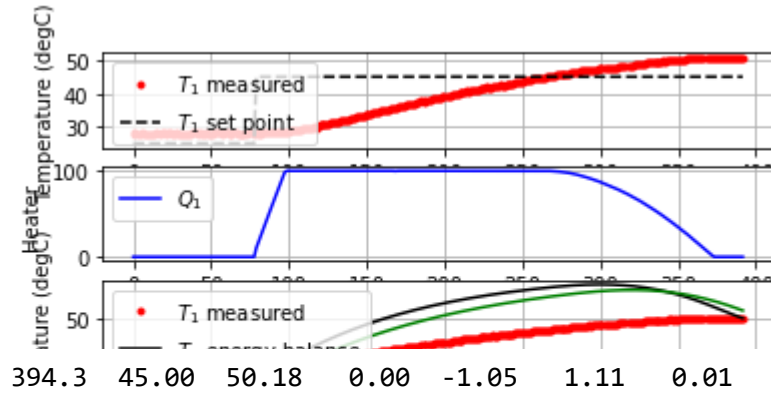


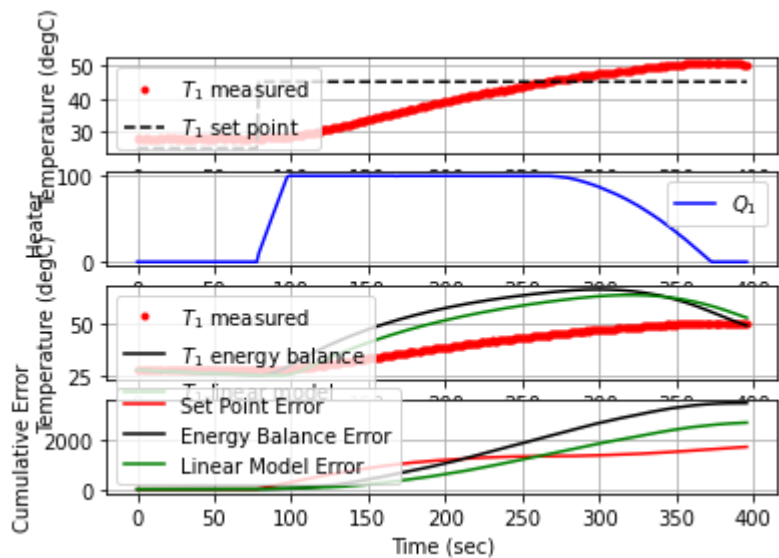
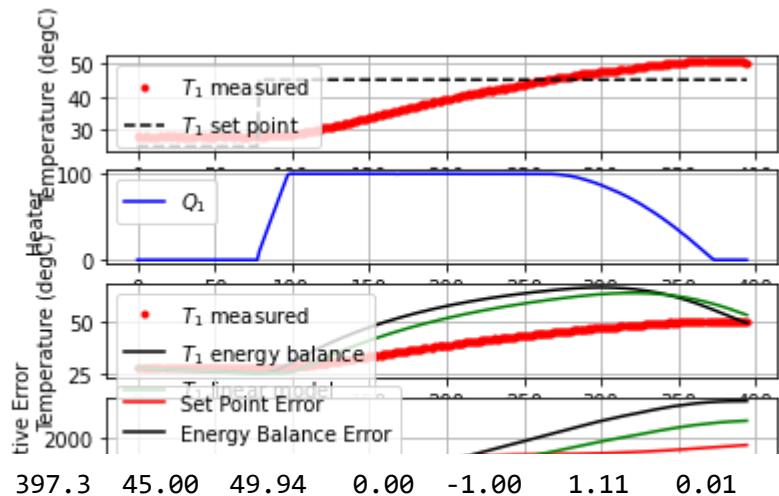
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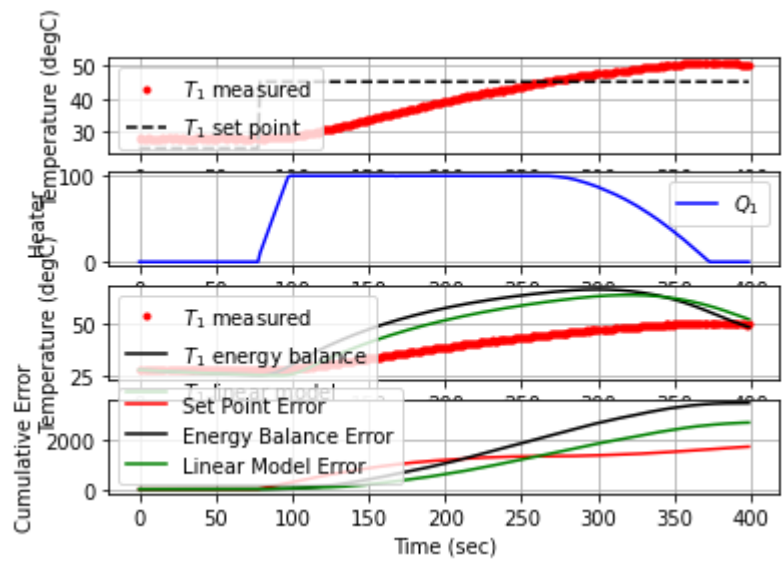
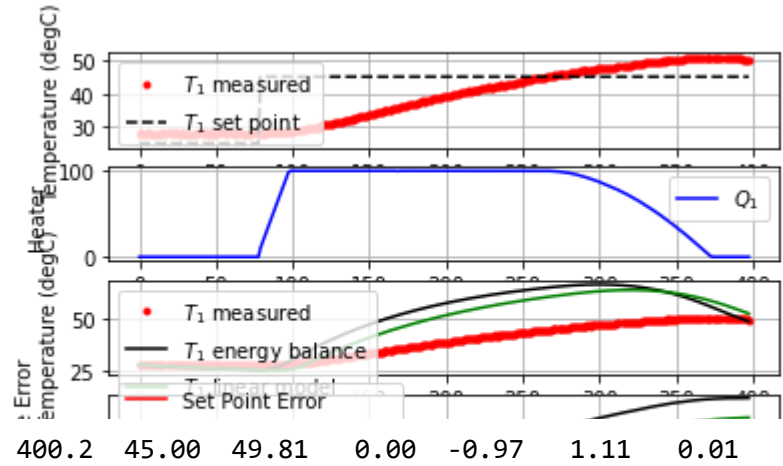
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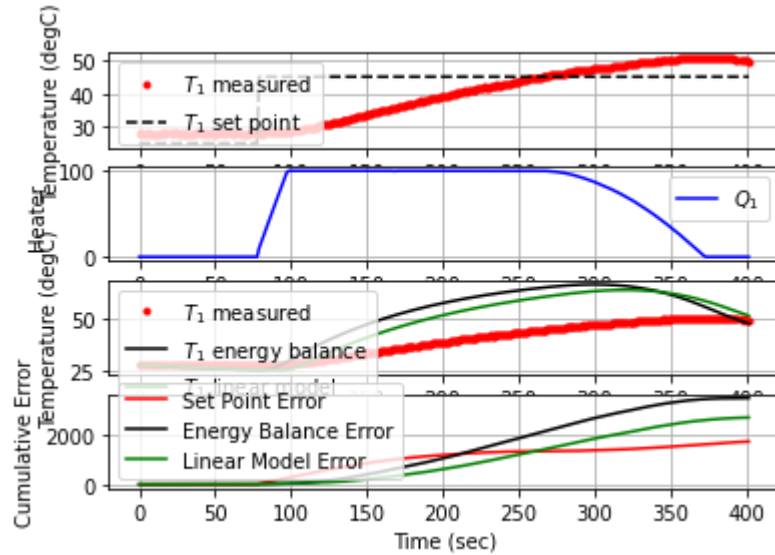
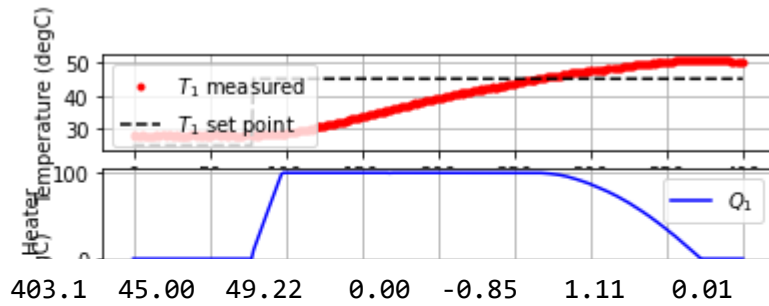


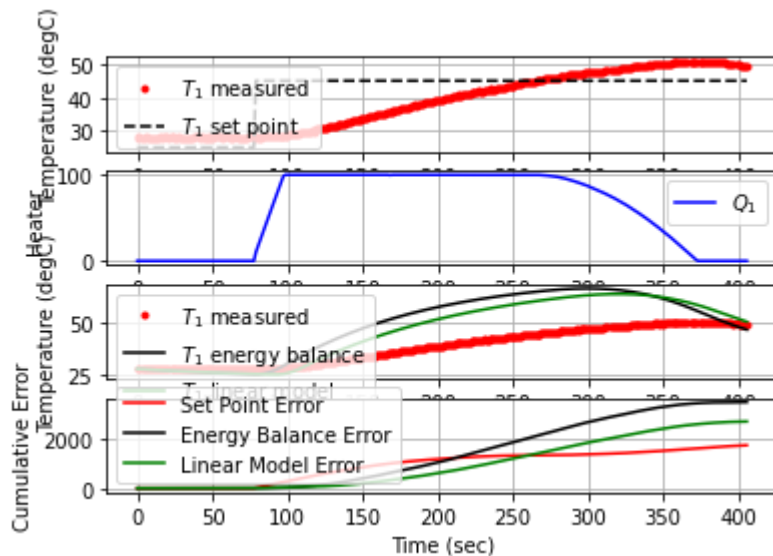
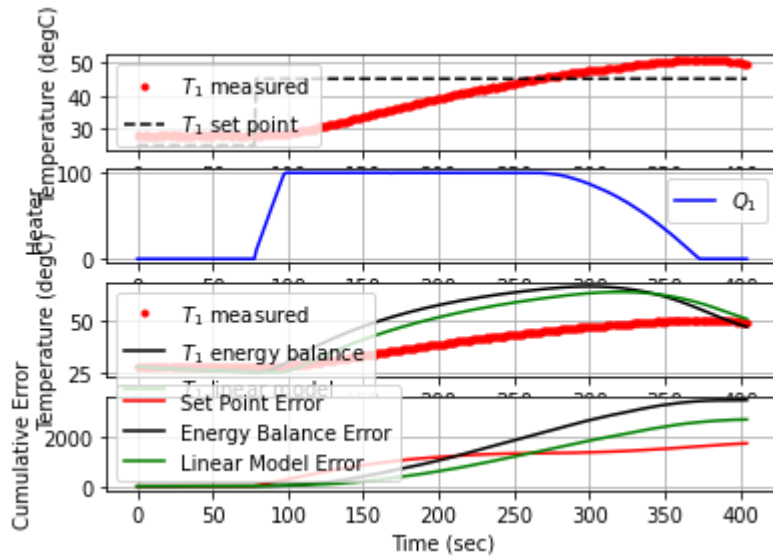
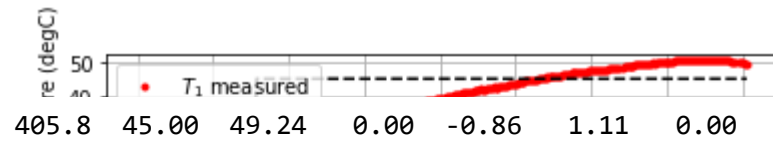




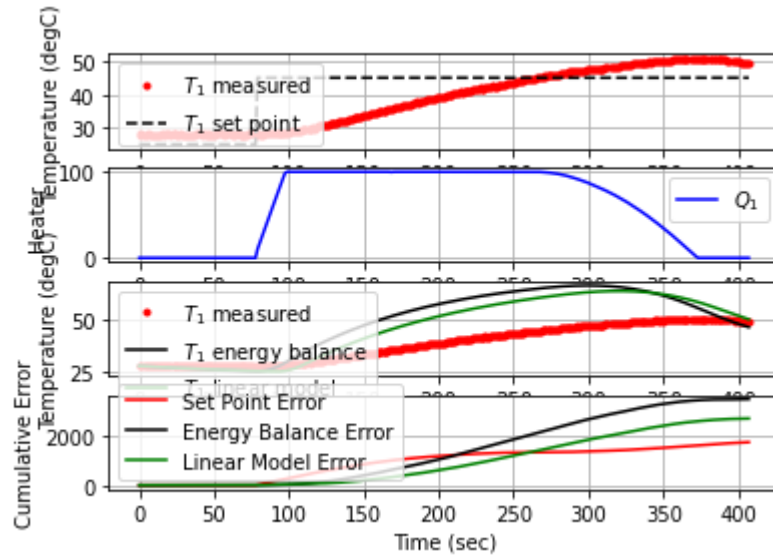
398.6 45.00 49.99 0.00 -1.01 1.11 -0.00



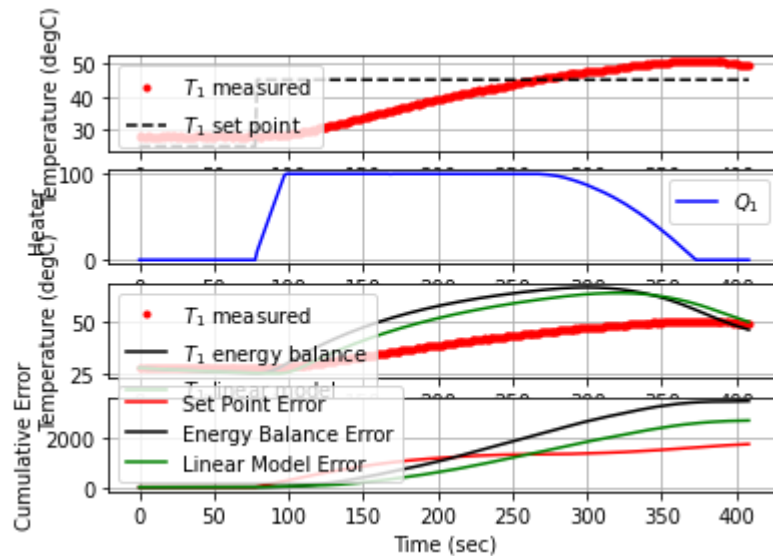




408.4 45.00 49.20 0.00 -0.85 1.11 0.00

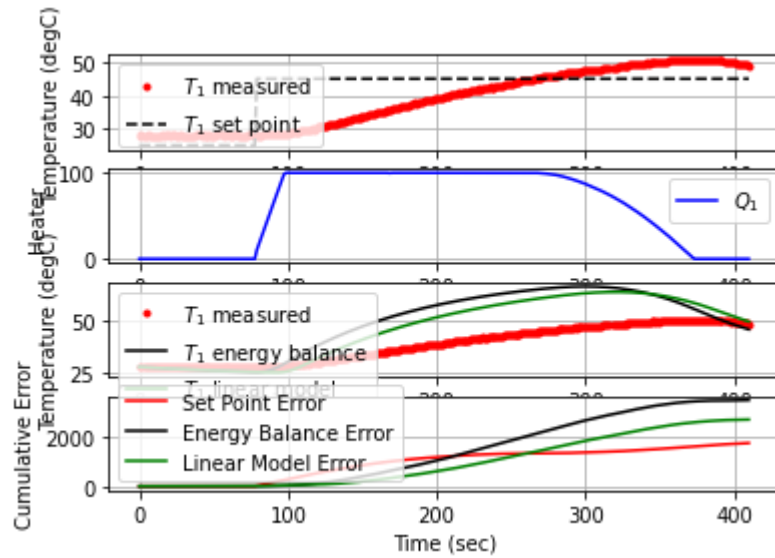


409.7 45.00 48.97 0.00 -0.80 1.11 0.01

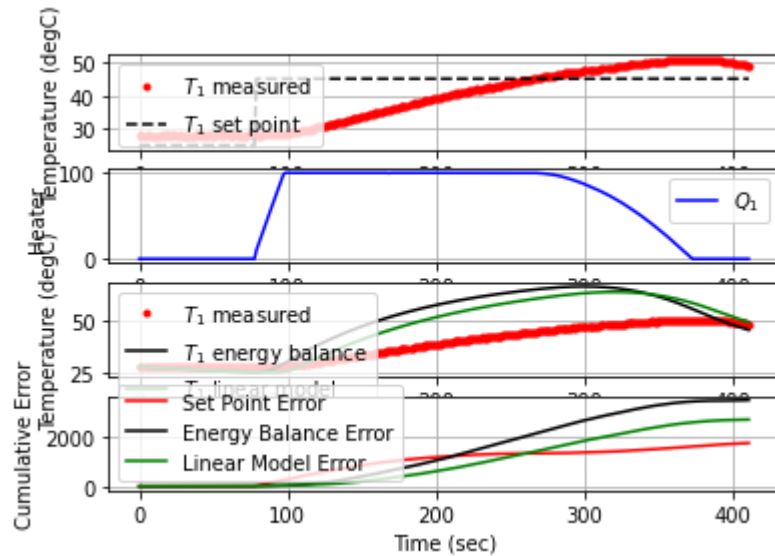




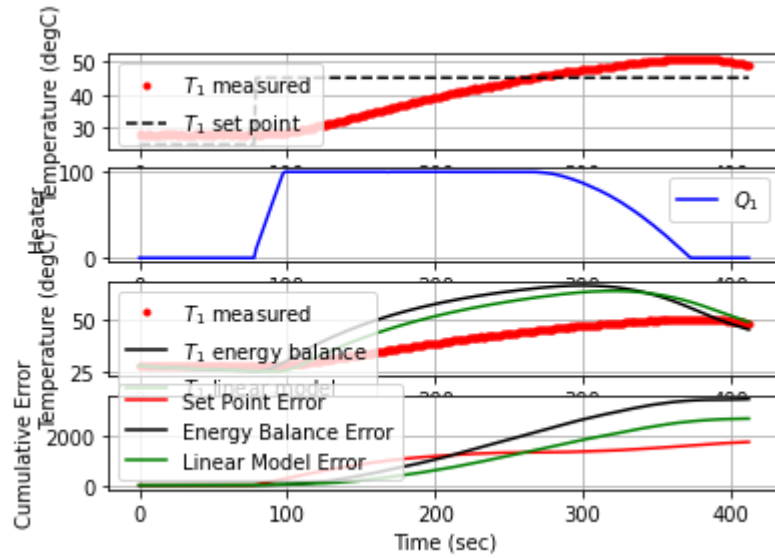
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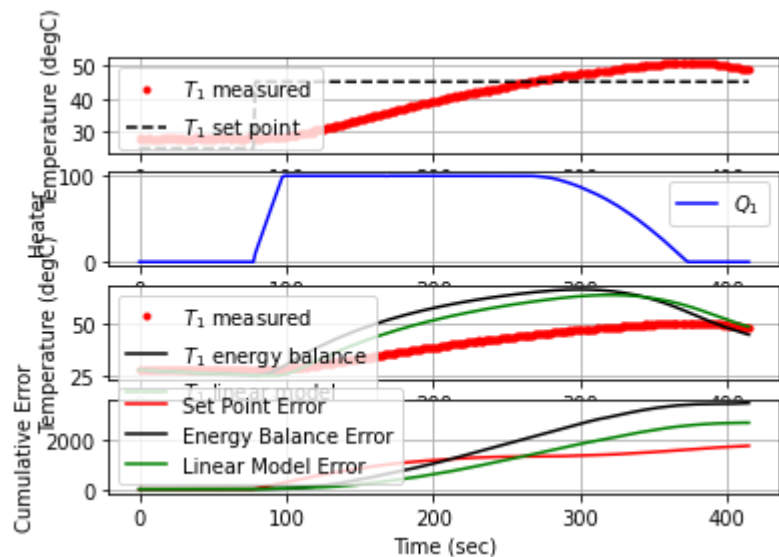
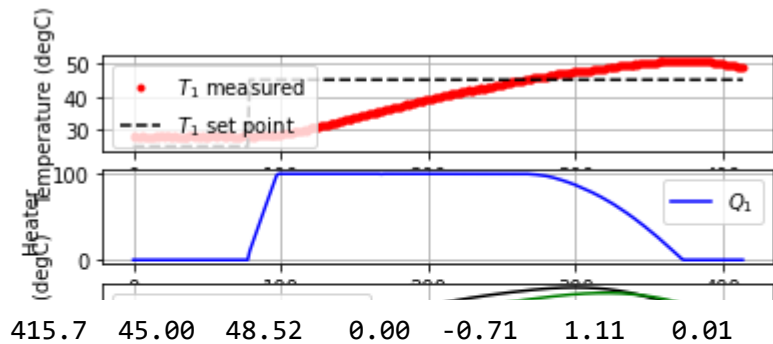
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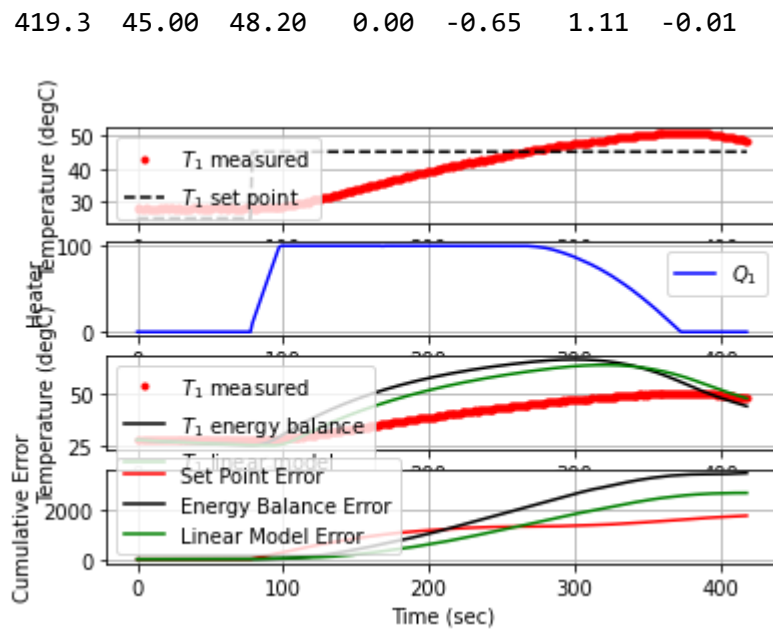
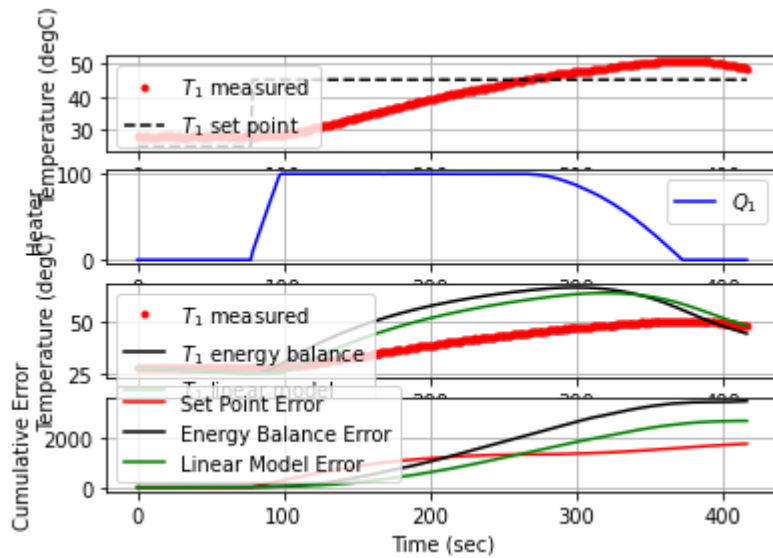
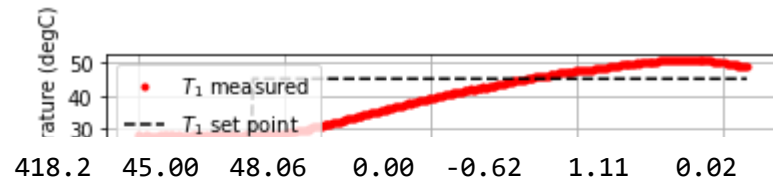


413.5 45.00 48.76 0.00 -0.76 1.11 0.00

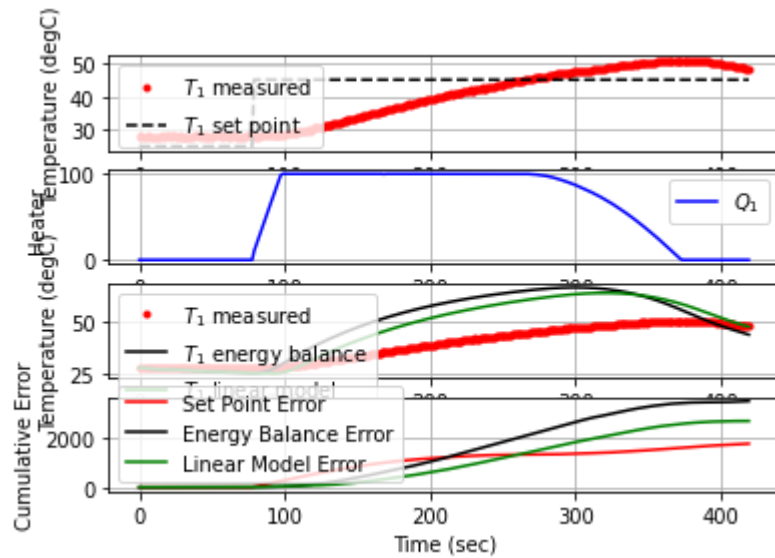


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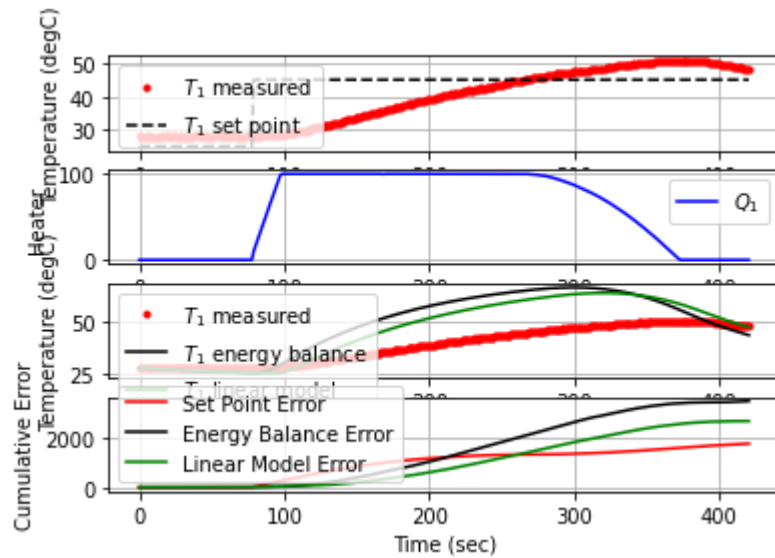




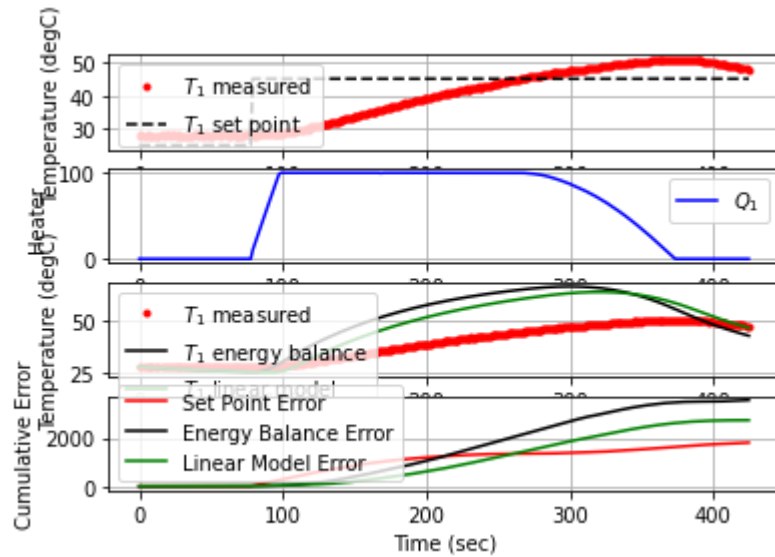
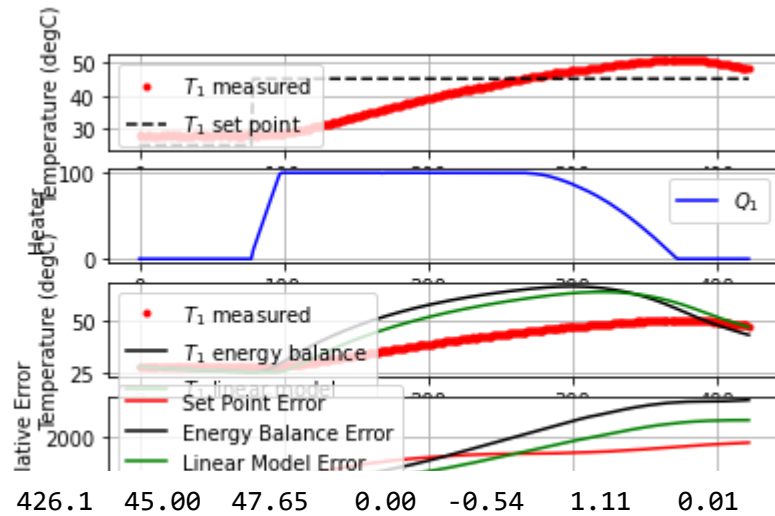
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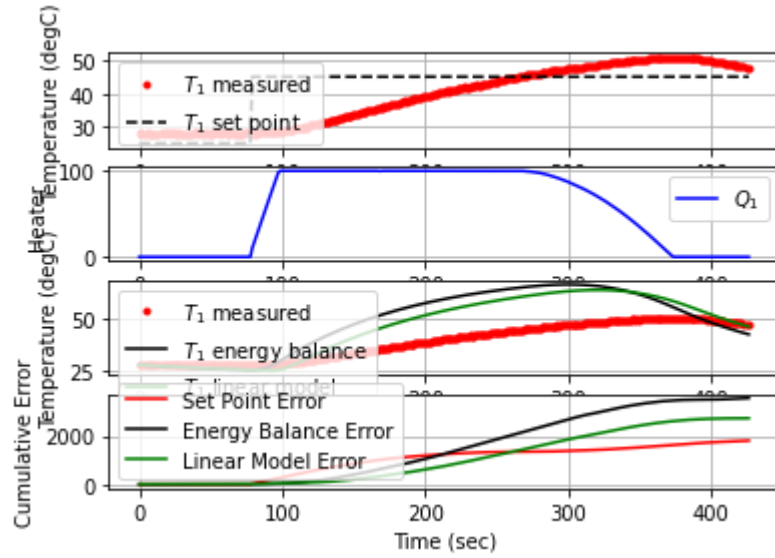


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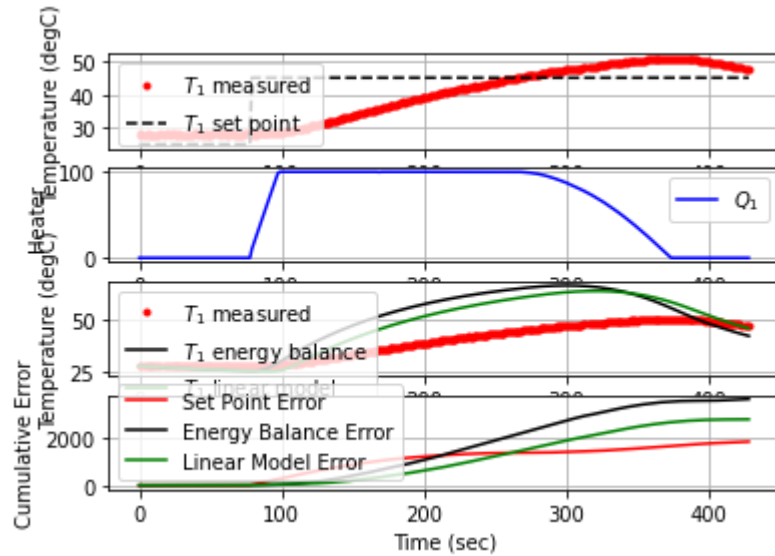


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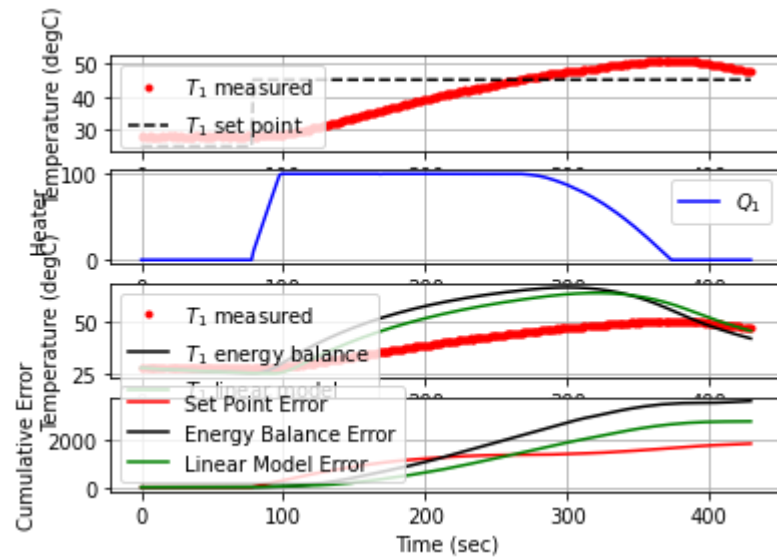




429.1 45.00 47.29 0.00 -0.46 1.11 0.01



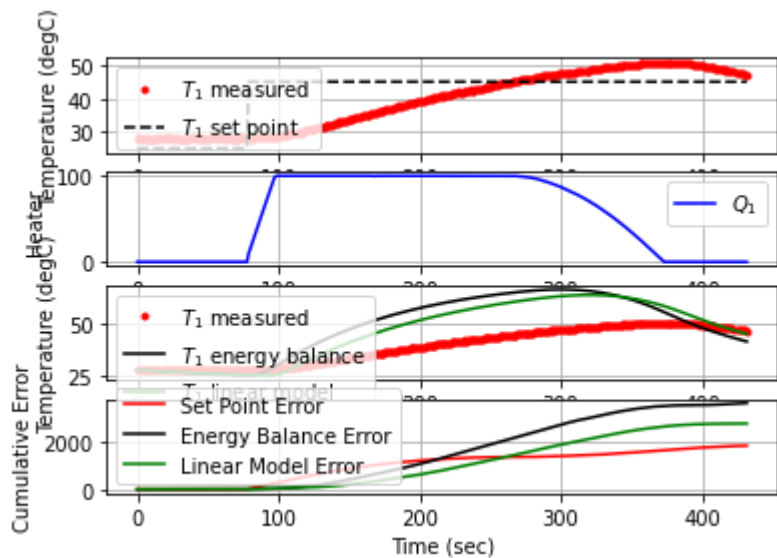
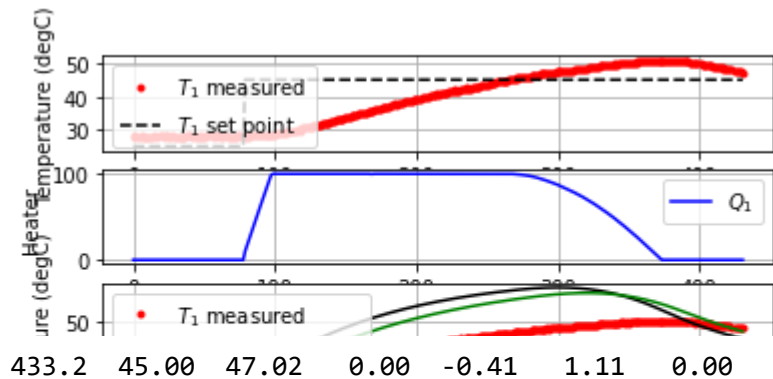
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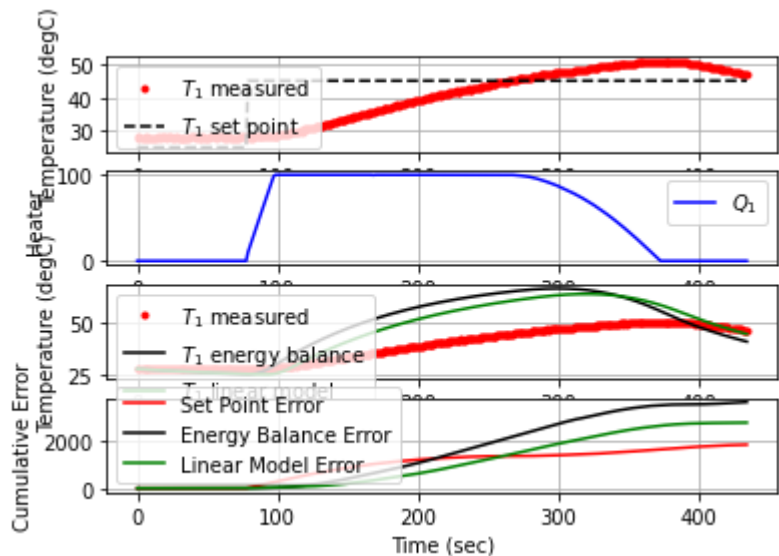
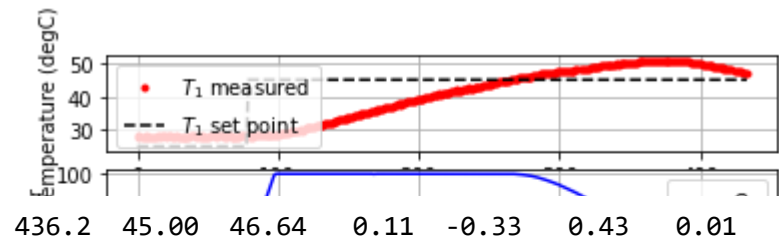


Connected to MQTT Broker!

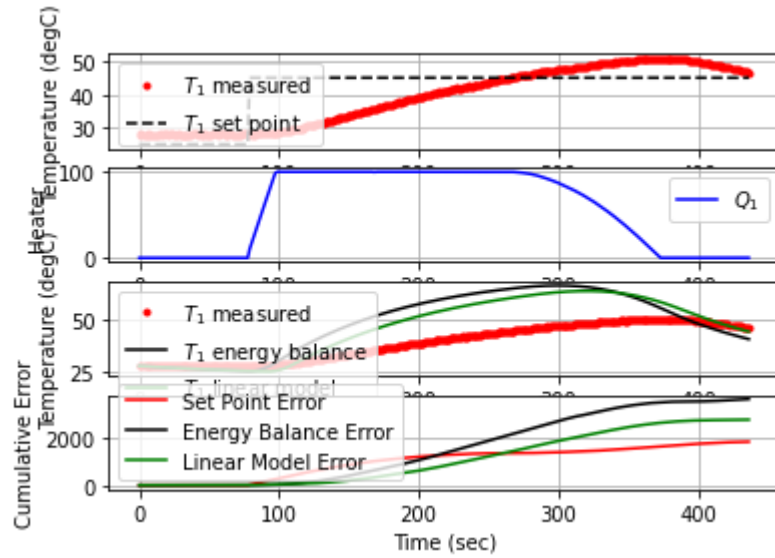
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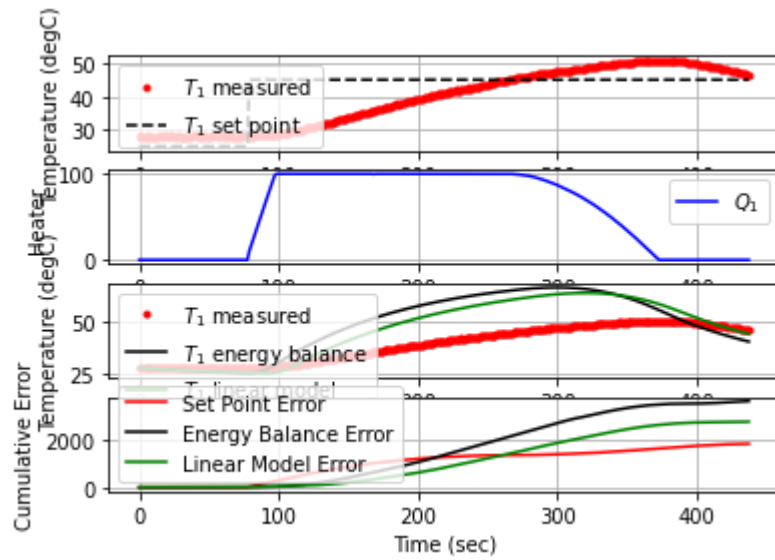




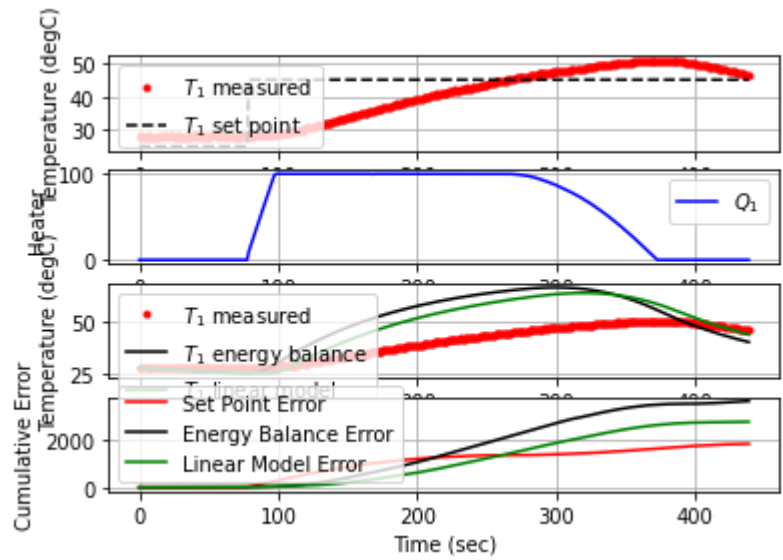
437.6 45.00 46.63 0.00 -0.33 0.43 0.00



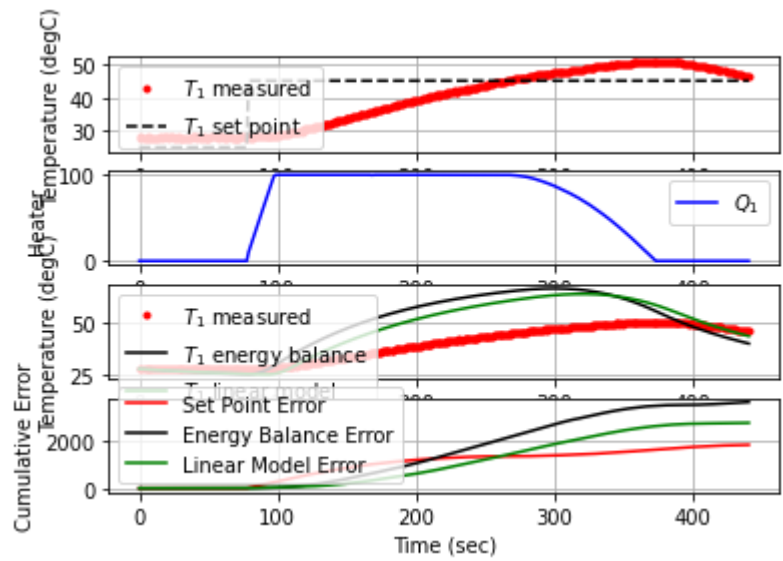
439.0 45.00 46.62 0.00 -0.33 0.43 0.00



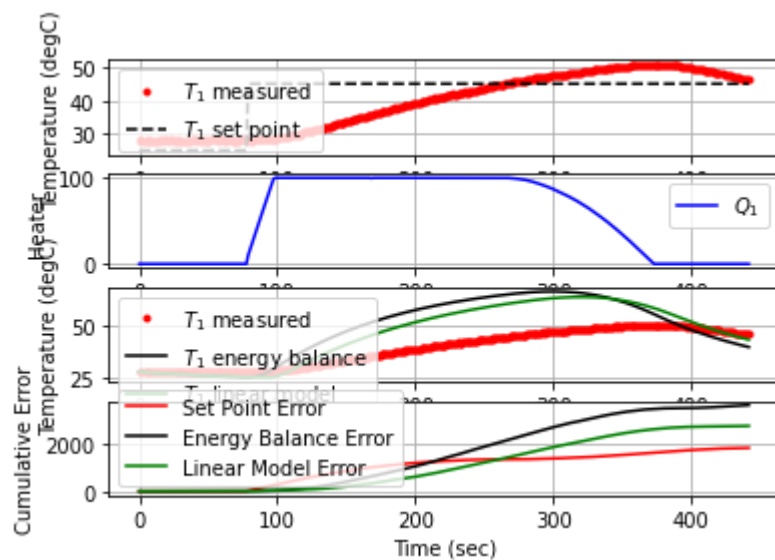
440.4 45.00 46.43 0.00 -0.29 0.43 0.01



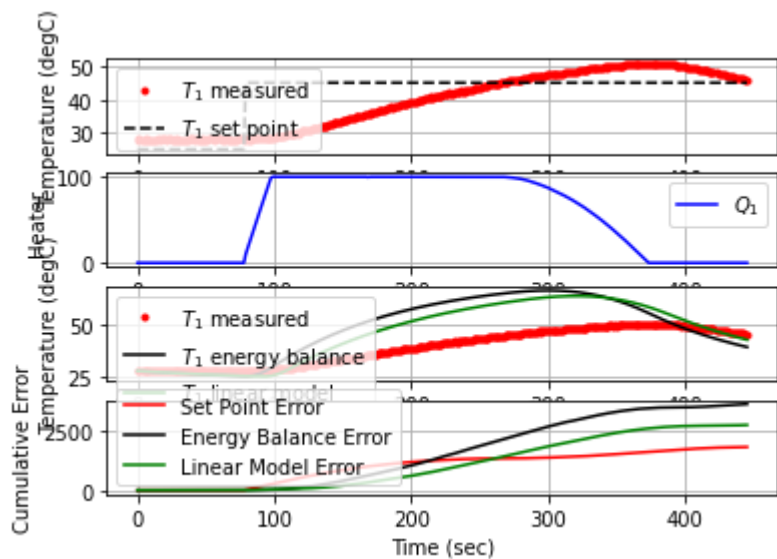
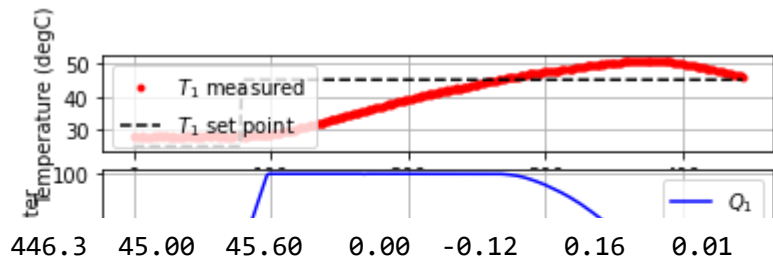
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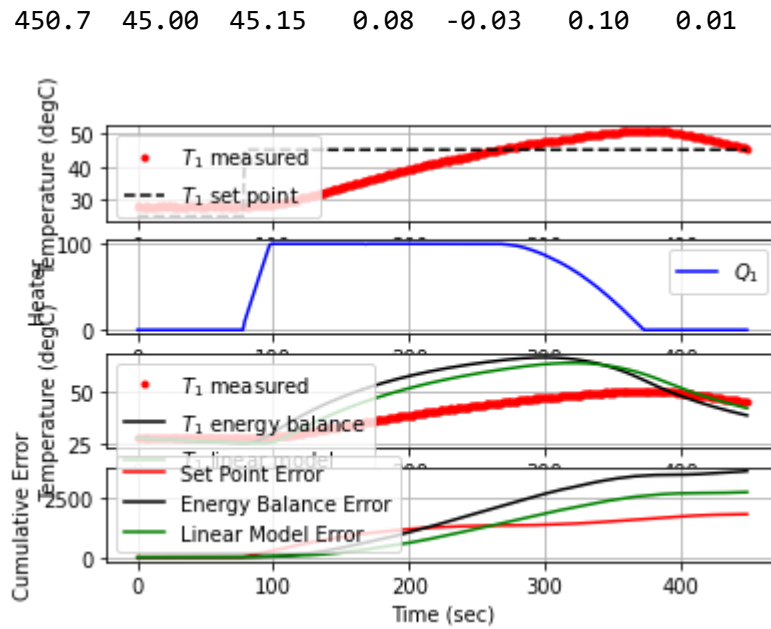
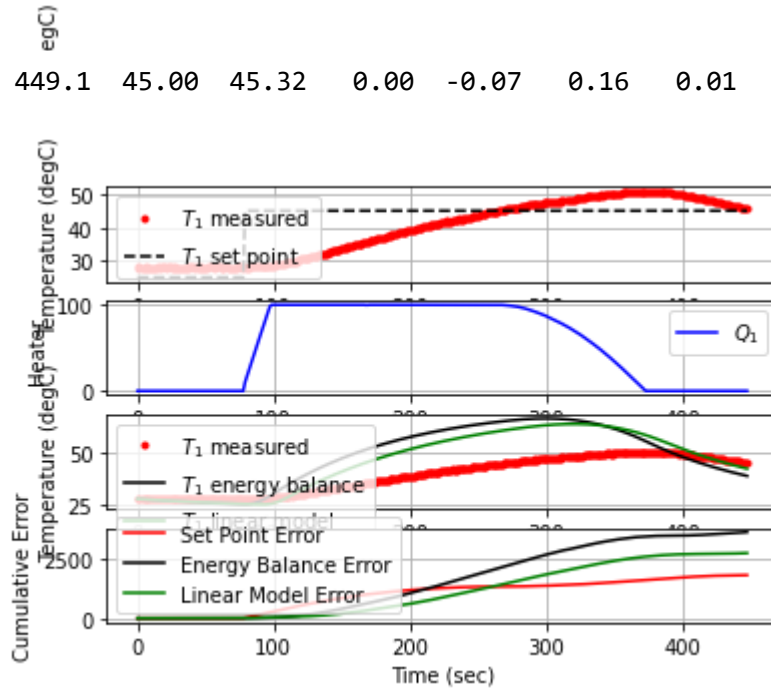


443.6 45.00 46.08 0.00 -0.22 0.43 0.01

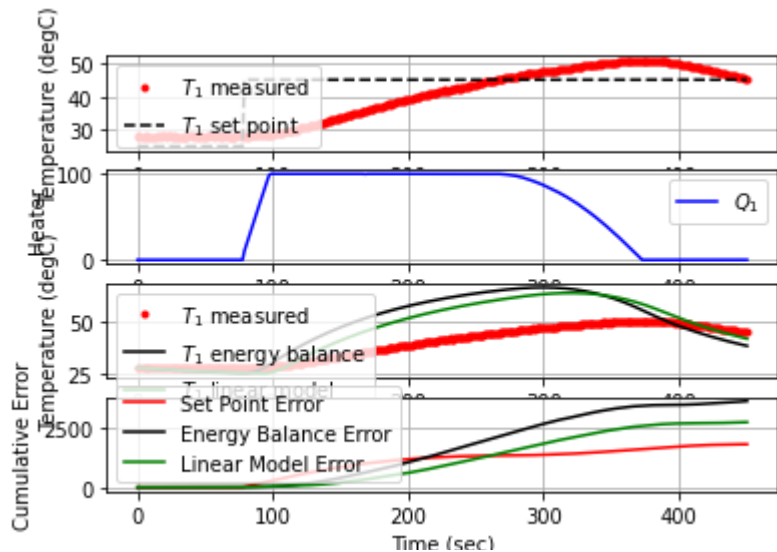


444.9 45.00 45.72 0.03 -0.15 0.16 0.02

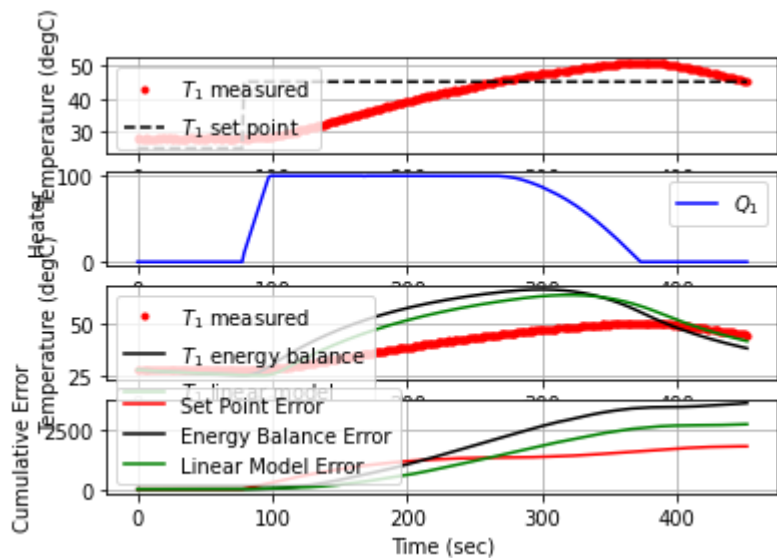




452.1 45.00 45.07 0.06 -0.01 0.07 0.00

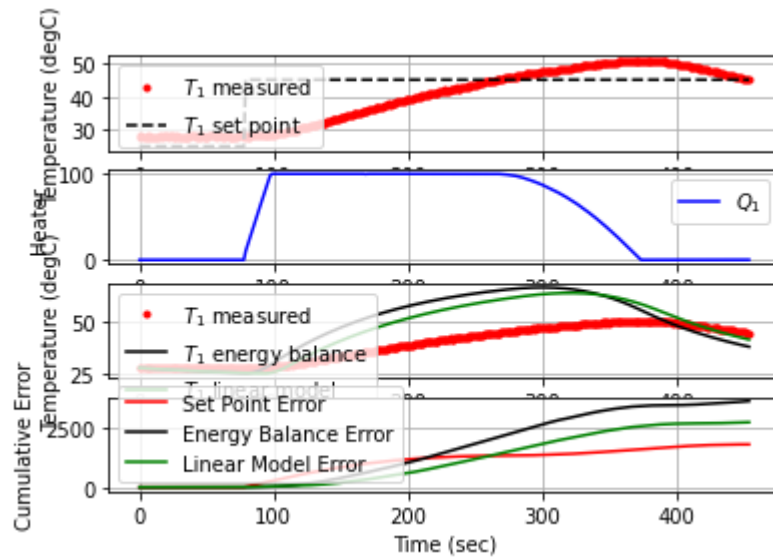


453.6 45.00 44.94 0.12 0.01 0.10 0.01

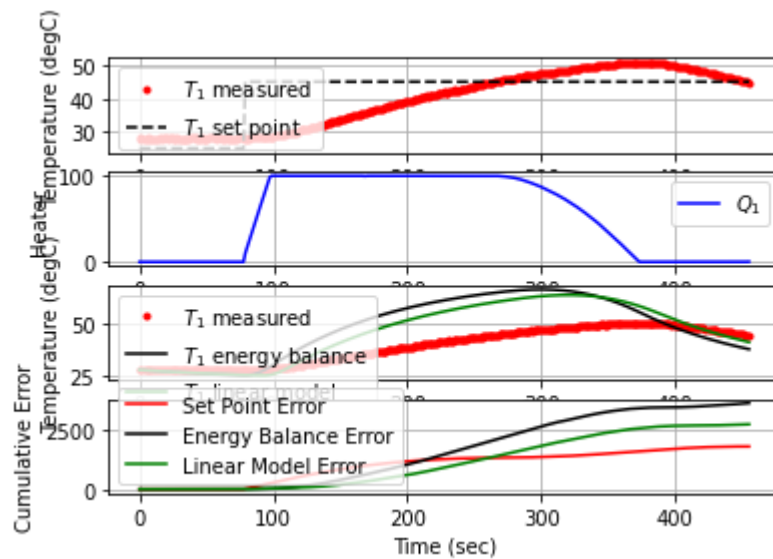




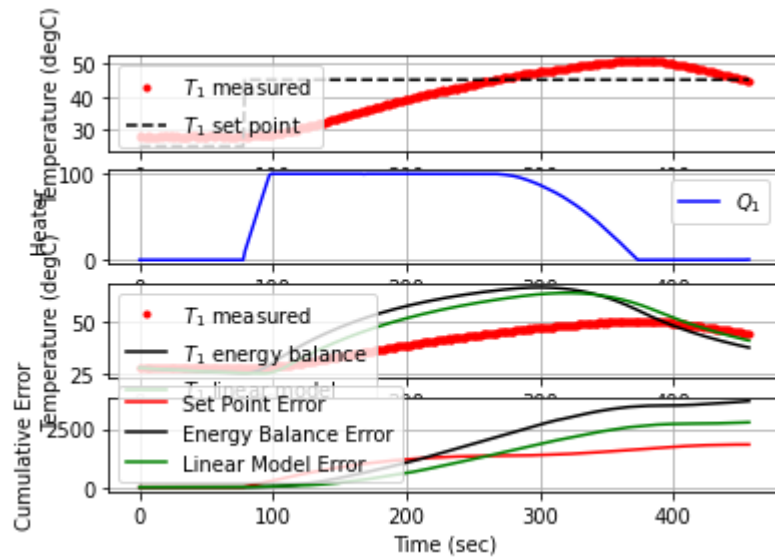
455.1 45.00 44.74 0.28 0.06 0.21 0.01



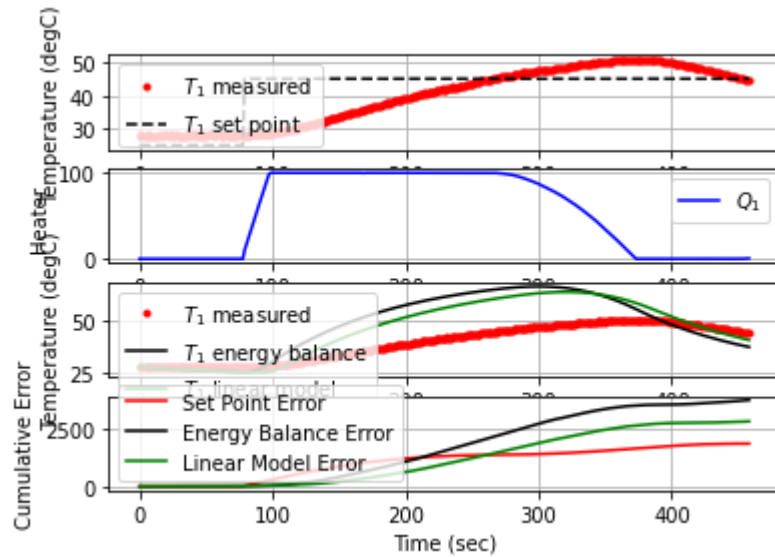
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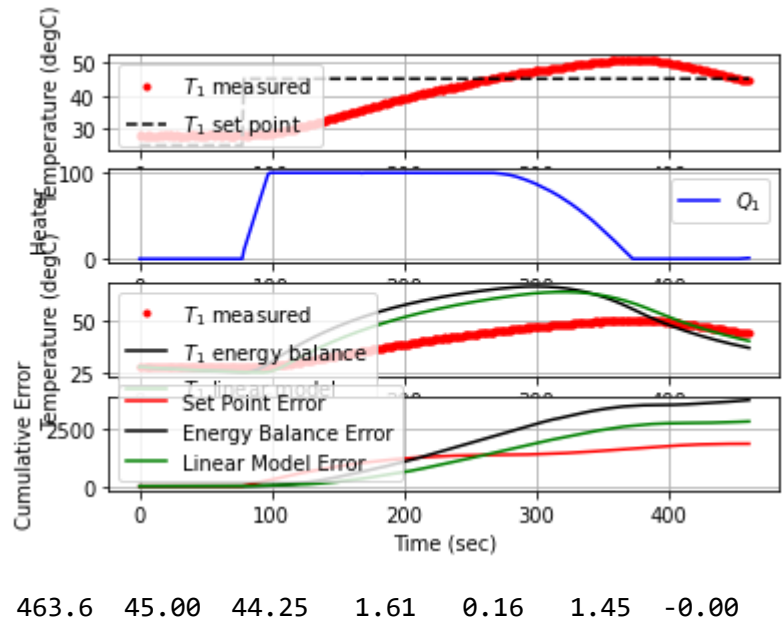
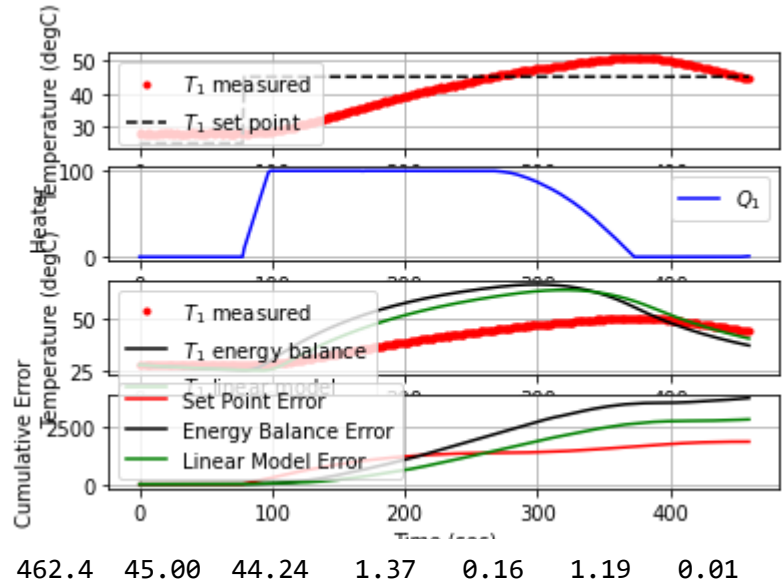
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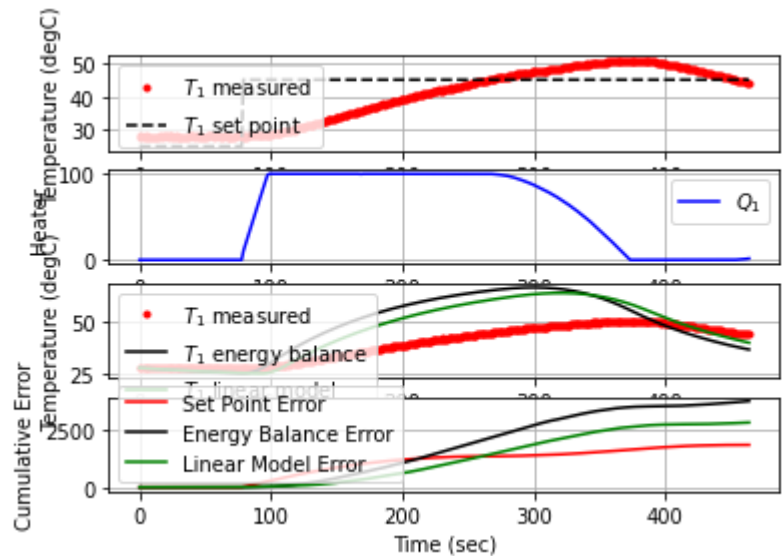
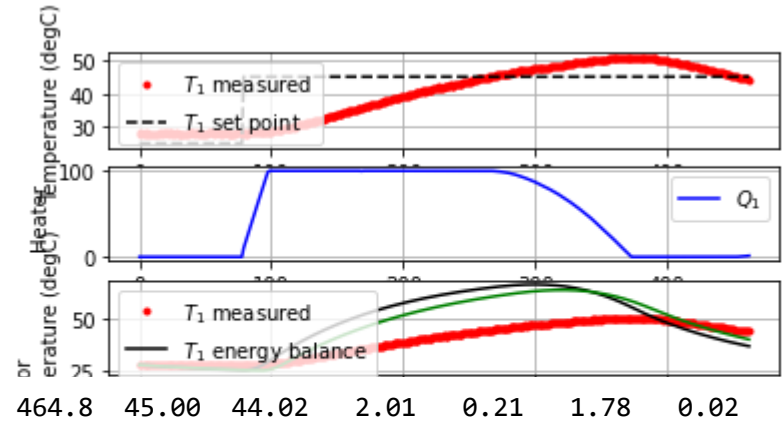


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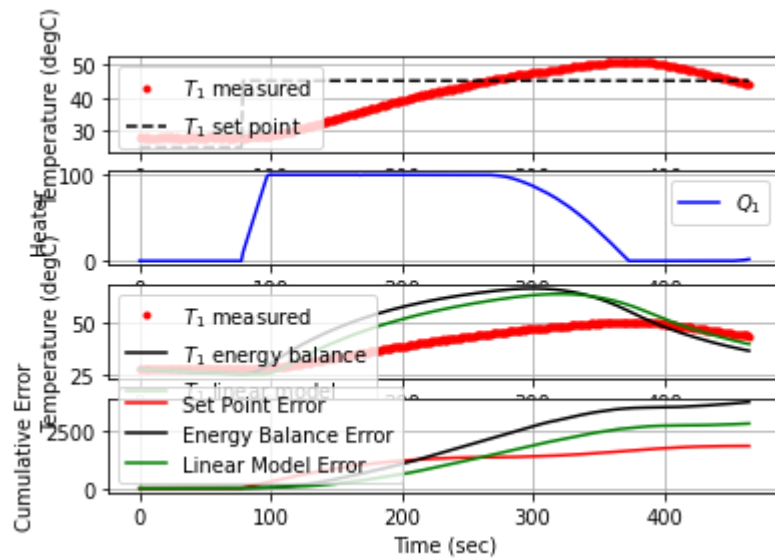


461.1 45.00 44.43 1.05 0.12 0.93 0.00

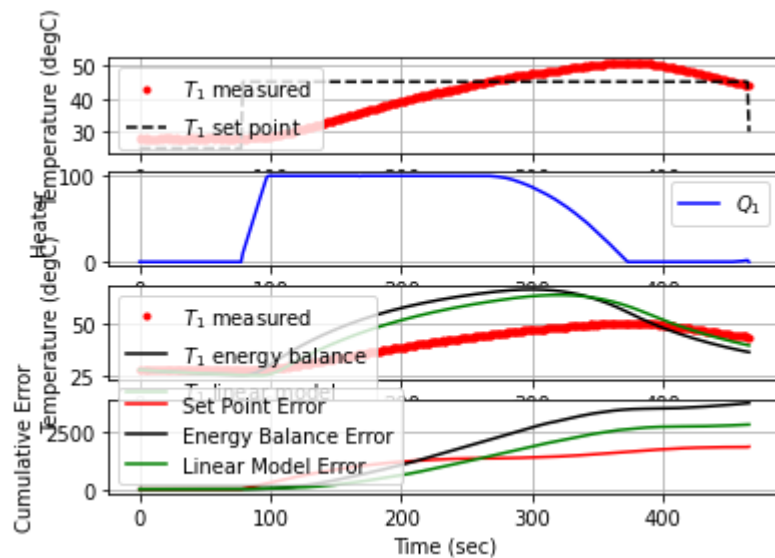




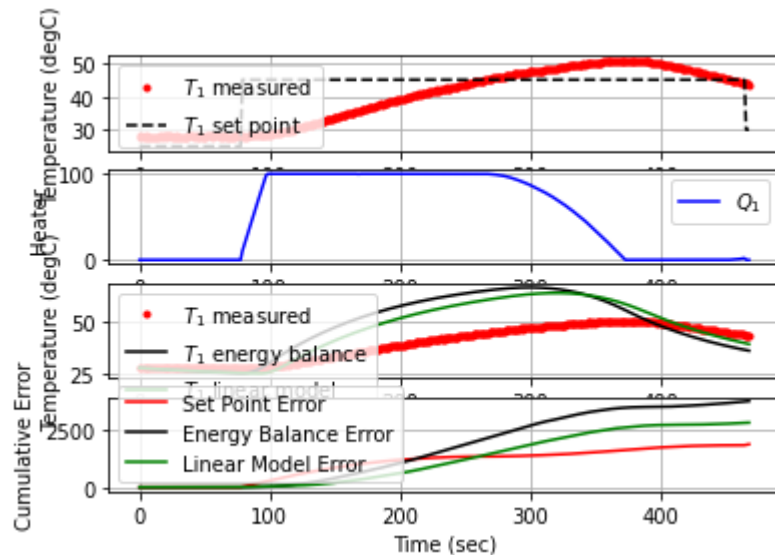
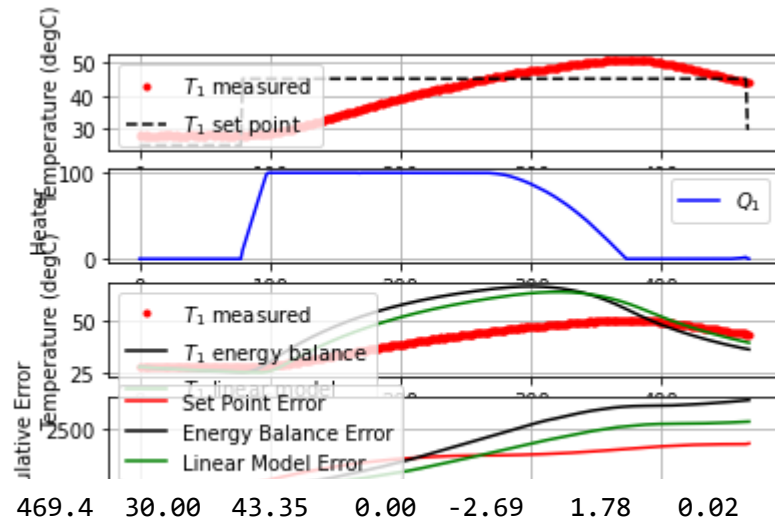
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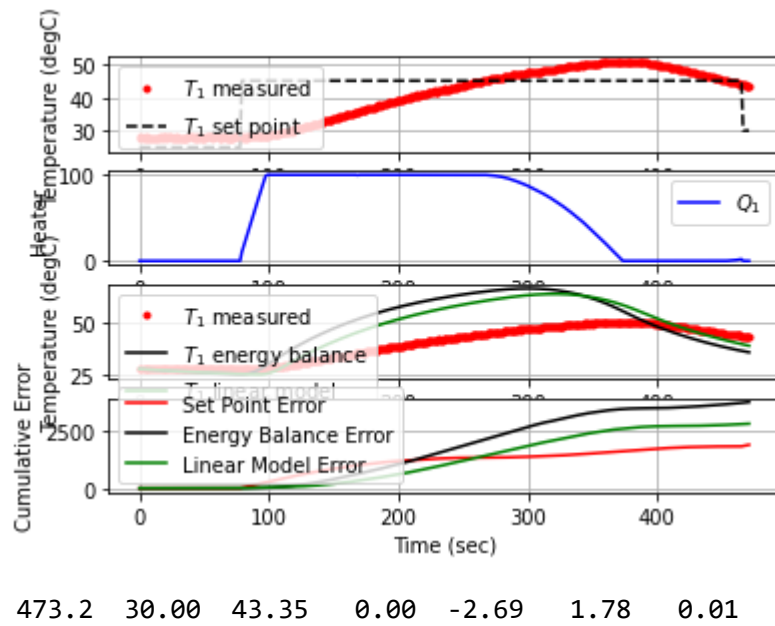
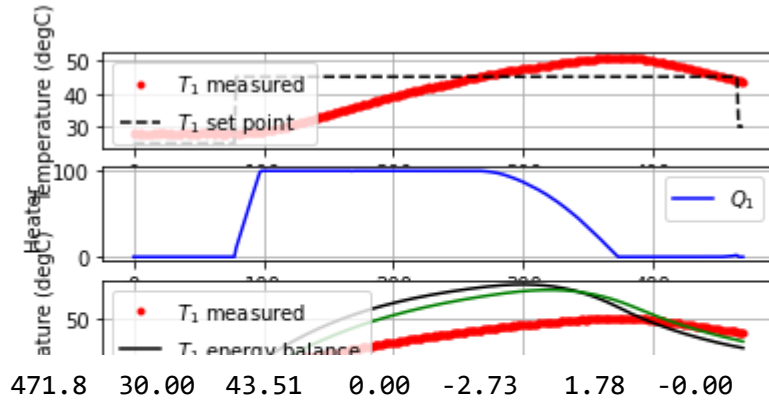


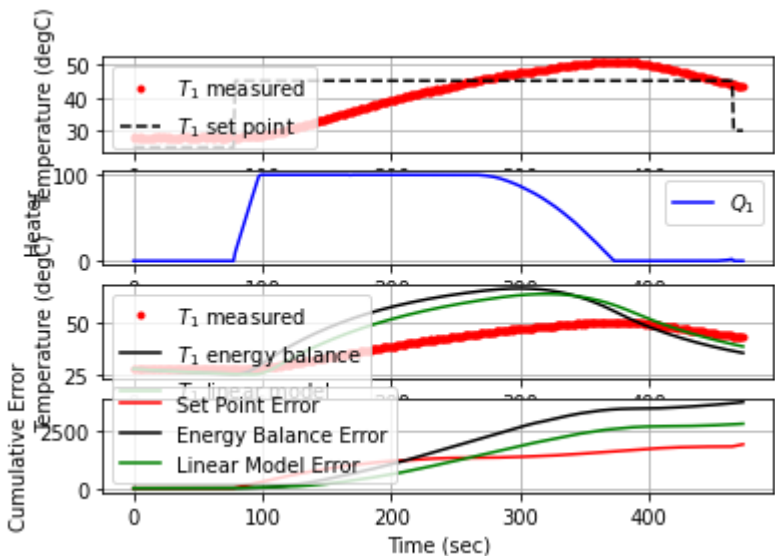
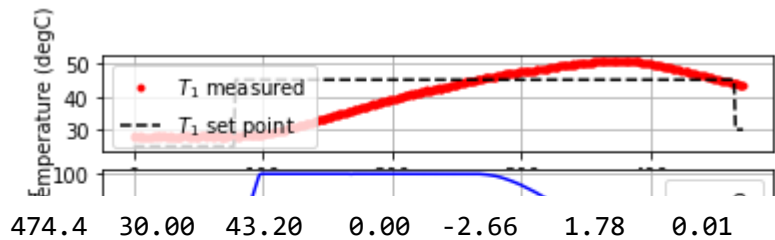
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468.2 30.00 43.64 0.00 -2.75 1.78 0.00



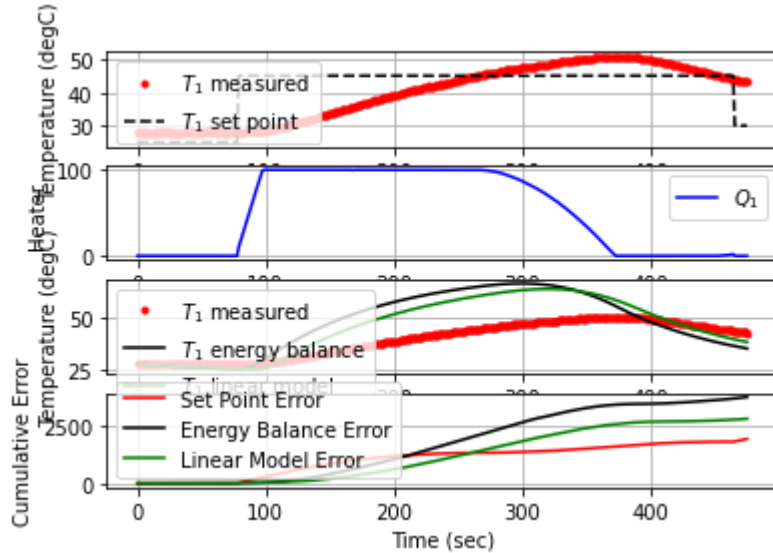




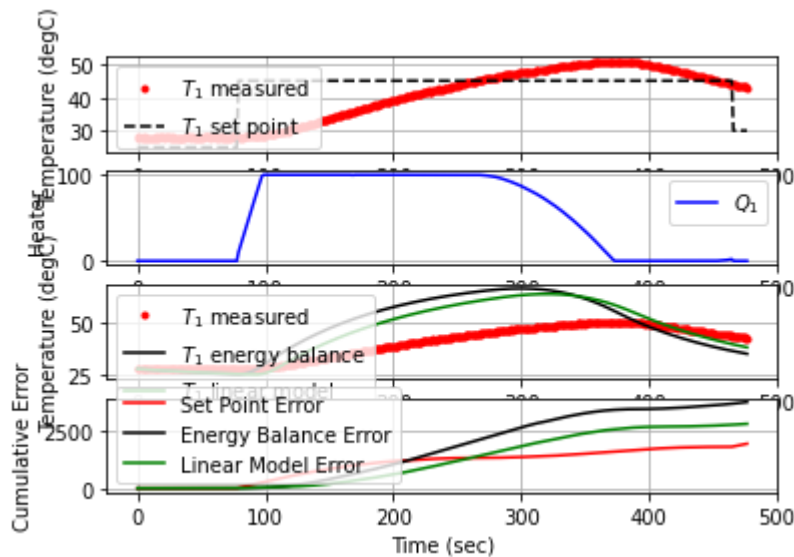
475.6 30.00 43.07 0.00 -2.64 1.78 0.01



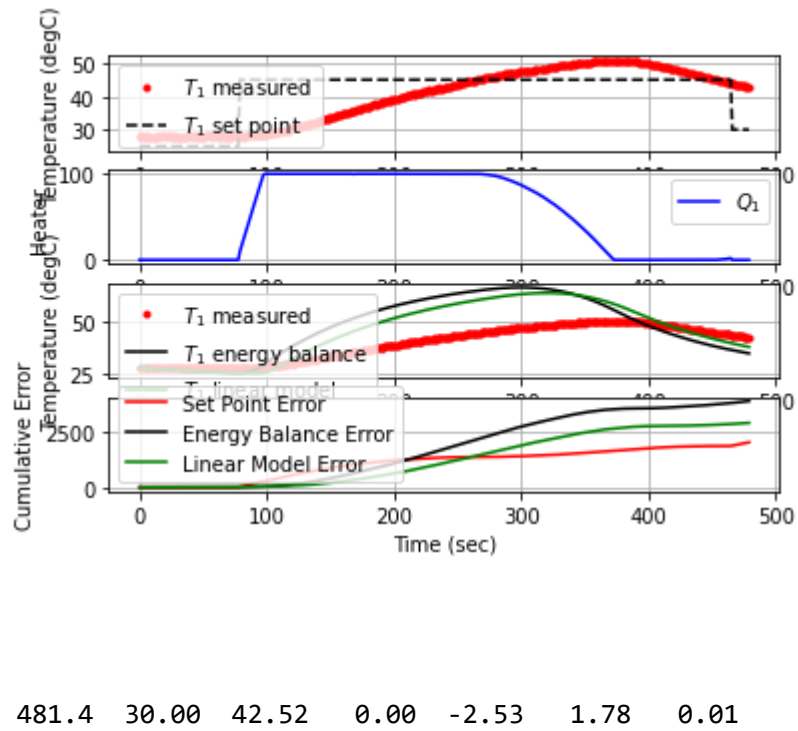
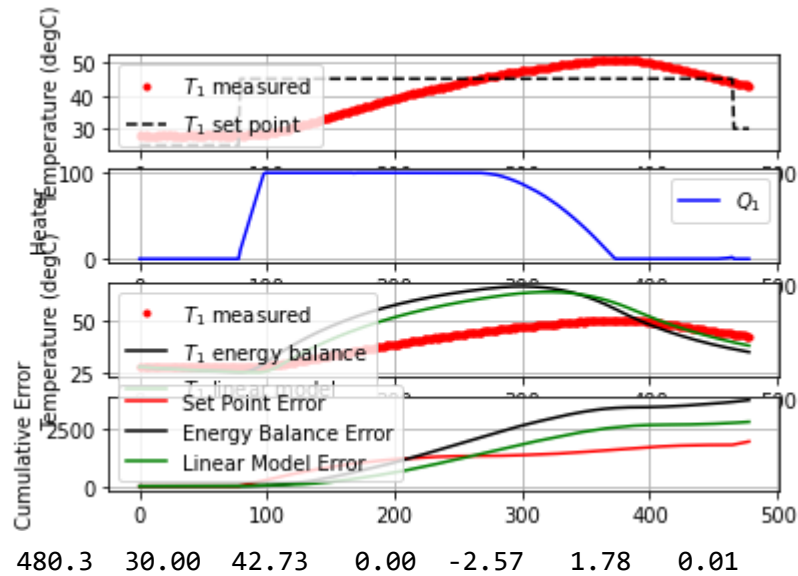
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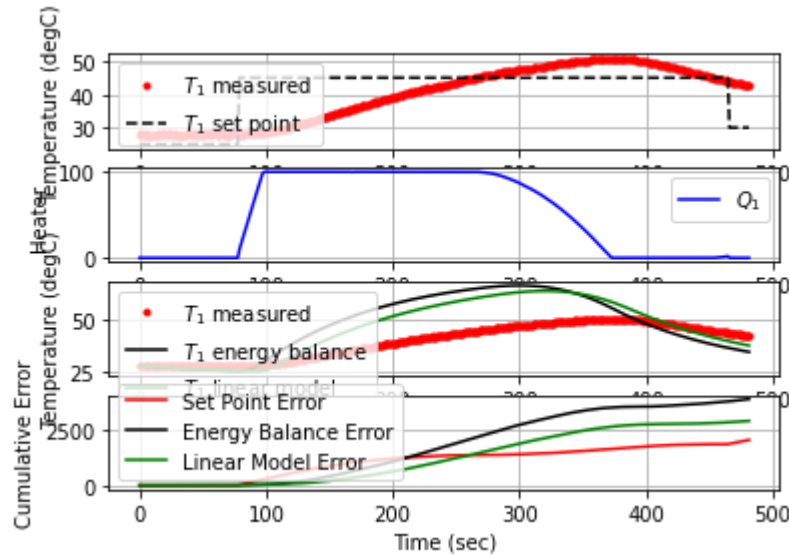
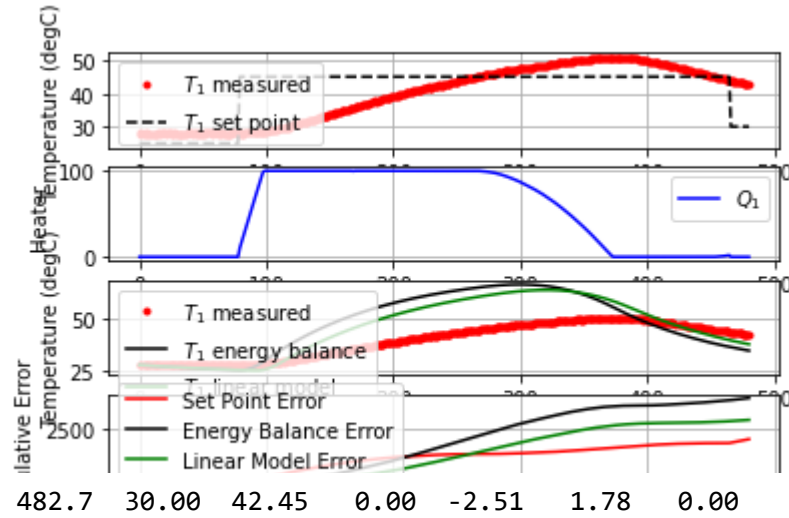


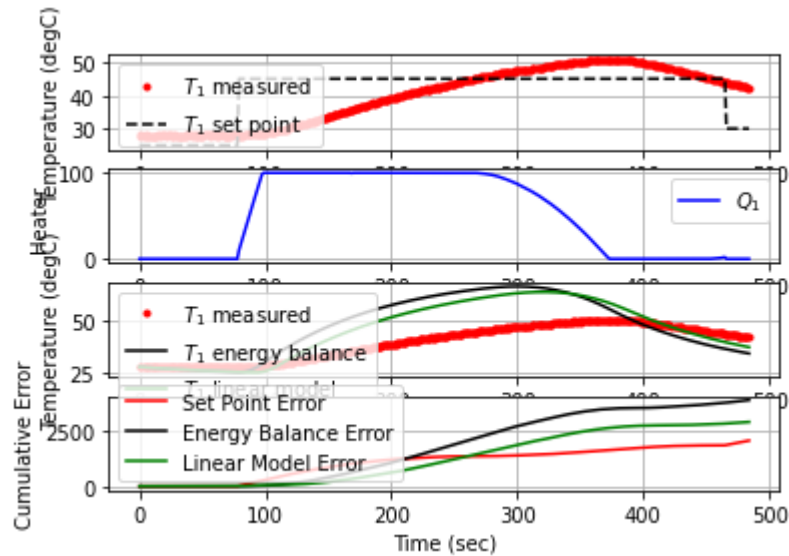
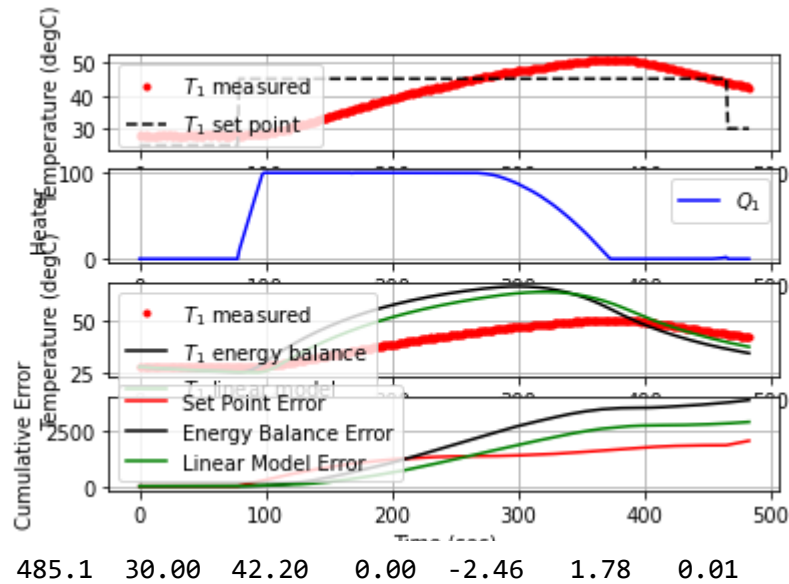
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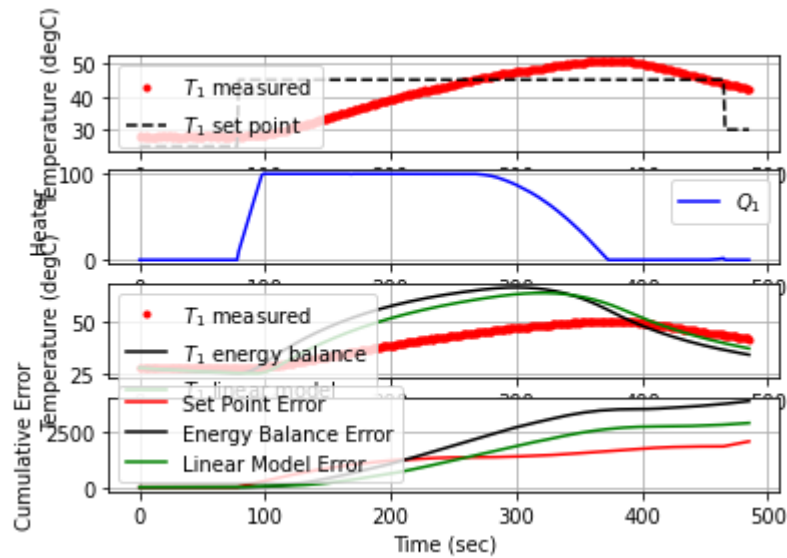
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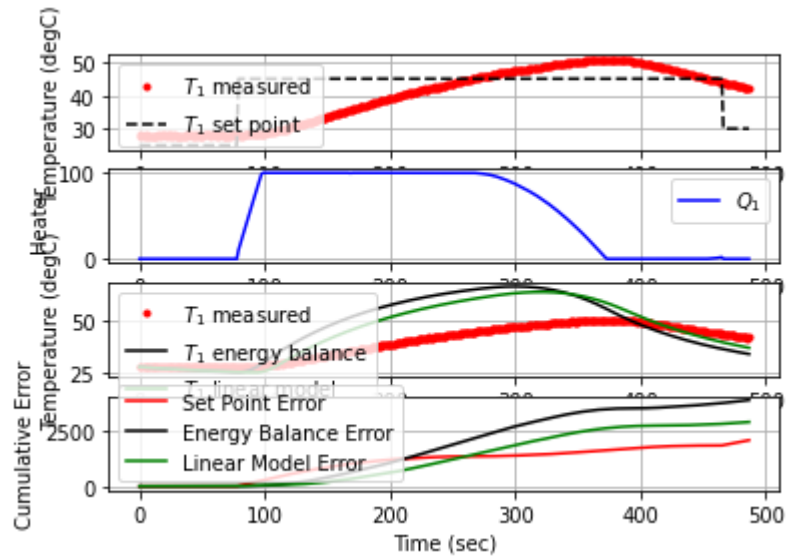




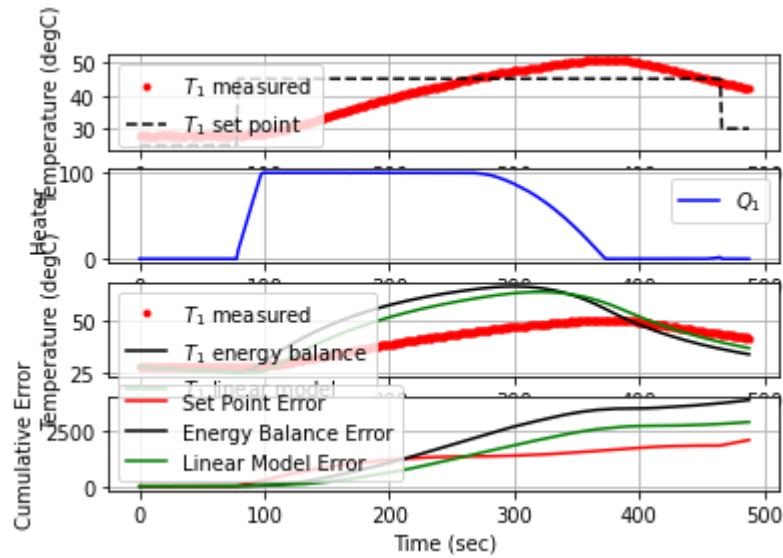
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 Connected to MQTT Broker!



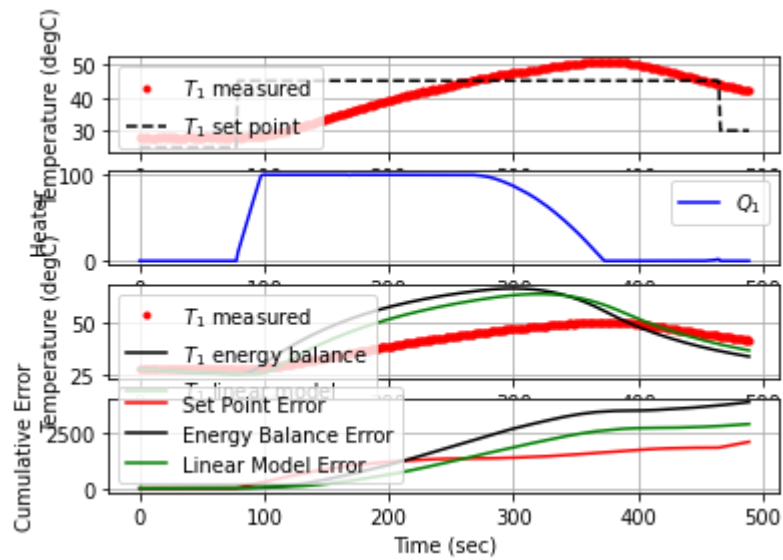
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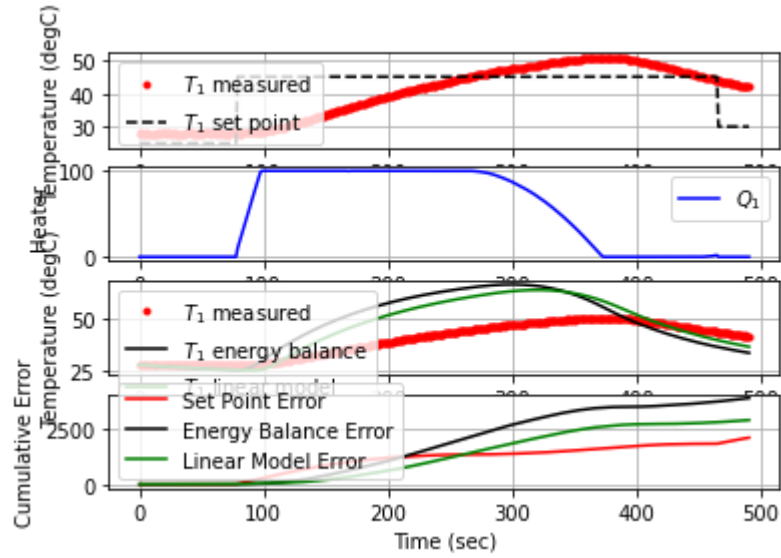
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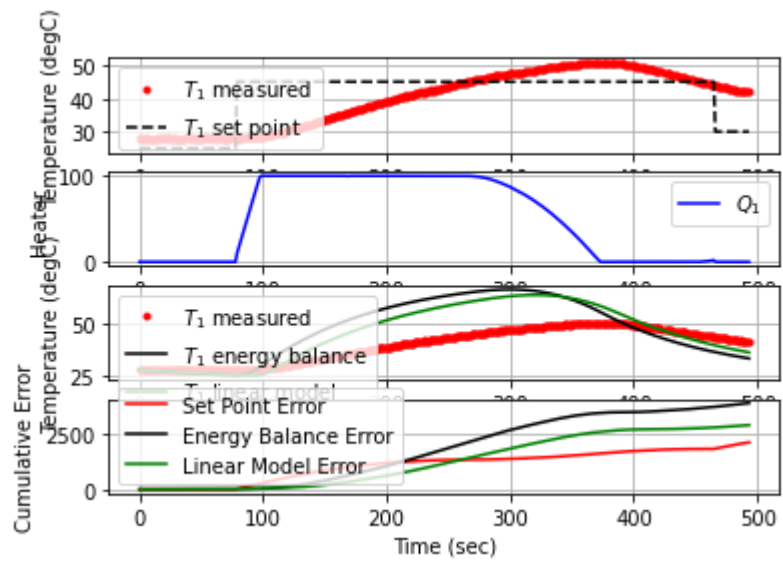
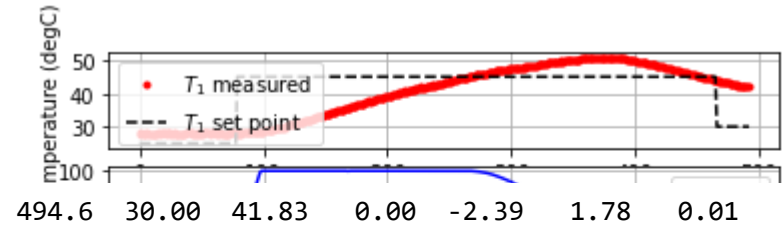
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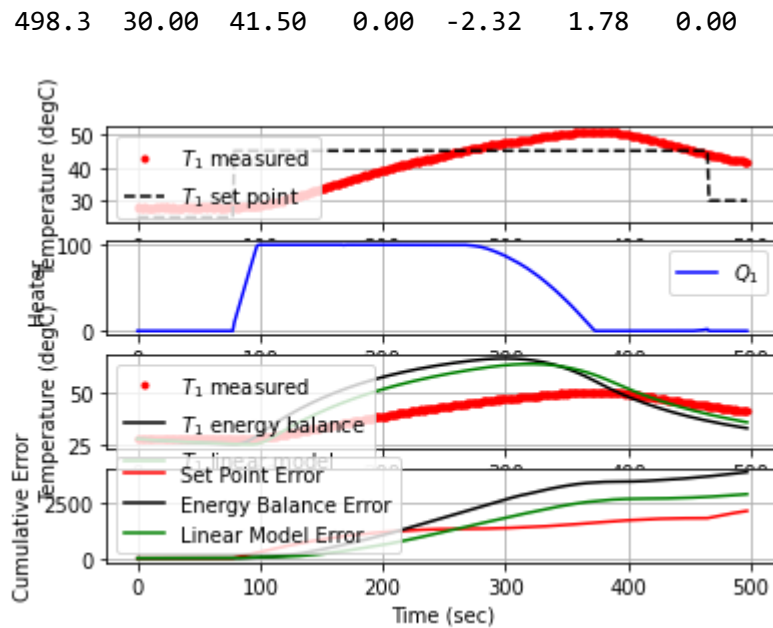
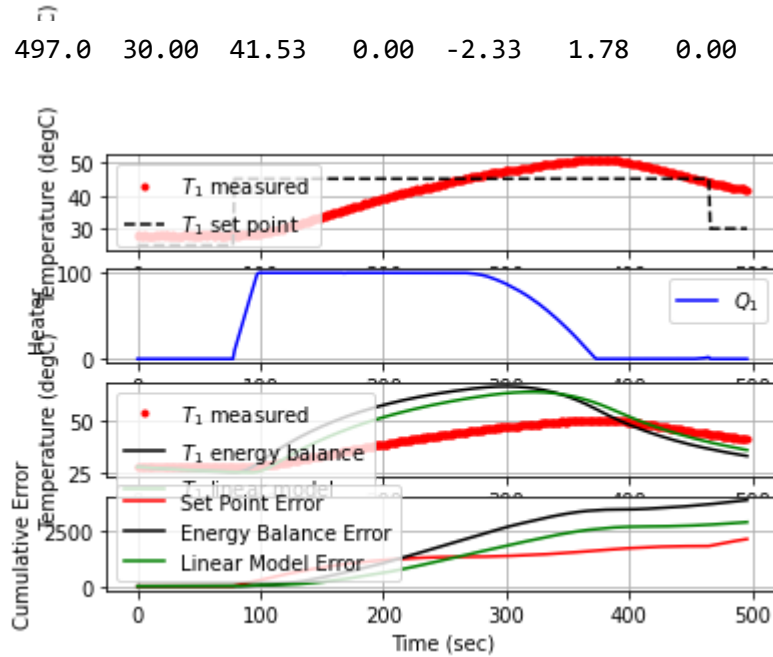
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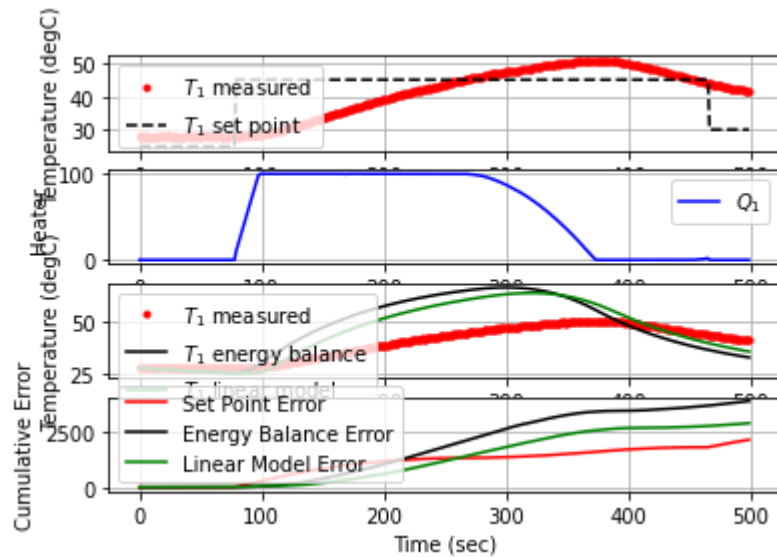
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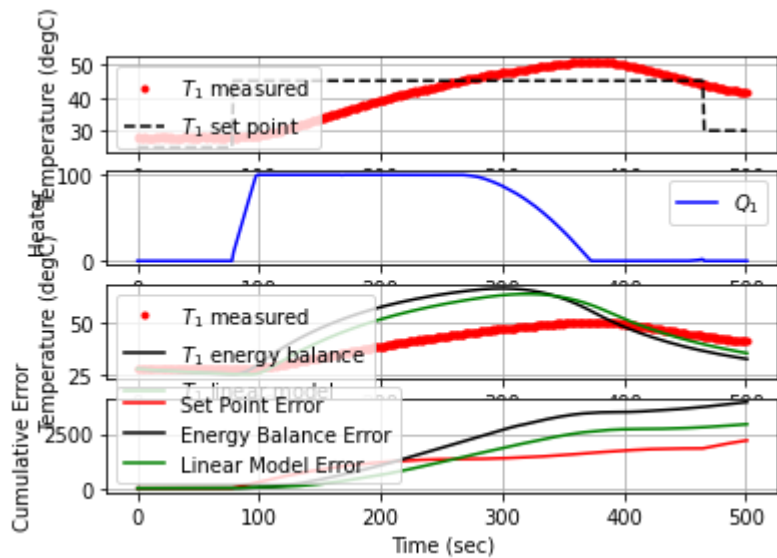
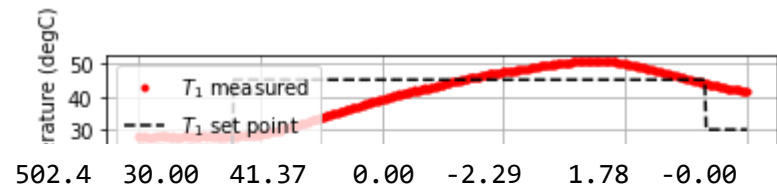




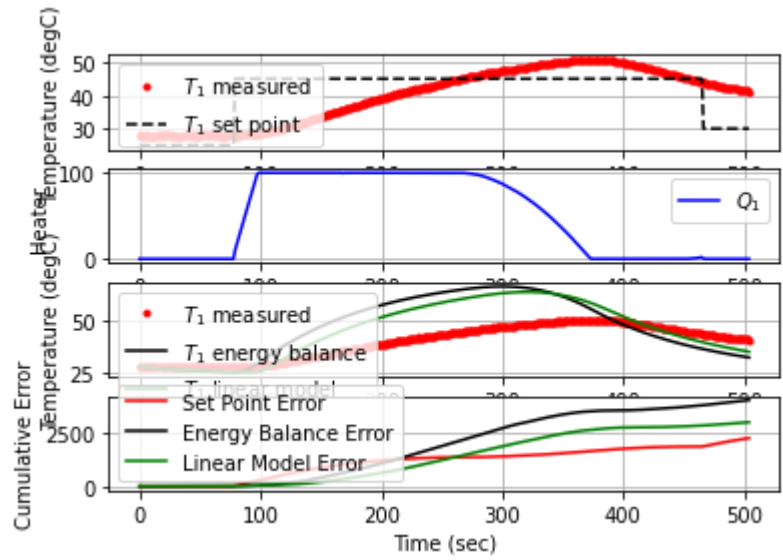
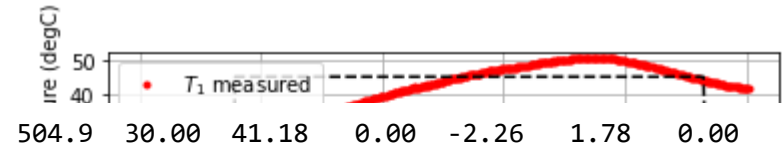
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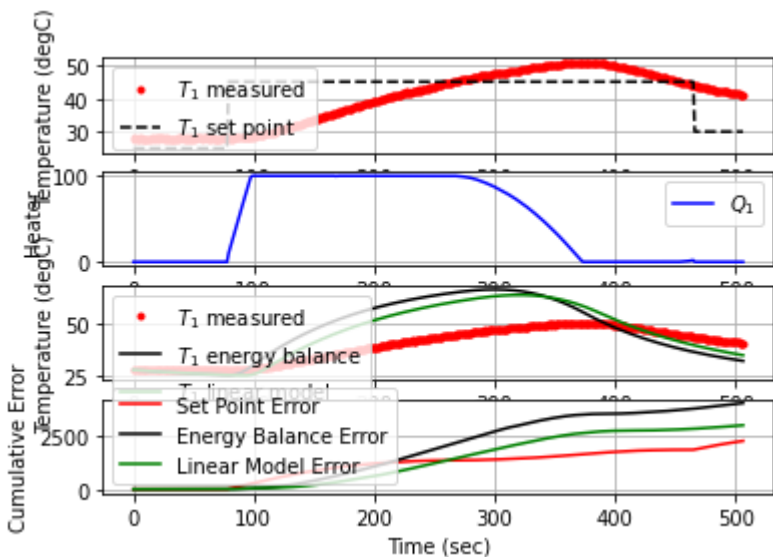
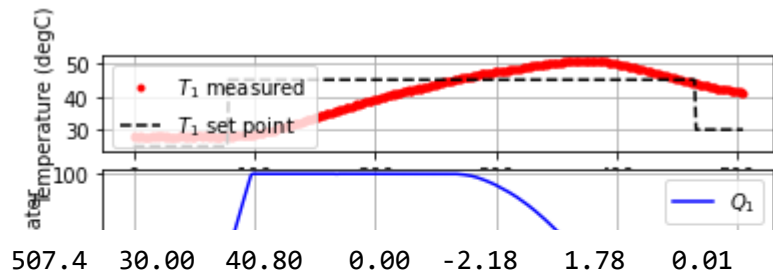
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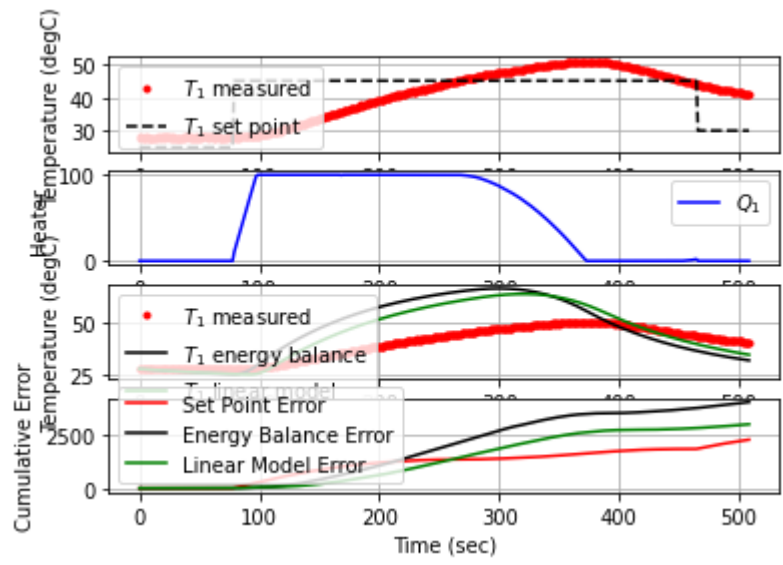
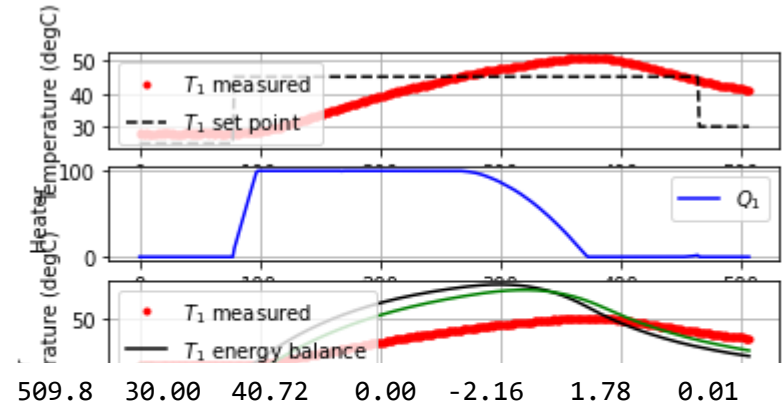
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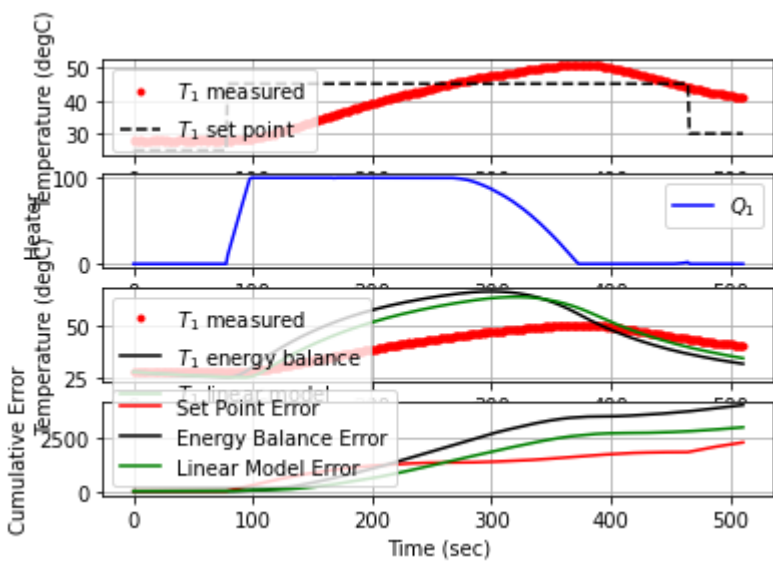
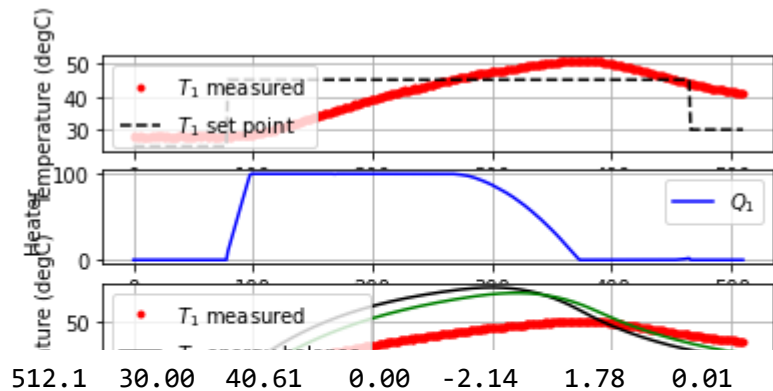
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508.6 30.00 40.87 0.00 -2.19 1.78 -0.00

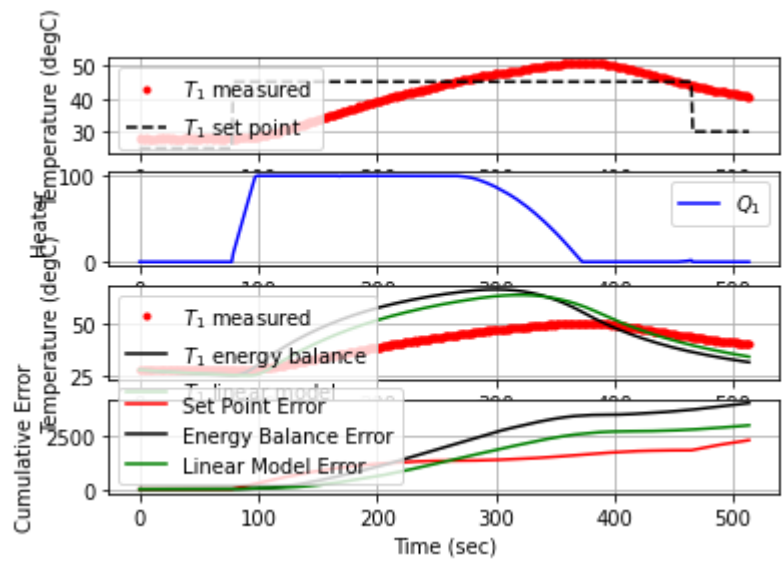
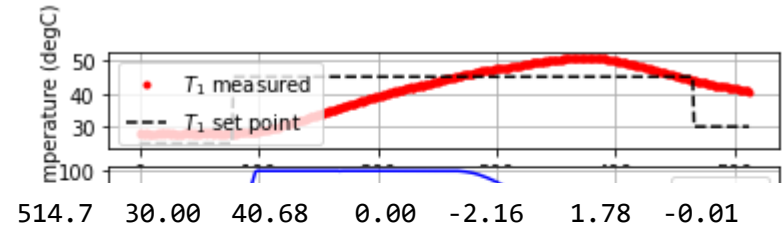


510.9 30.00 40.82 0.00 -2.18 1.78 -0.01



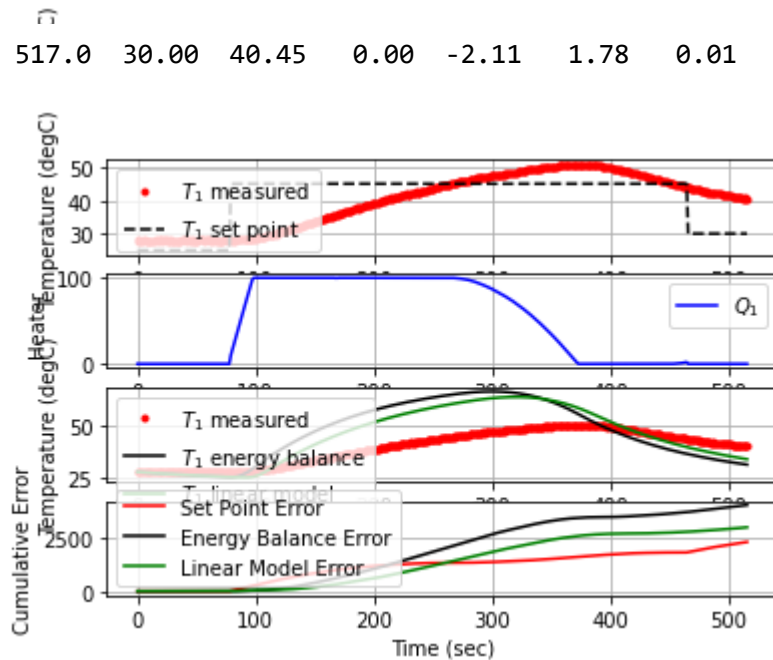
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513.4 30.00 40.58 0.00 -2.14 1.78 0.00

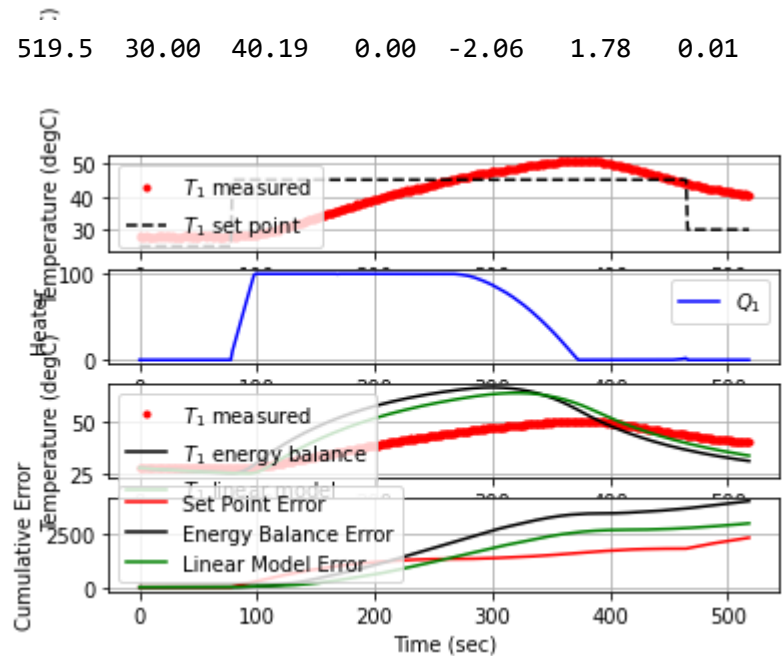


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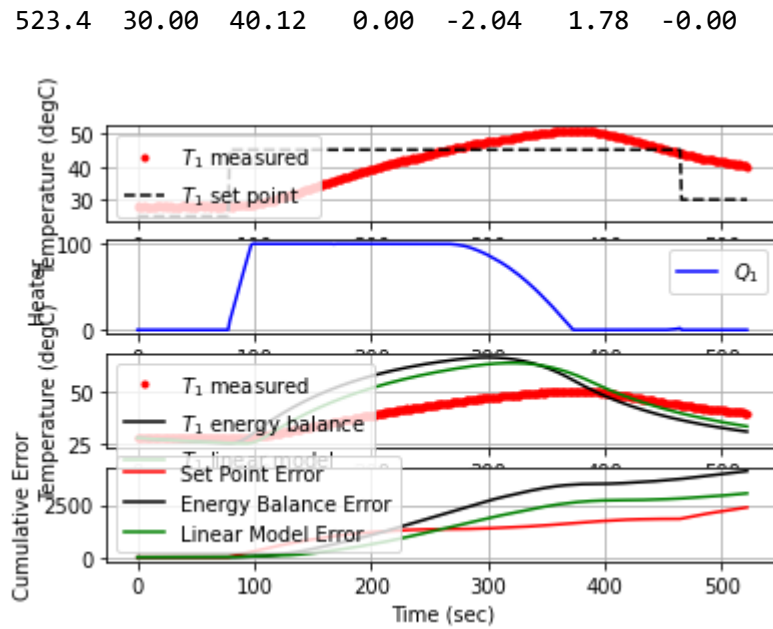
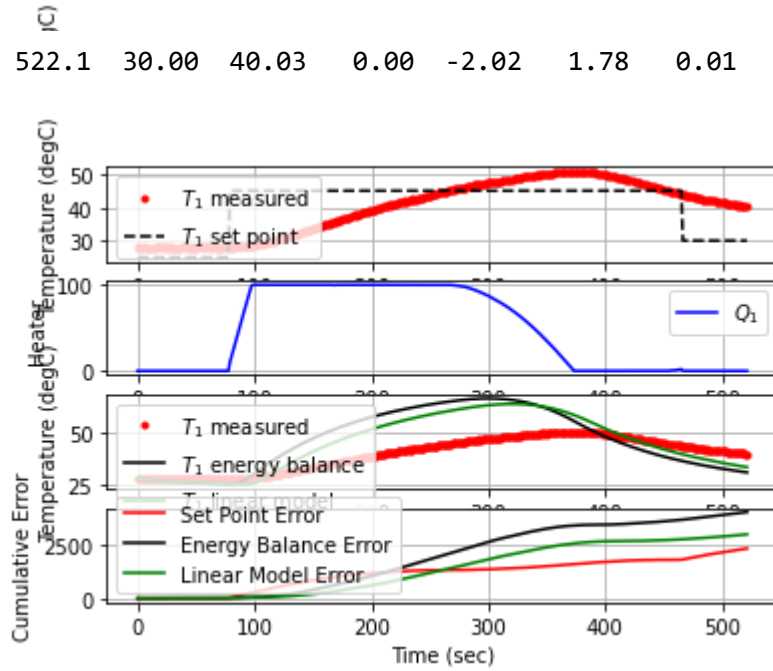




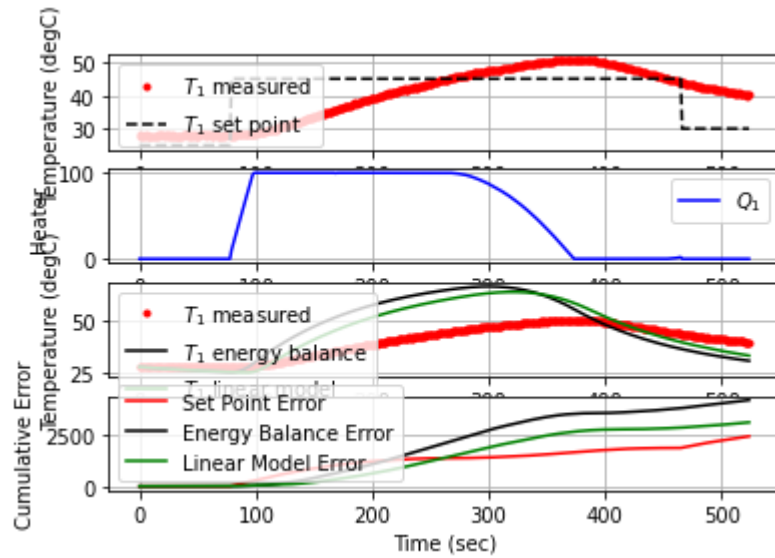
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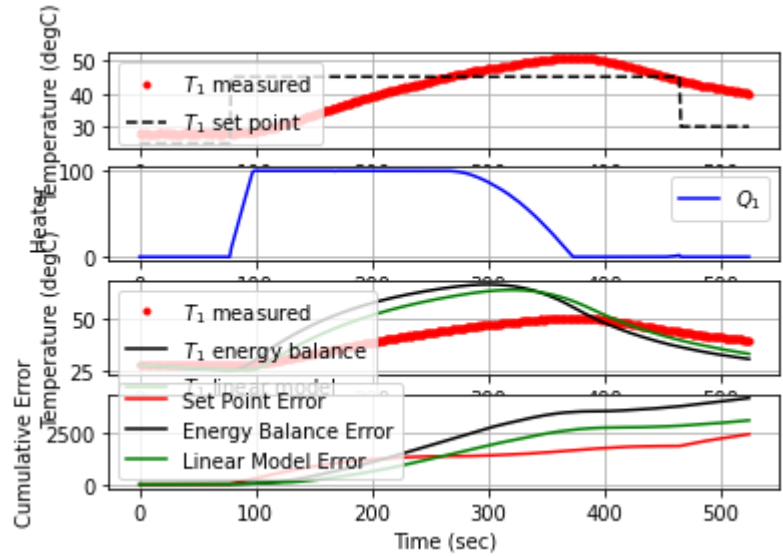
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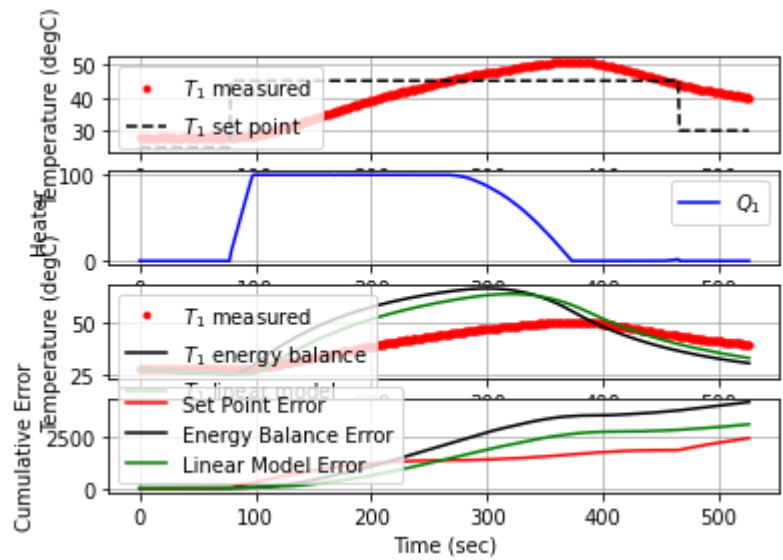
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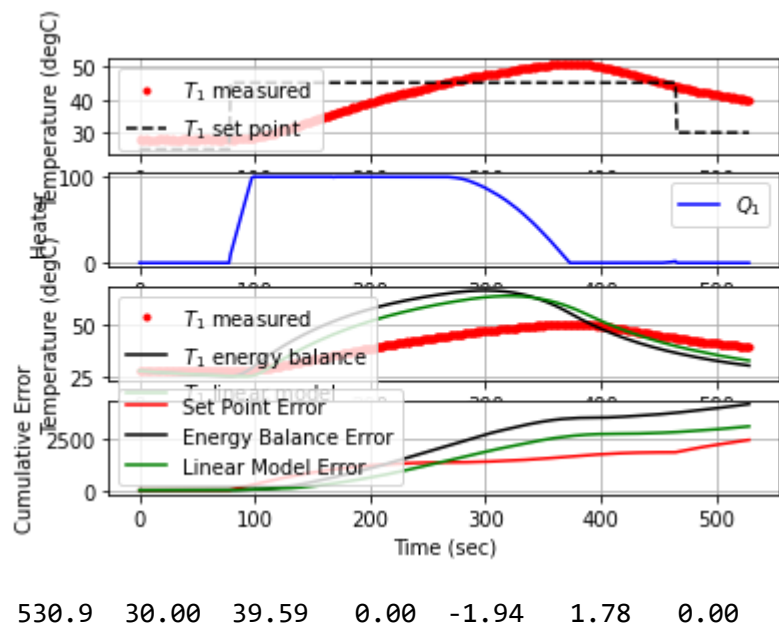
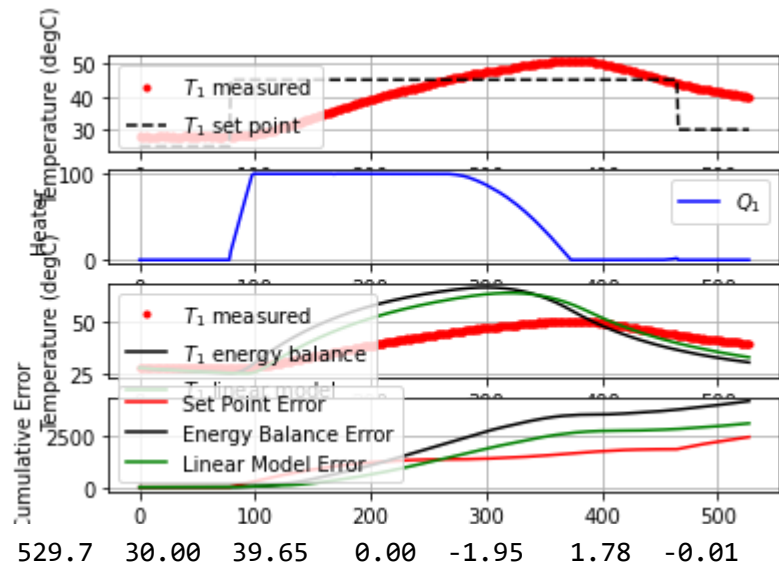
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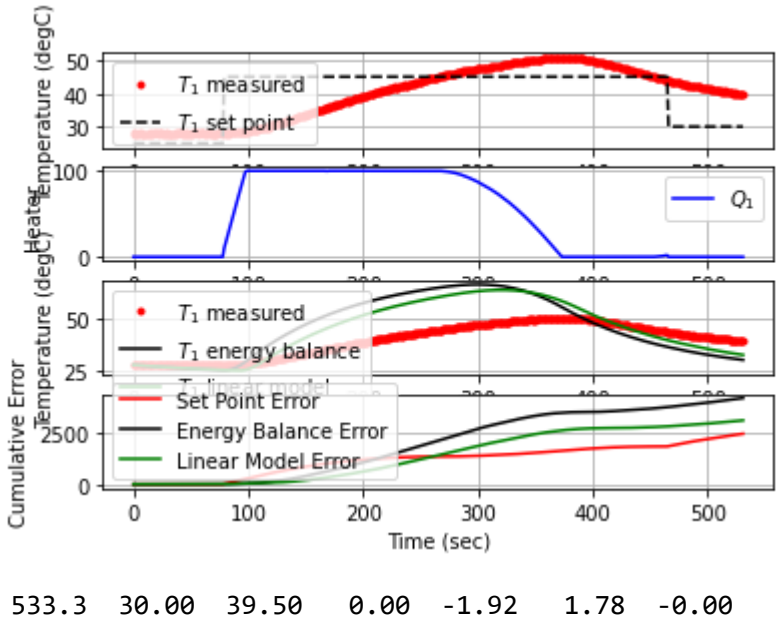
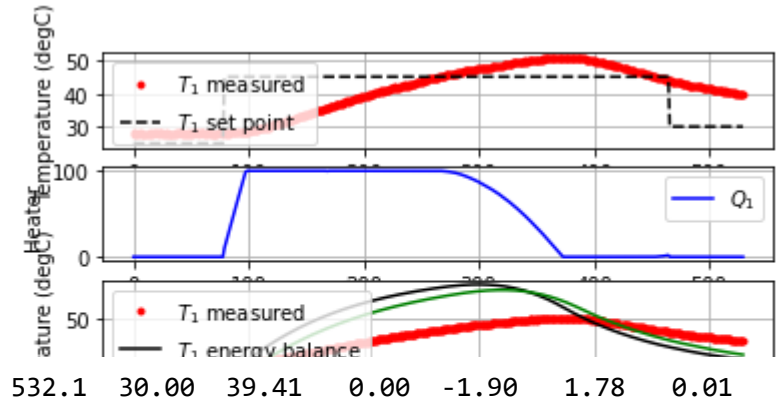


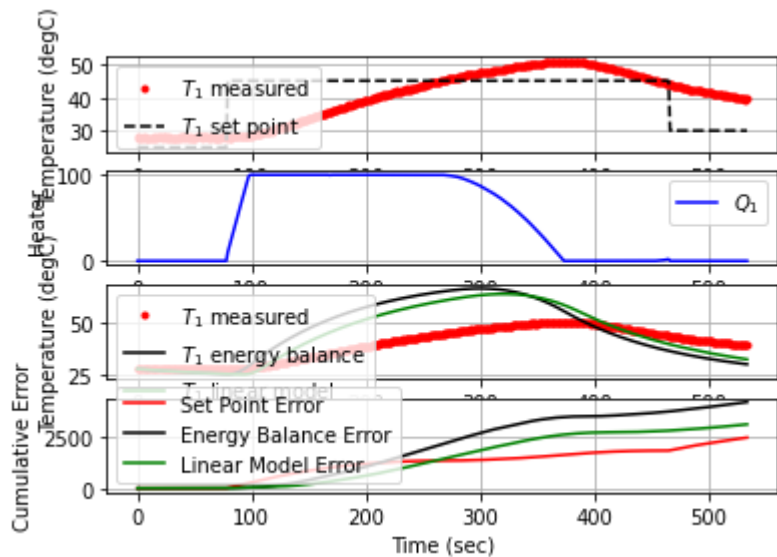
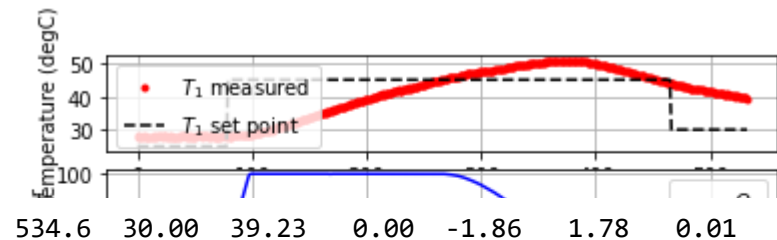
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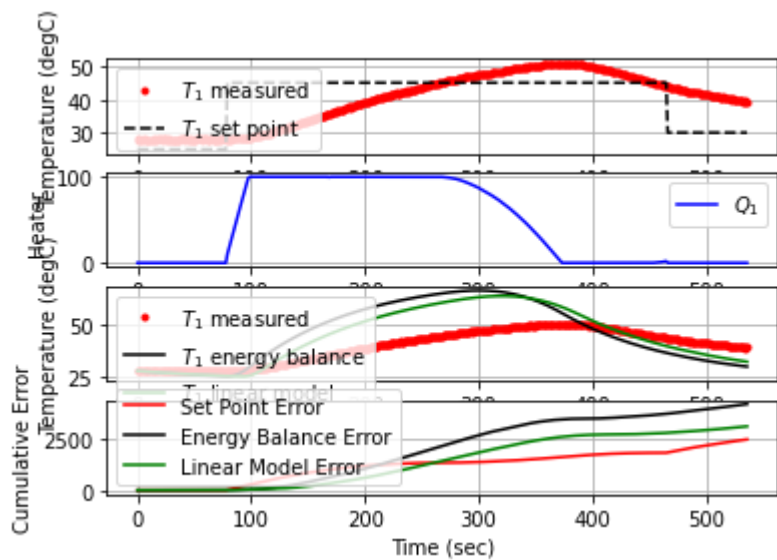
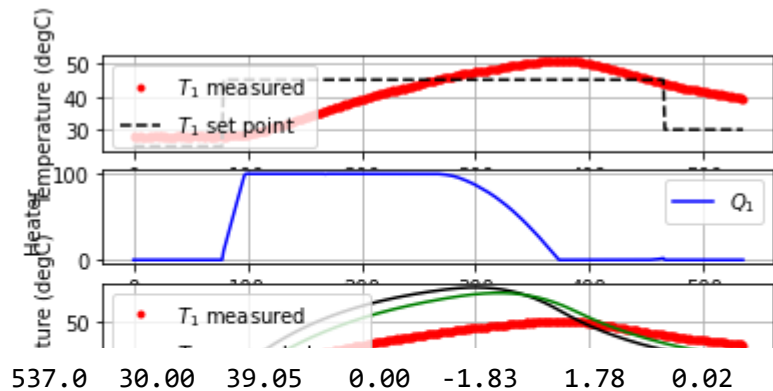
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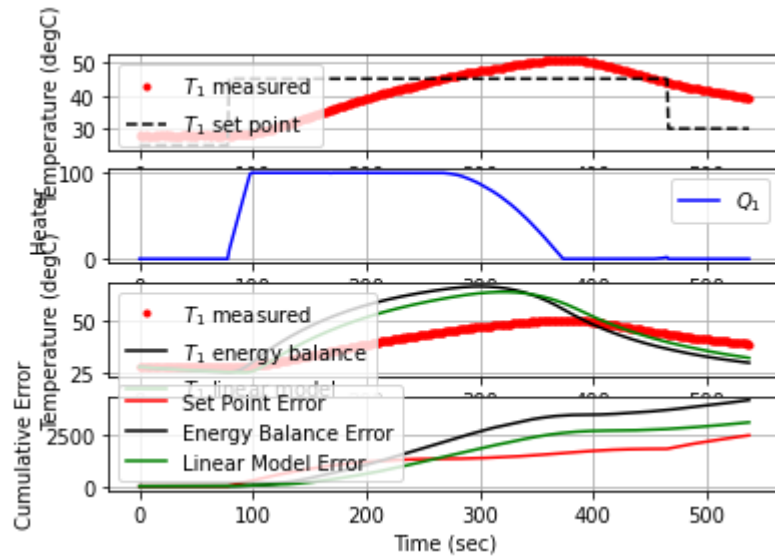




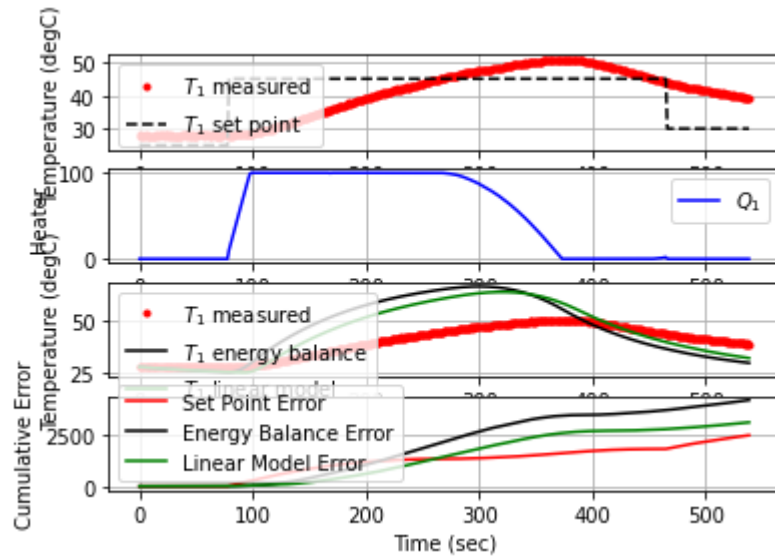




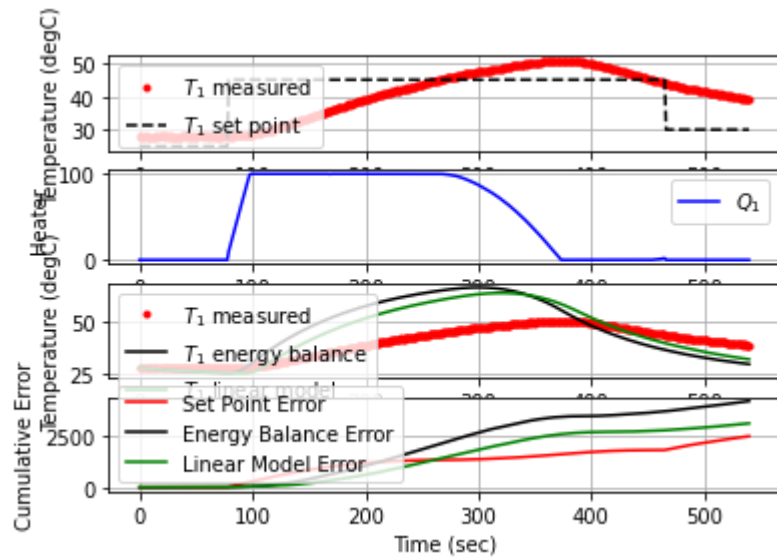




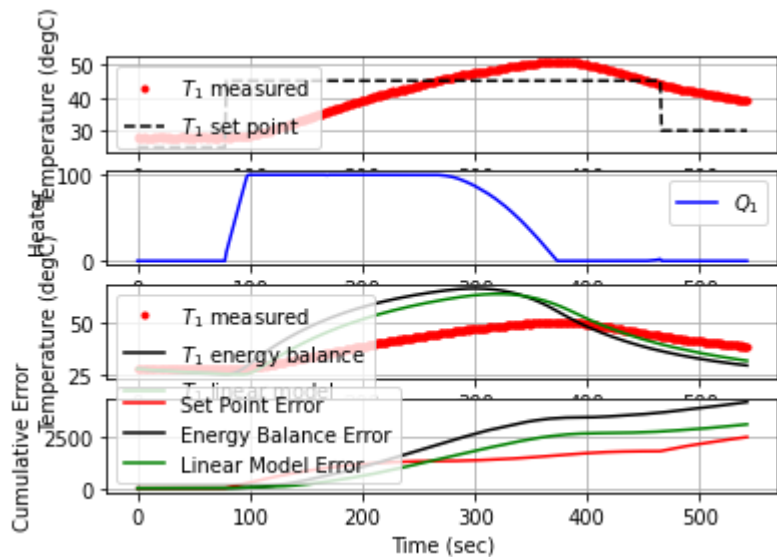
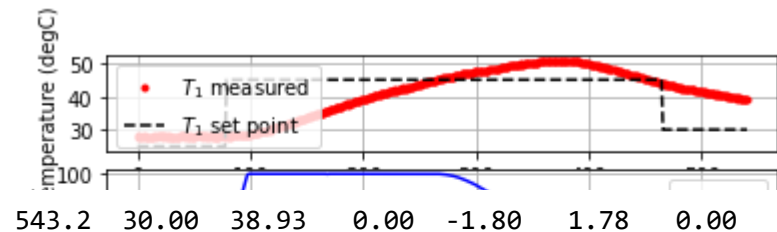
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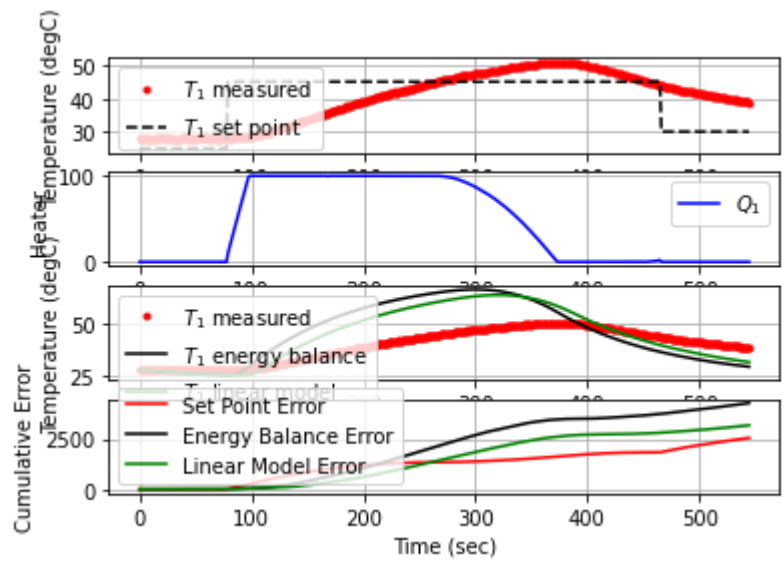
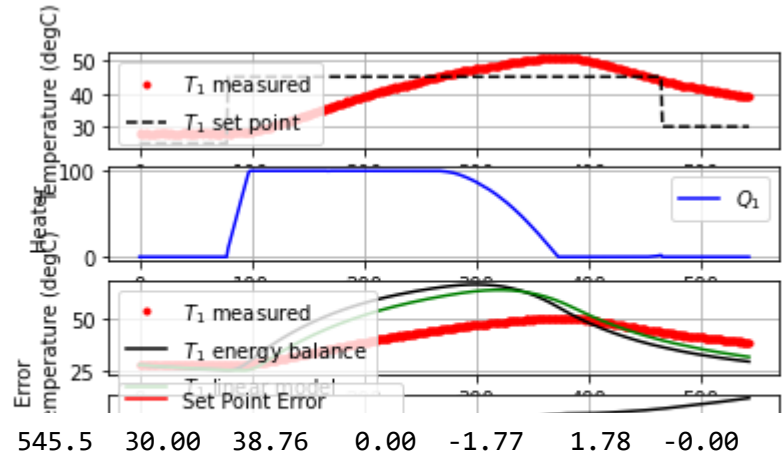
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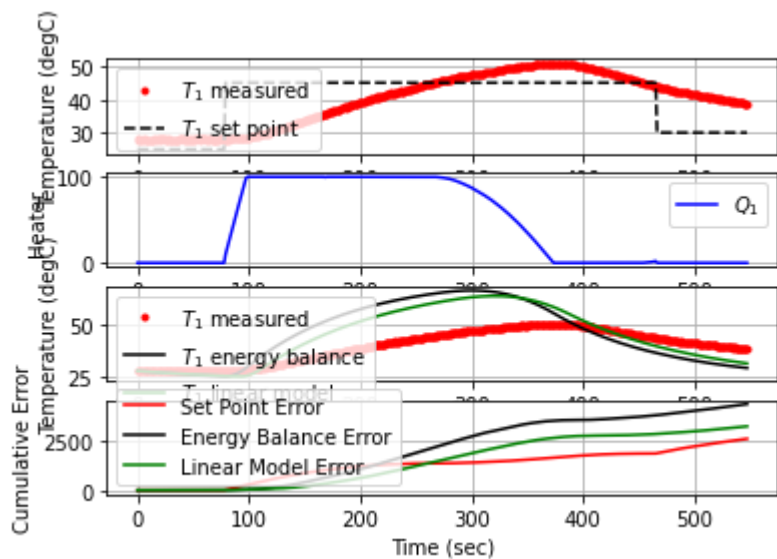
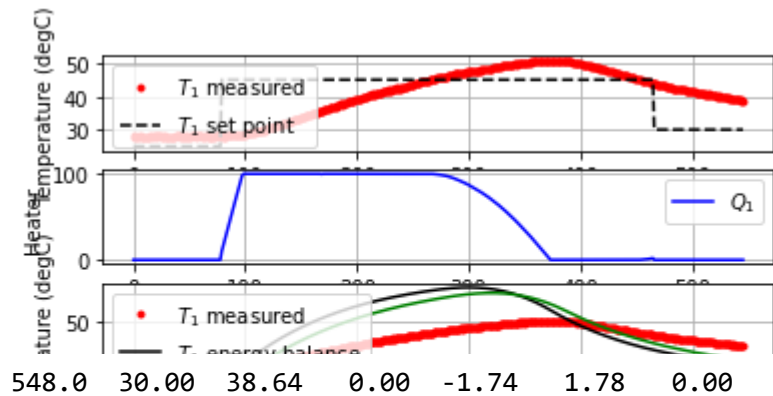
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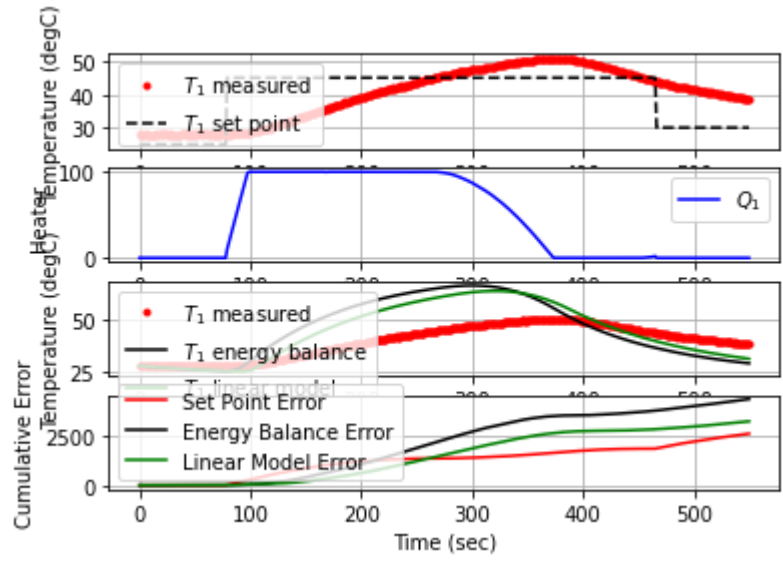
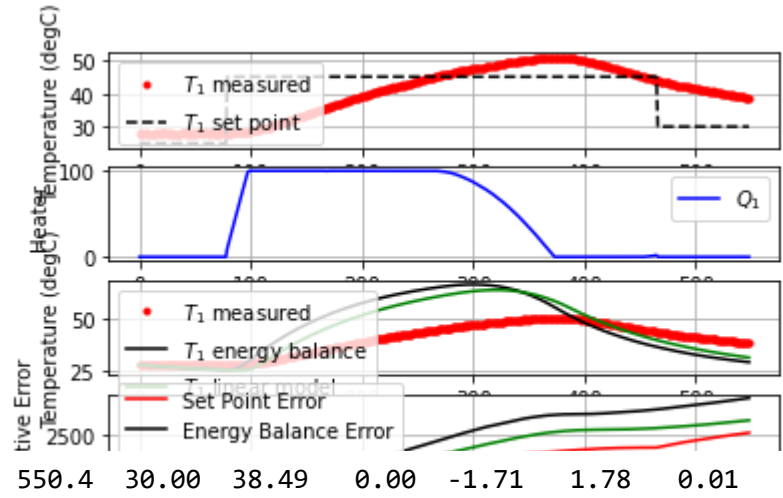


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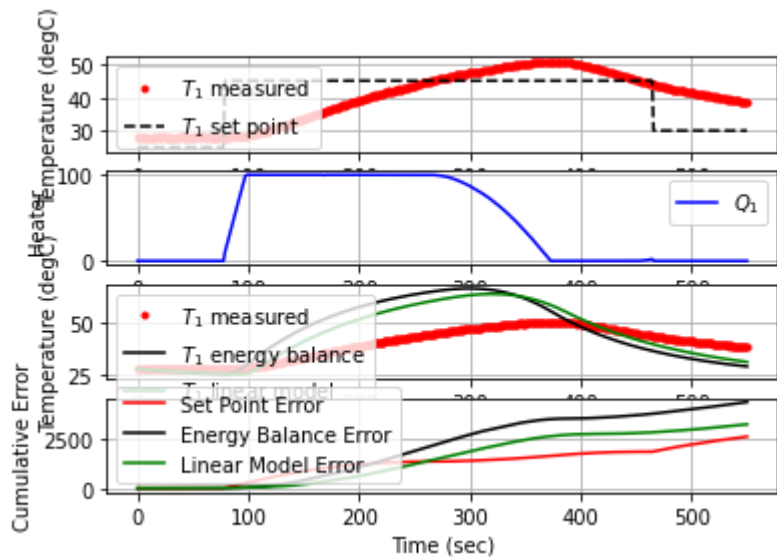


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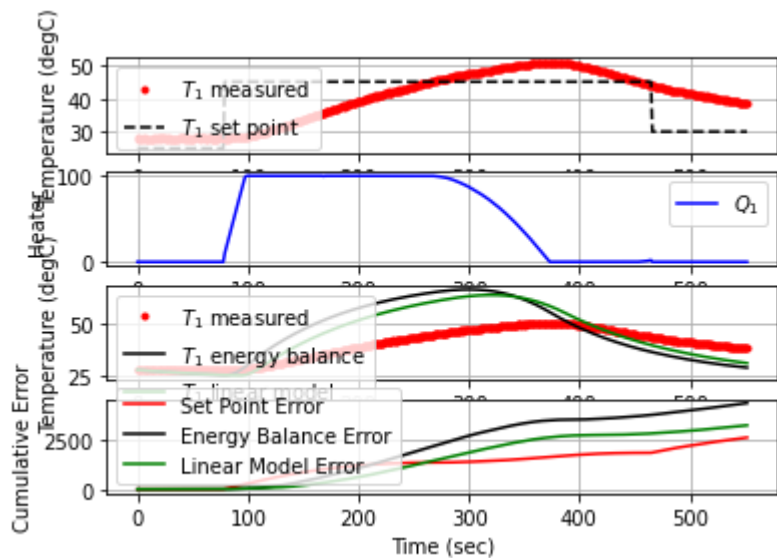




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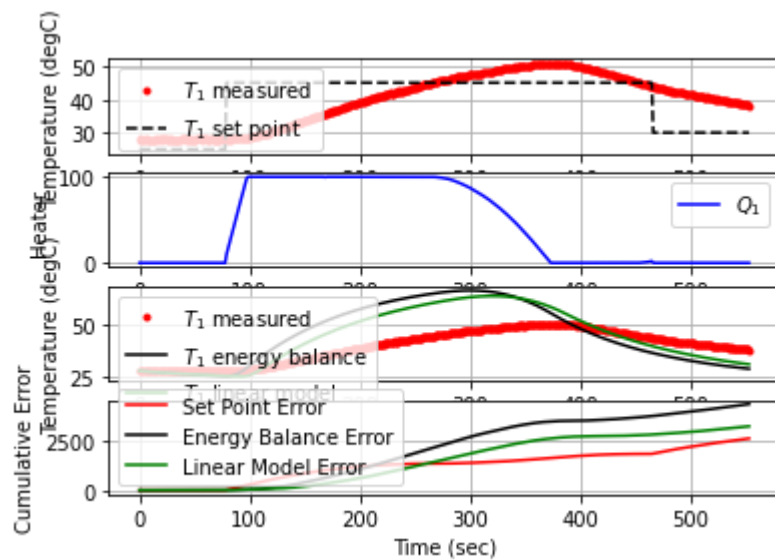


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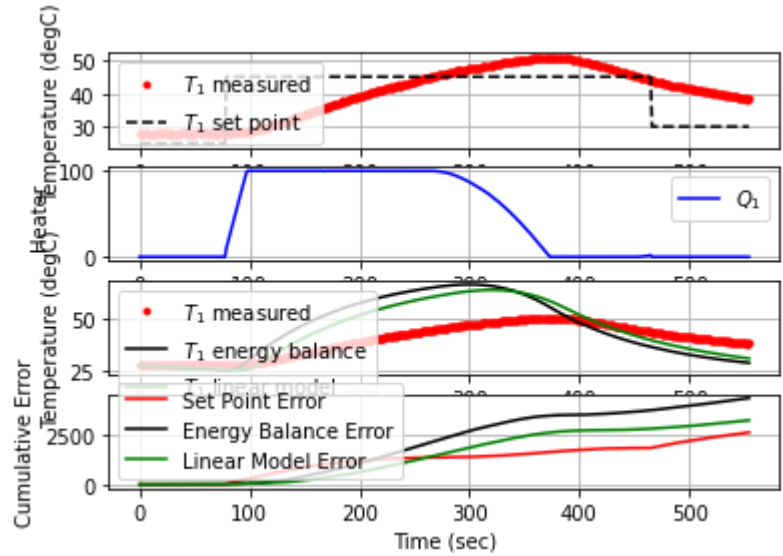




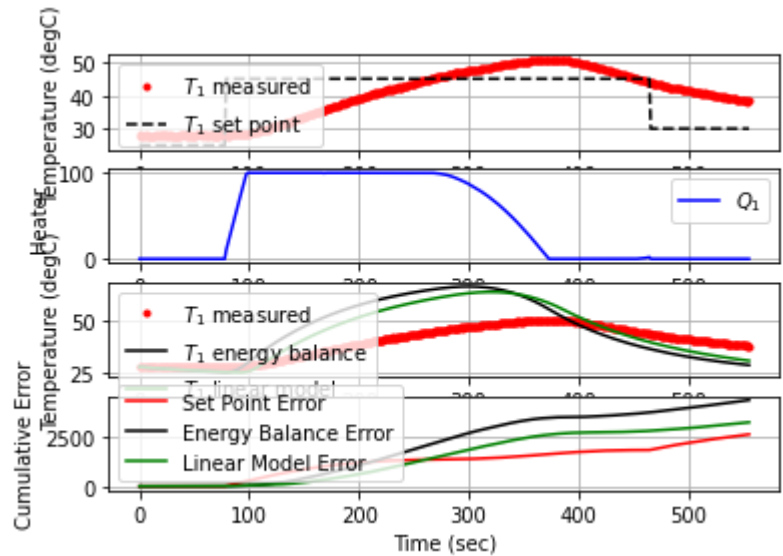
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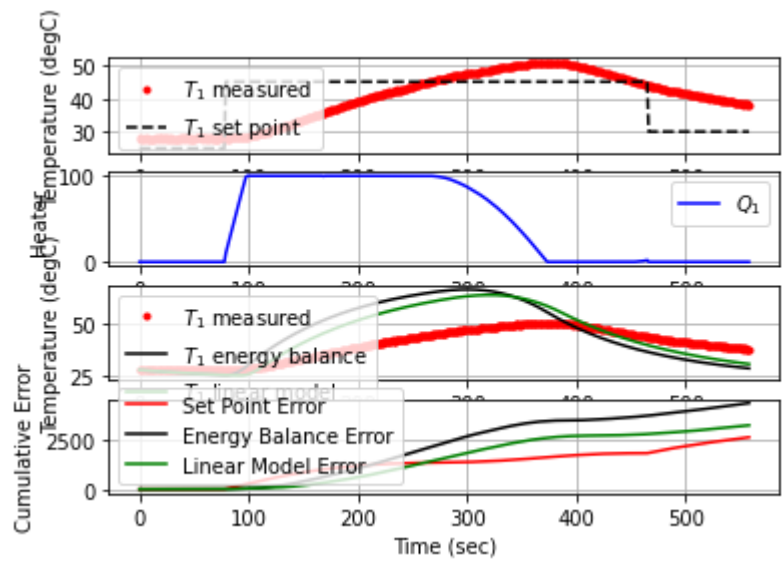
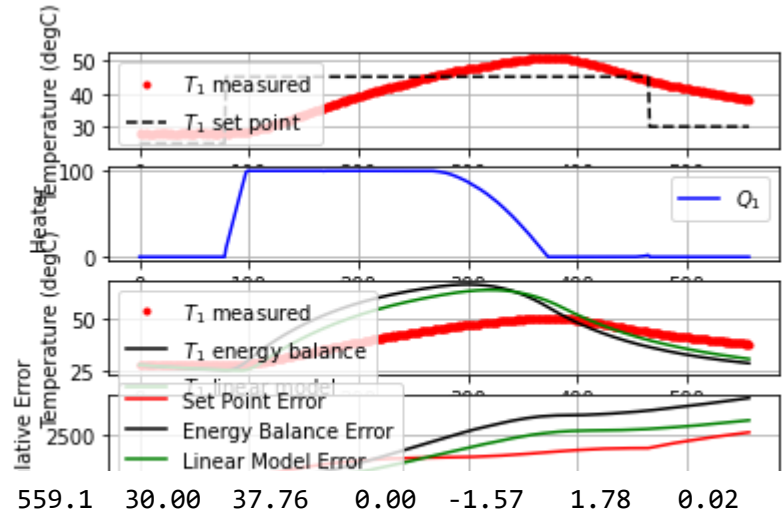
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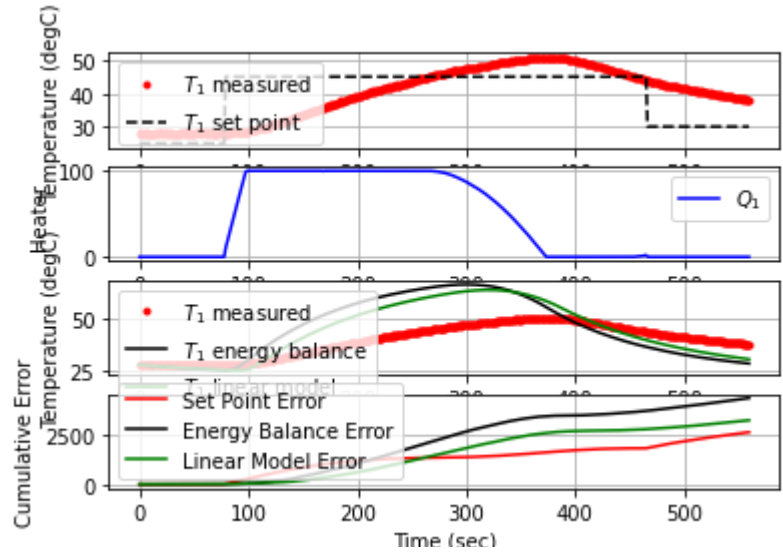


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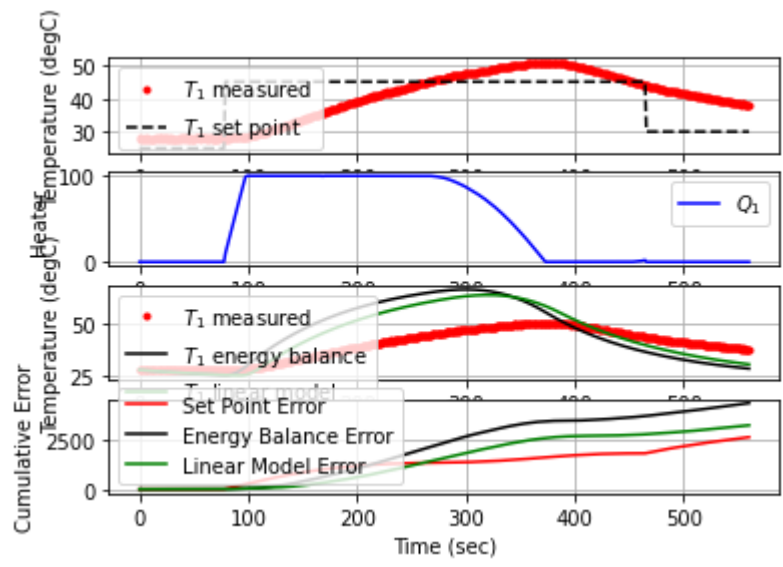


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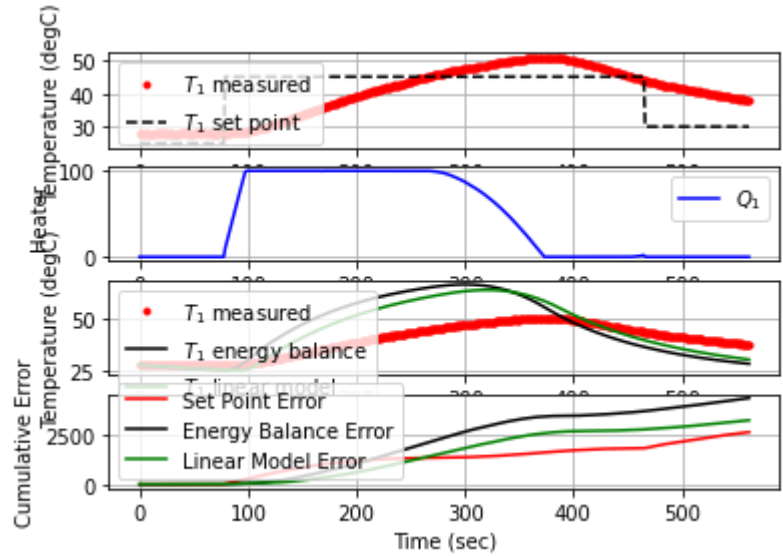




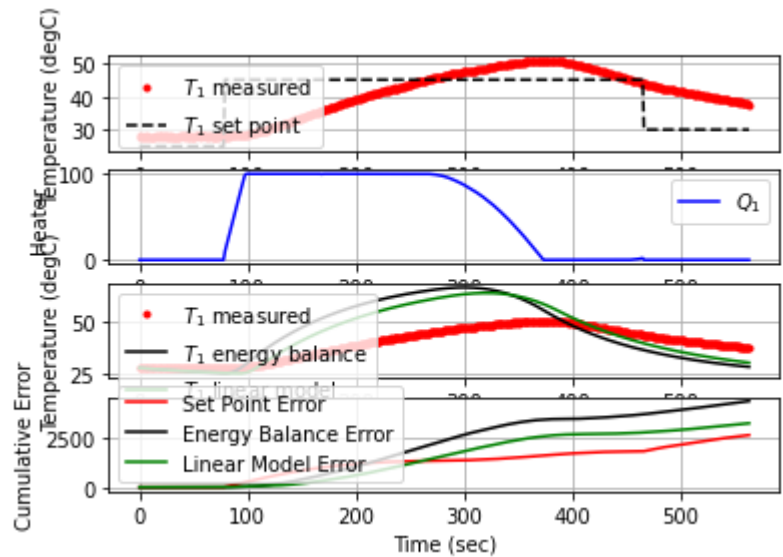
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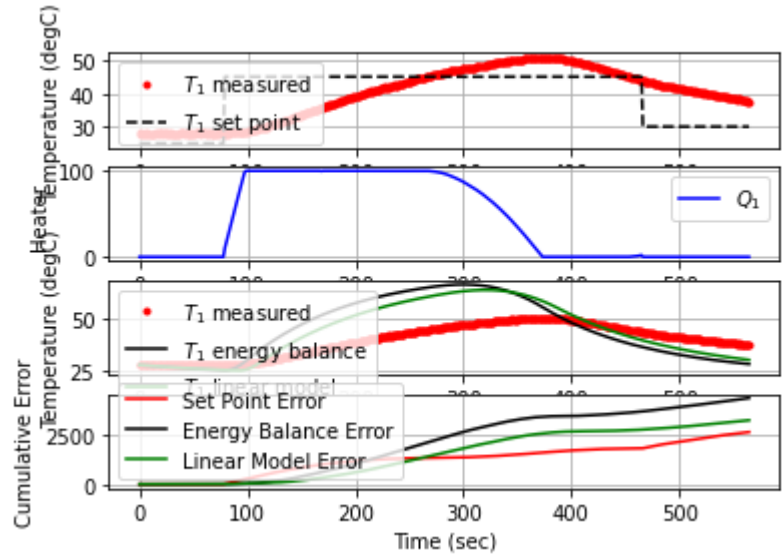
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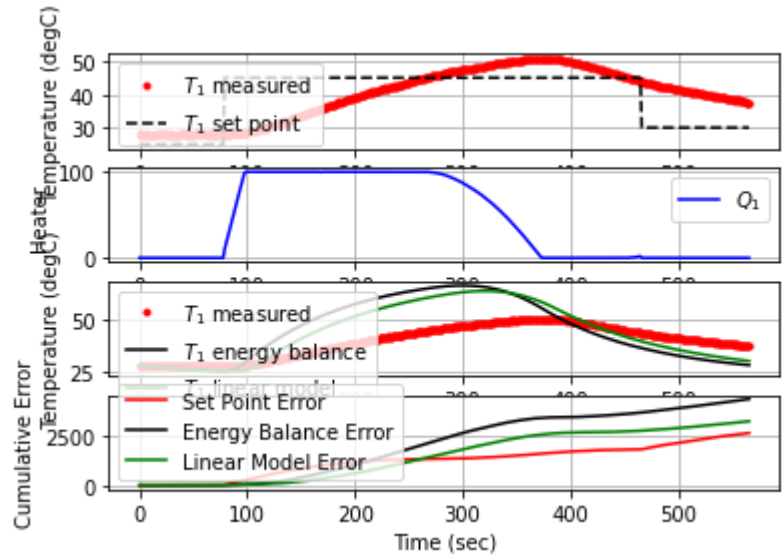
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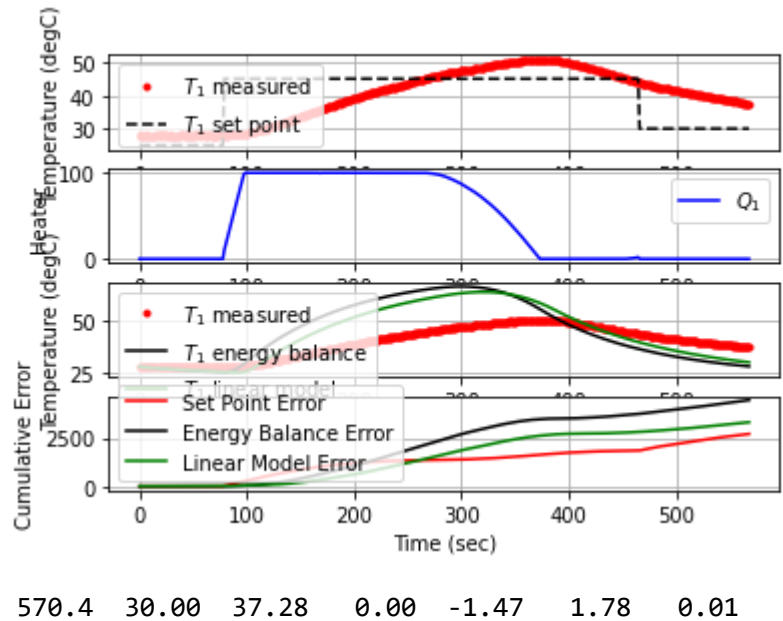
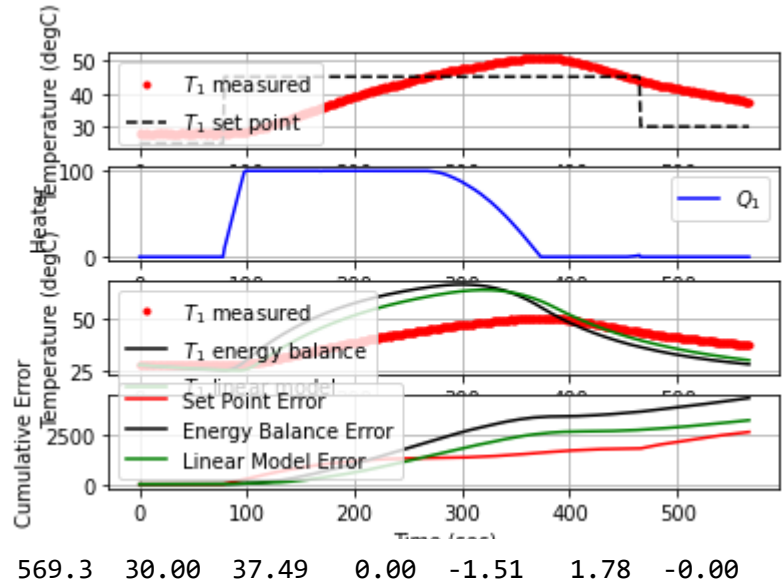
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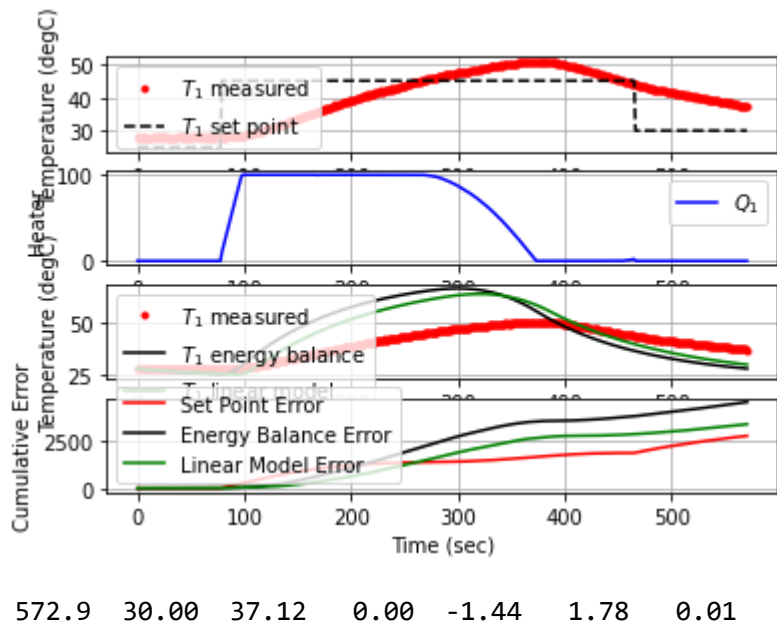
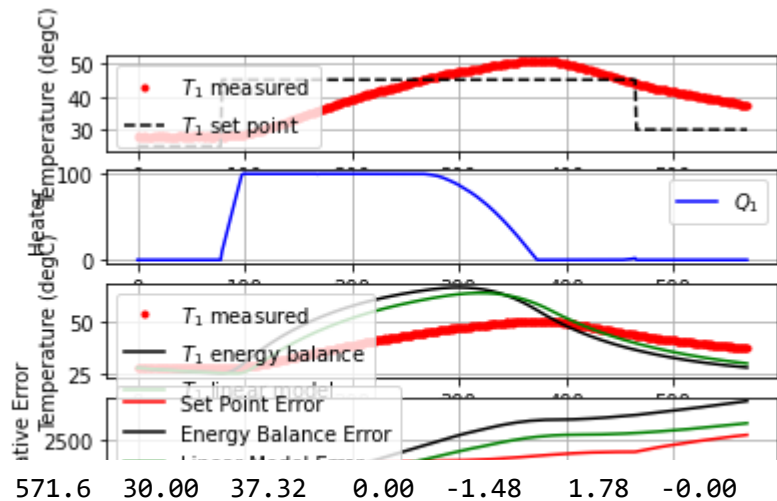


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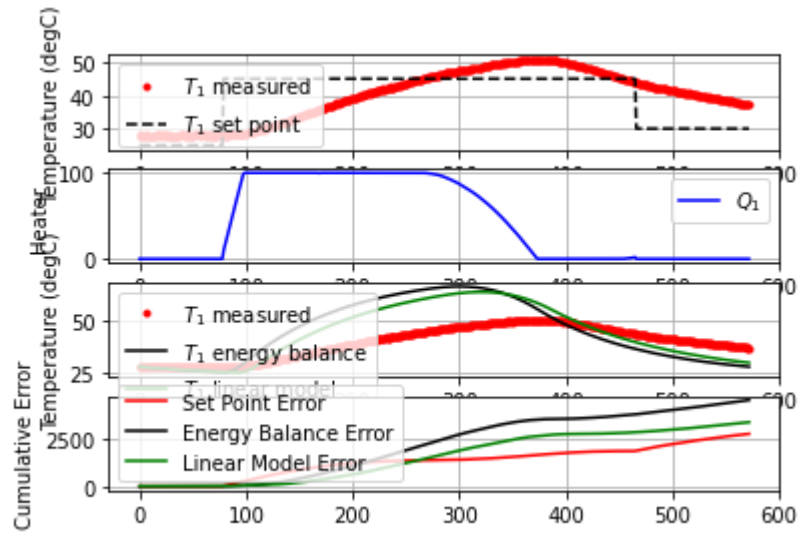


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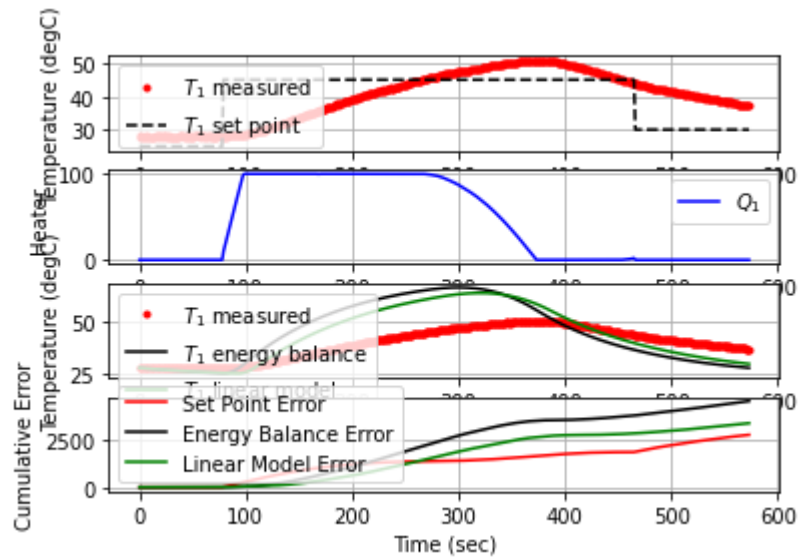




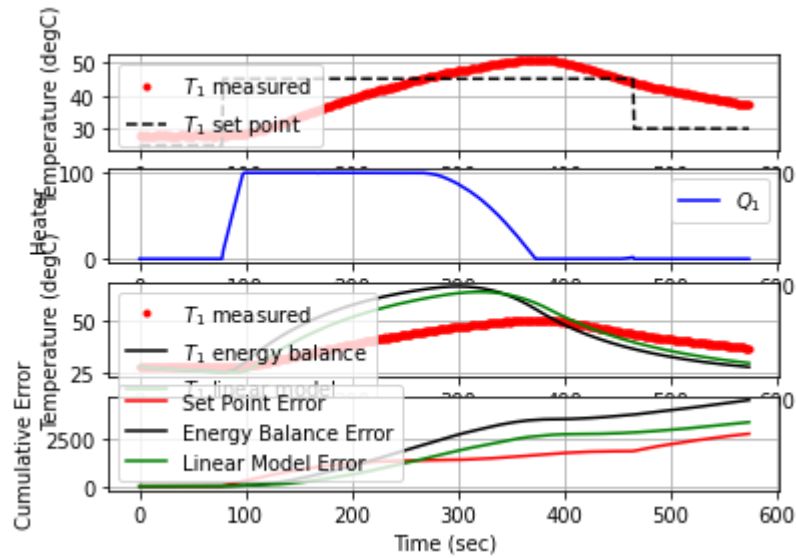




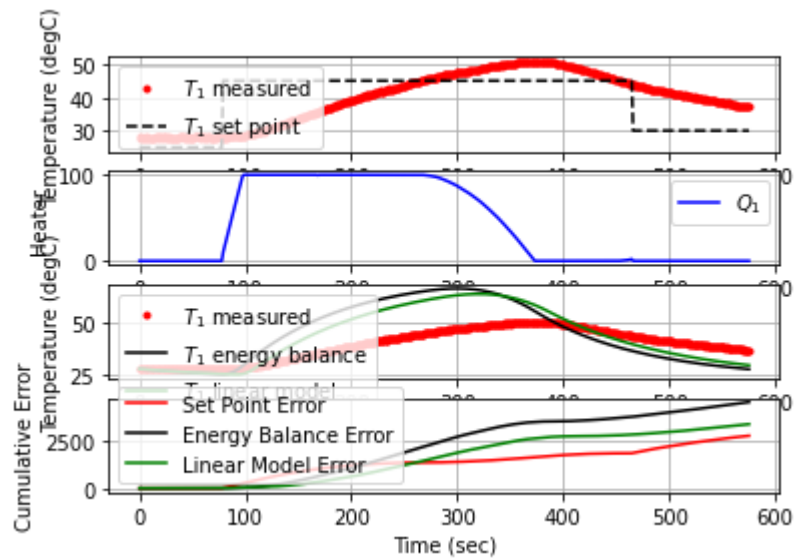
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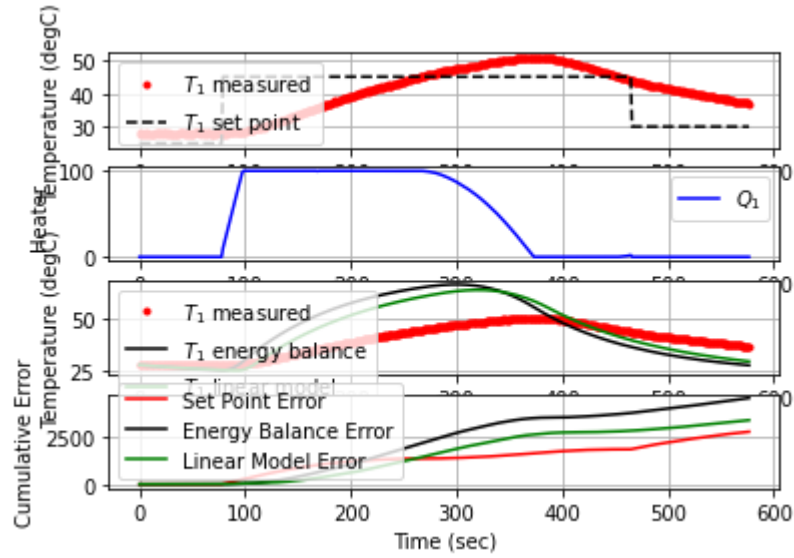
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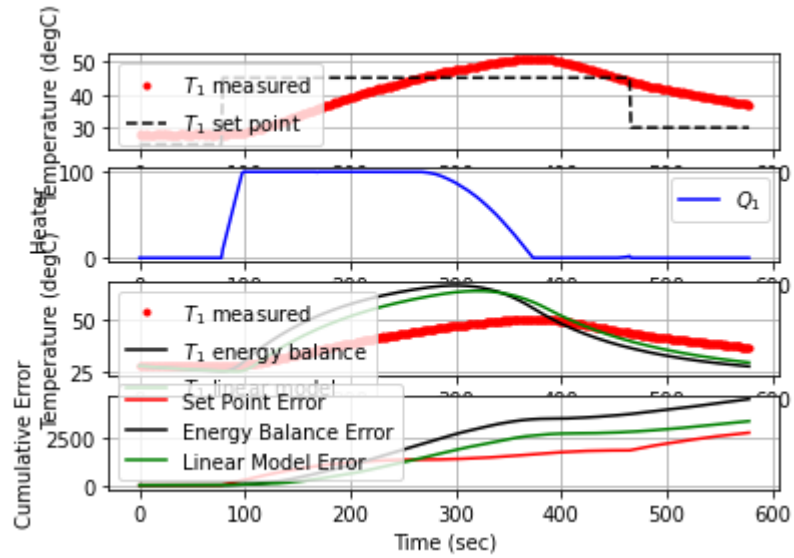
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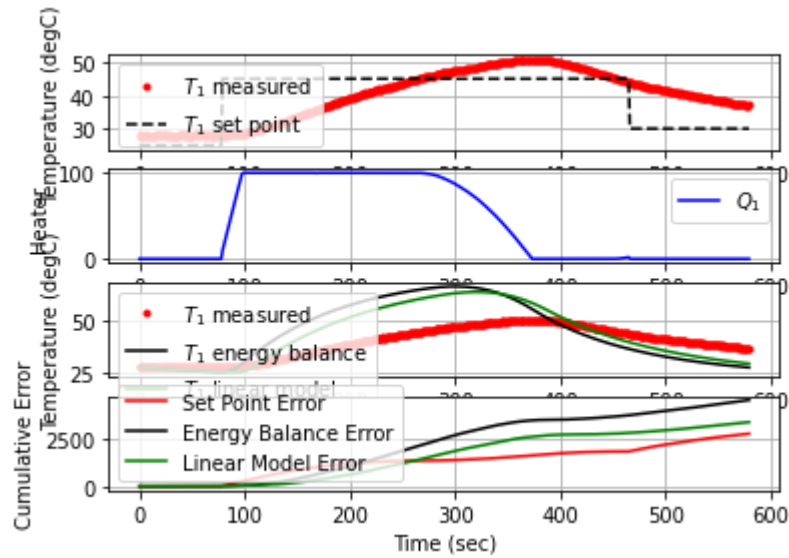
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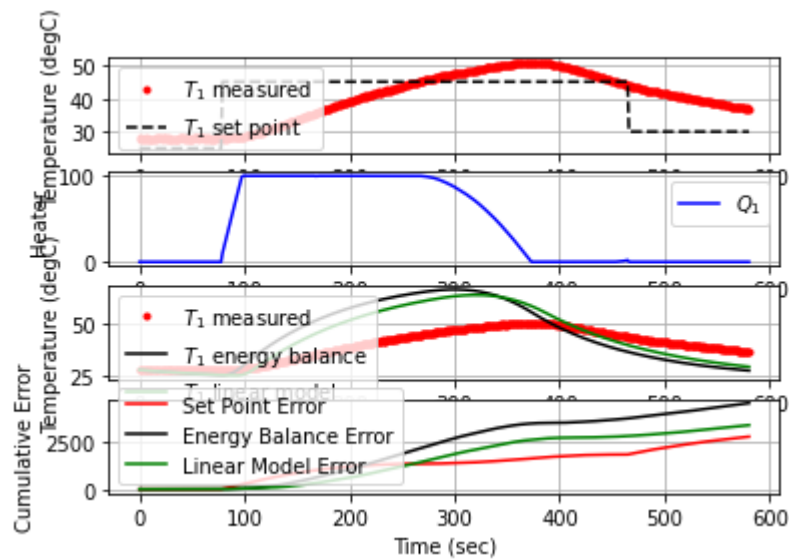
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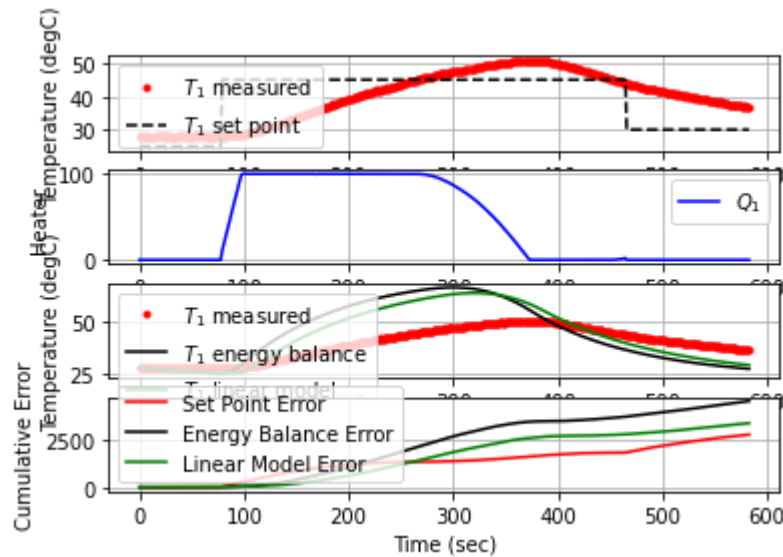
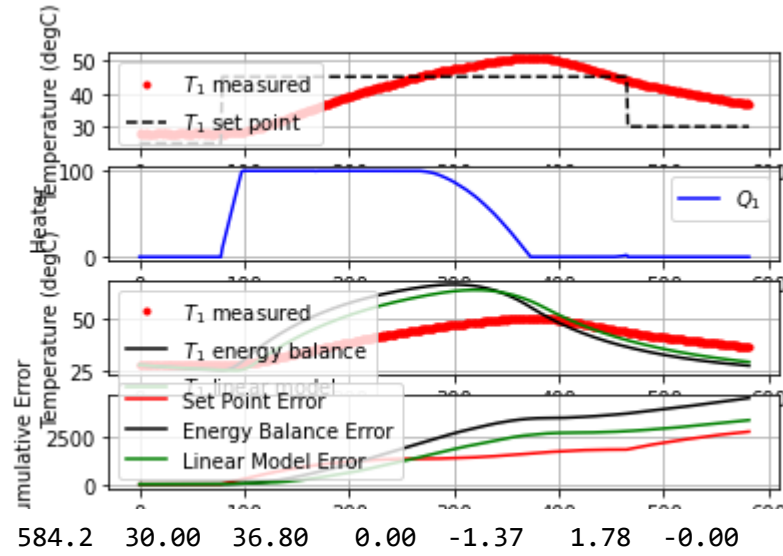
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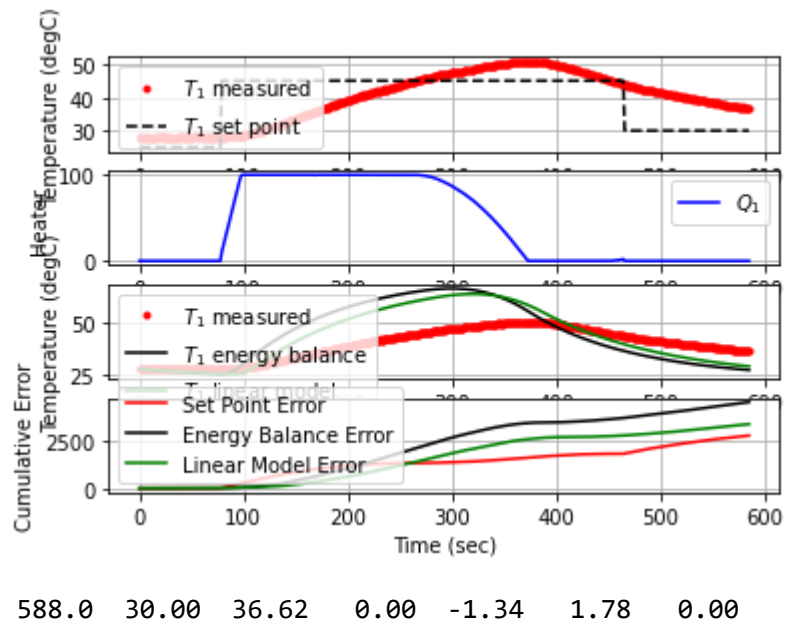
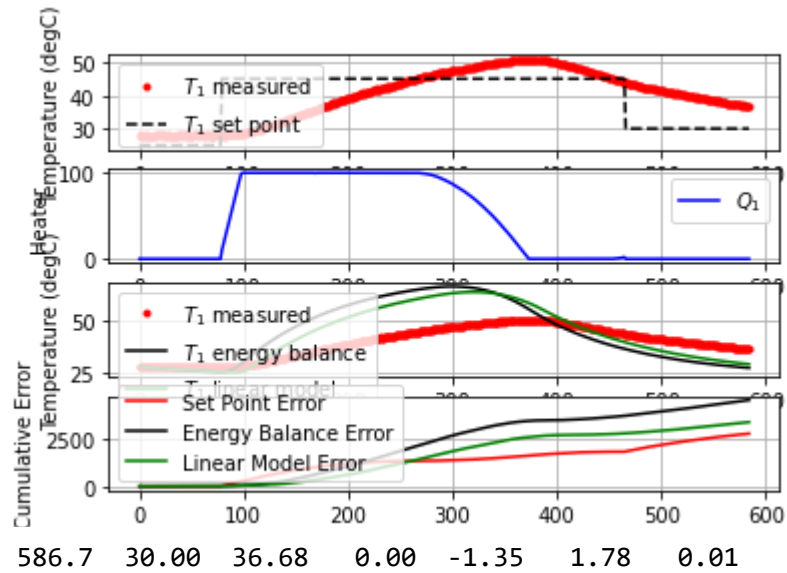


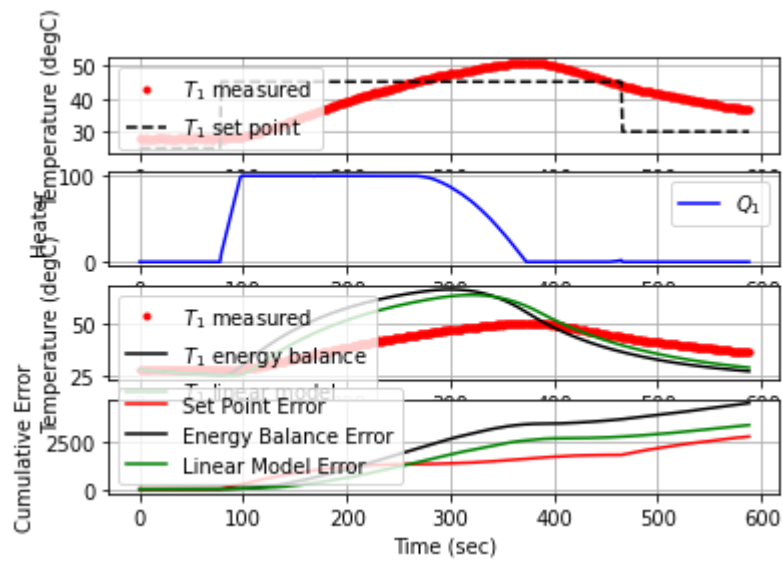
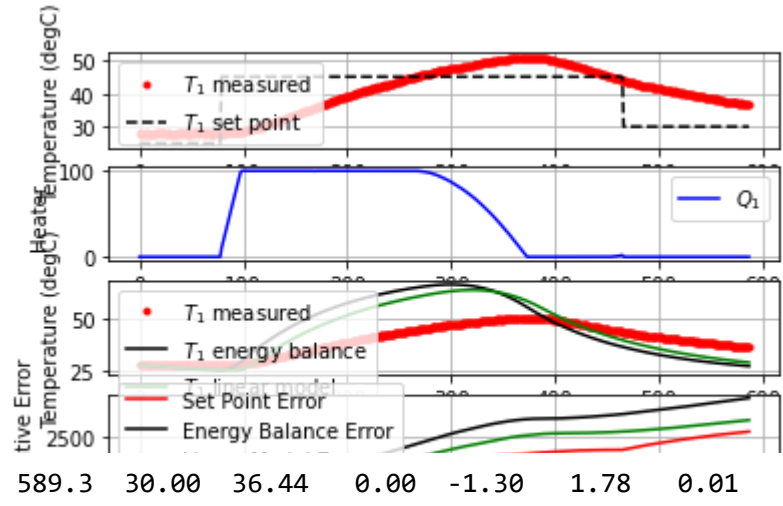
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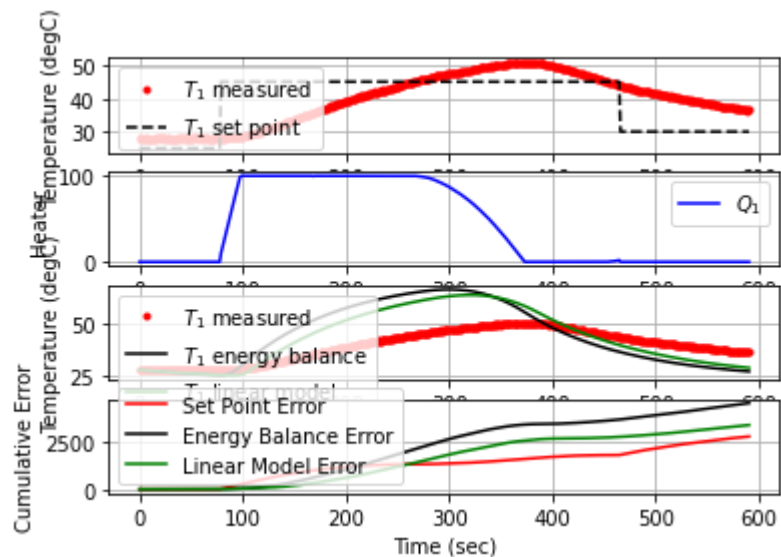
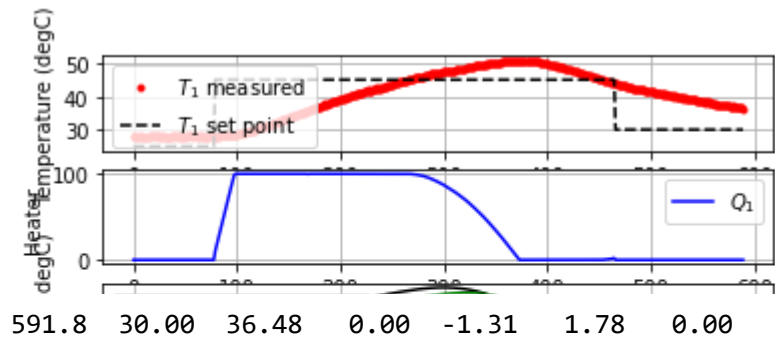


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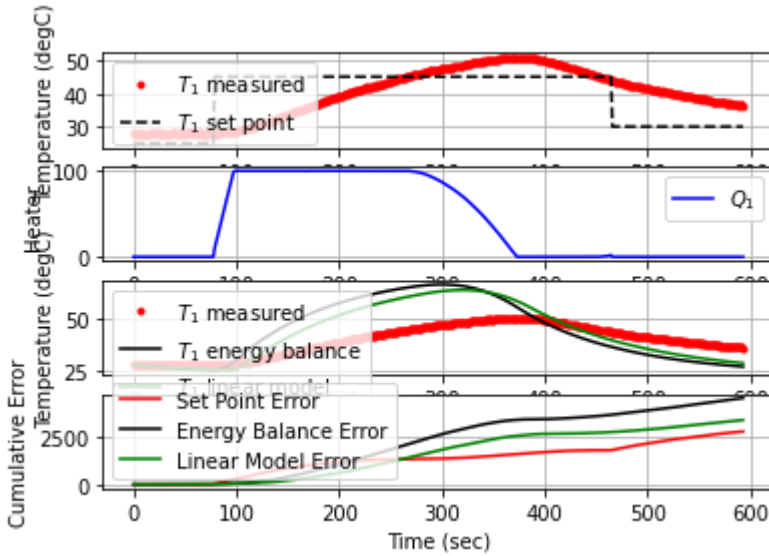
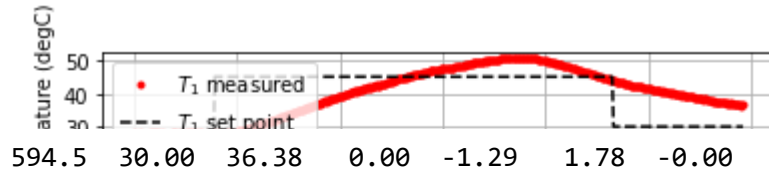




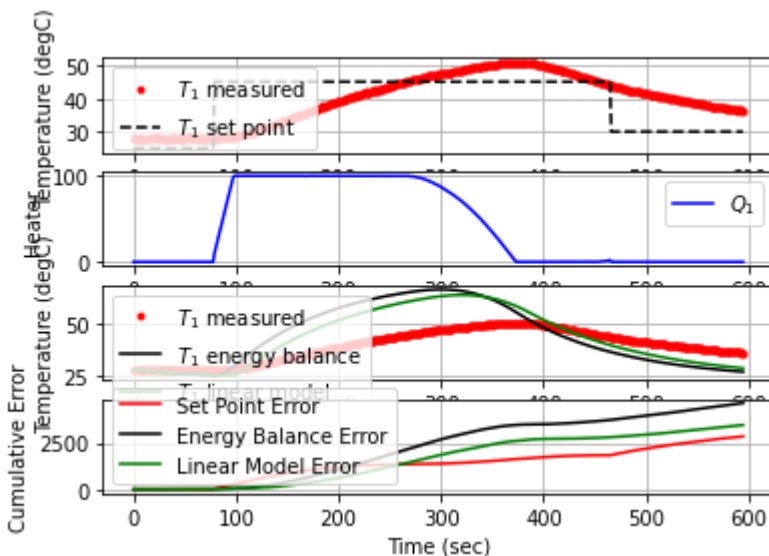




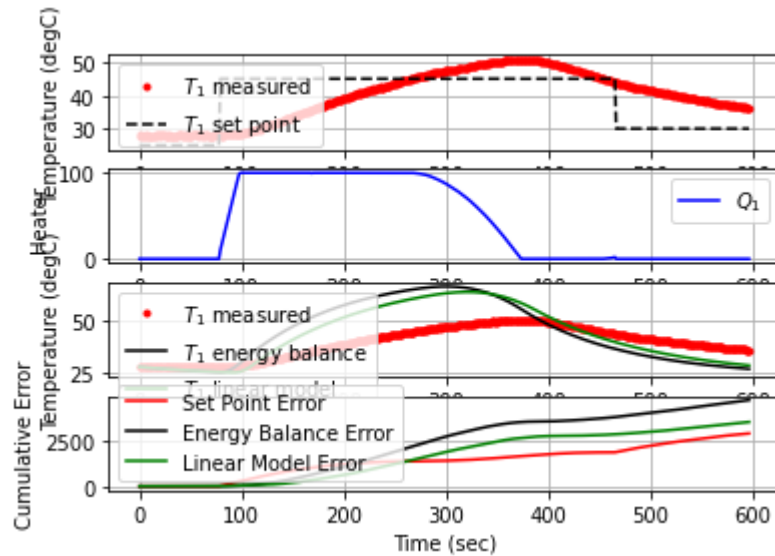




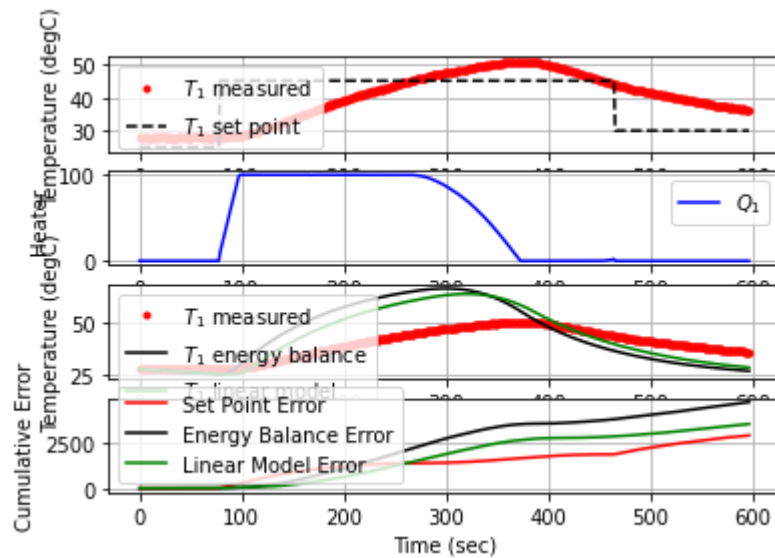
595.8 30.00 36.27 0.00 -1.27 1.78 0.01



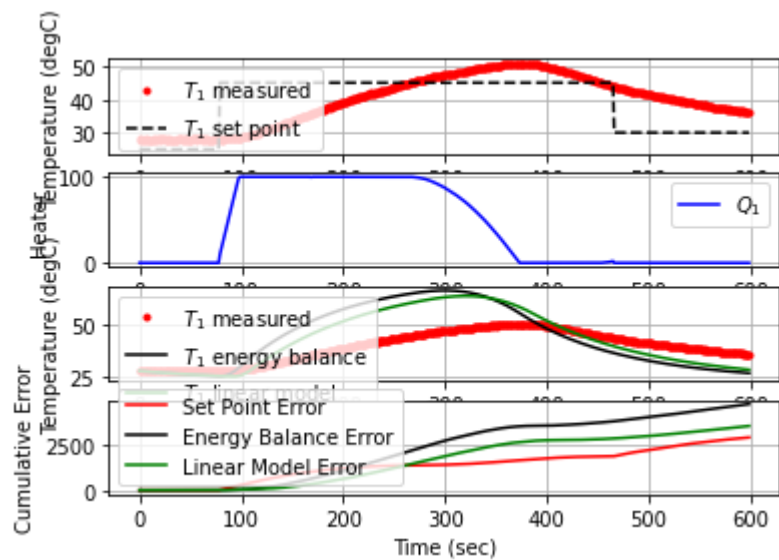
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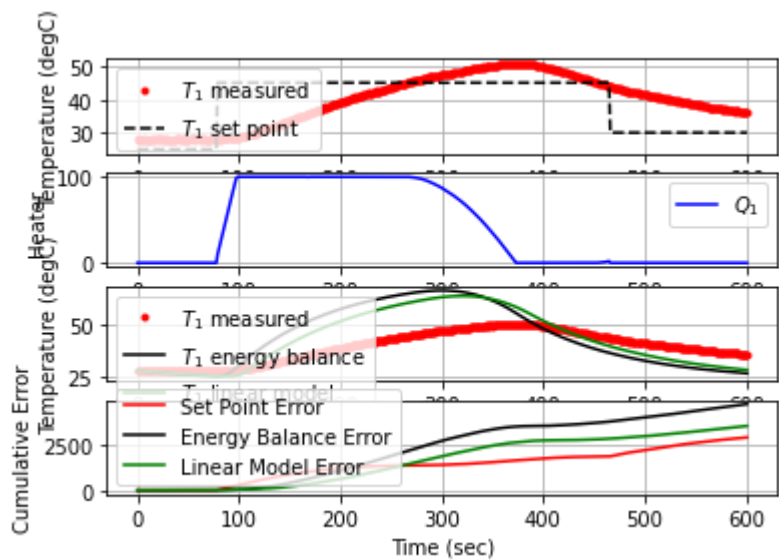
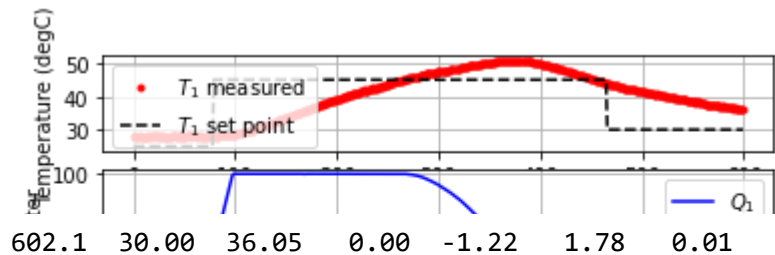
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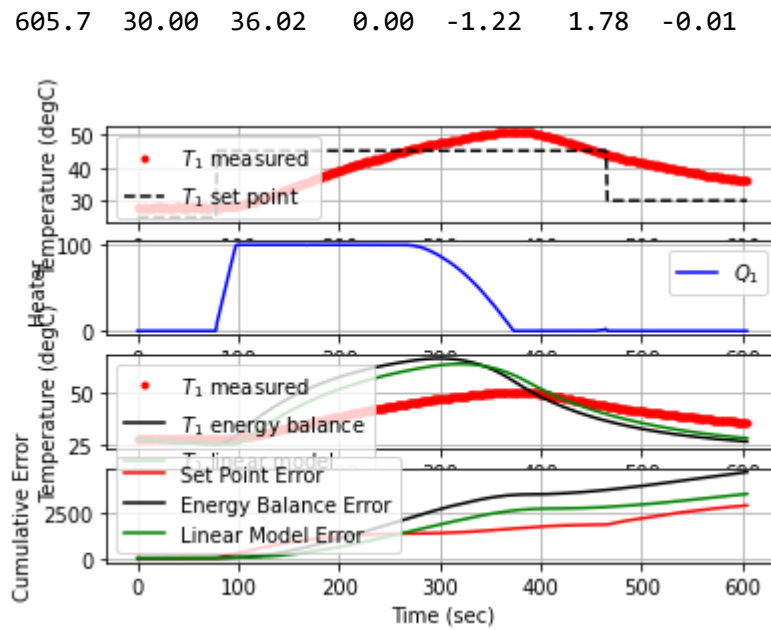
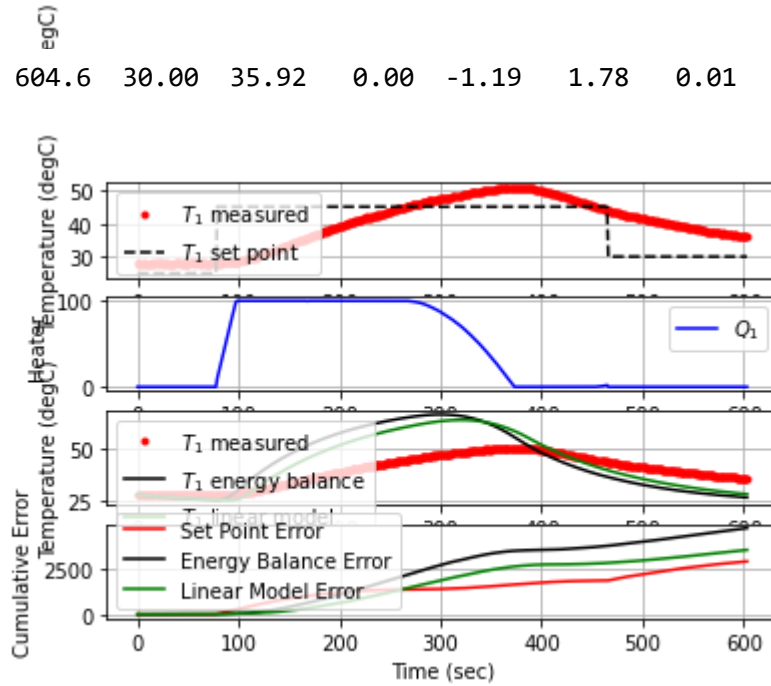


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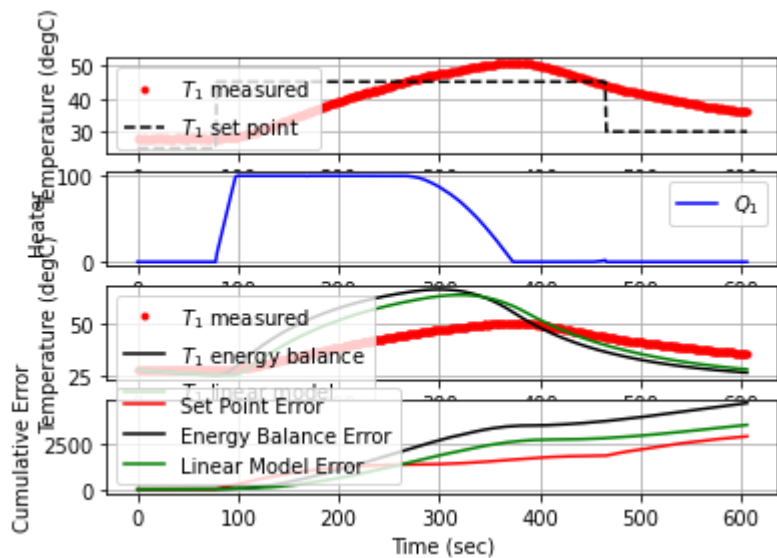


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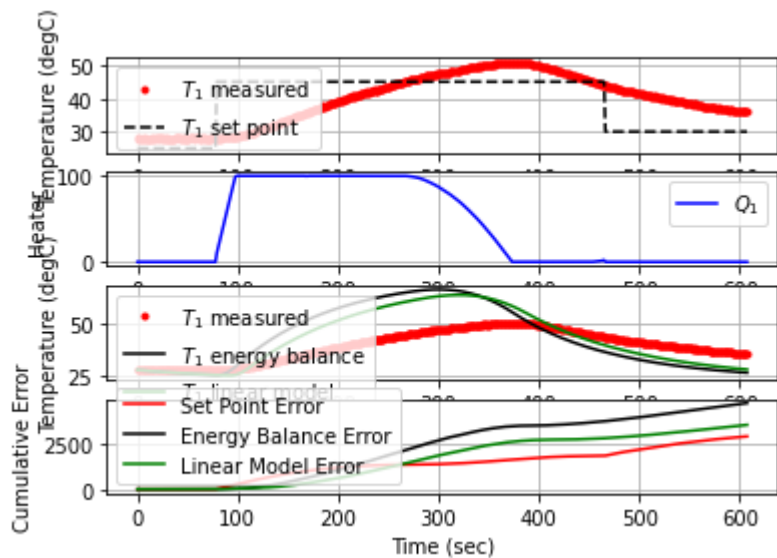




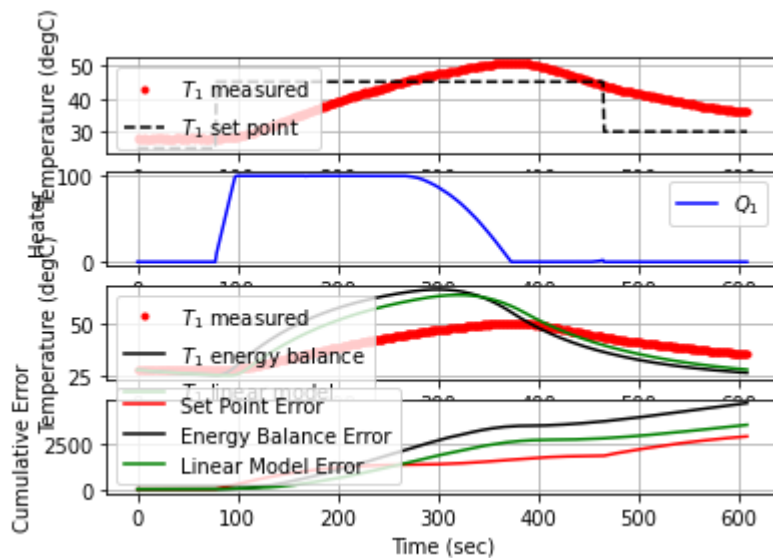
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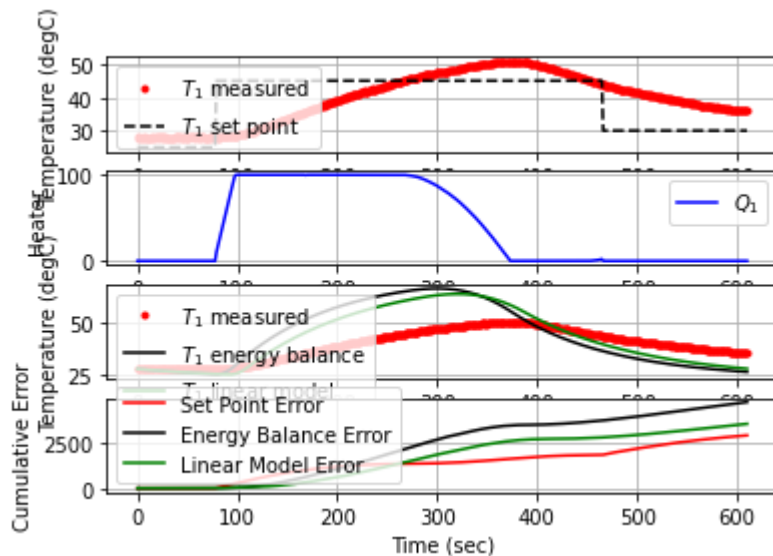
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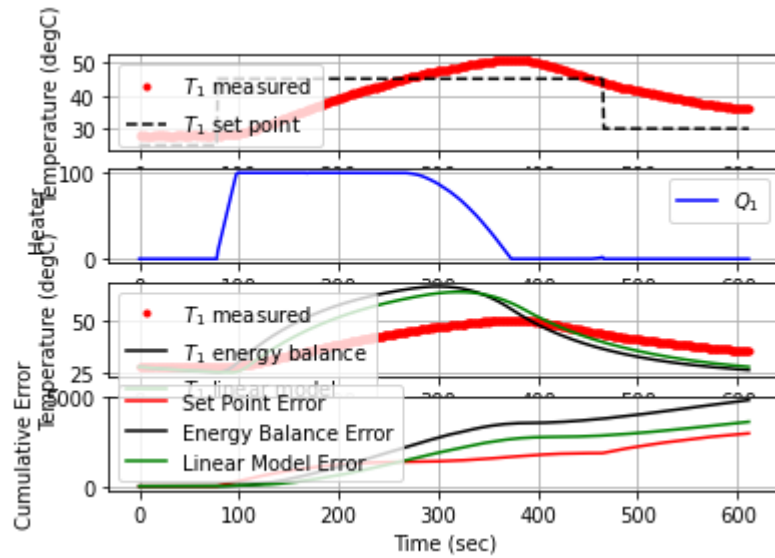
610.0 30.00 35.92 0.00 -1.19 1.78 -0.00



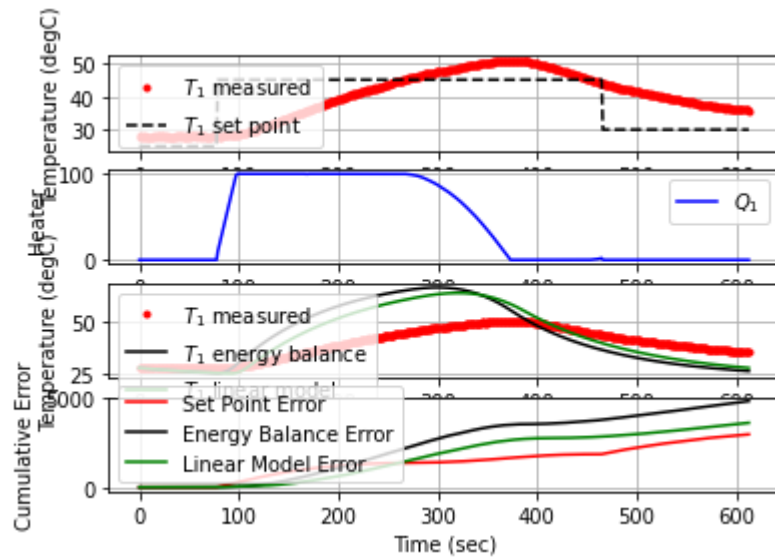
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612.7 30.00 35.83 0.00 -1.18 1.78 0.00

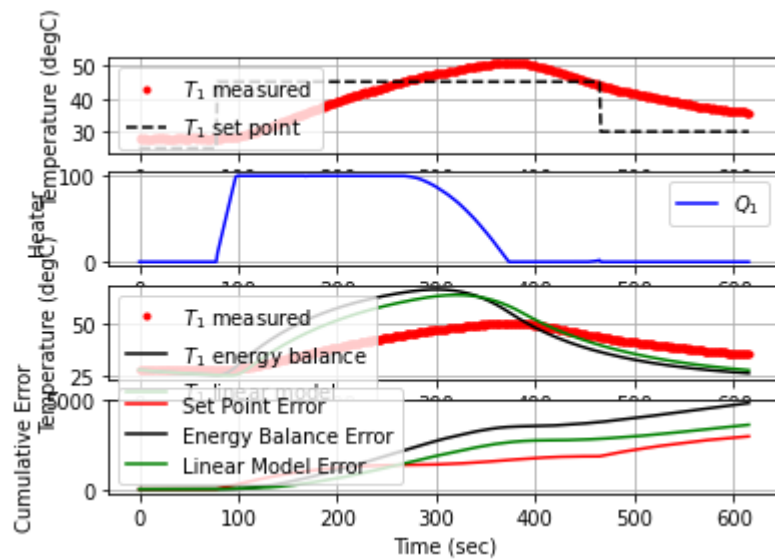
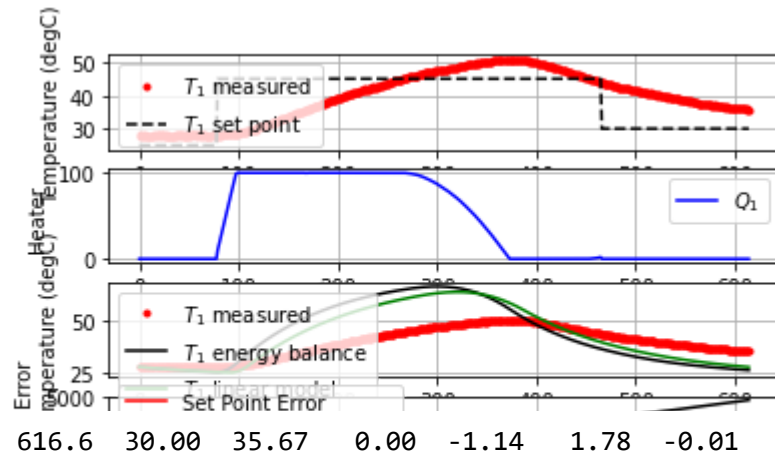


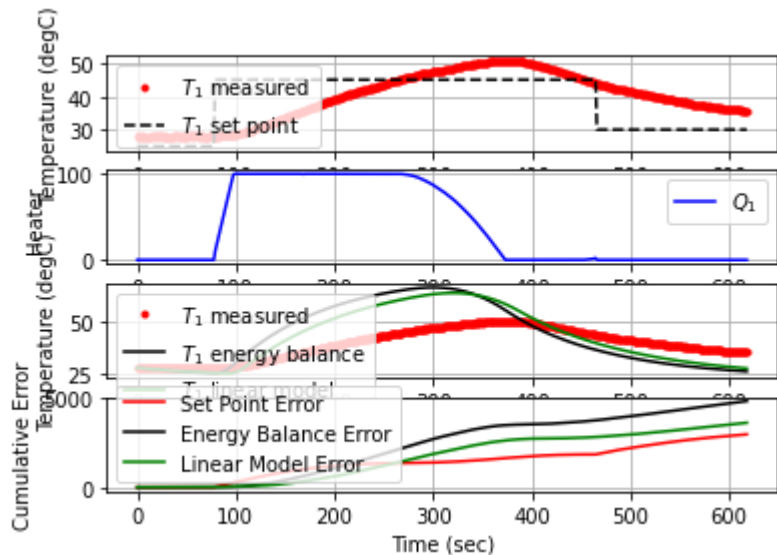
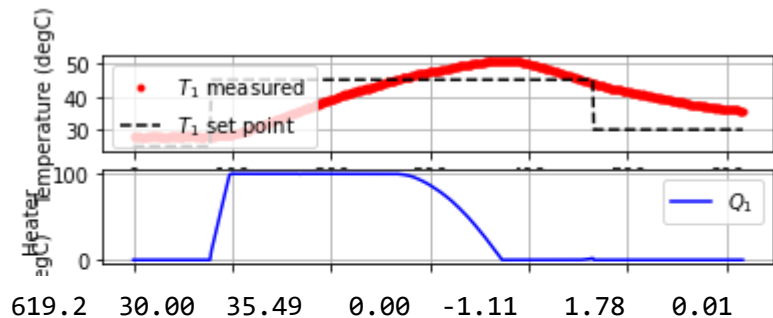
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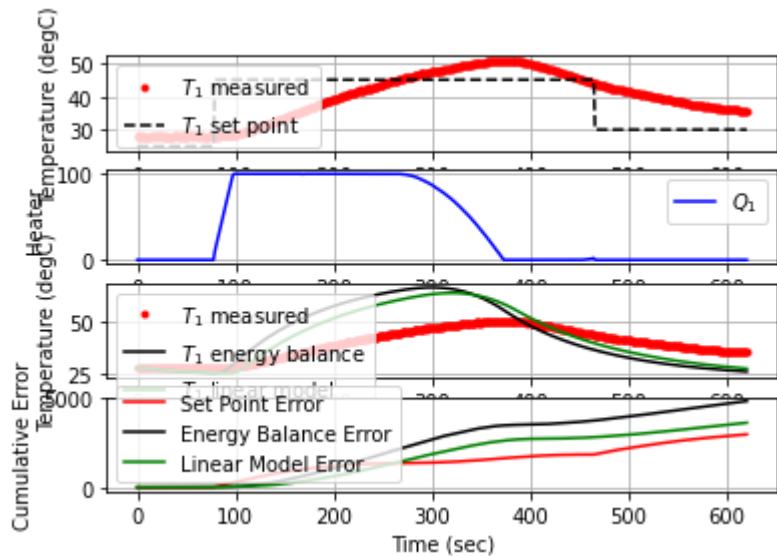
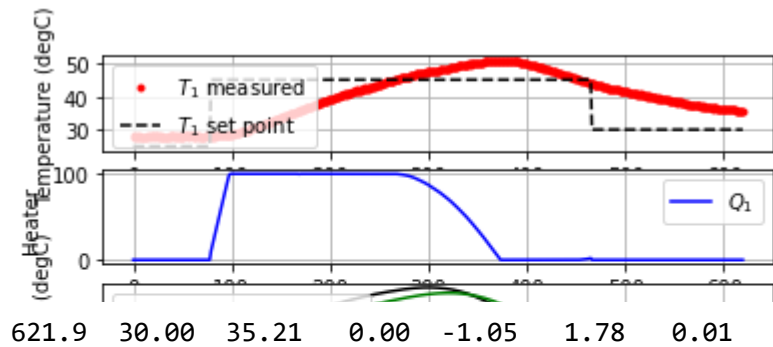
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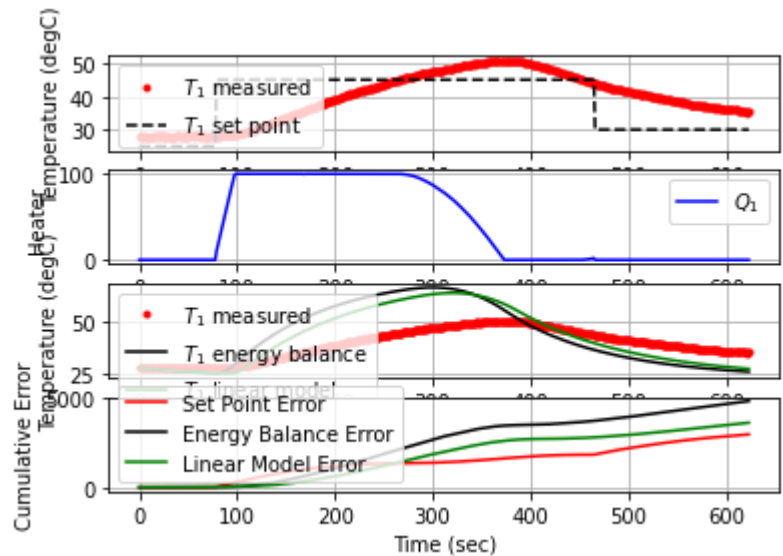
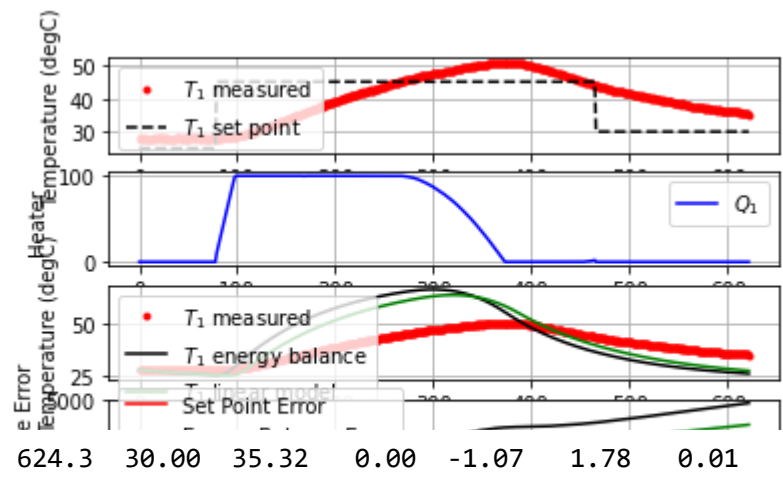


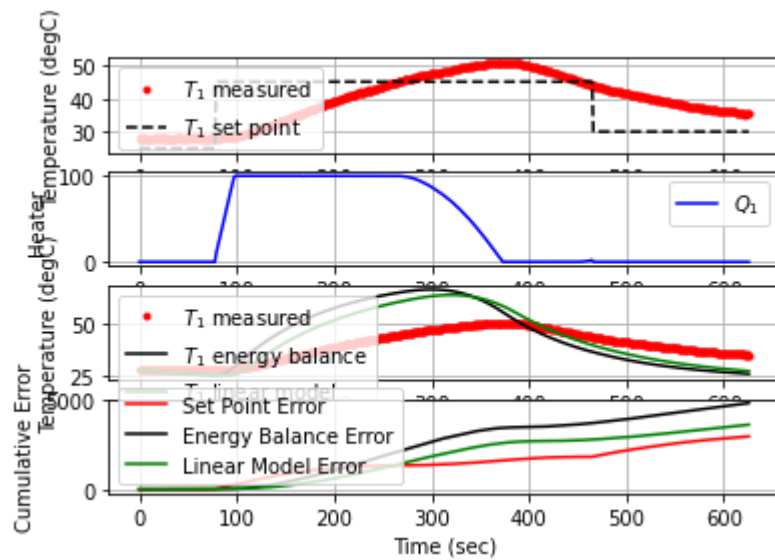
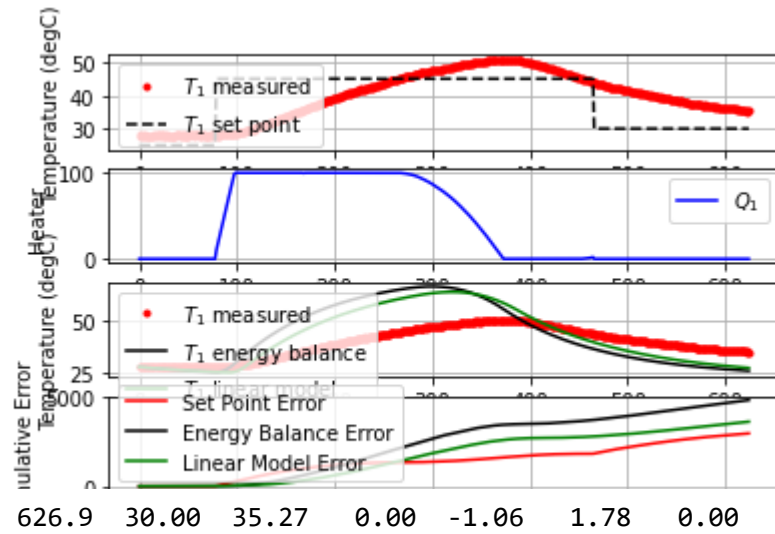


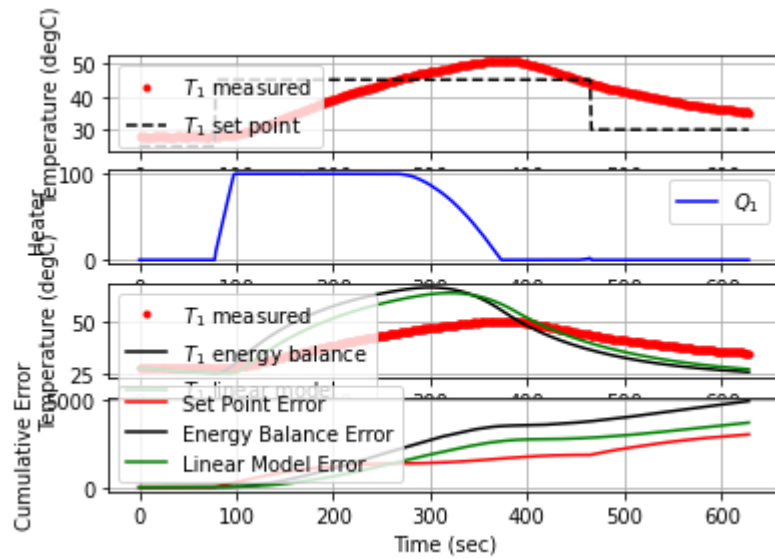
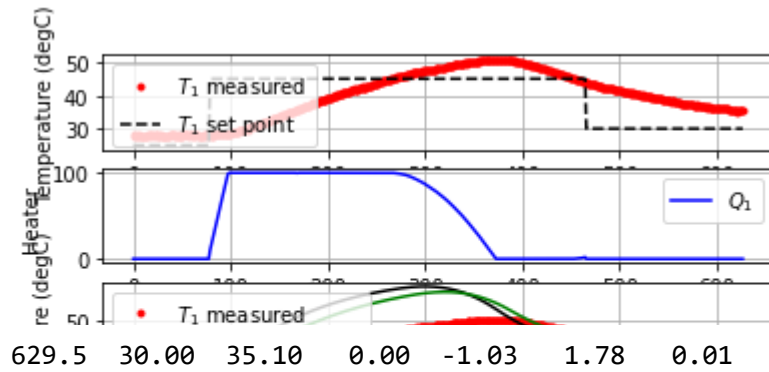


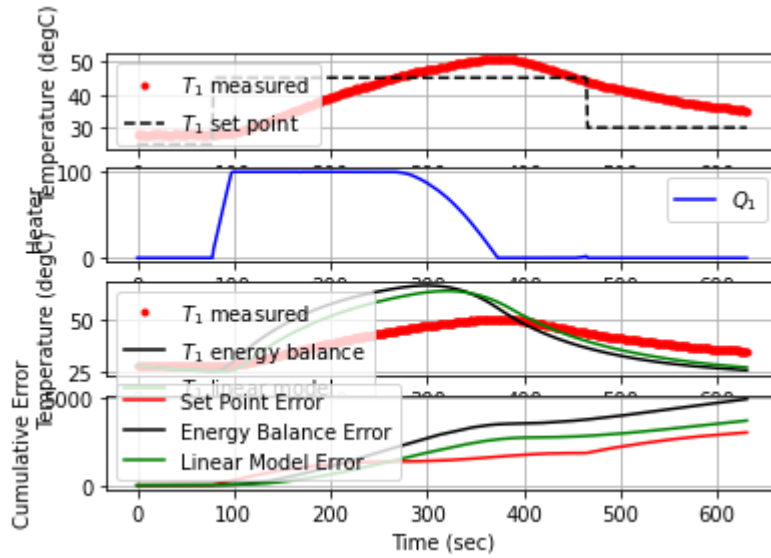
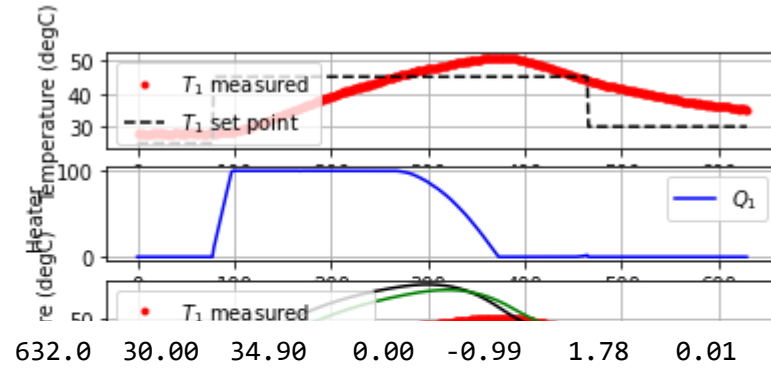
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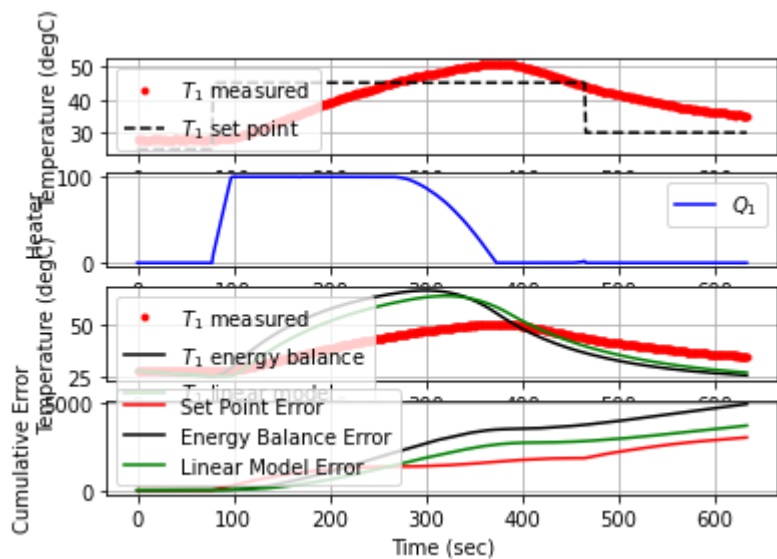
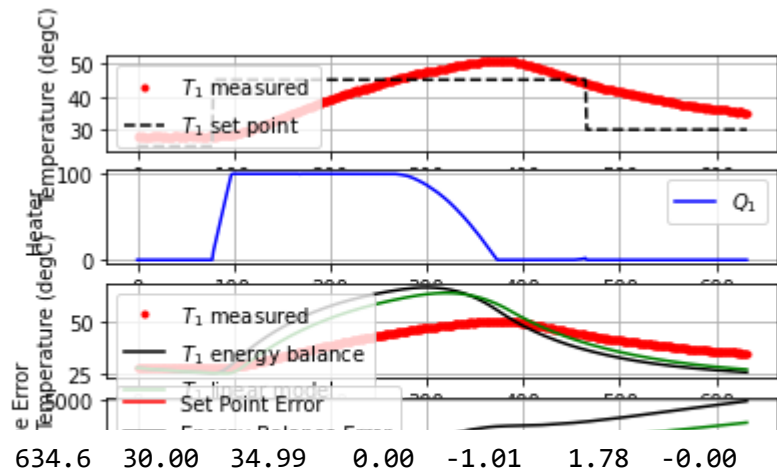






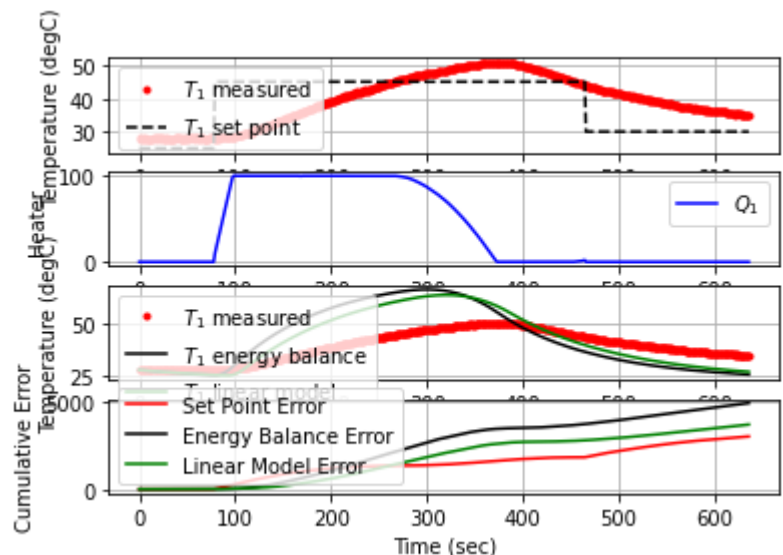
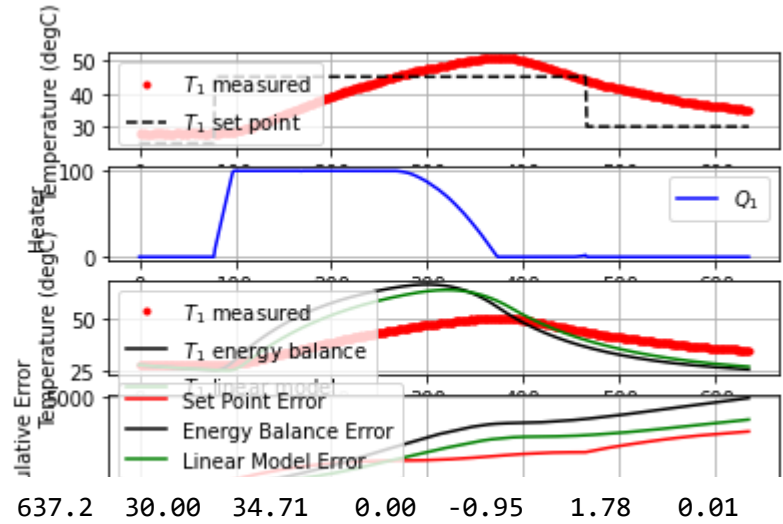


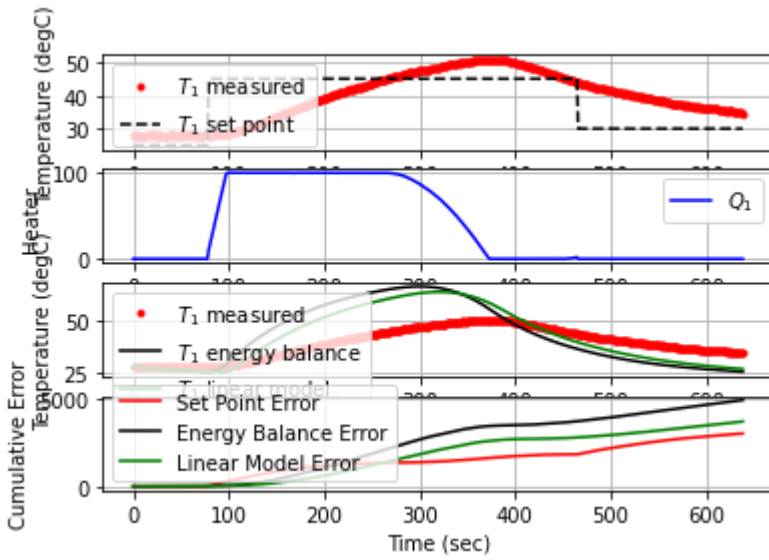
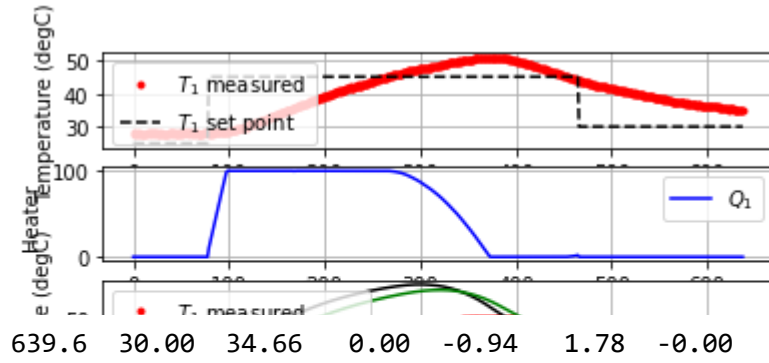
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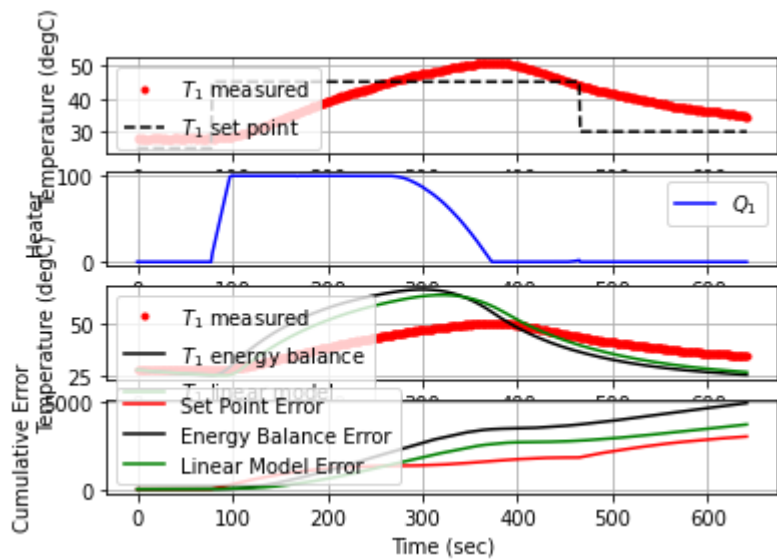
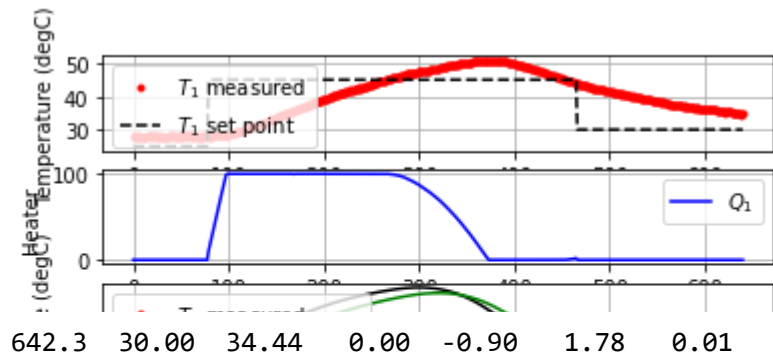
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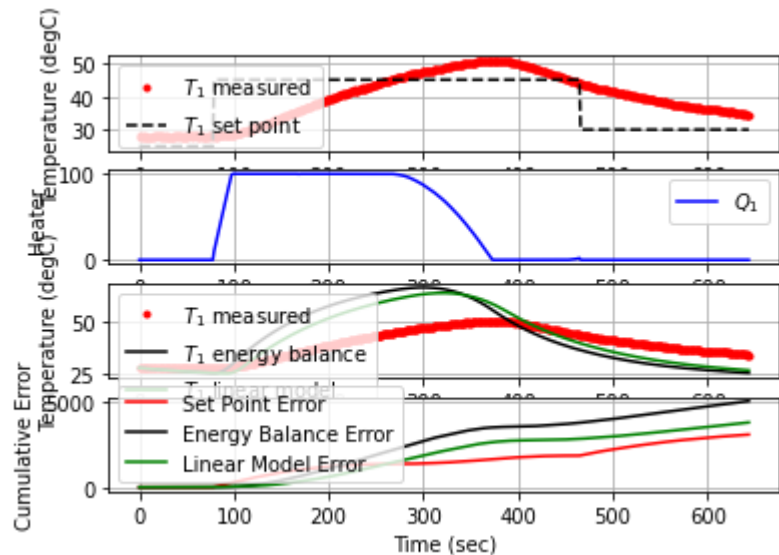
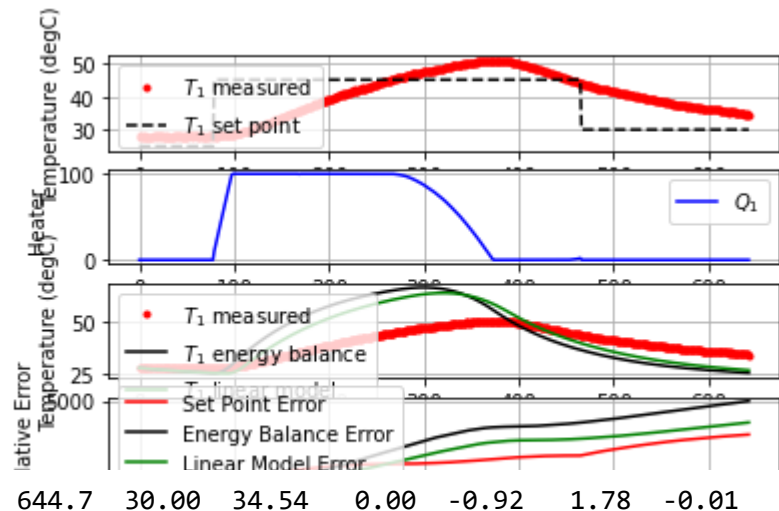




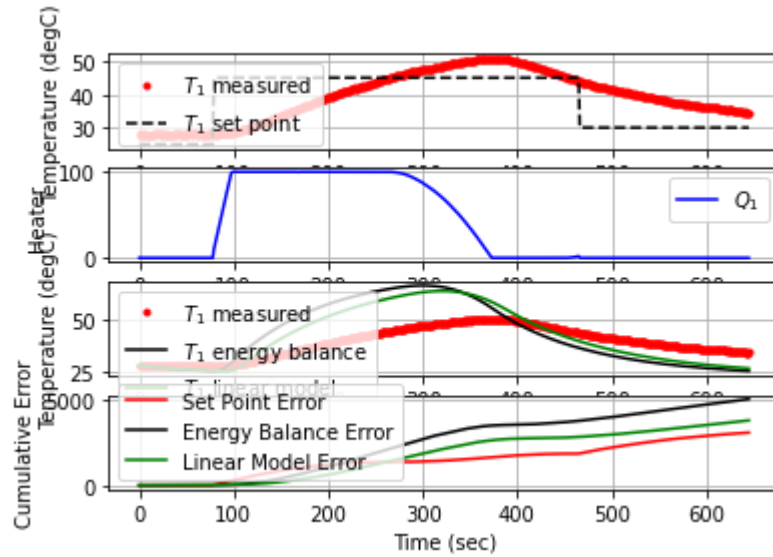
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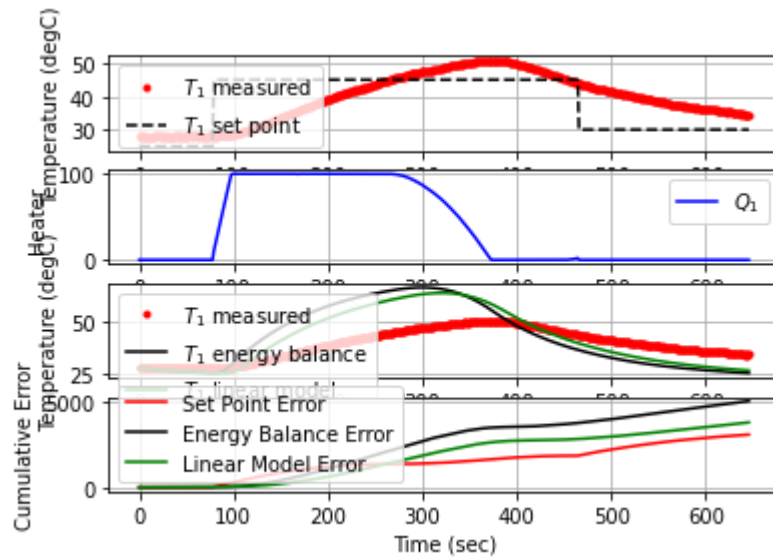
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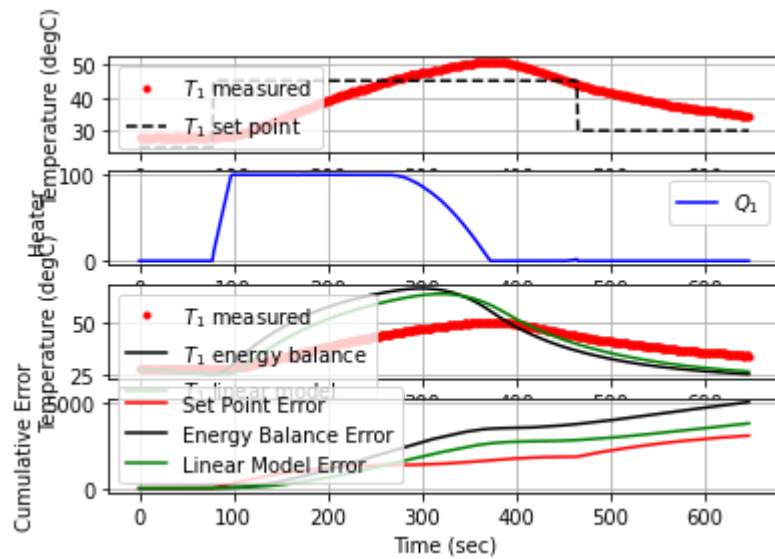
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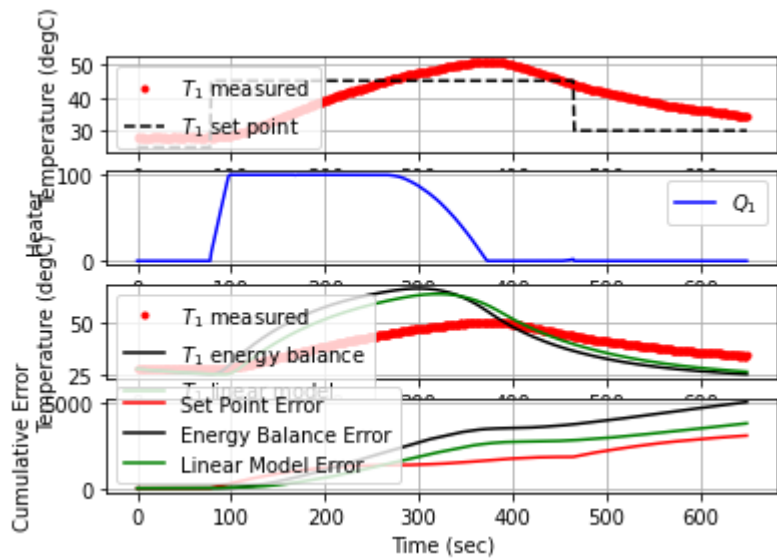
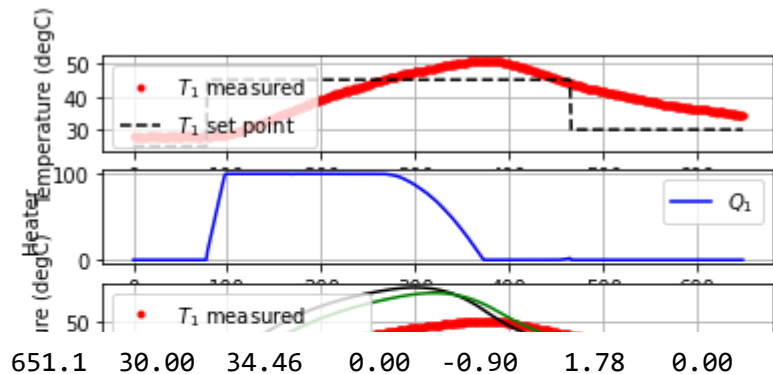
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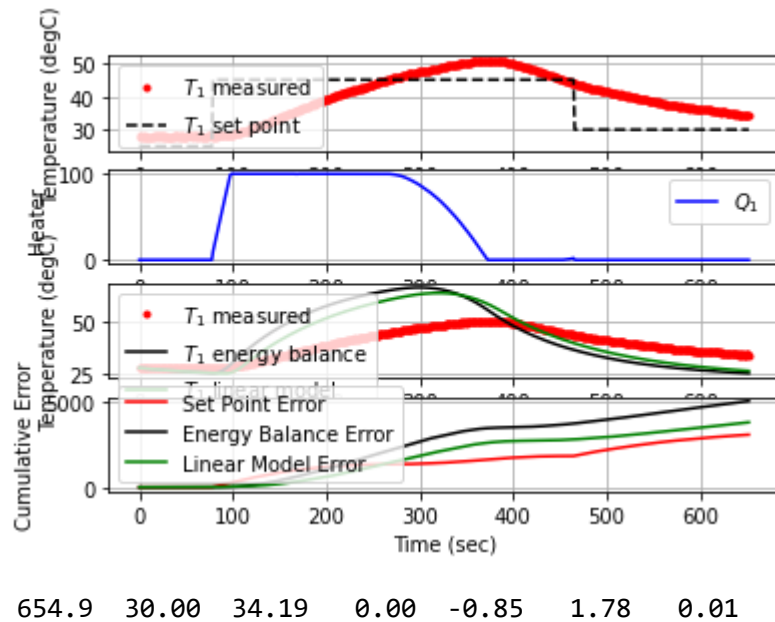
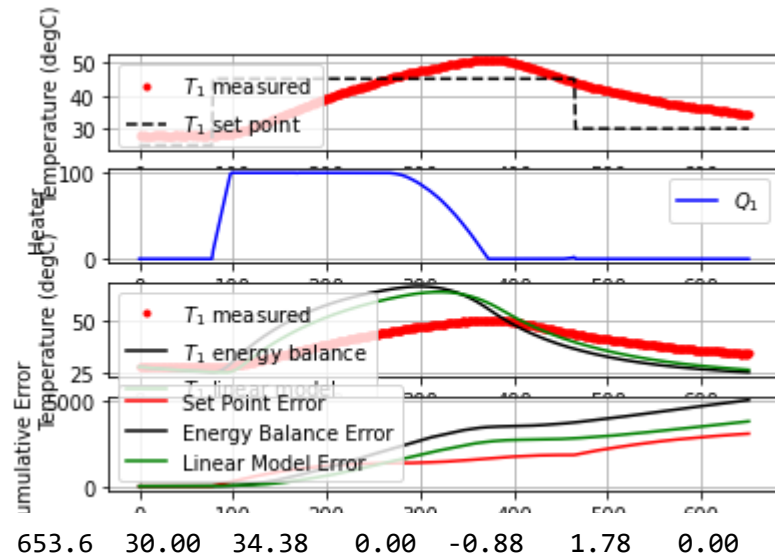


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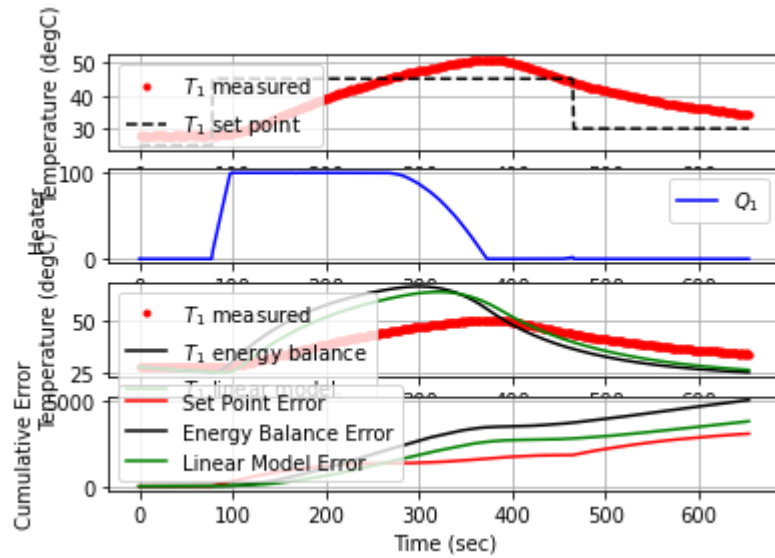


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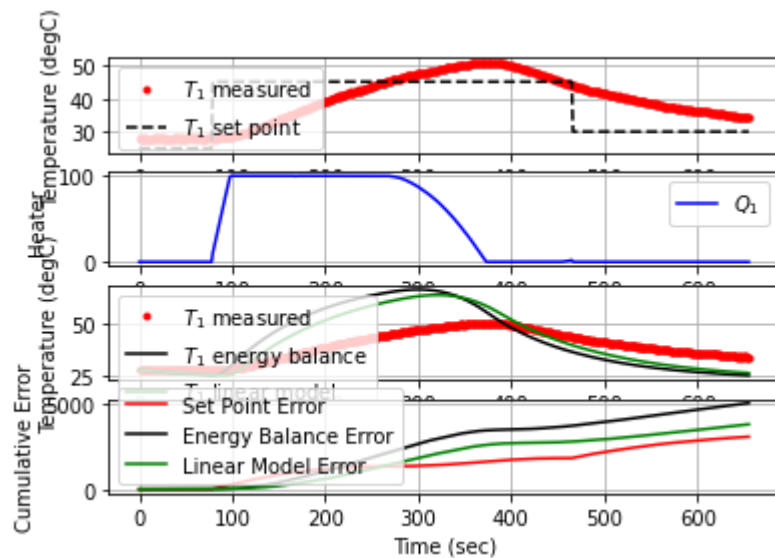




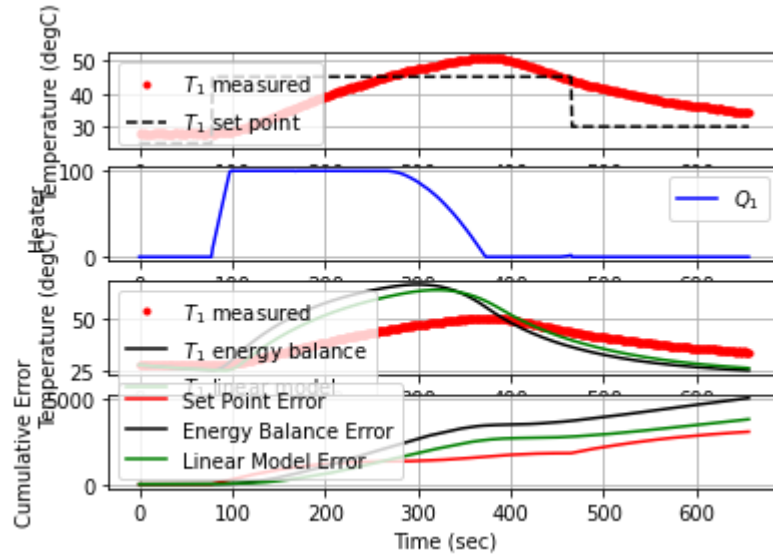




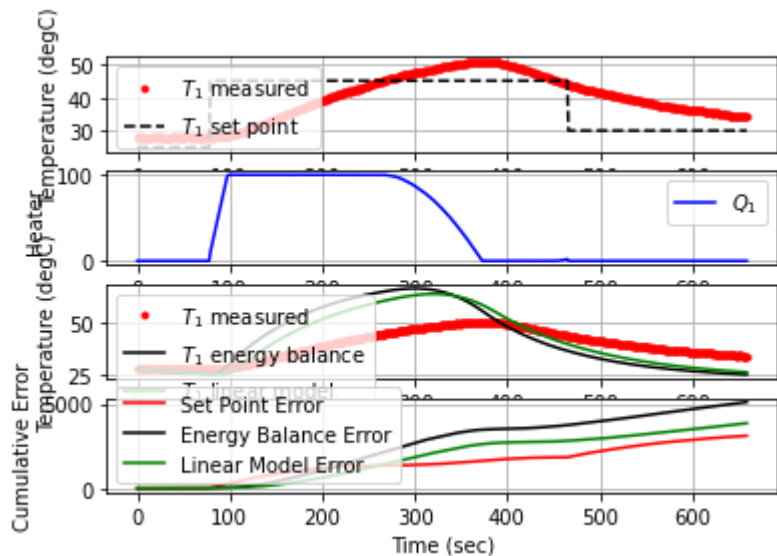
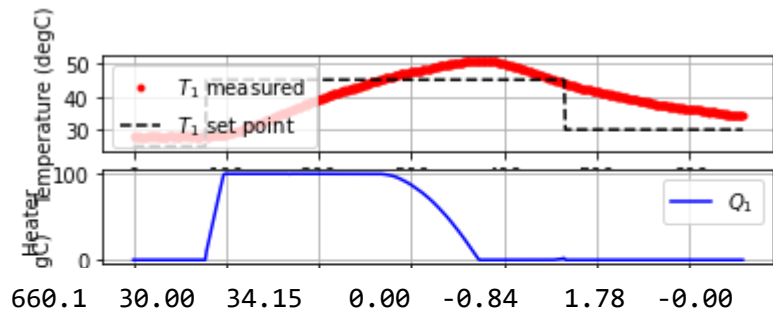
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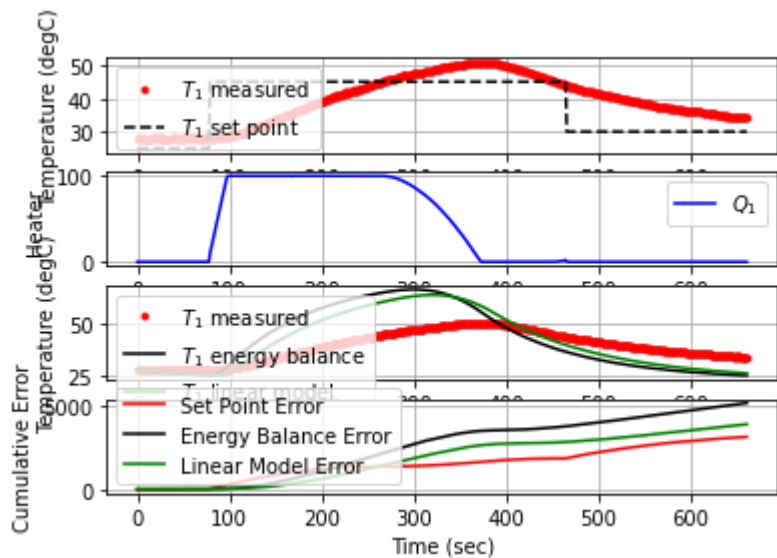
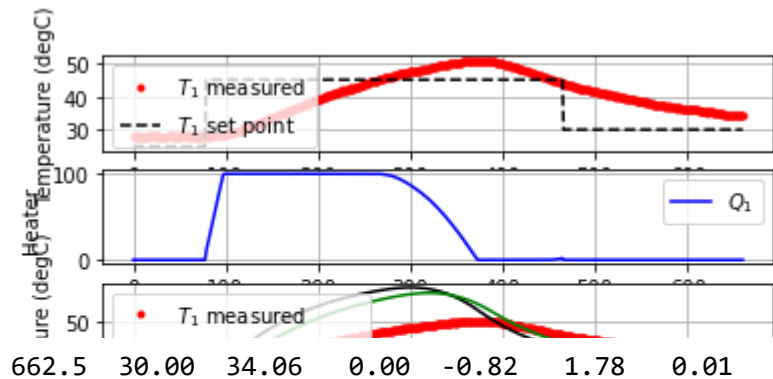


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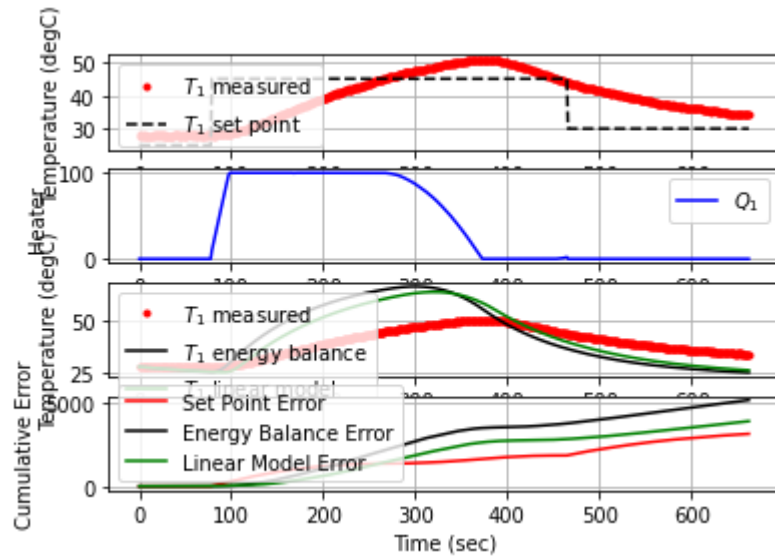


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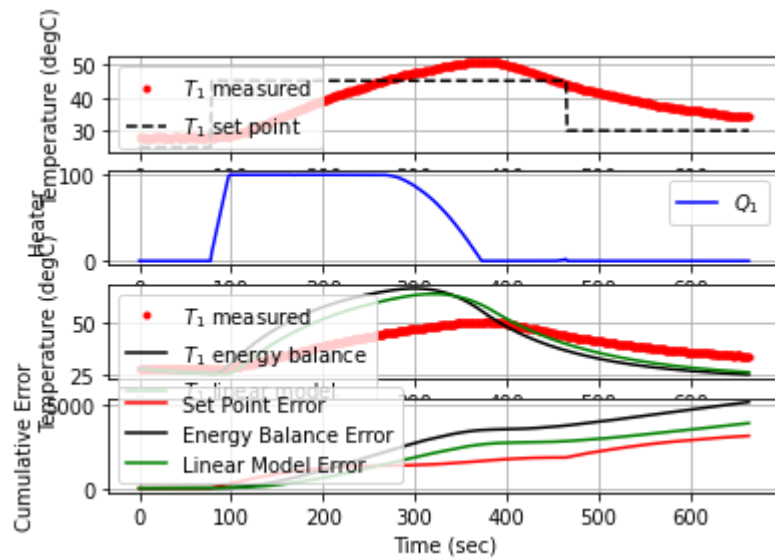




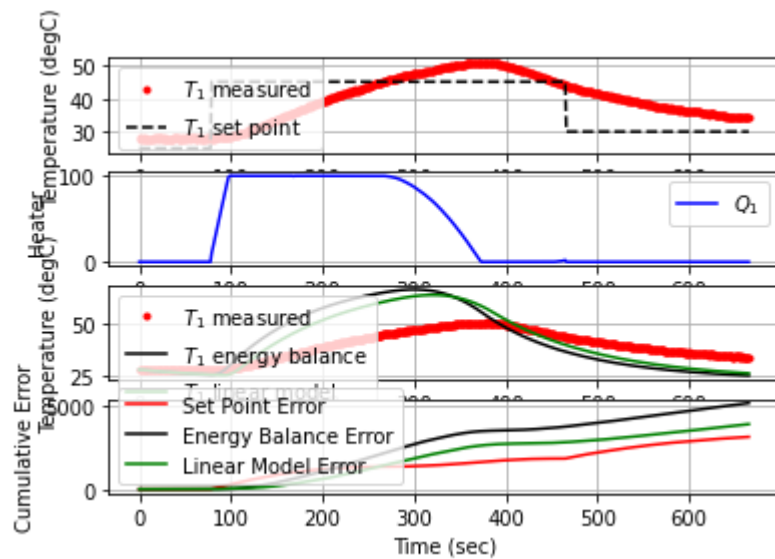
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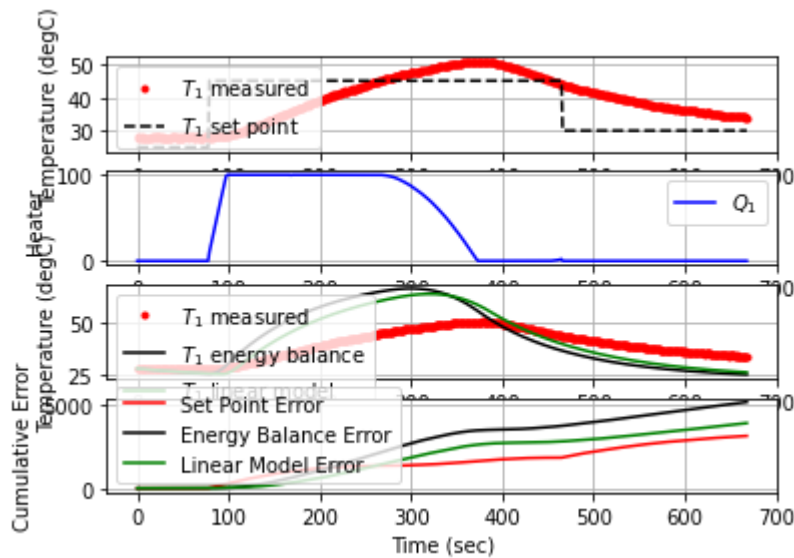
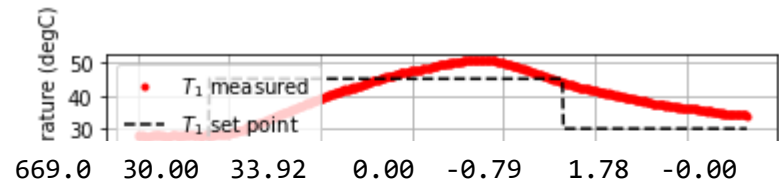
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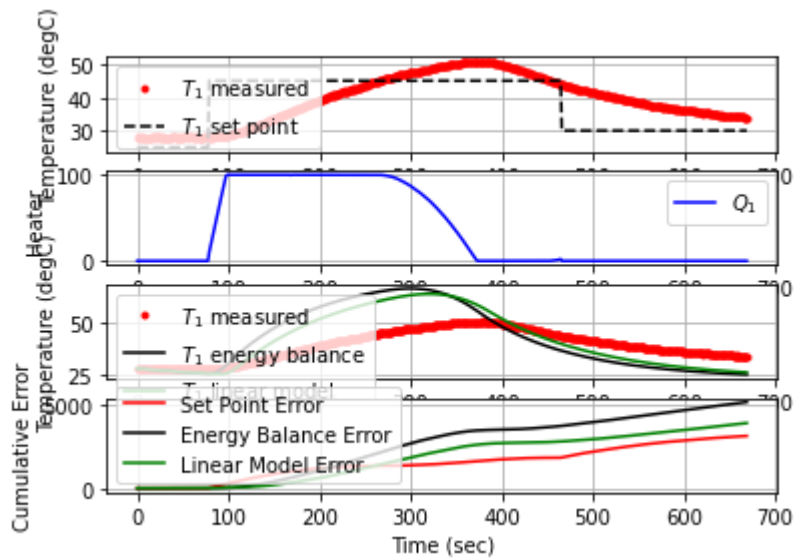
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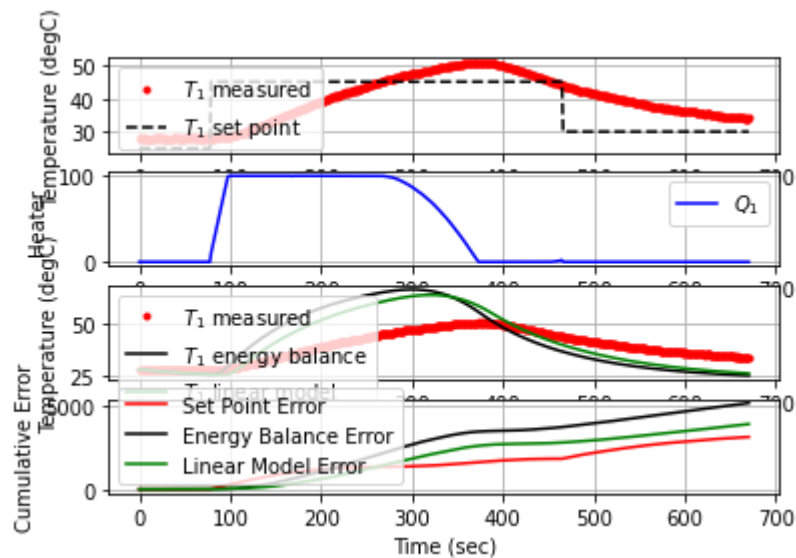
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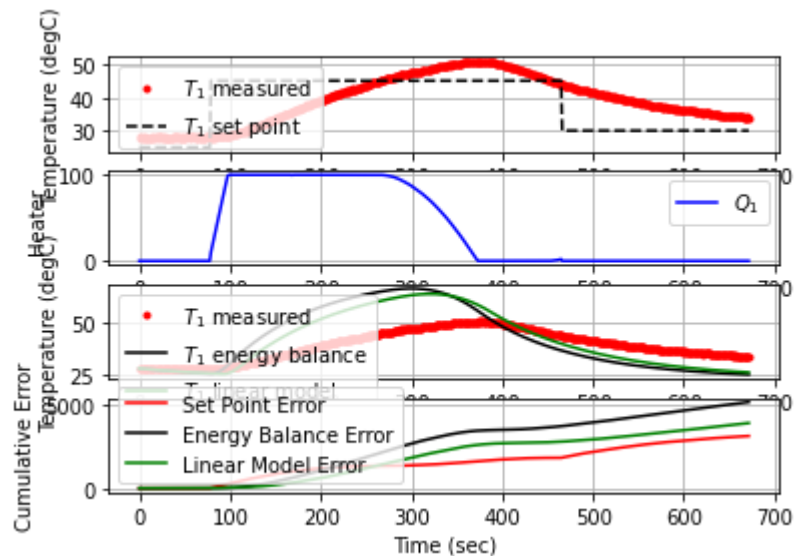
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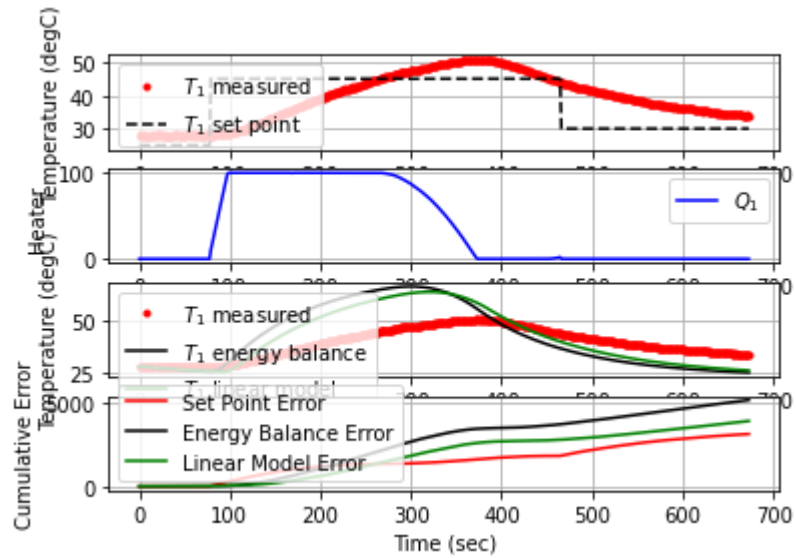


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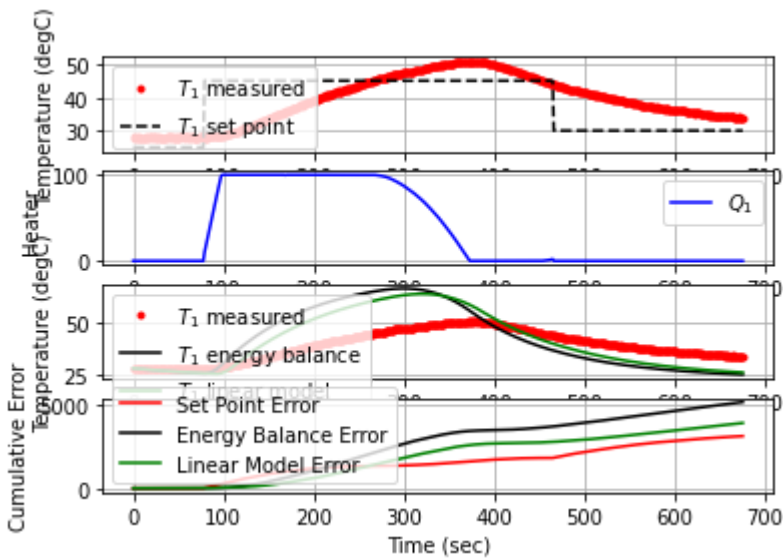
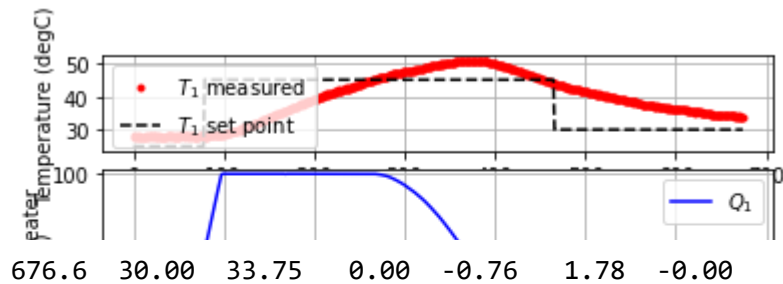




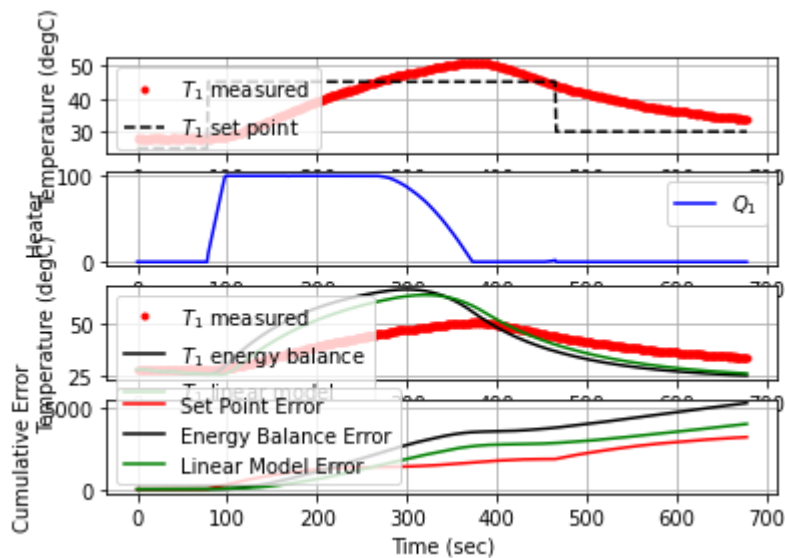
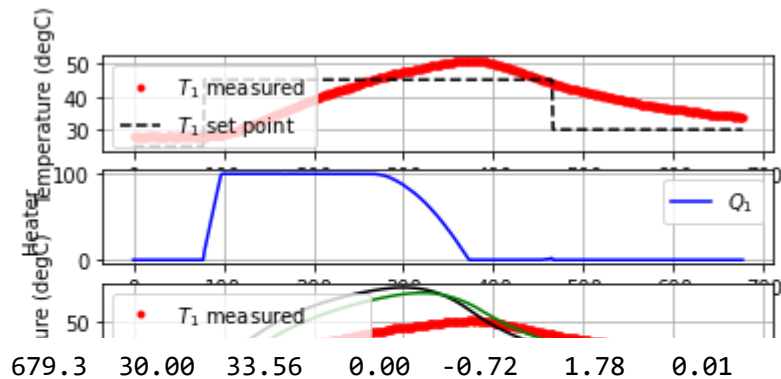
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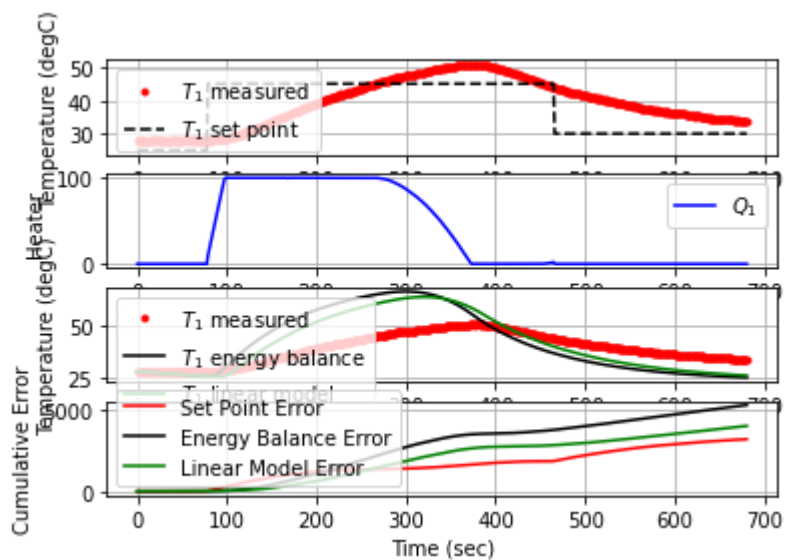
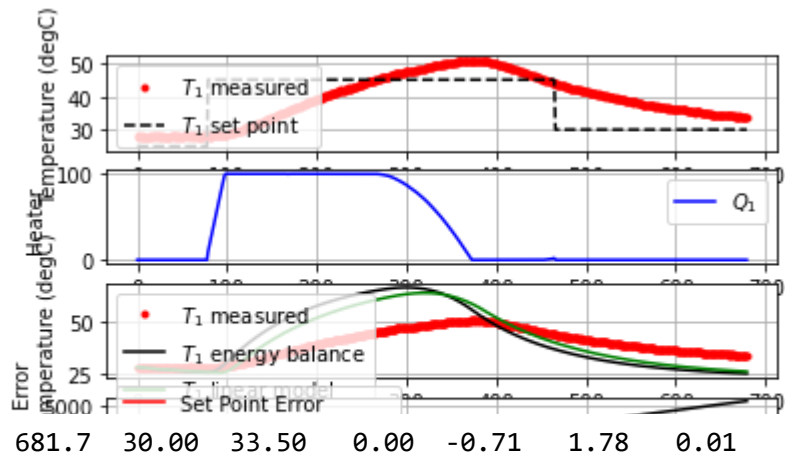


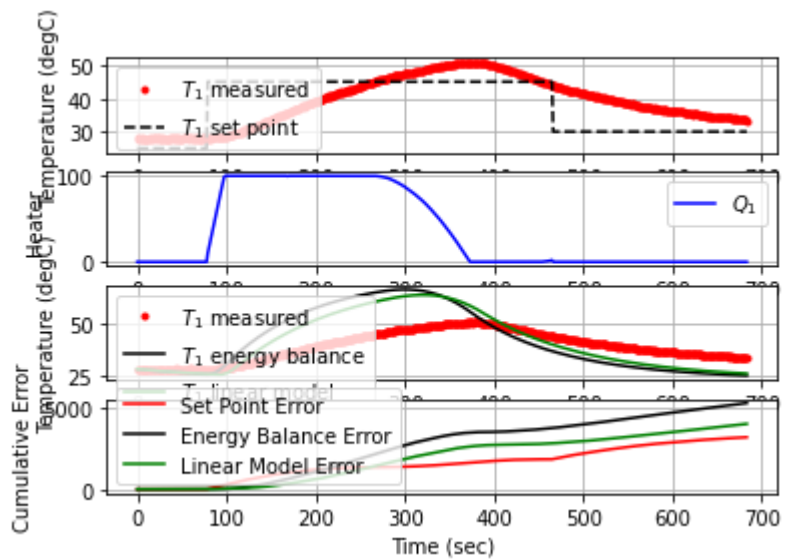
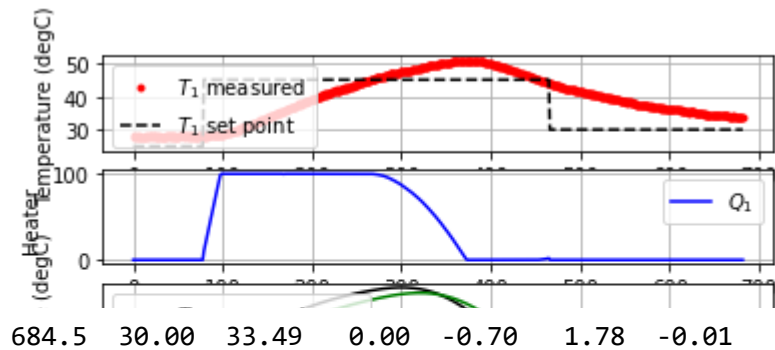
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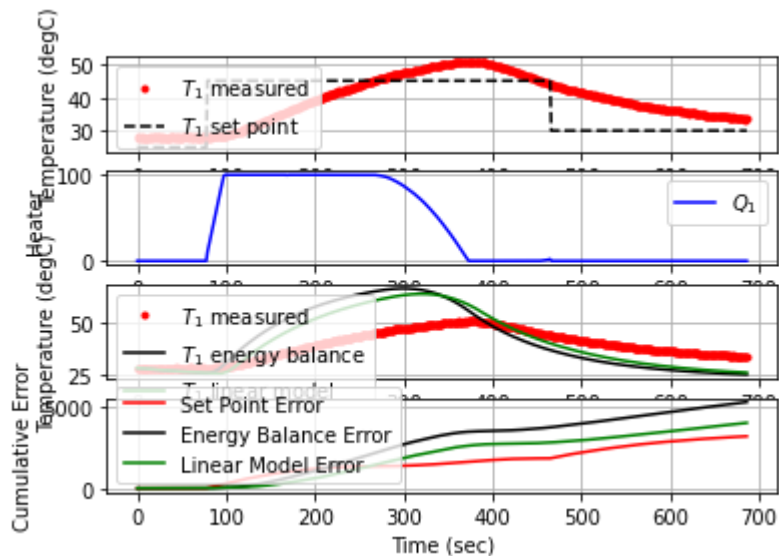
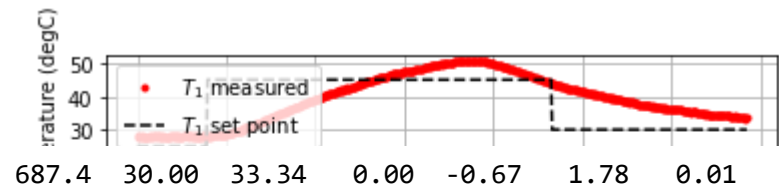


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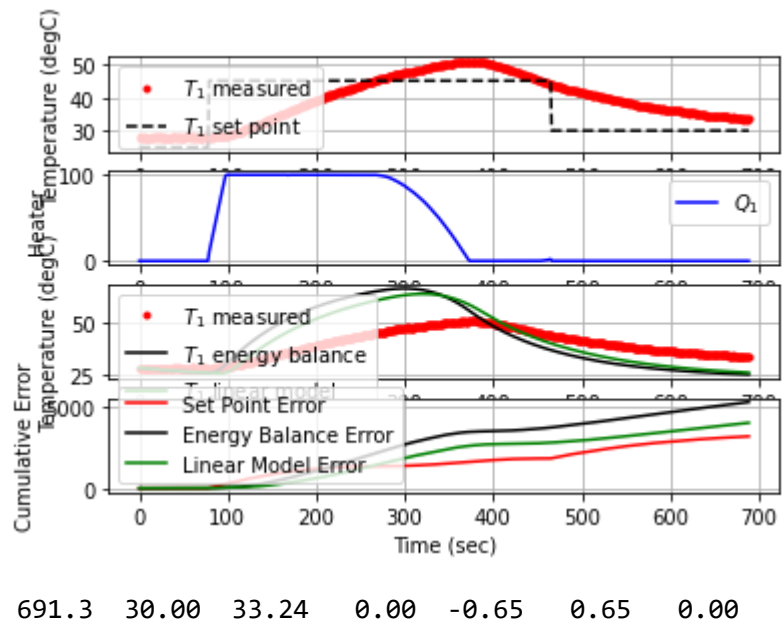
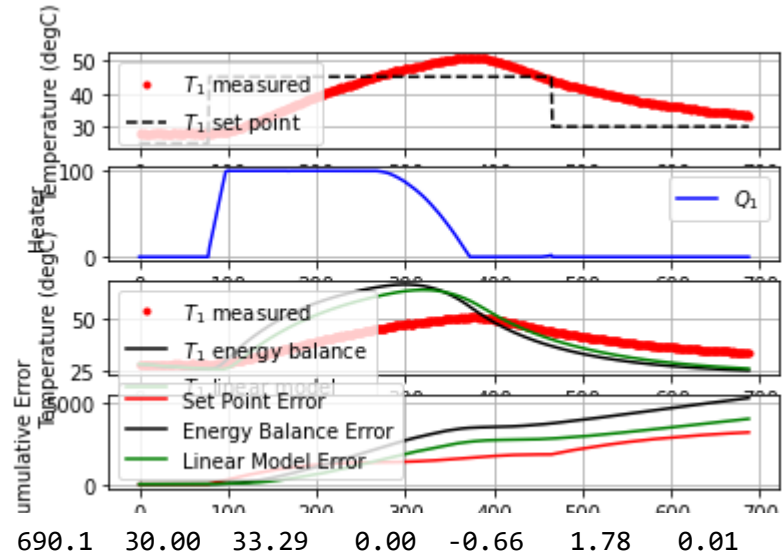


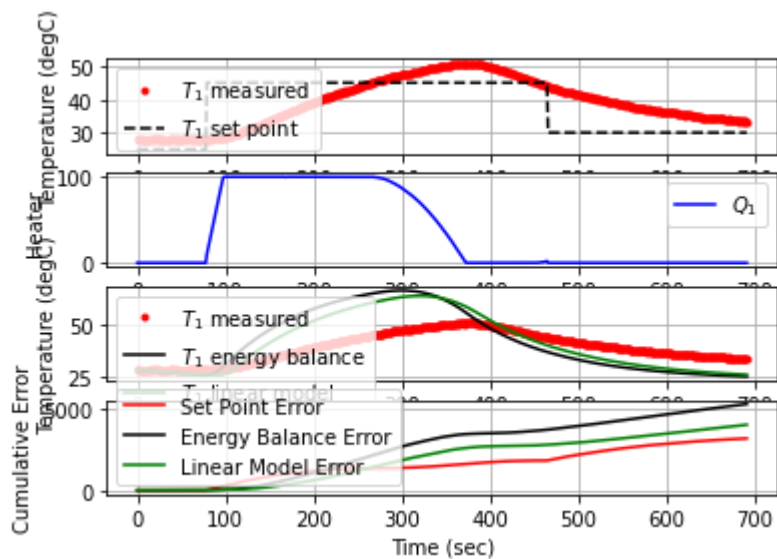
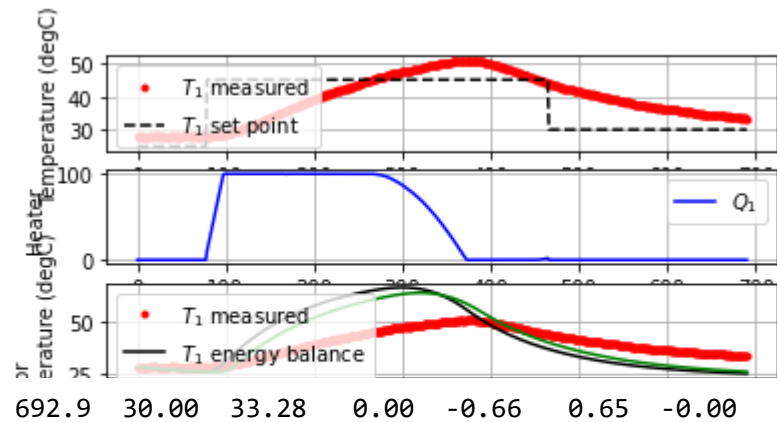




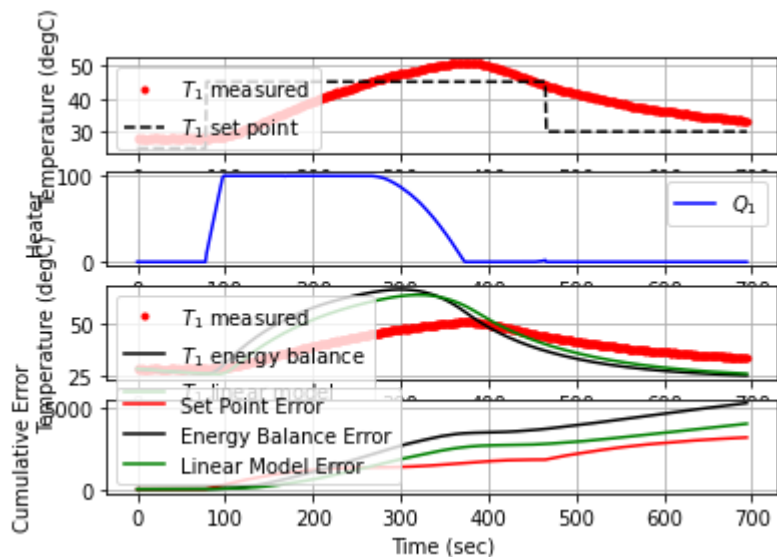
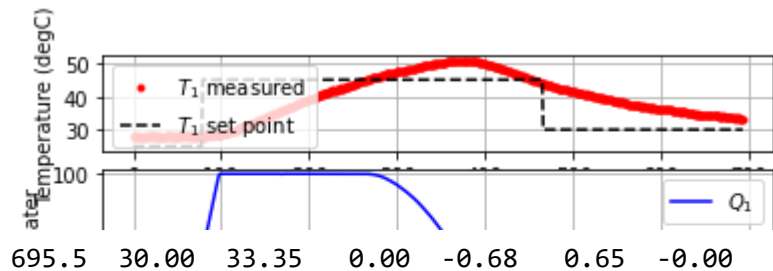


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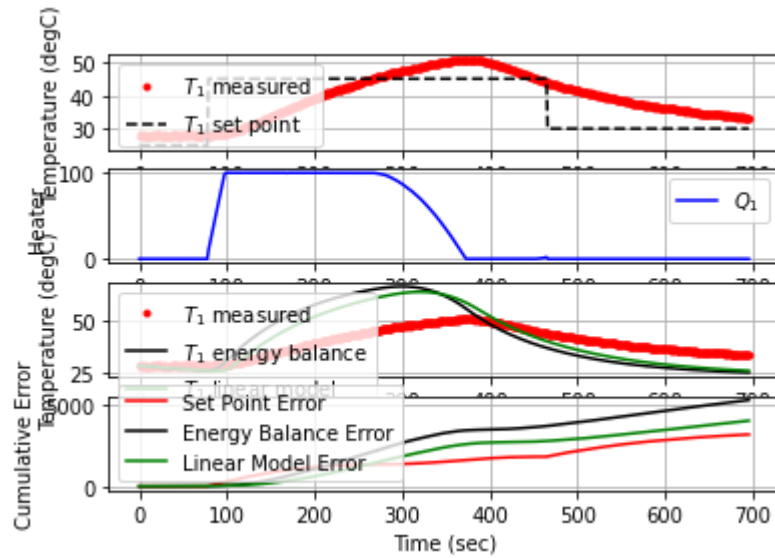




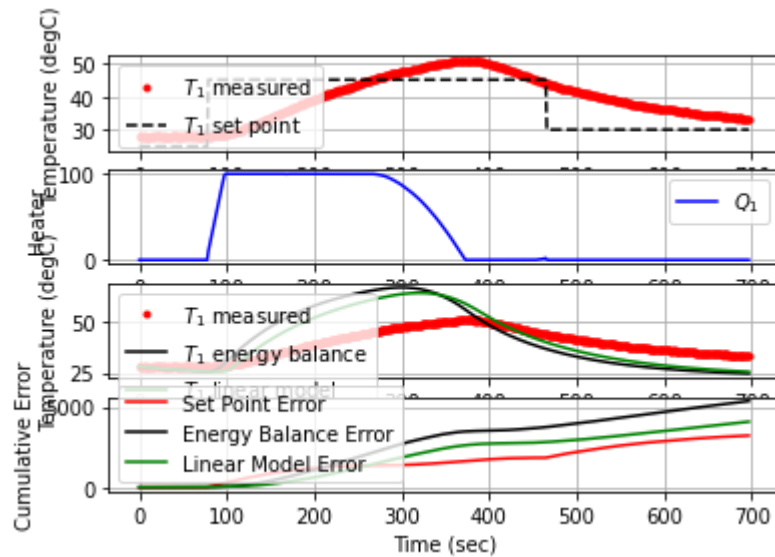




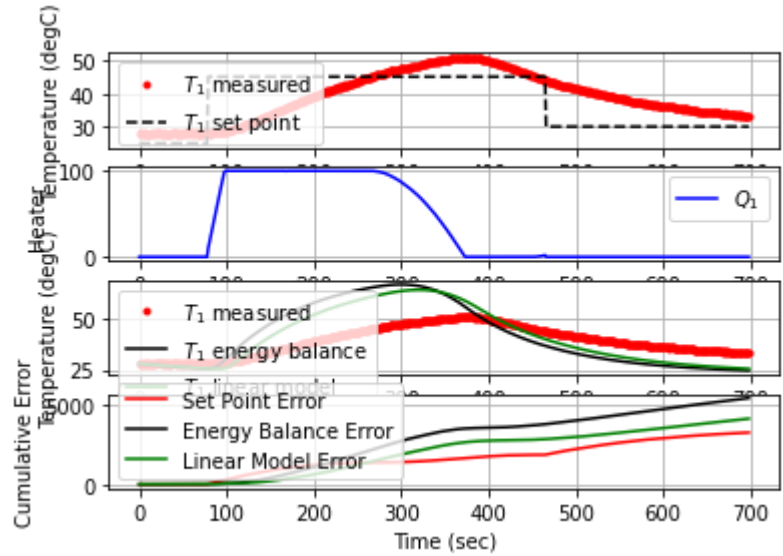
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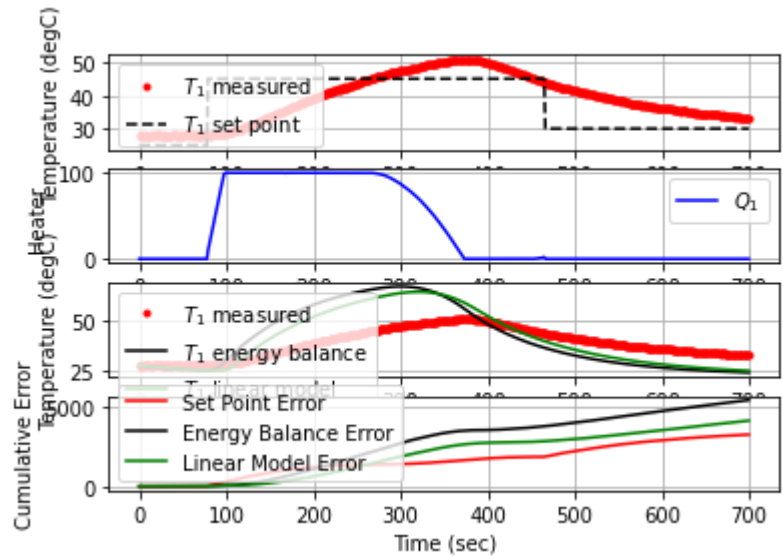
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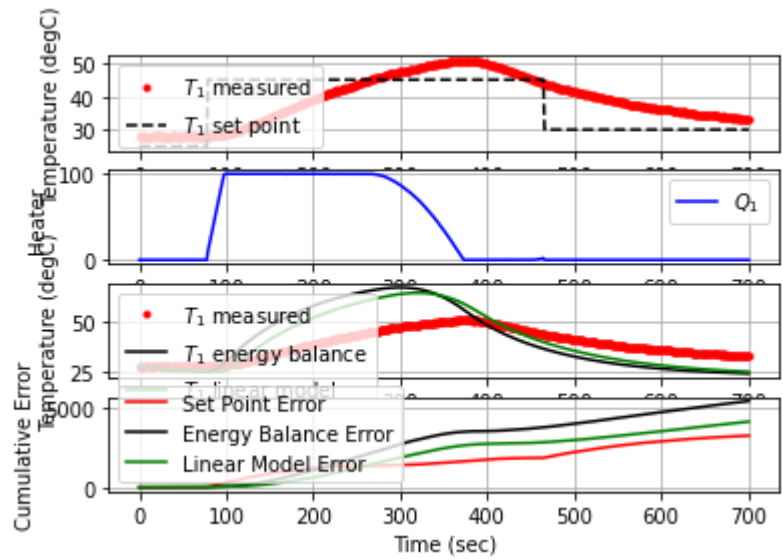
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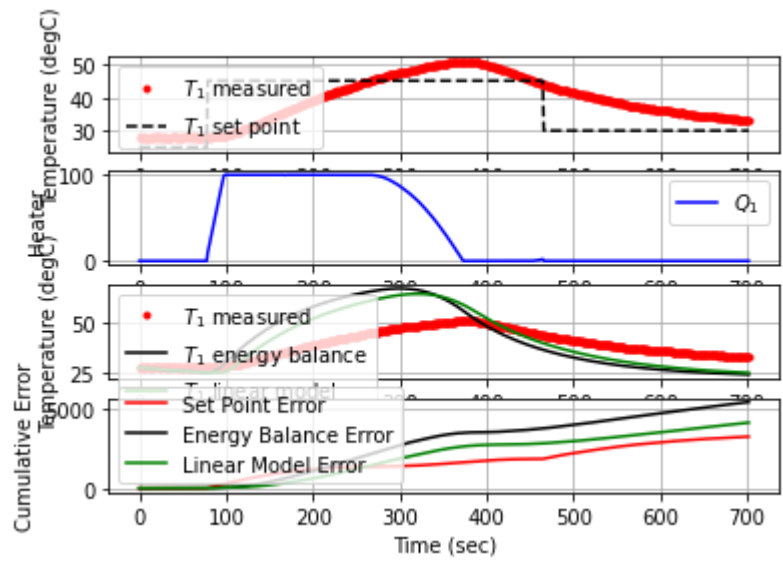
700.9 30.00 33.07 0.00 -0.62 0.65 0.01



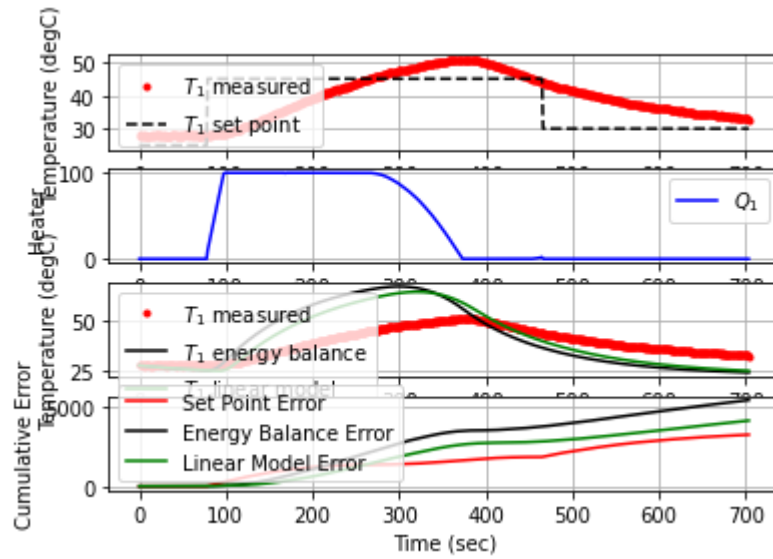
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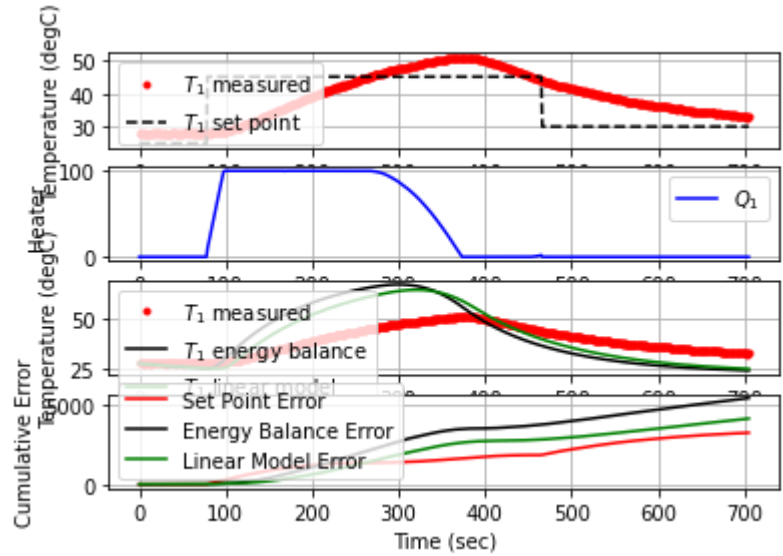
703.4 30.00 32.78 0.00 -0.56 0.65 0.02



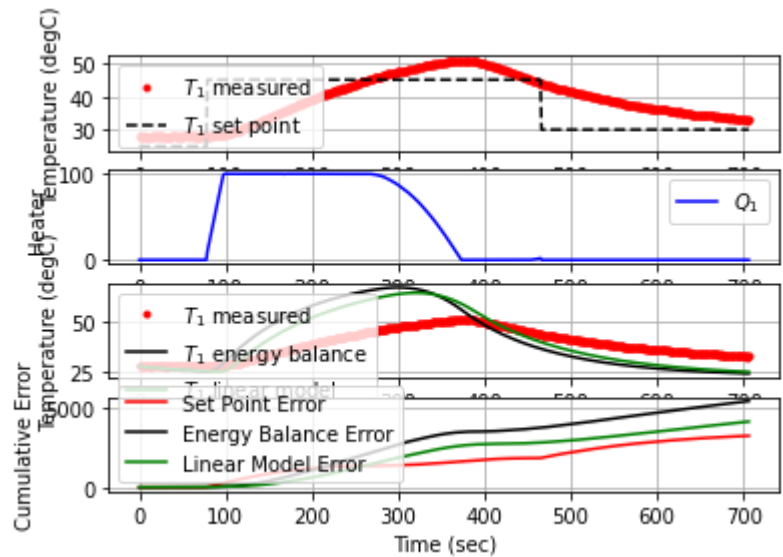
704.7 30.00 32.84 0.00 -0.57 0.65 -0.00



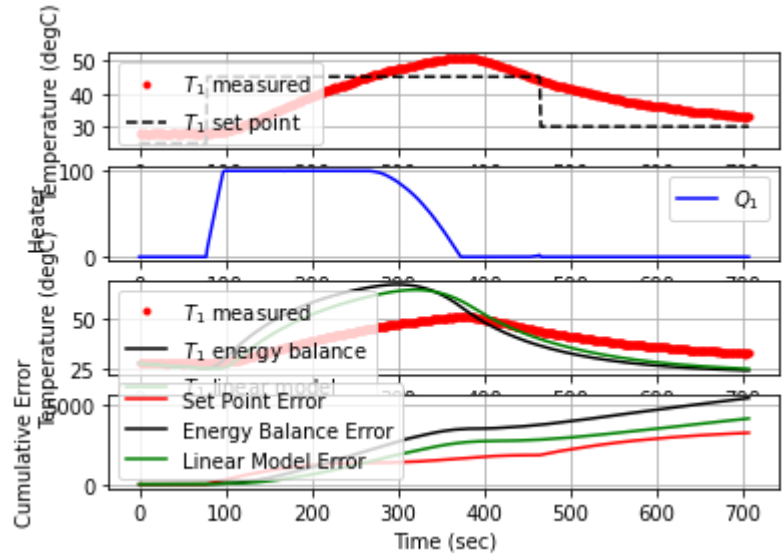
706.1 30.00 32.88 0.00 -0.58 0.65 -0.00



707.4 30.00 32.94 0.00 -0.59 0.65 -0.00

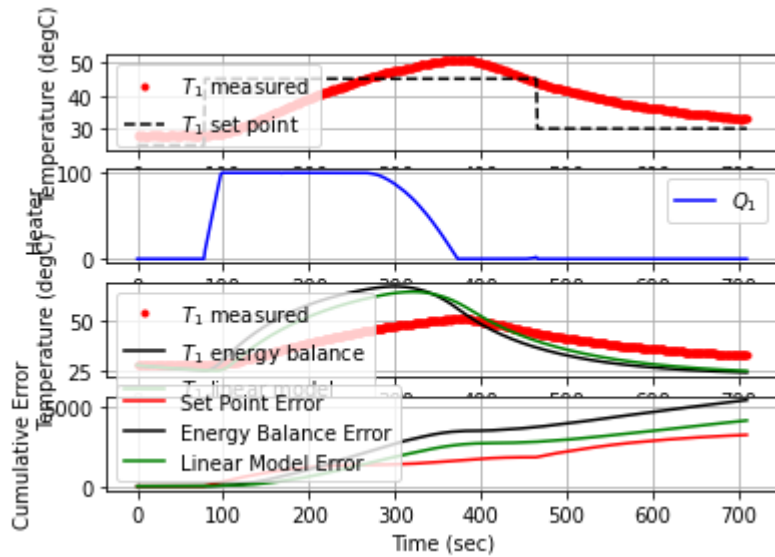


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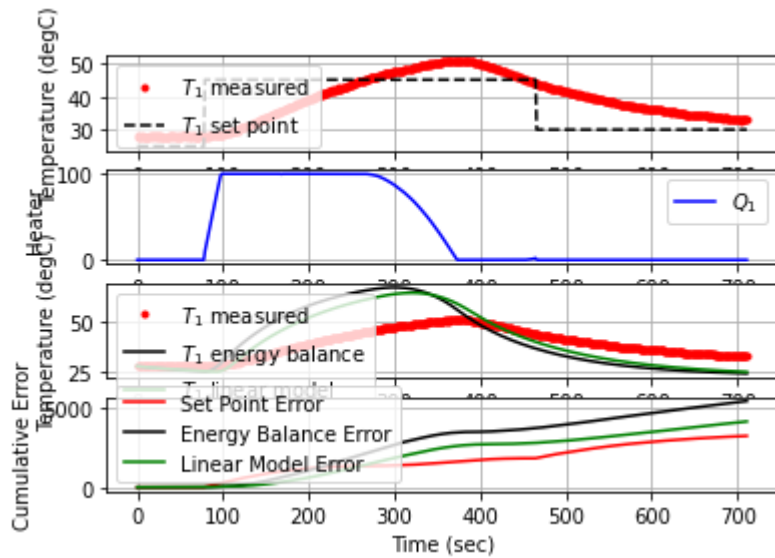


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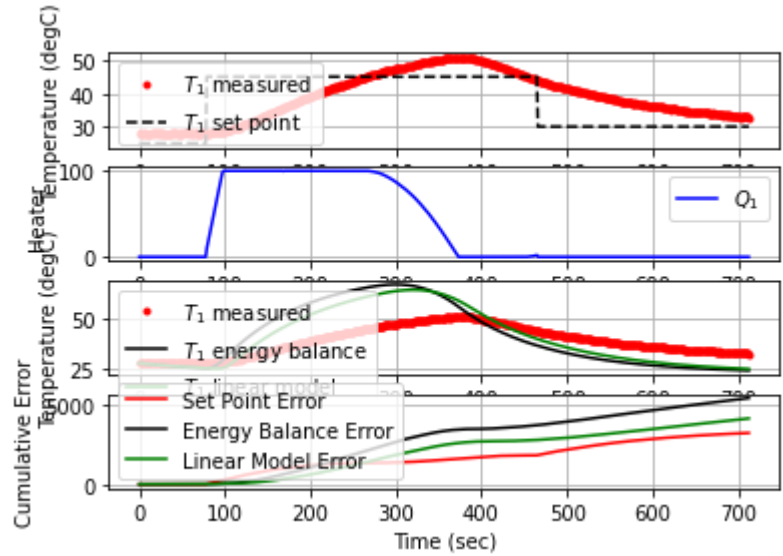


712.4 30.00 32.69 0.00 -0.54 0.65 0.01

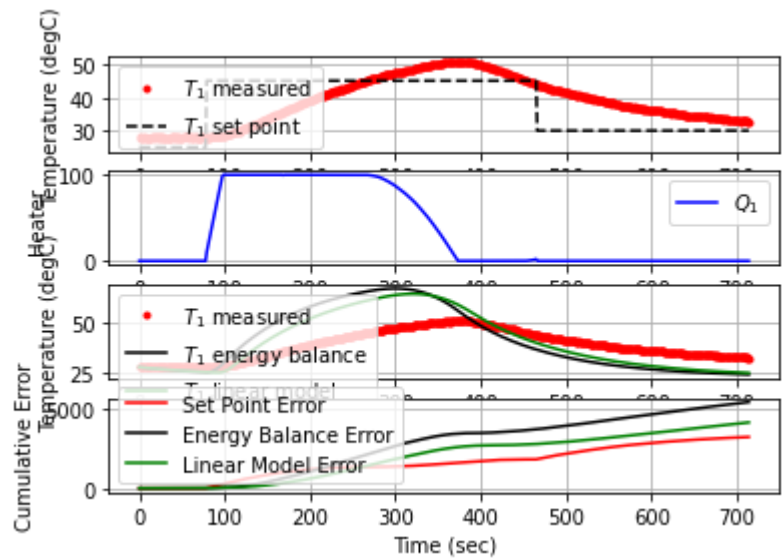


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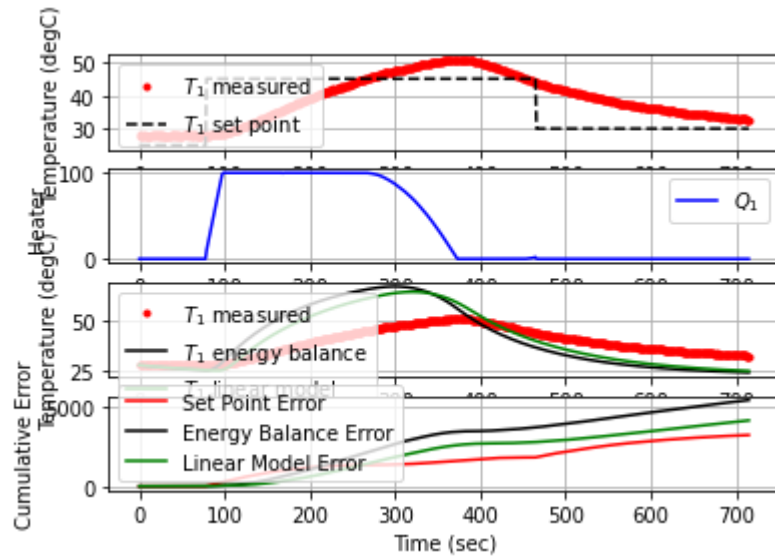




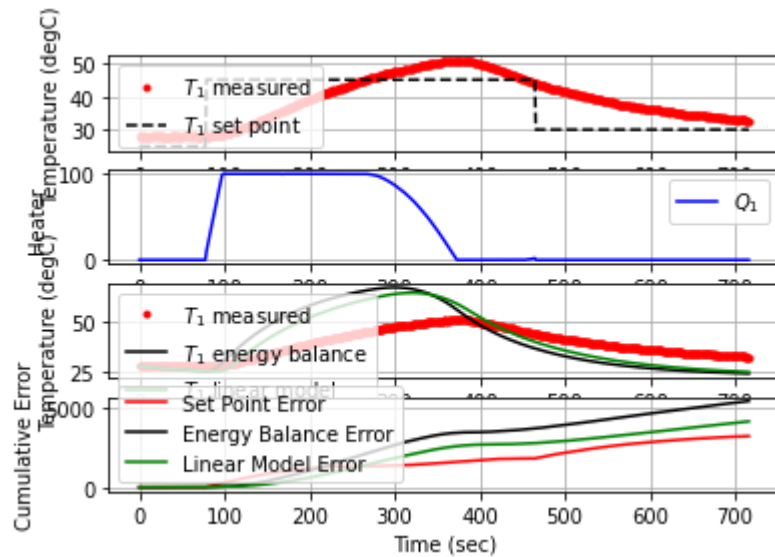
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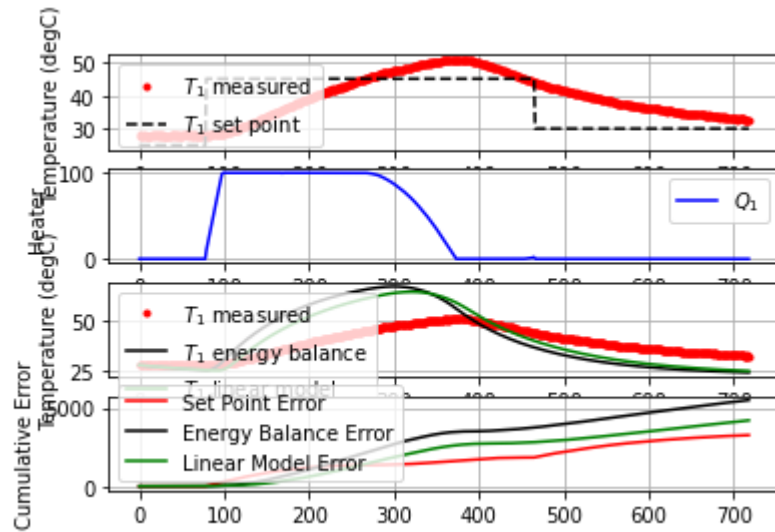
716.2 30.00 32.57 0.00 -0.52 0.65 0.01



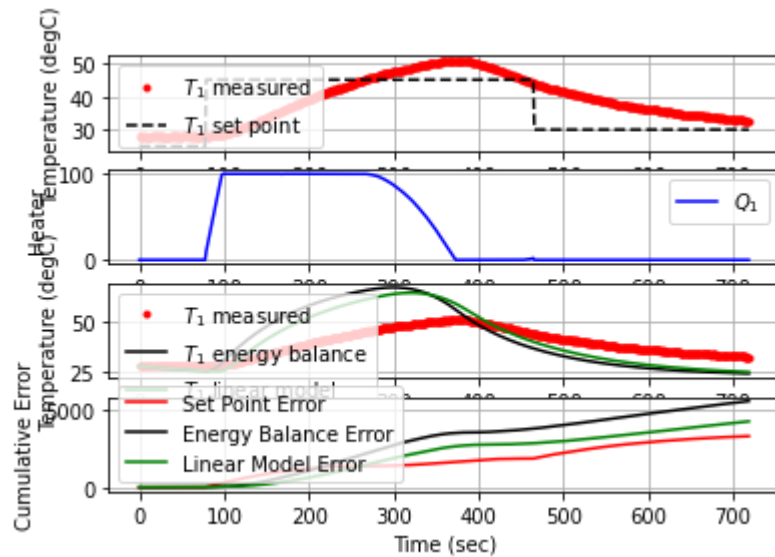
717.5 30.00 32.66 0.00 -0.54 0.65 -0.00



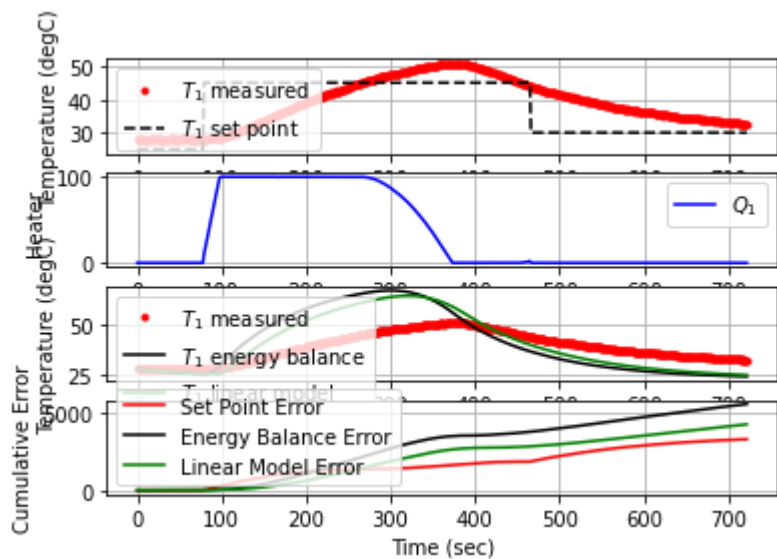
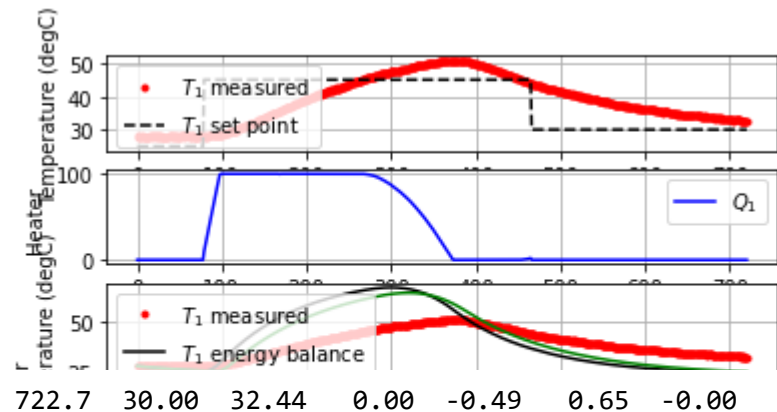
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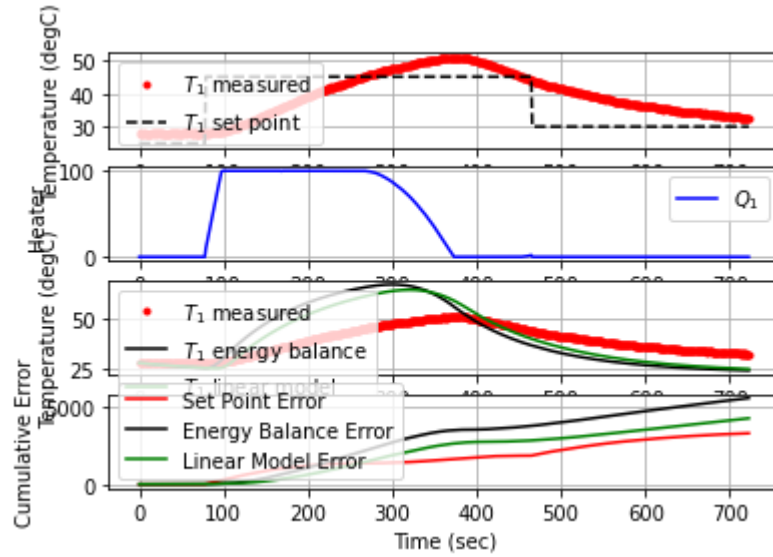
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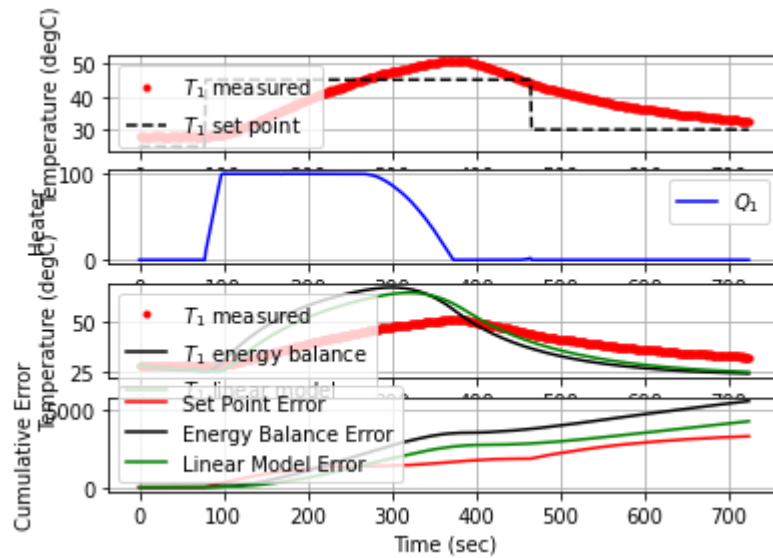
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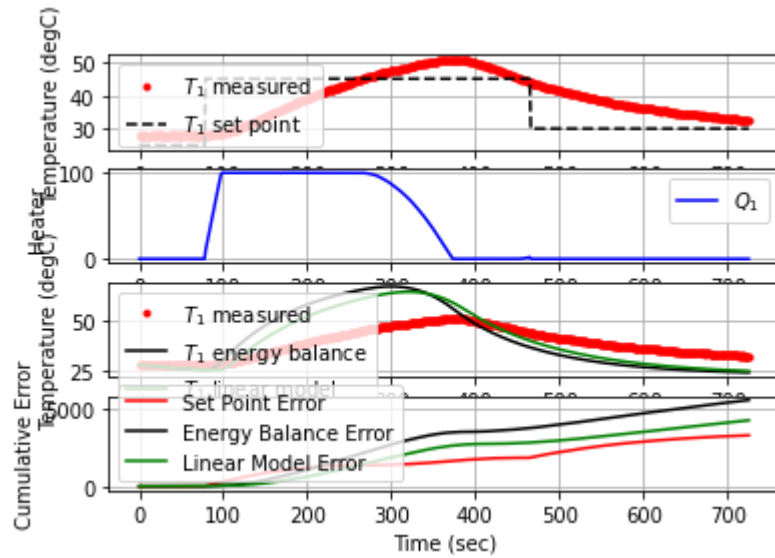
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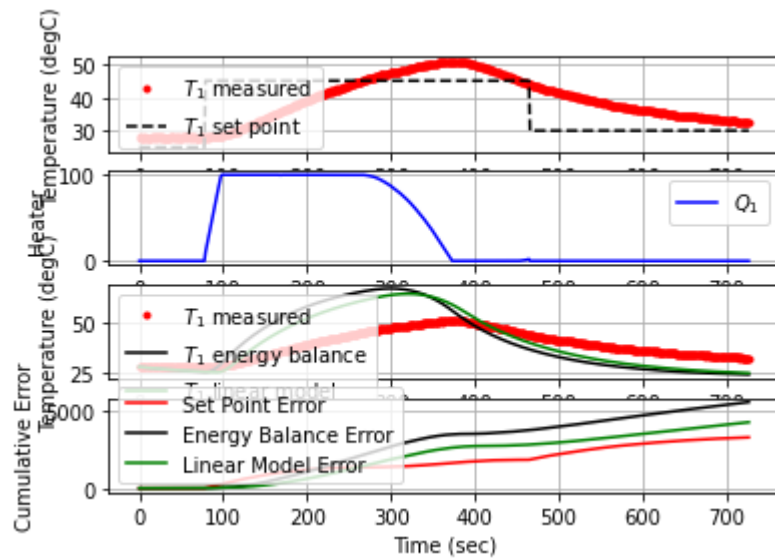
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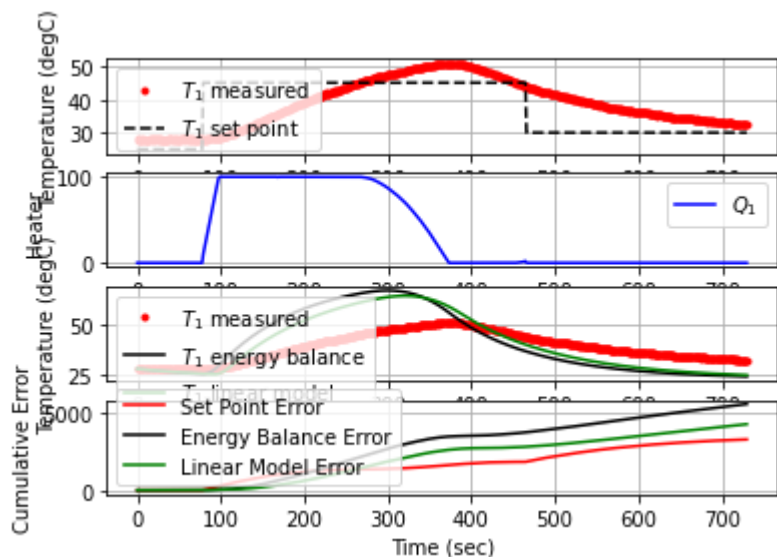
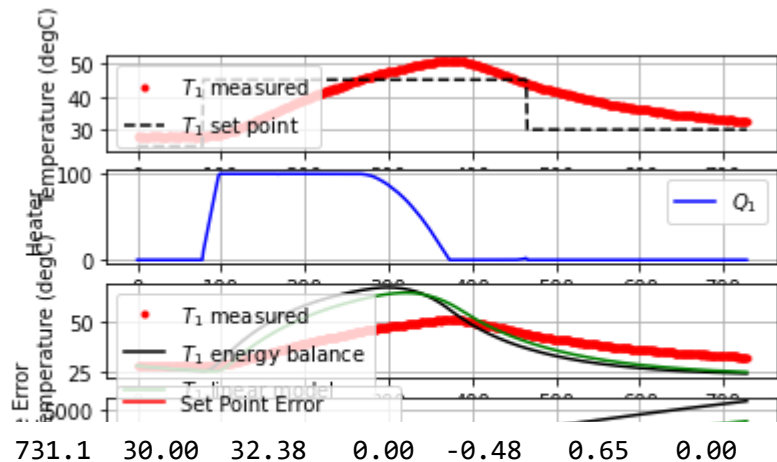
726.9 30.00 32.53 0.00 -0.51 0.65 -0.00



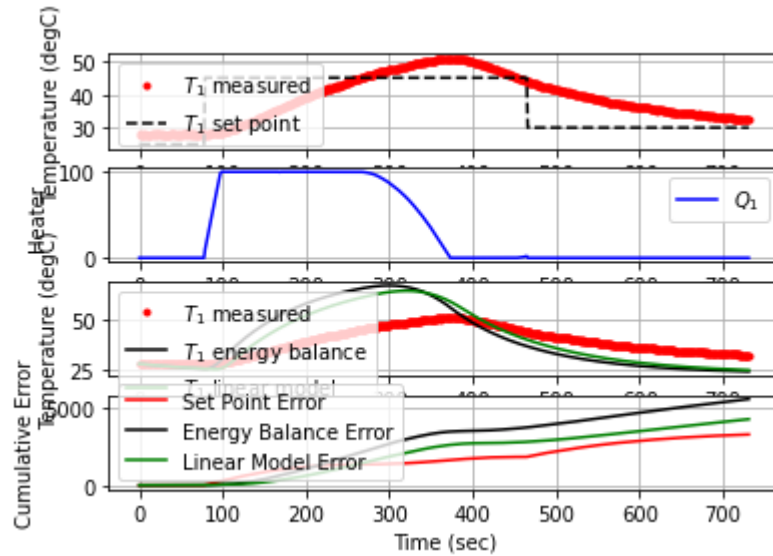
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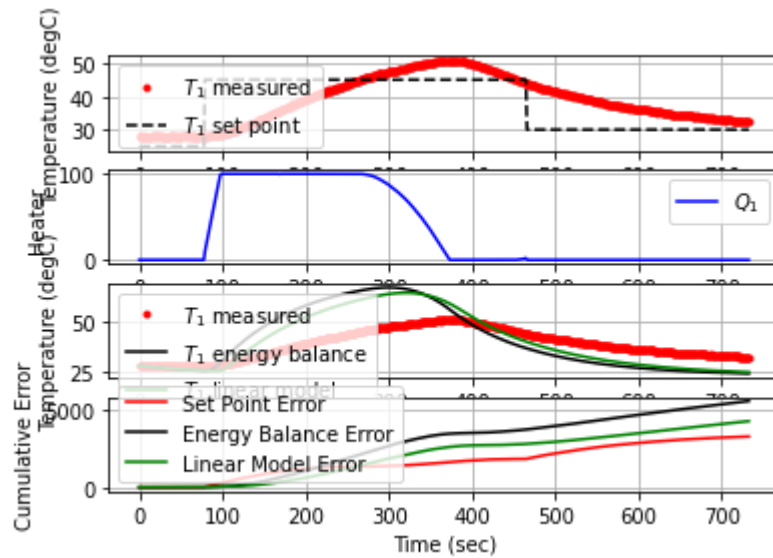
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732.5 30.00 32.47 0.00 -0.50 0.65 -0.00

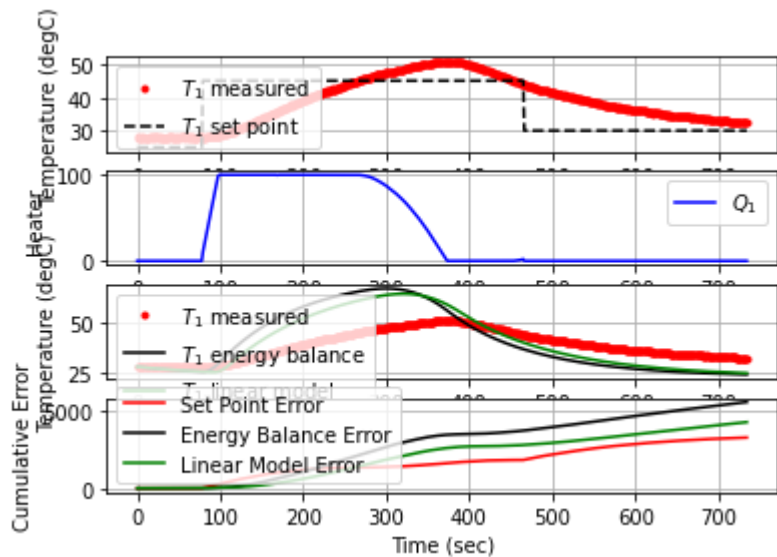


733.9 30.00 32.40 0.00 -0.49 0.65 0.00

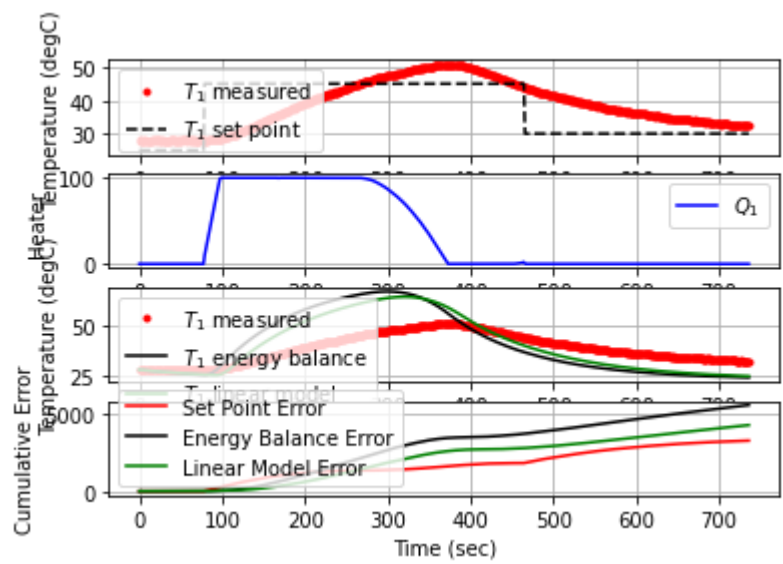
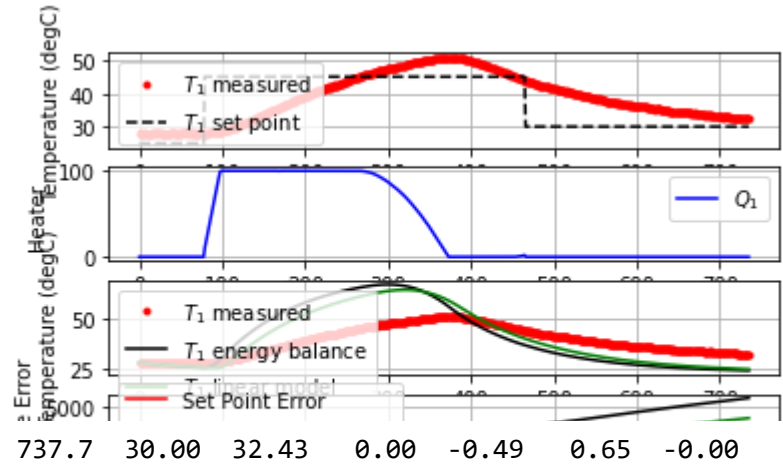


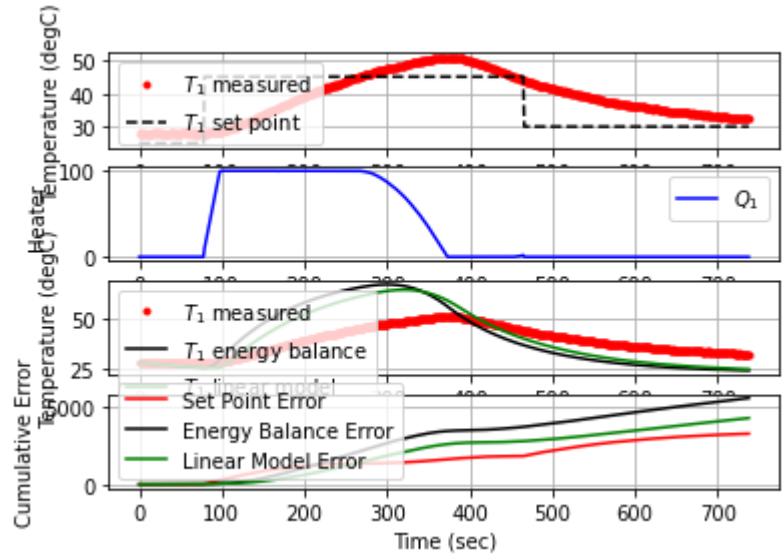


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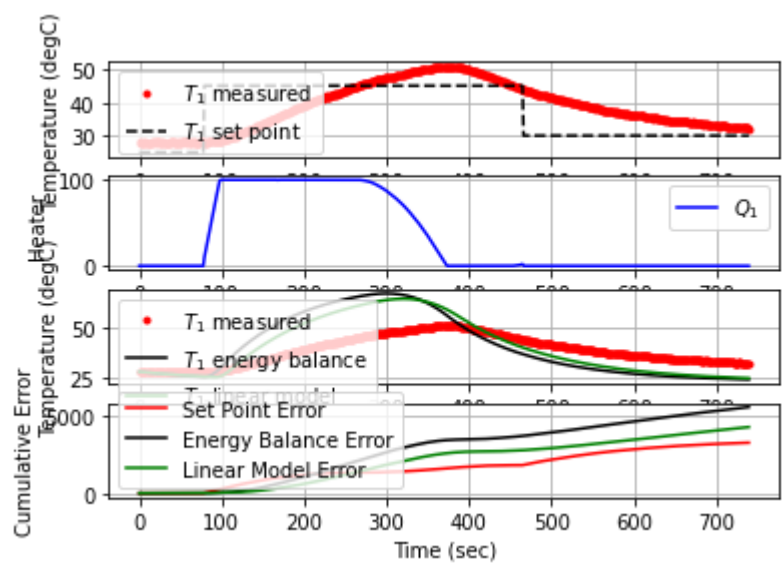


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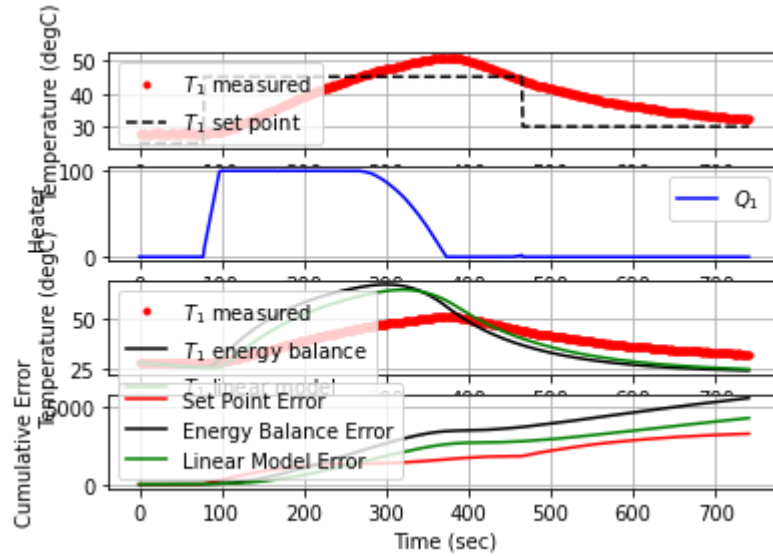




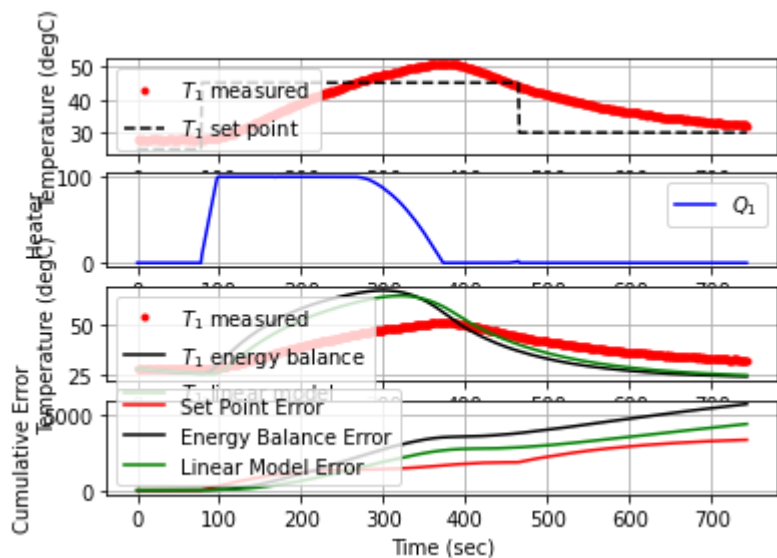
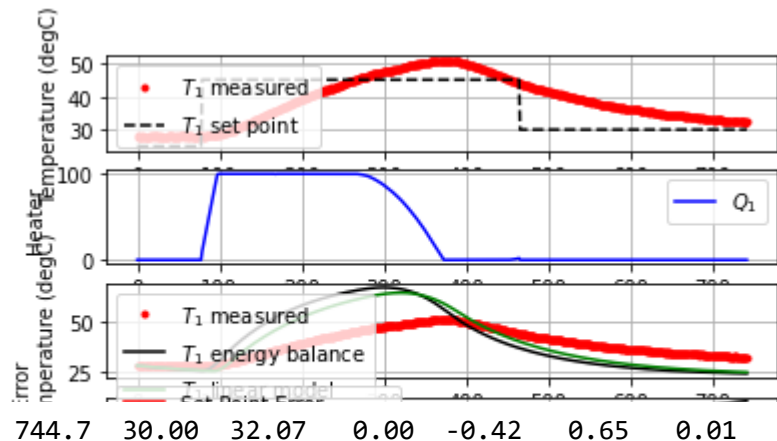
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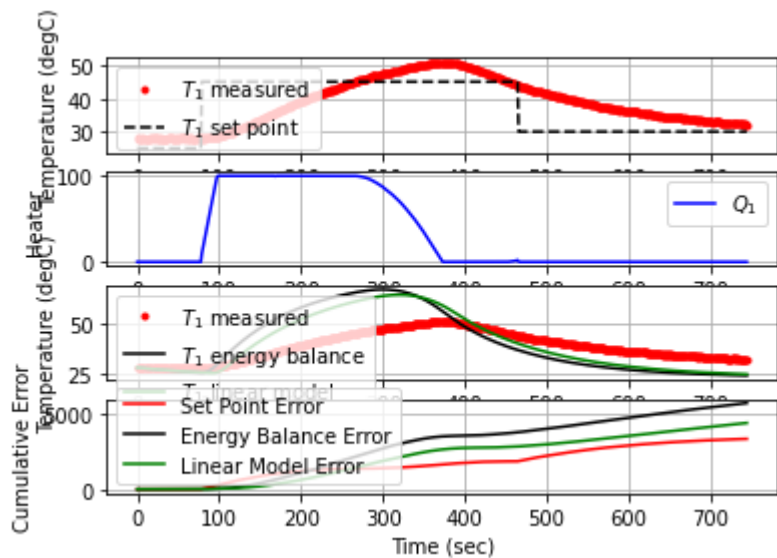
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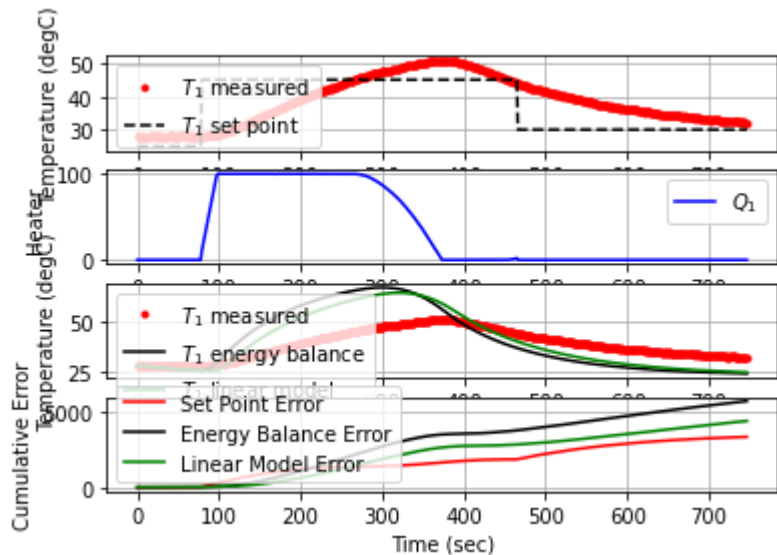
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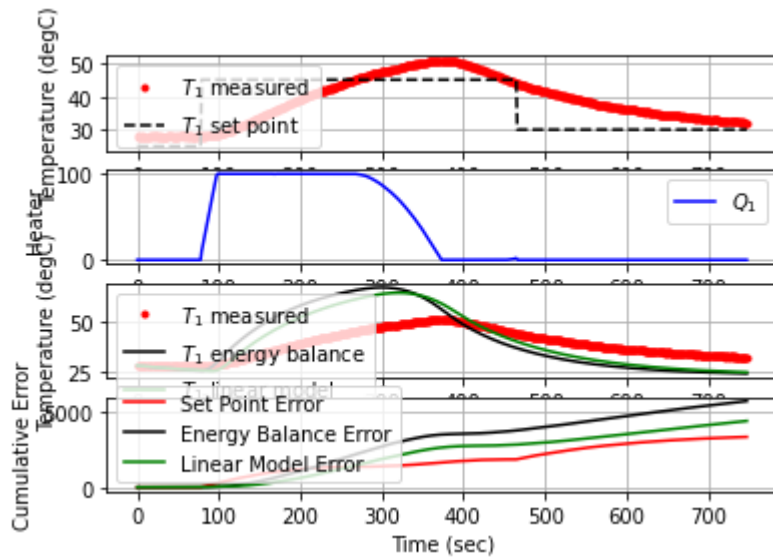
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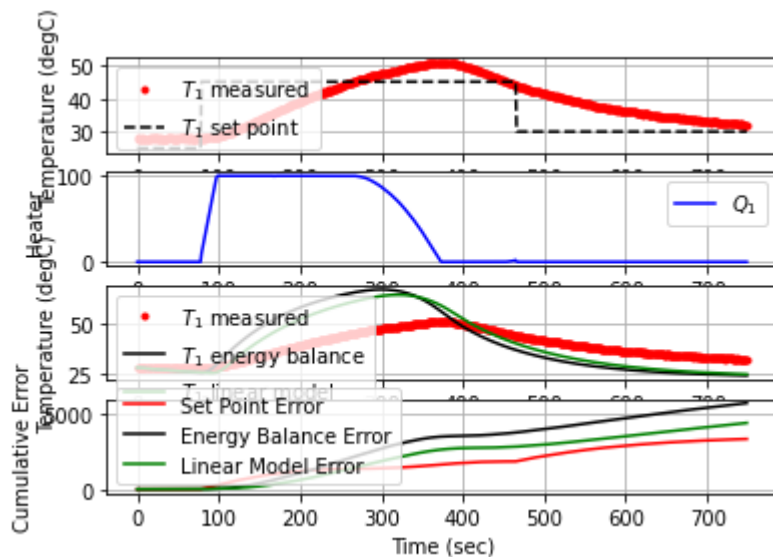
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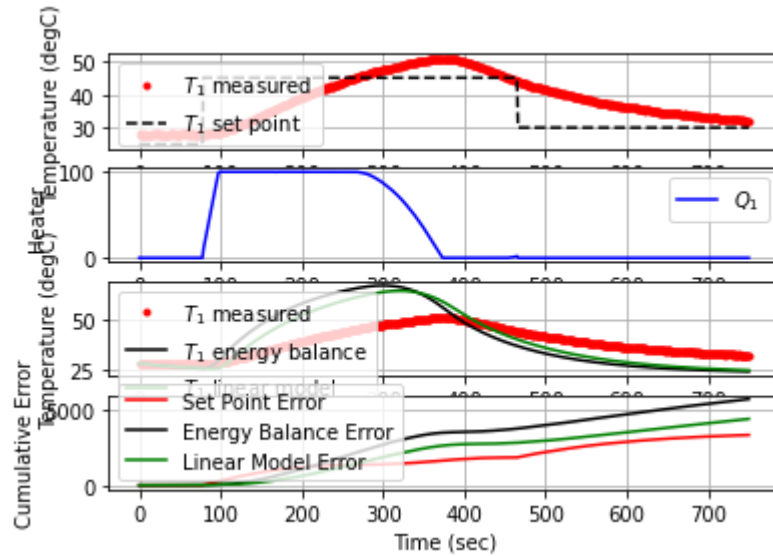
748.6 30.00 32.02 0.00 -0.41 0.65 0.01



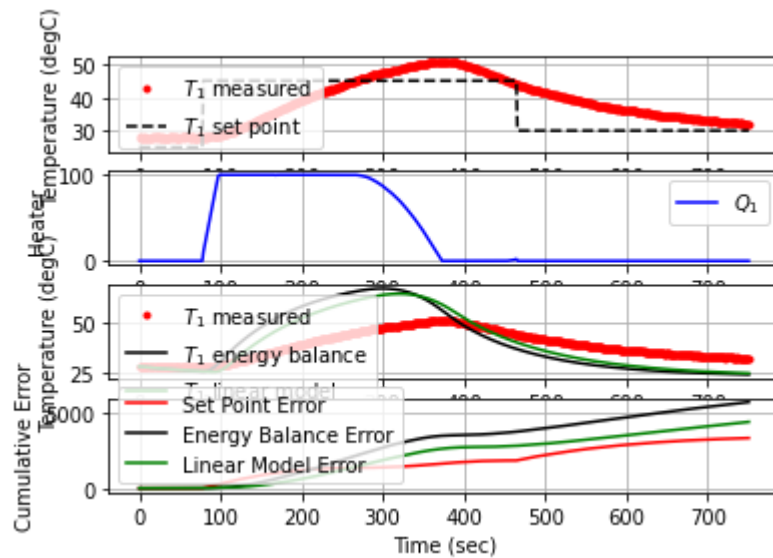
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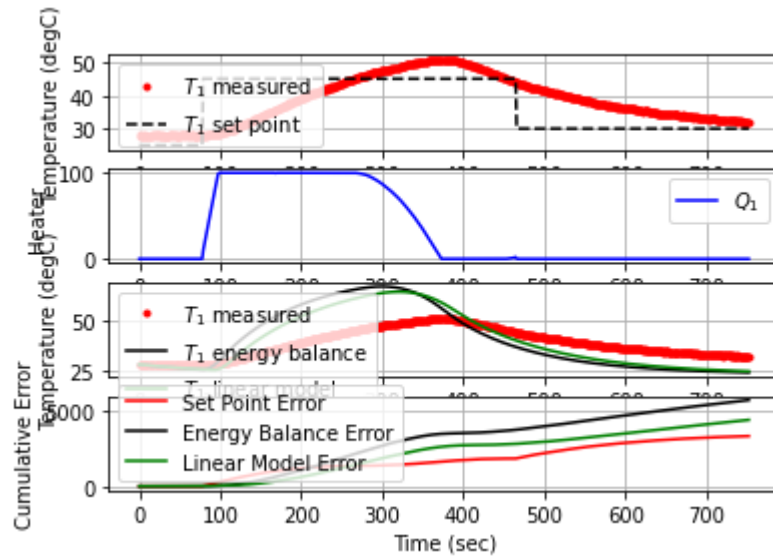


752.6 30.00 32.10 0.00 -0.43 0.65 -0.00

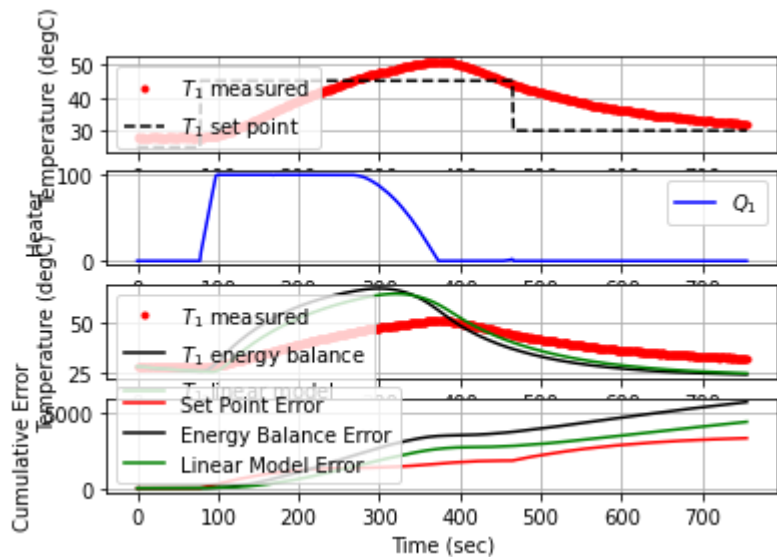
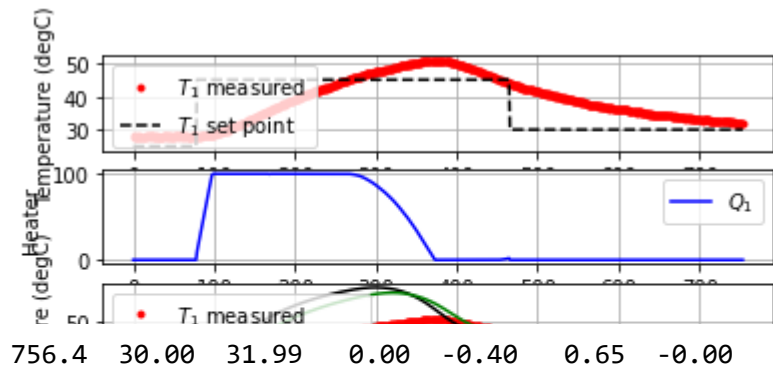


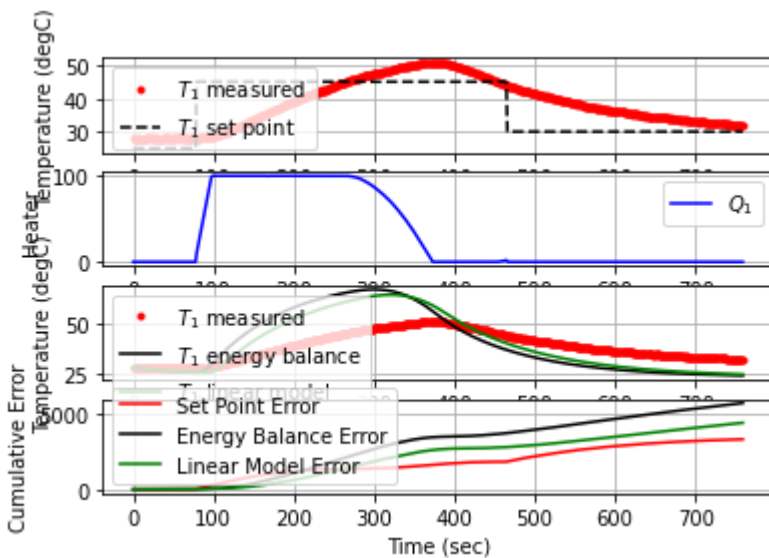
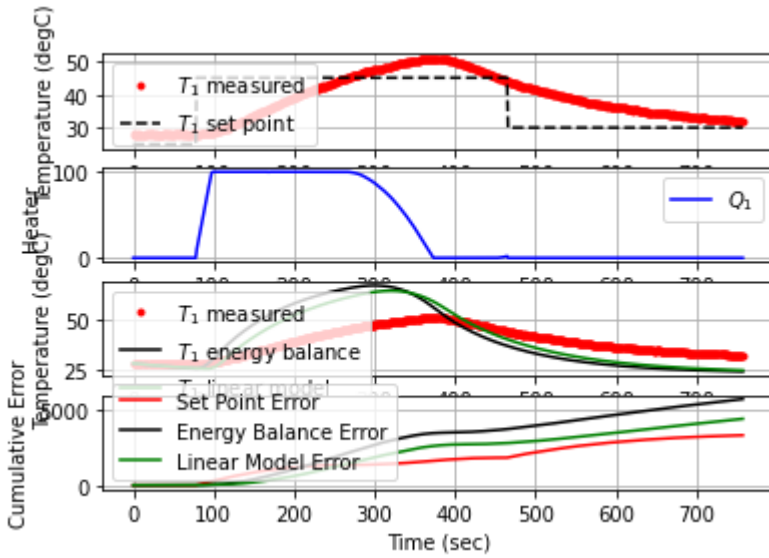
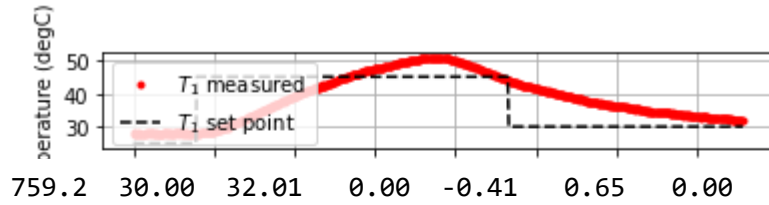


753.9 30.00 31.92 0.00 -0.39 0.65 0.01

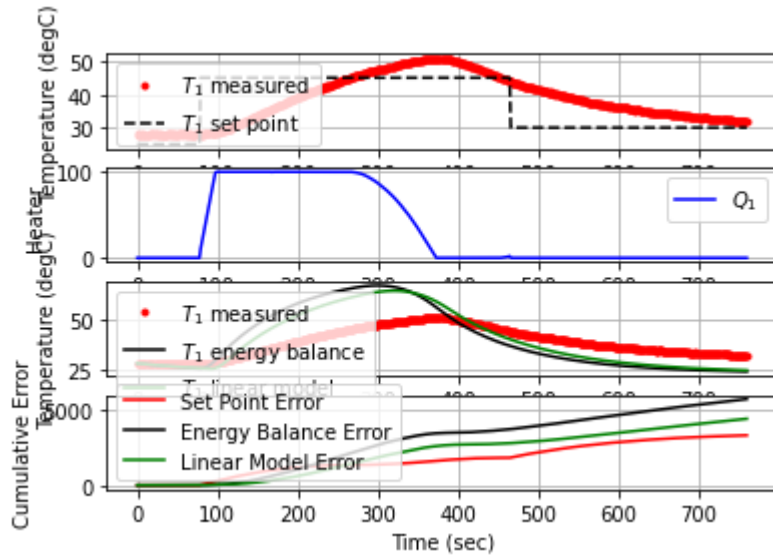


755.2 30.00 31.97 0.00 -0.40 0.65 -0.00

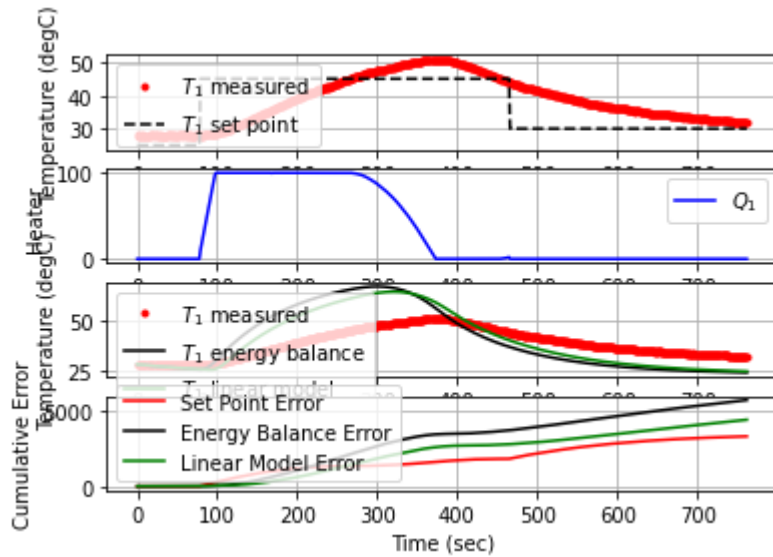




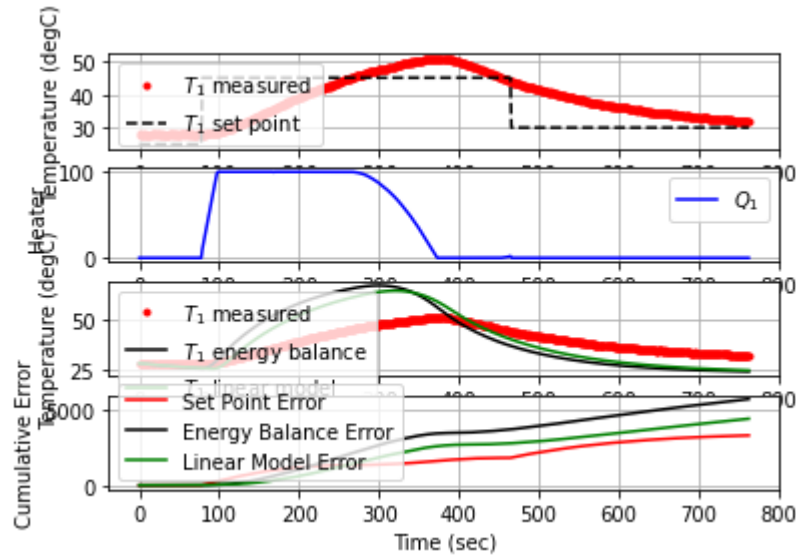
761.9 30.00 32.15 0.00 -0.44 0.65 -0.01



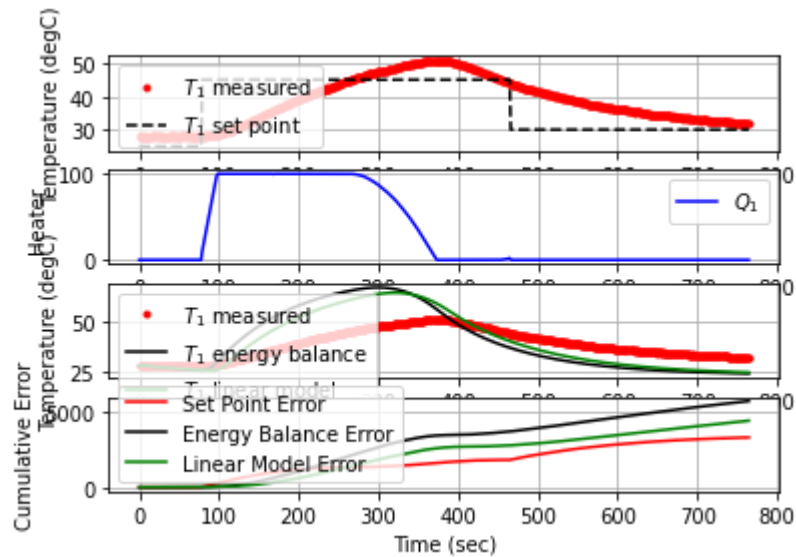
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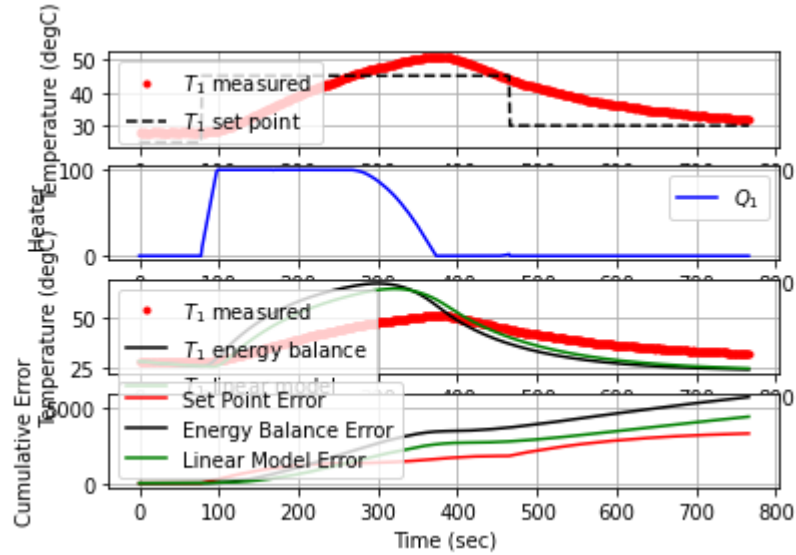
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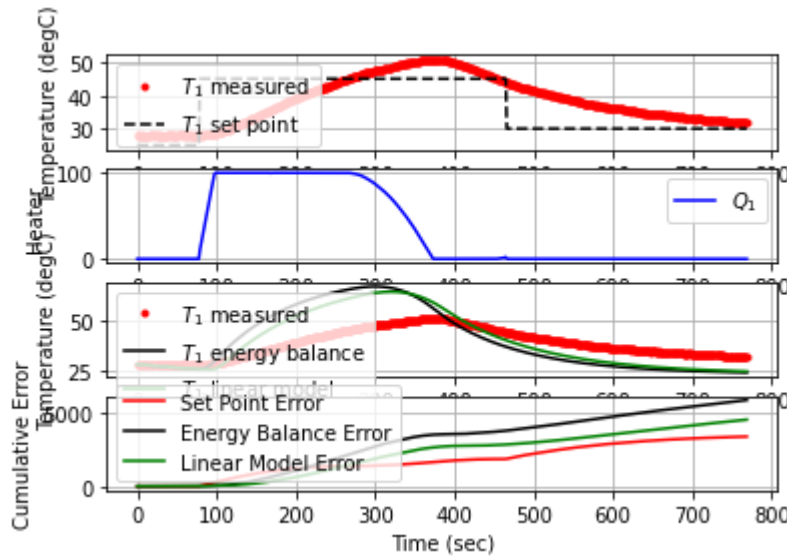
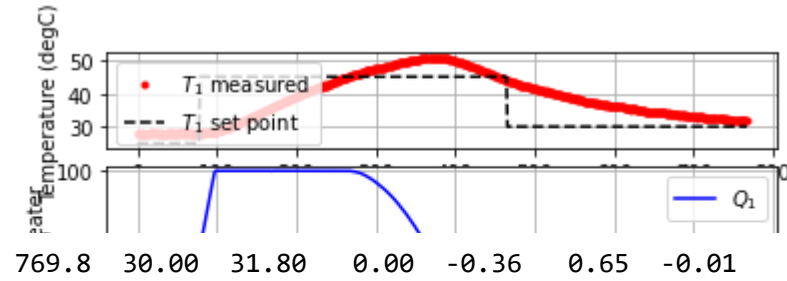
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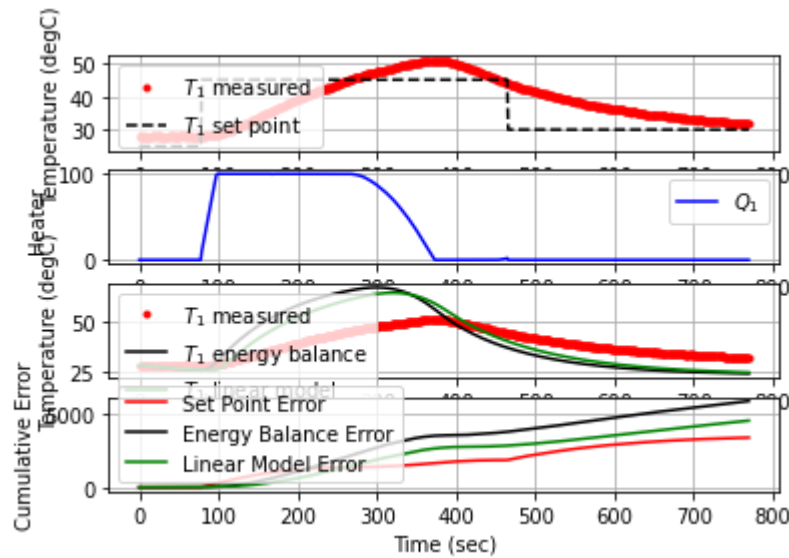
767.3 30.00 31.64 0.00 -0.33 0.65 0.01



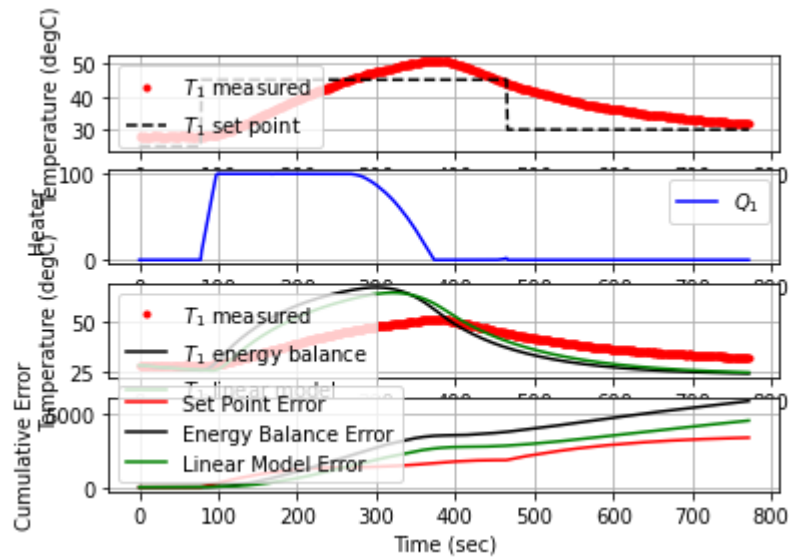
768.6 30.00 31.66 0.00 -0.34 0.65 -0.00



771.3 30.00 31.62 0.00 -0.33 0.65 0.01

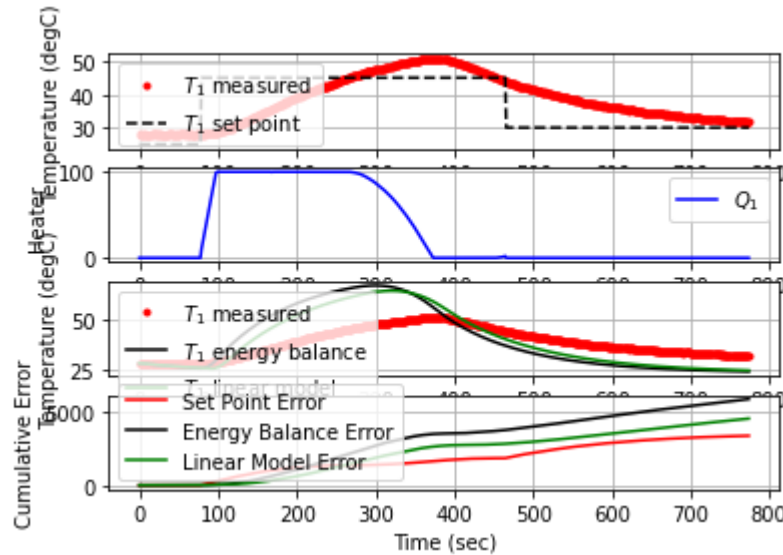
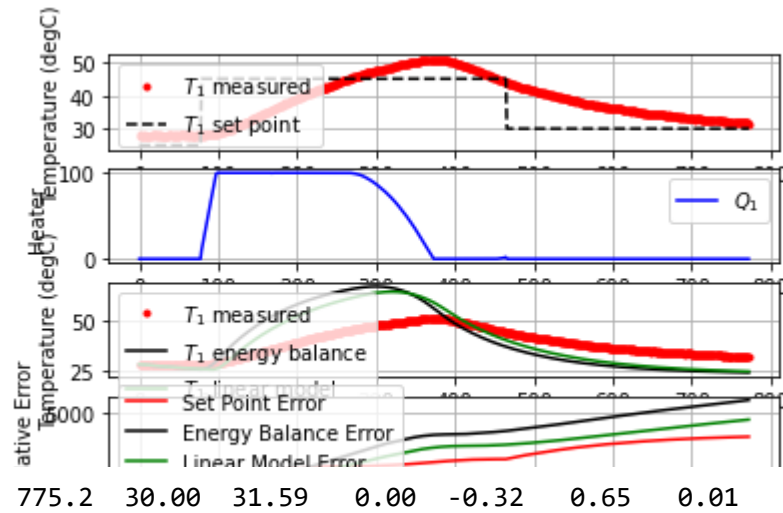


772.6 30.00 31.59 0.00 -0.32 0.65 0.00

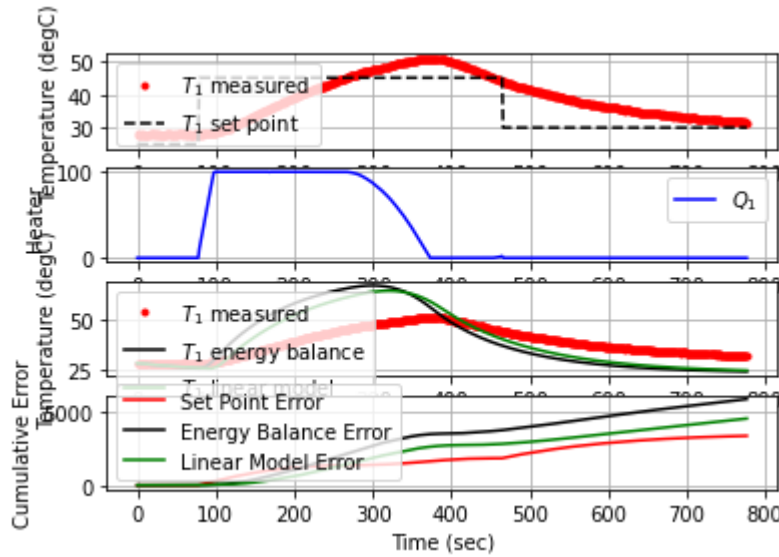
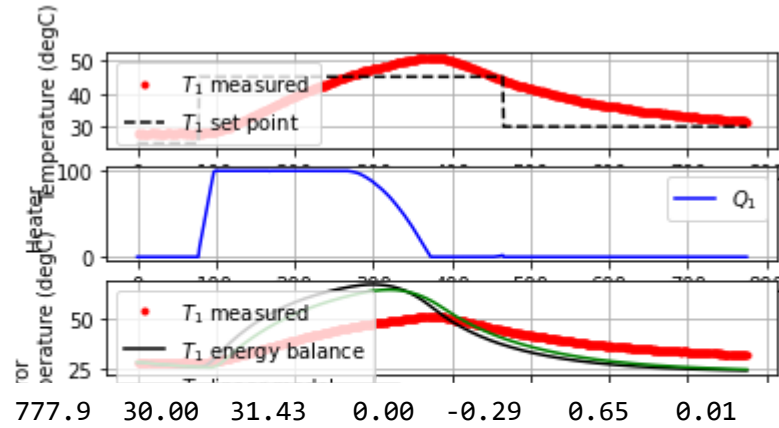


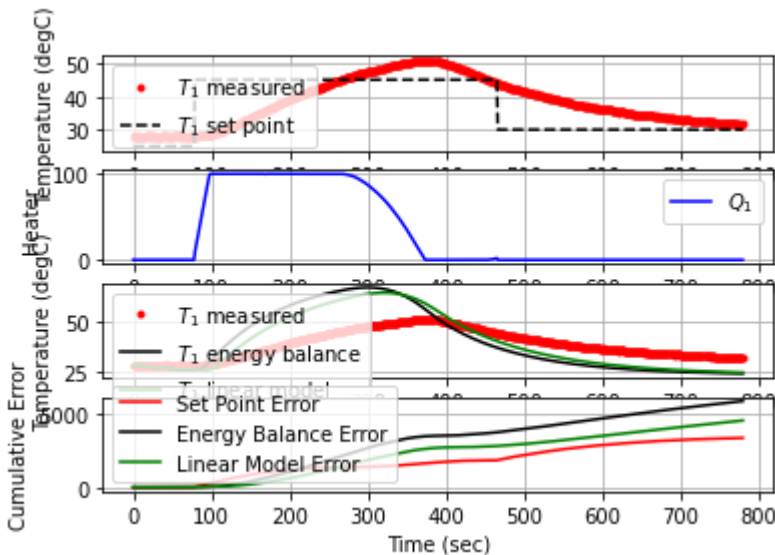
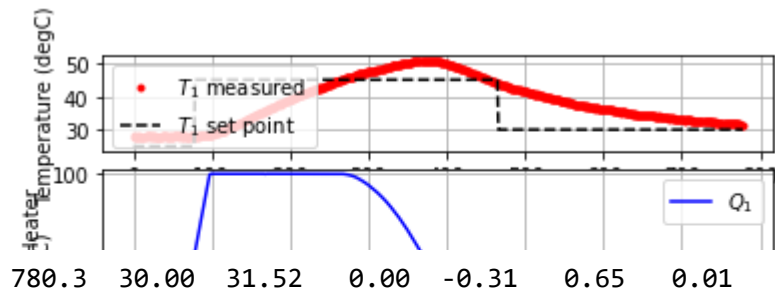
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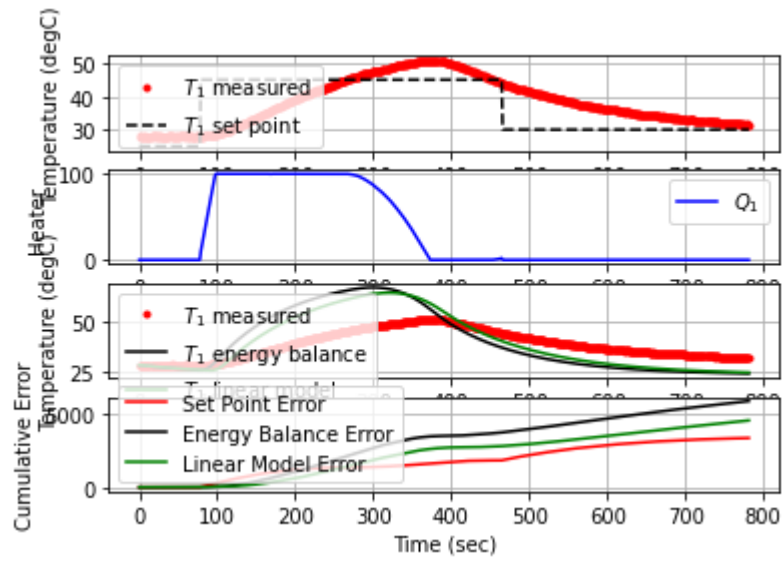
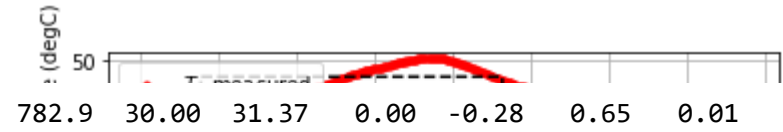


776.4 30.00 31.55 0.00 -0.32 0.65 0.00

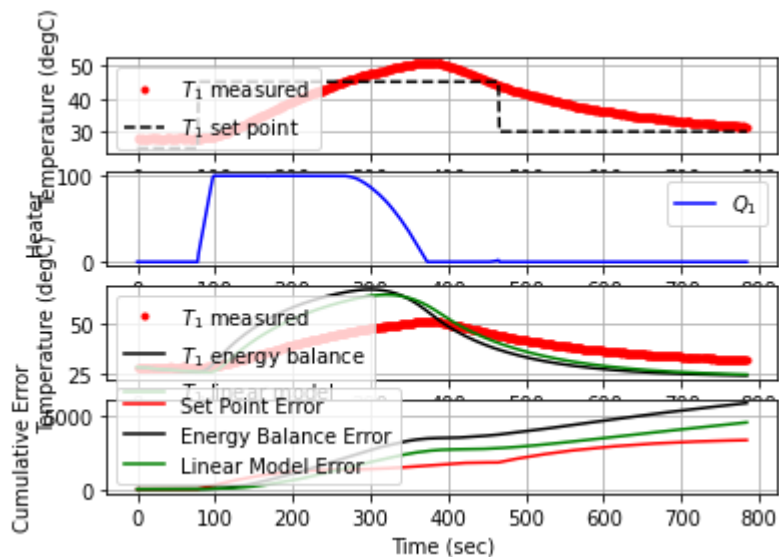
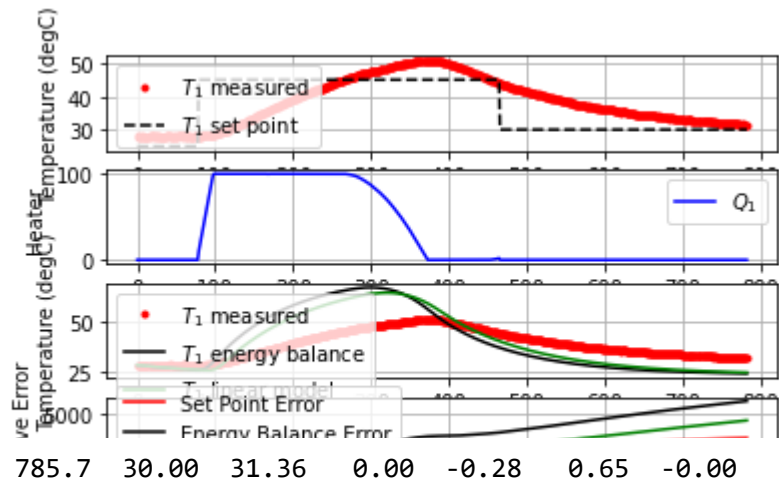


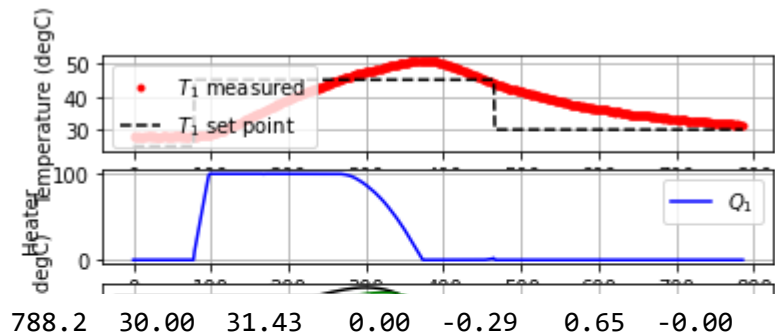


781.6 30.00 31.48 0.00 -0.30 0.65 0.00

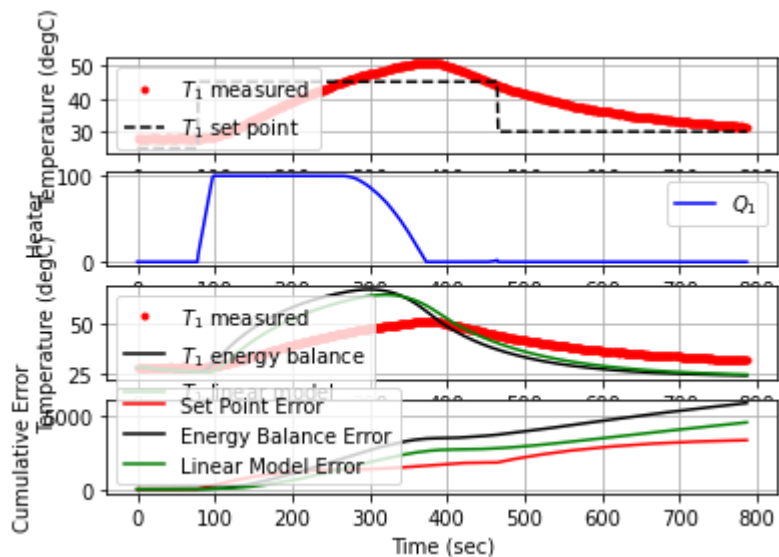


784.4 30.00 31.35 0.00 -0.28 0.65 0.00

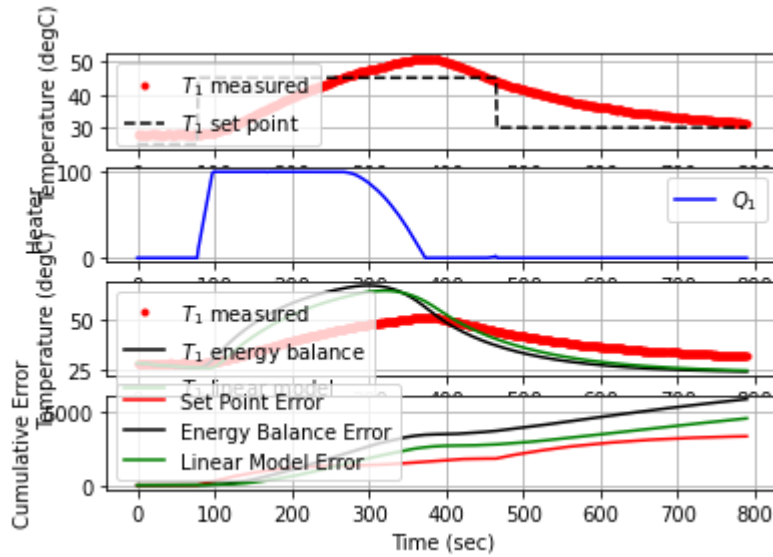
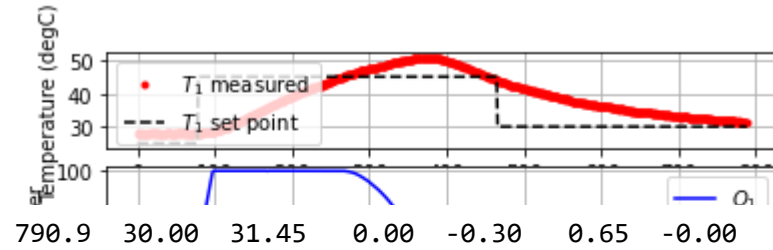




788.2 30.00 31.43 0.00 -0.29 0.65 -0.00

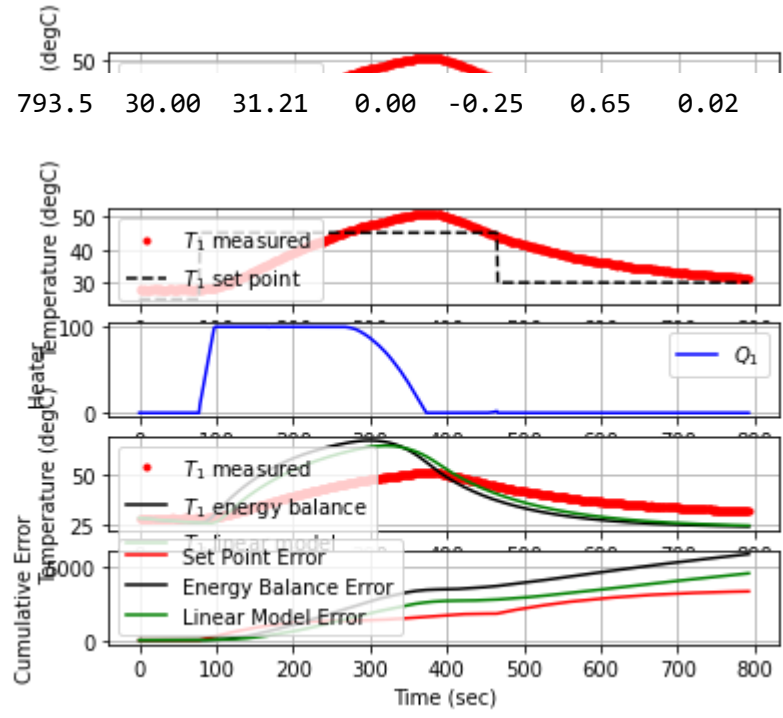


789.6 30.00 31.42 0.00 -0.29 0.65 0.00



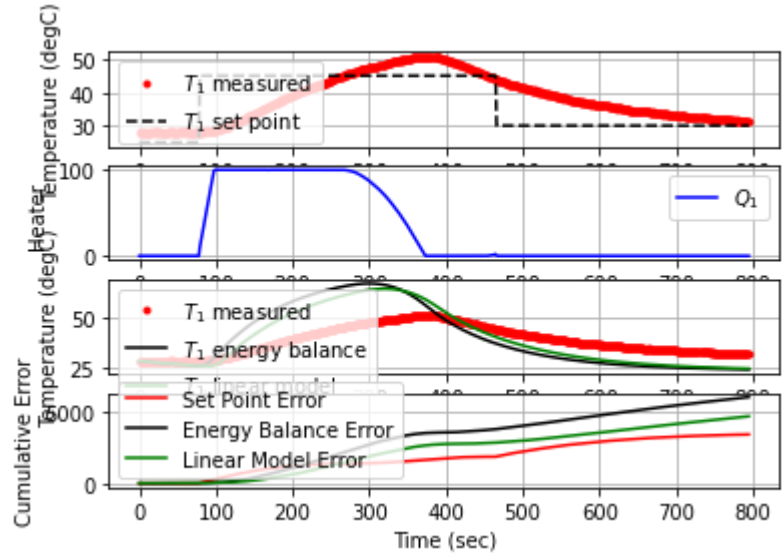
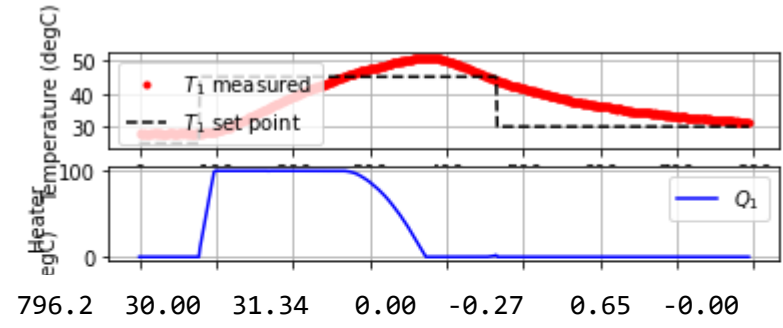
792.2 30.00 31.57 0.00 -0.32 0.65 -0.01



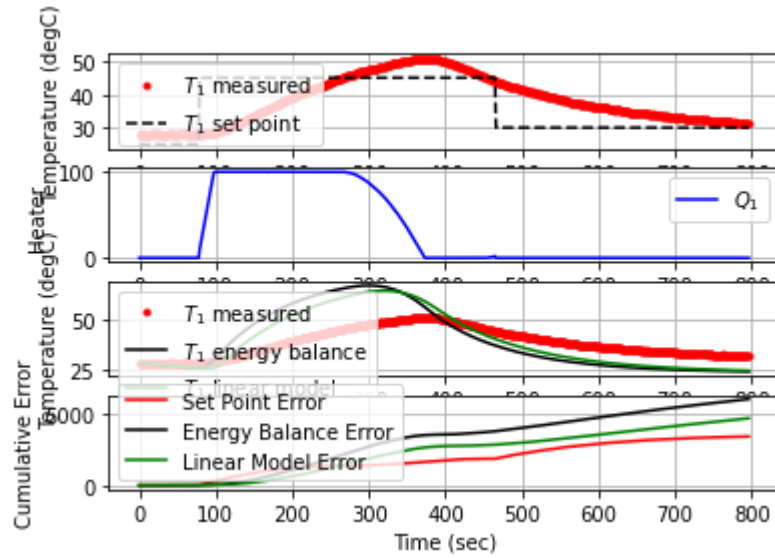


794.8 30.00 31.29 0.00 -0.26 0.65 -0.00

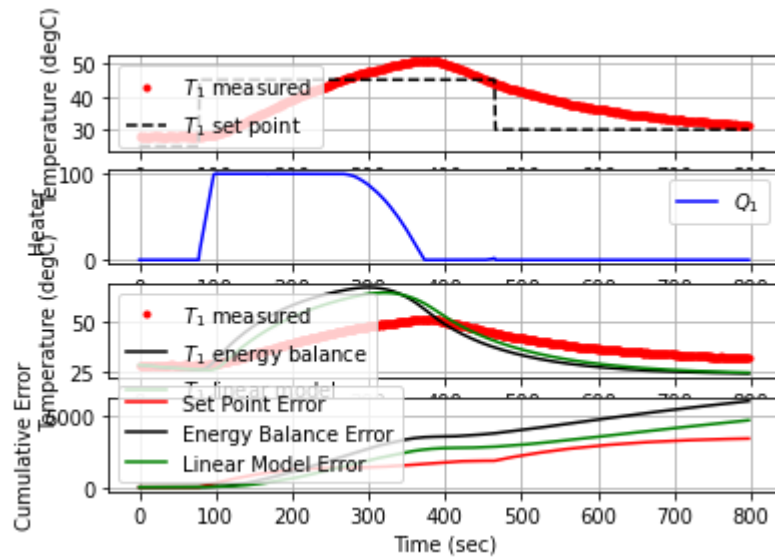




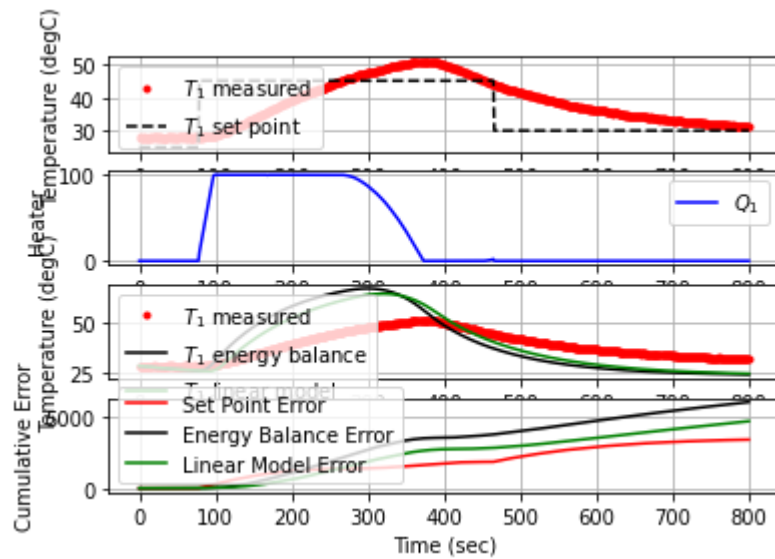
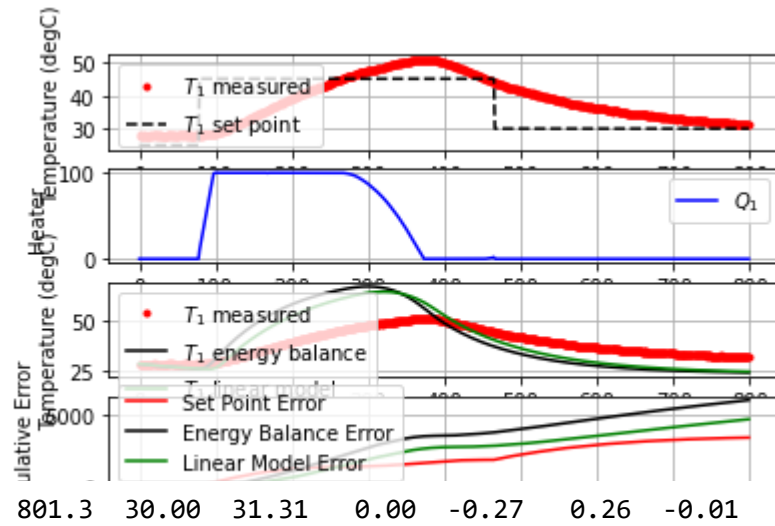
797.5 30.00 31.44 0.00 -0.29 0.65 -0.01

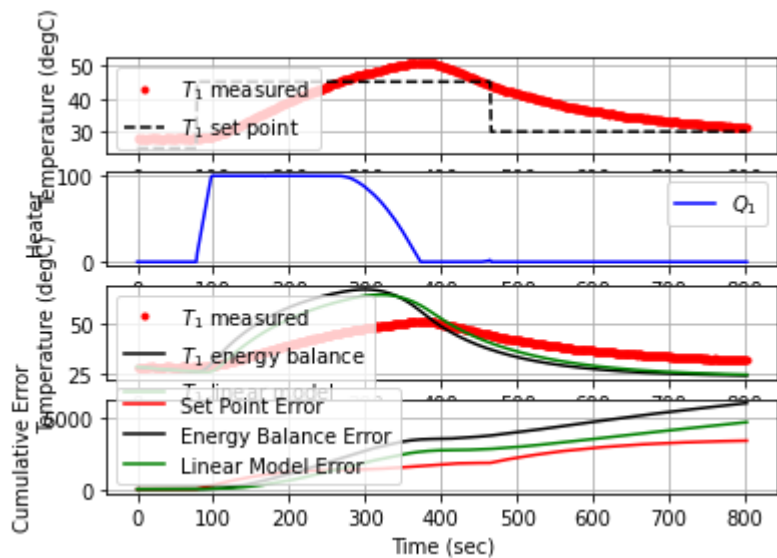
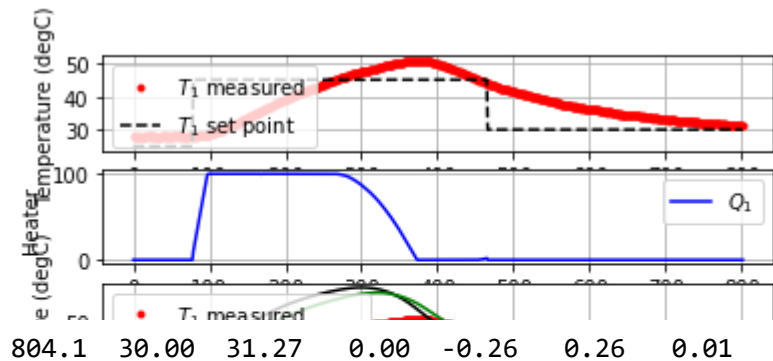


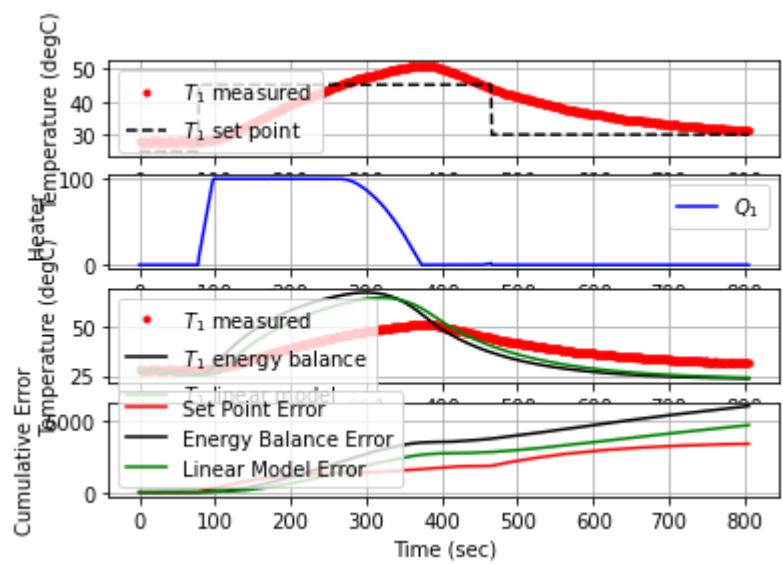
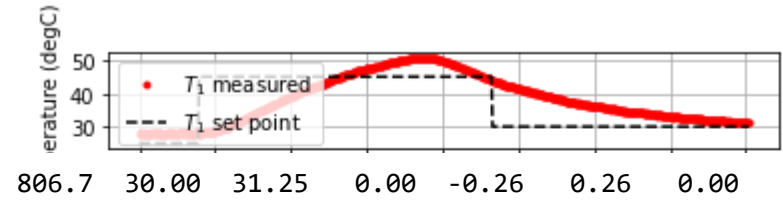
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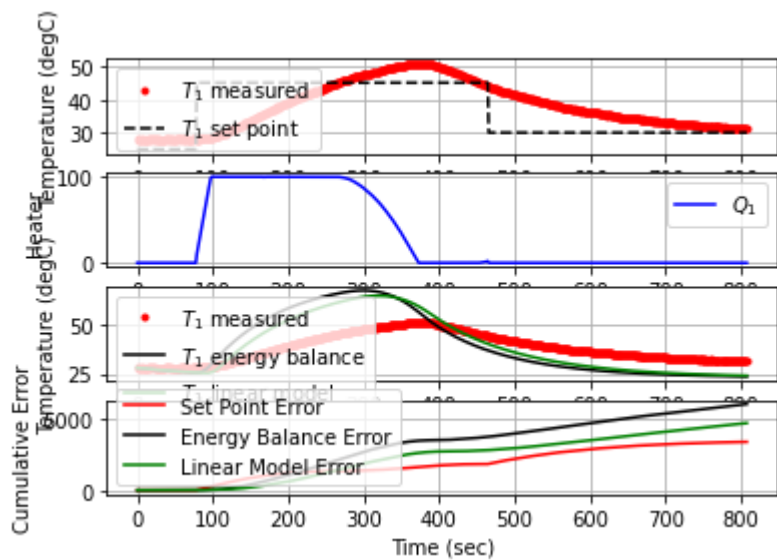
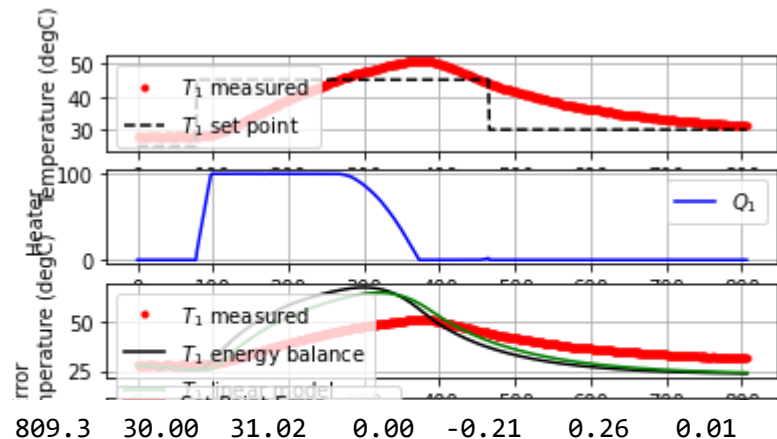
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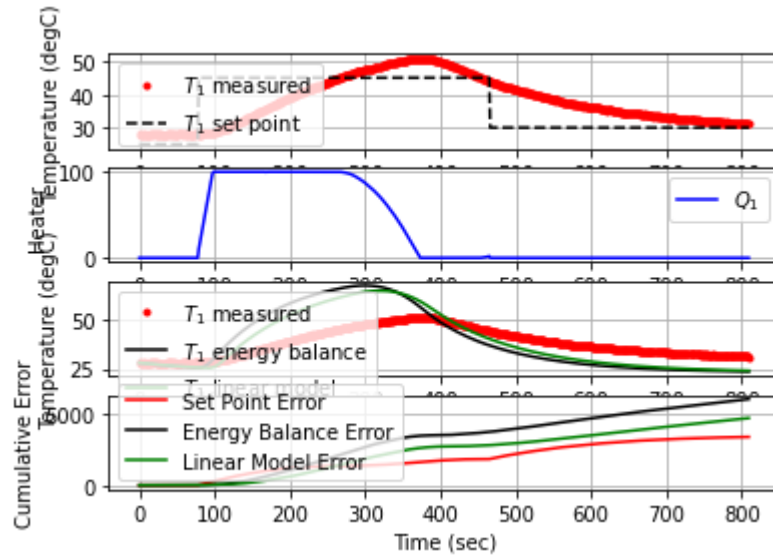




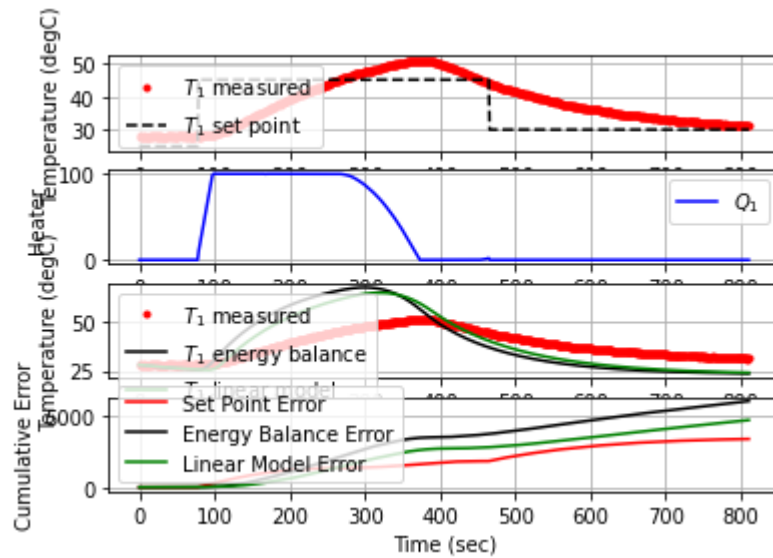
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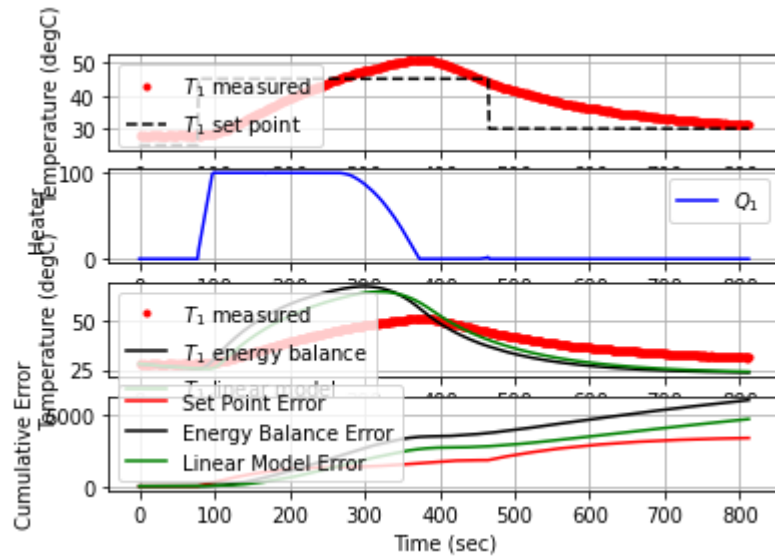
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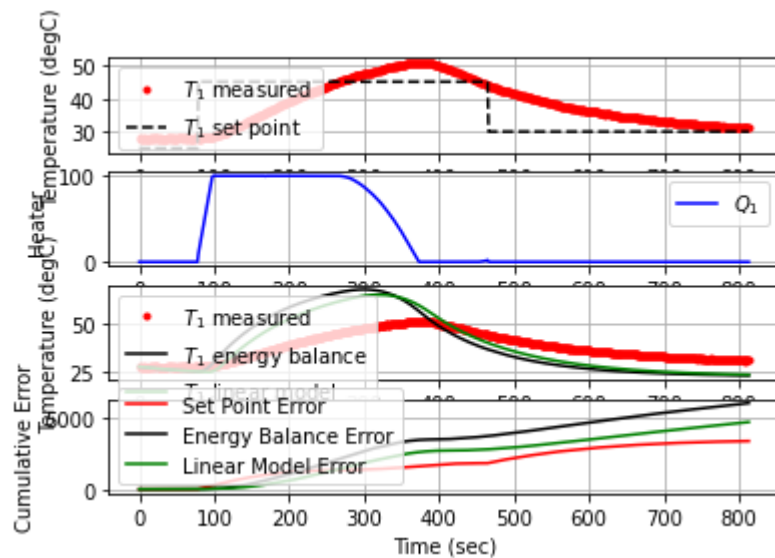
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813.1 30.00 31.14 0.00 -0.23 0.26 -0.00

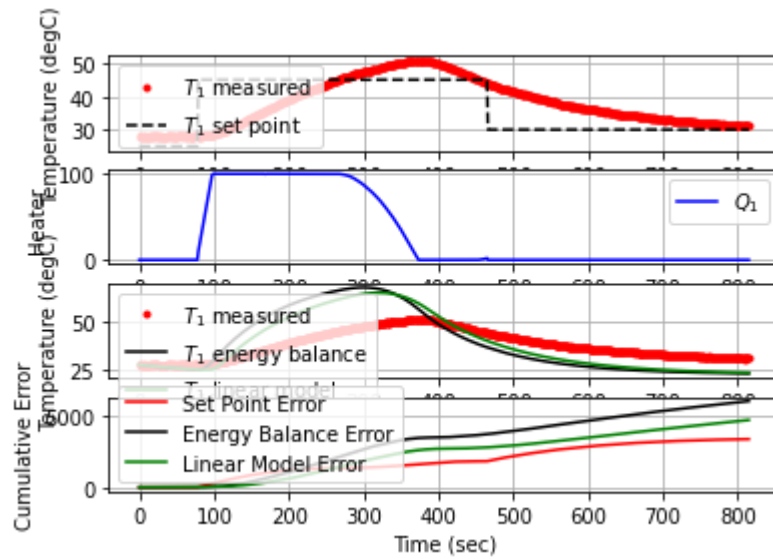


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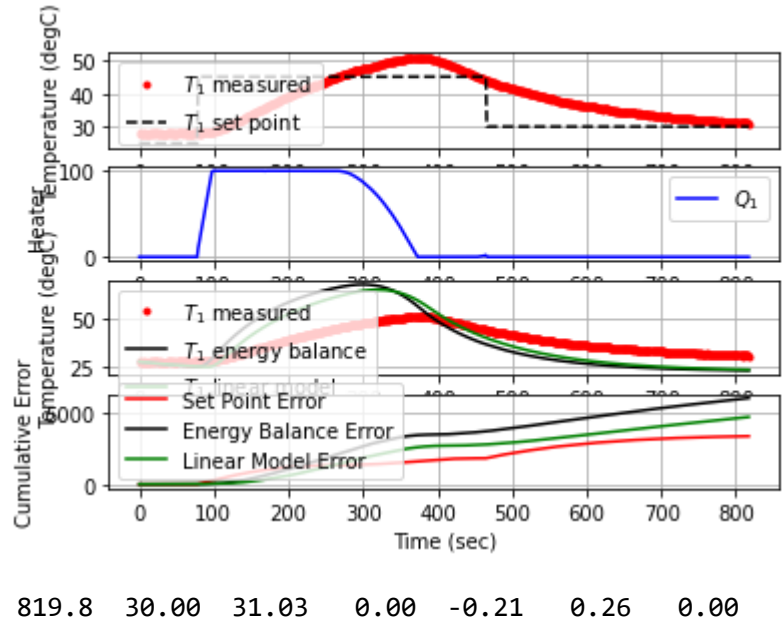
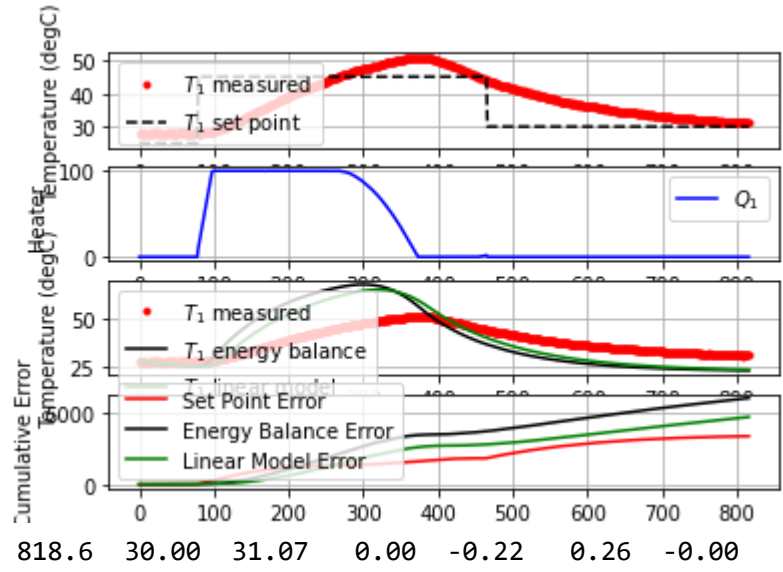


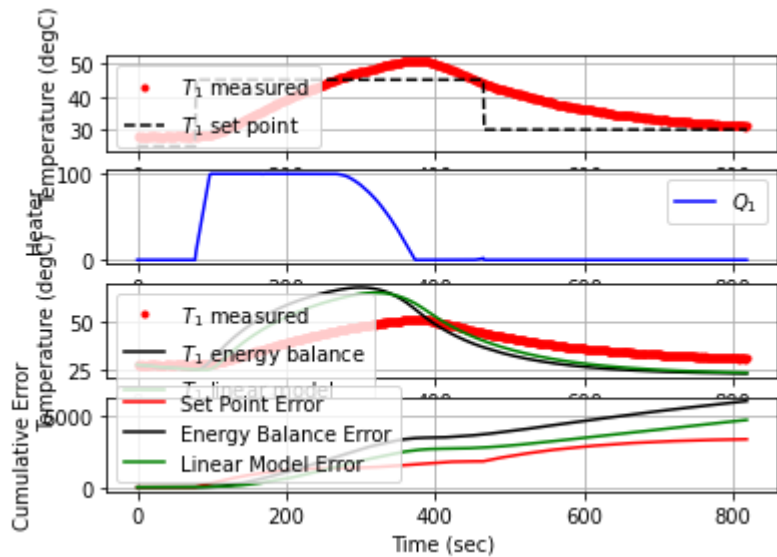


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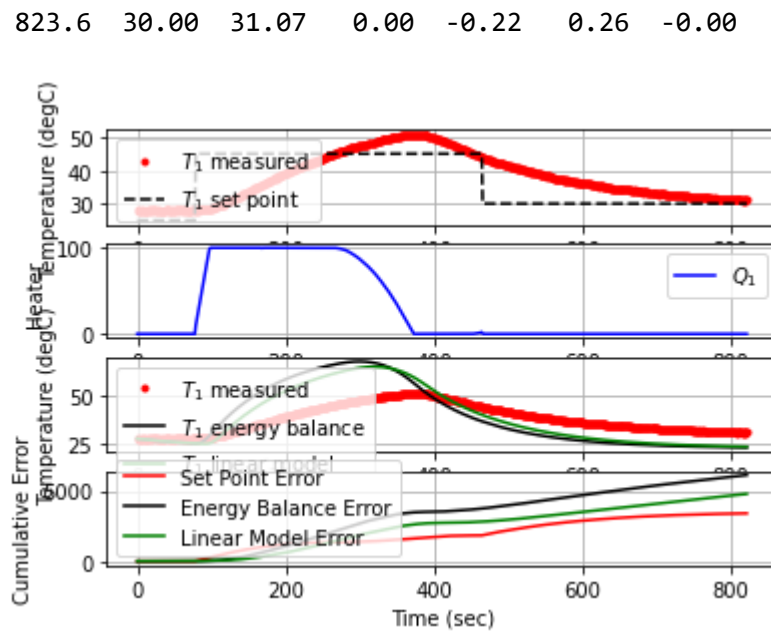
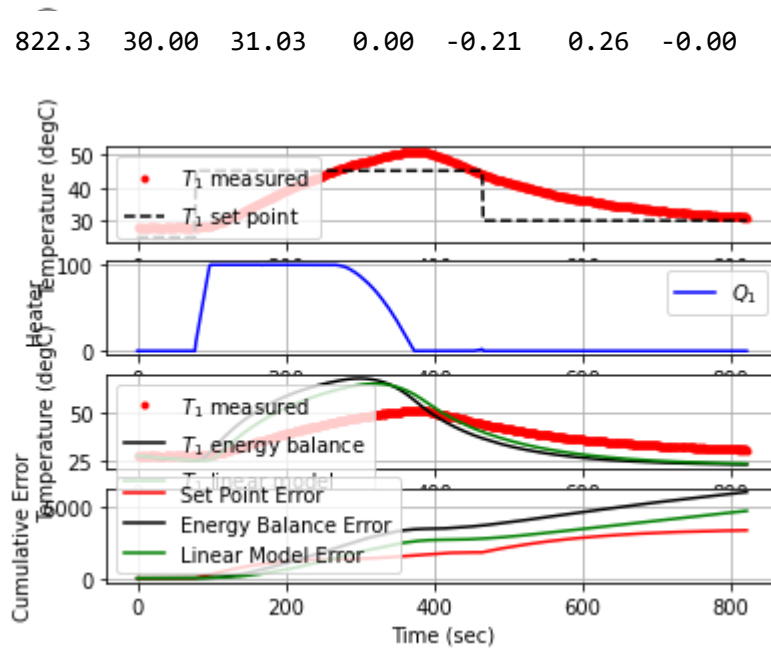


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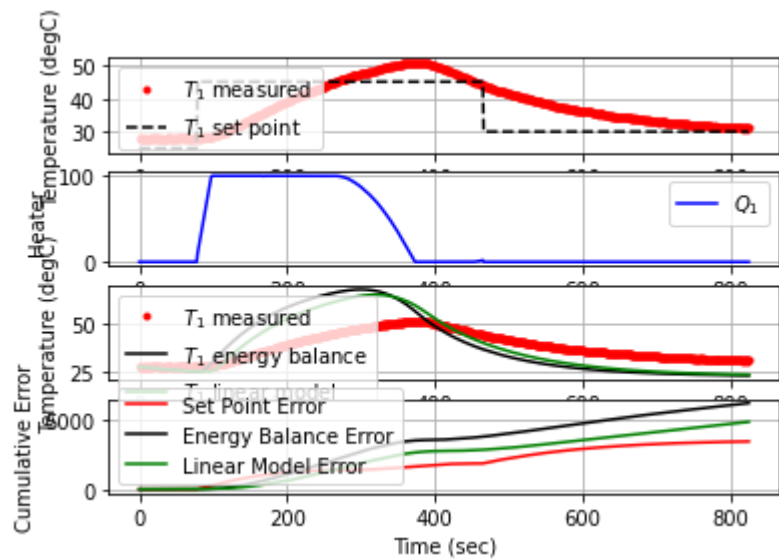
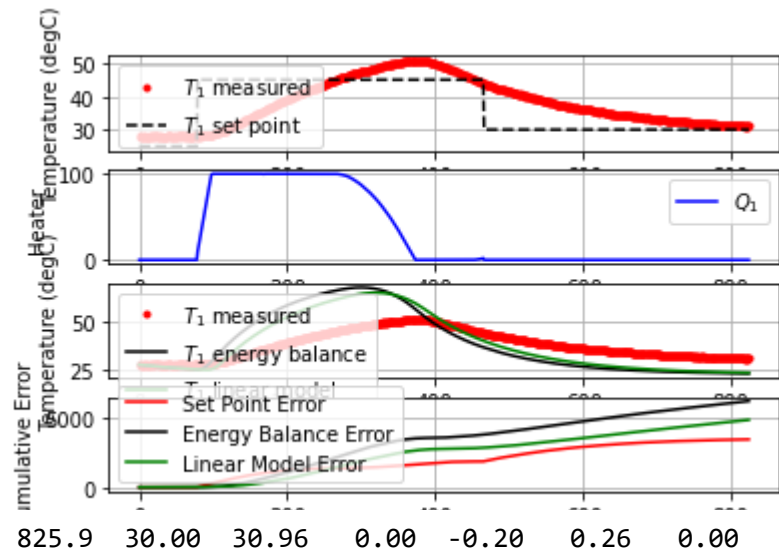




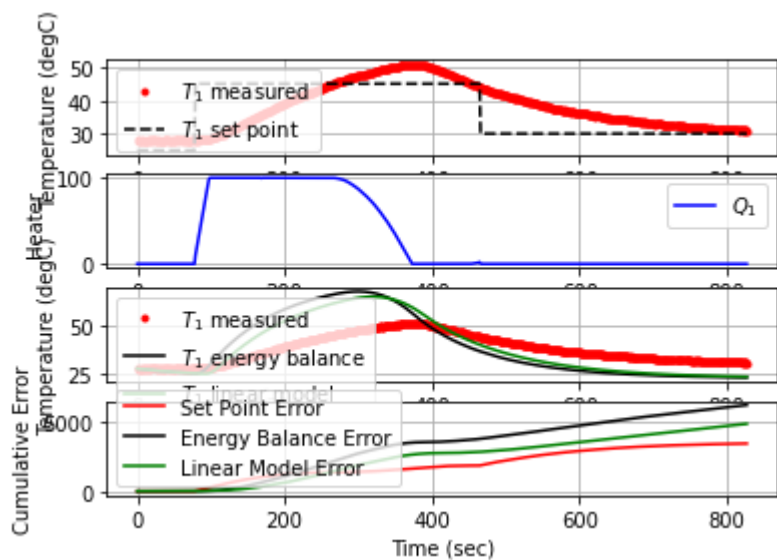
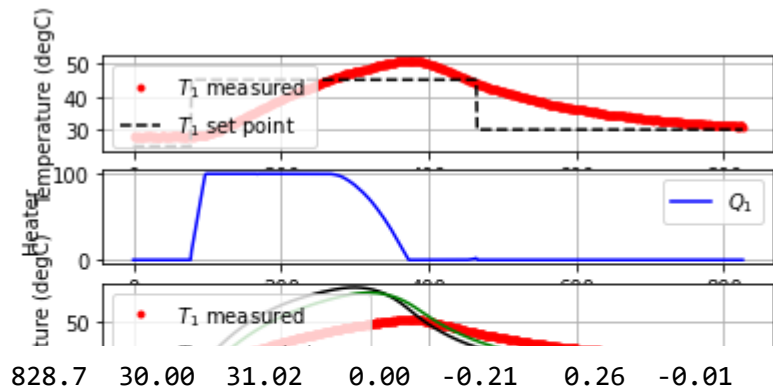
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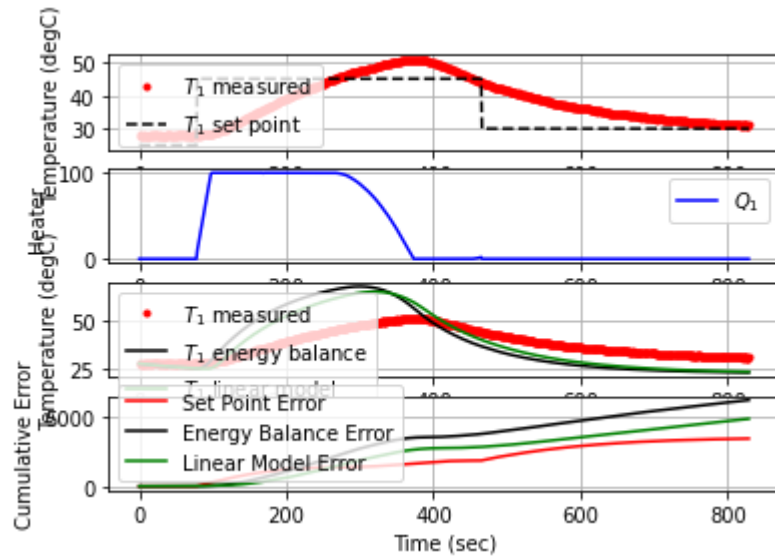
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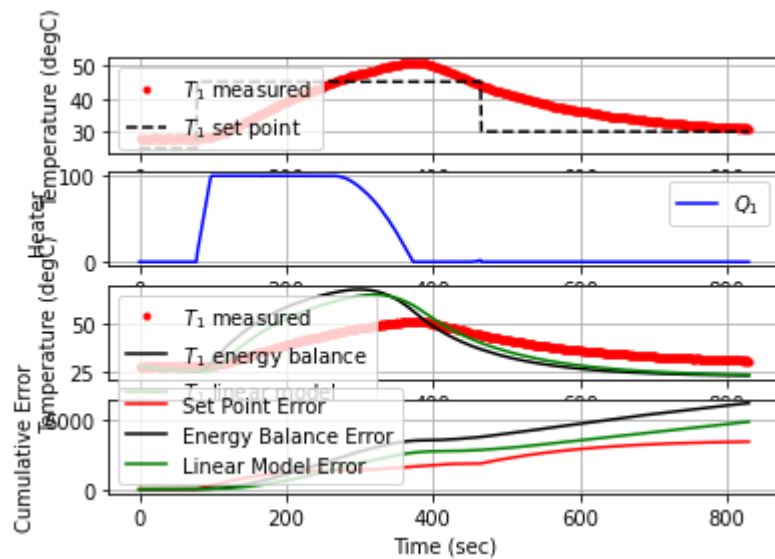
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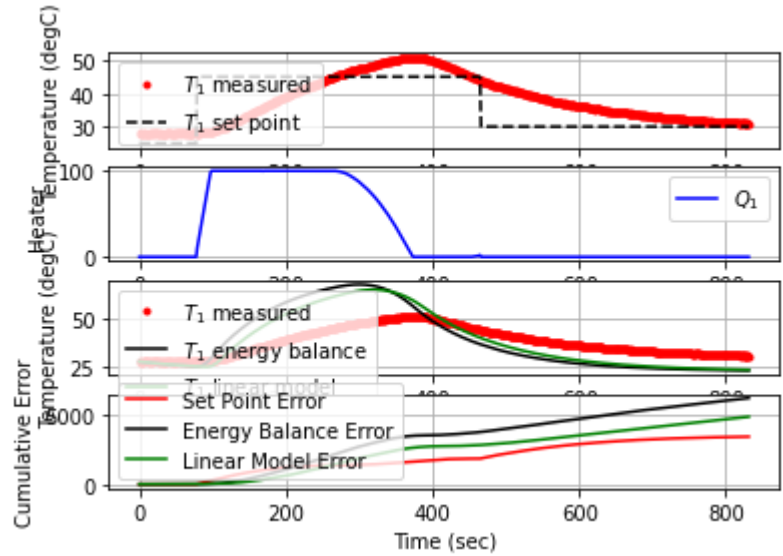
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831.2 30.00 30.89 0.00 -0.18 0.26 0.01

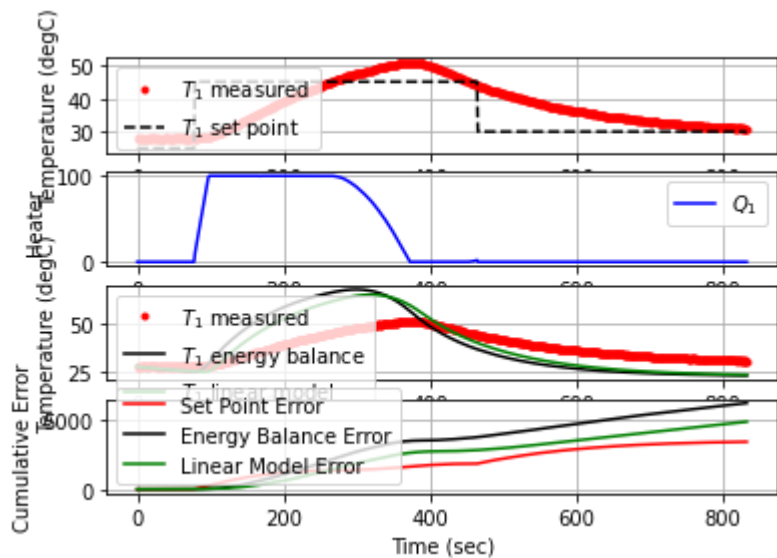
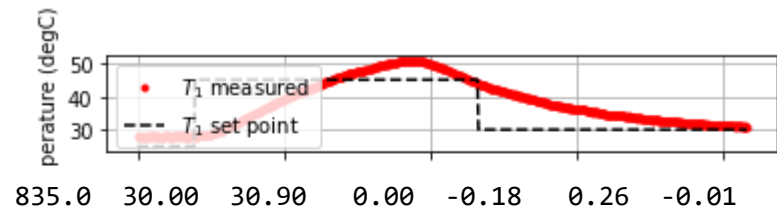


832.5 30.00 30.90 0.00 -0.18 0.26 -0.00



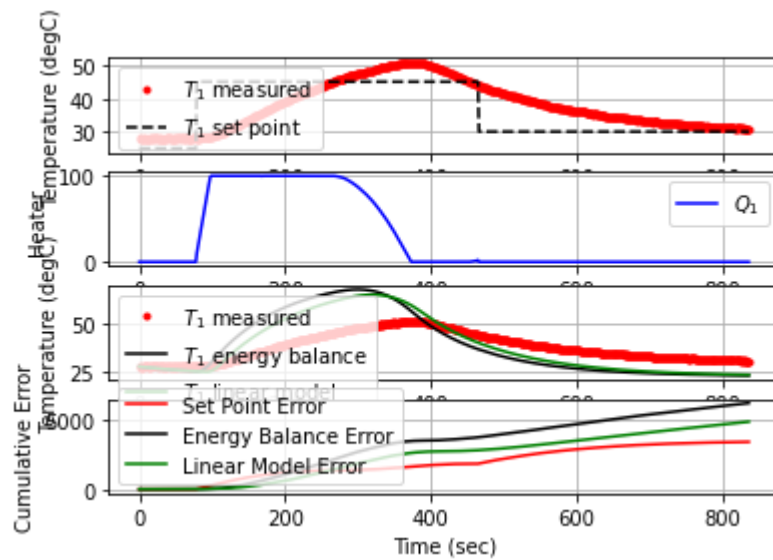
833.8 30.00 30.81 0.00 -0.17 0.26 0.00



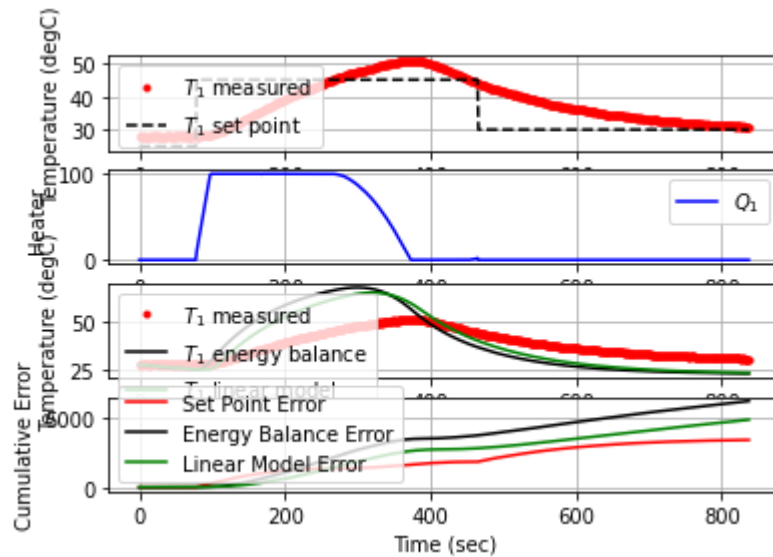


836.2 30.00 30.79 0.00 -0.16 0.26 0.01

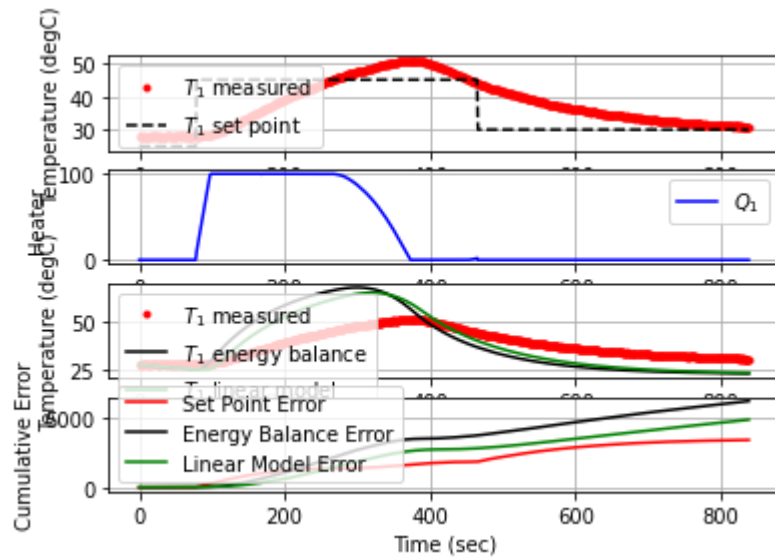
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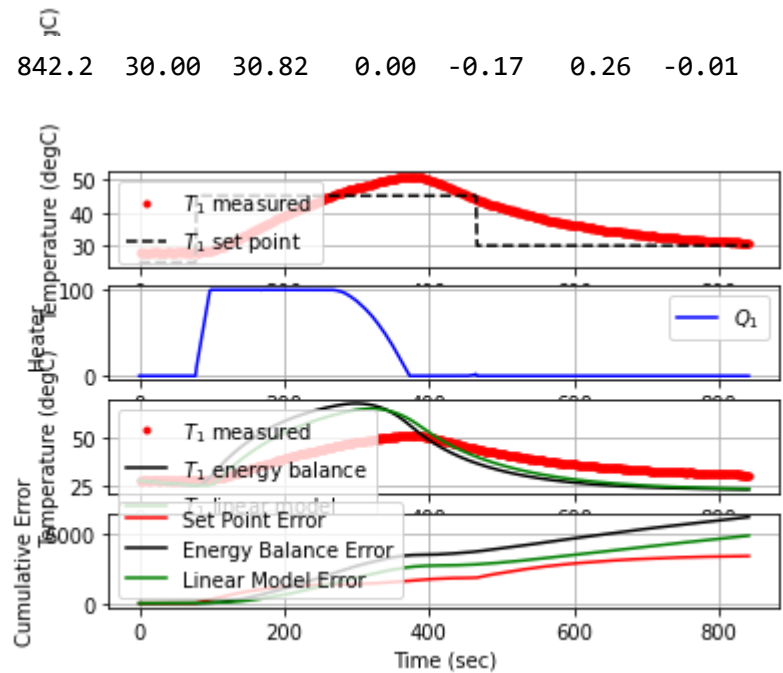
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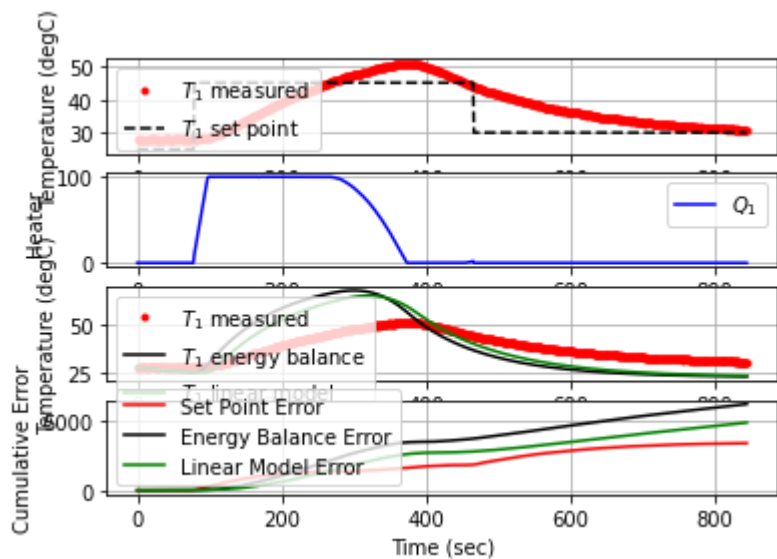
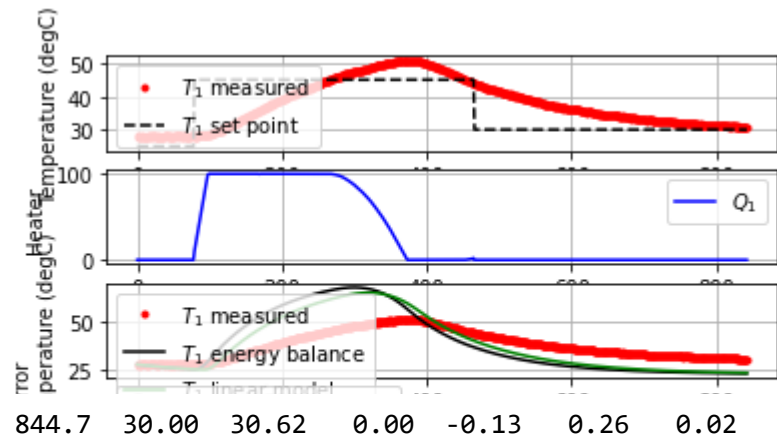
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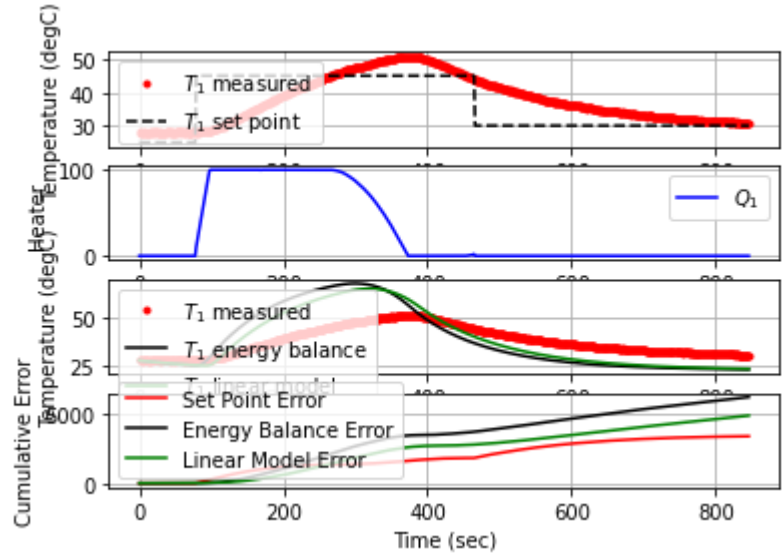
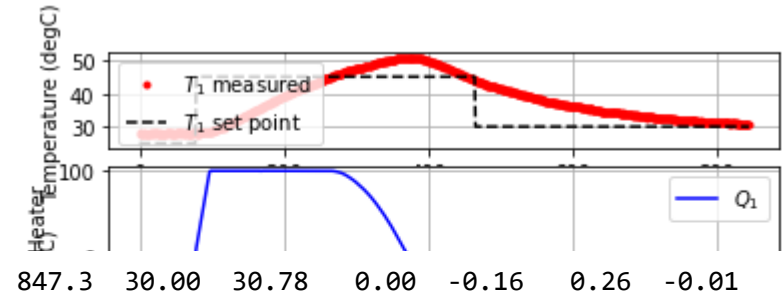


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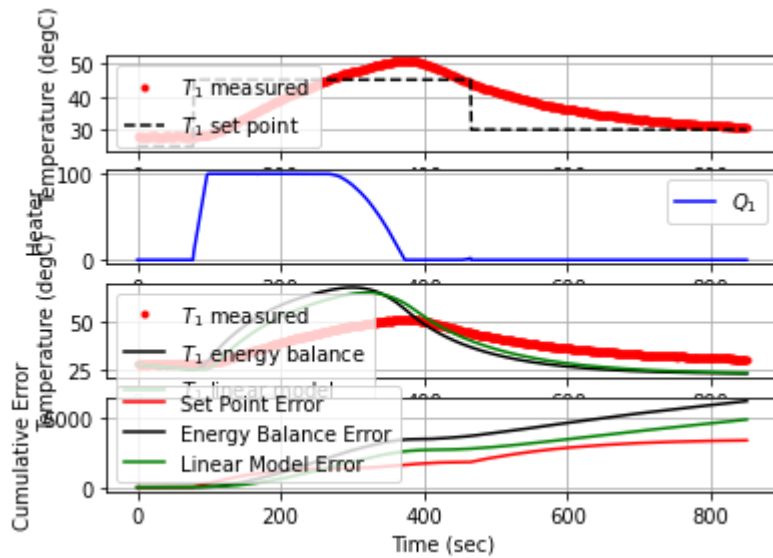
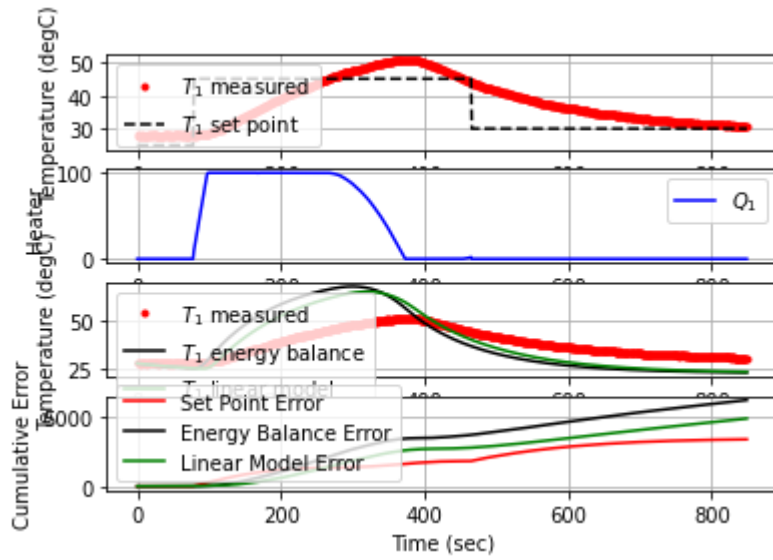
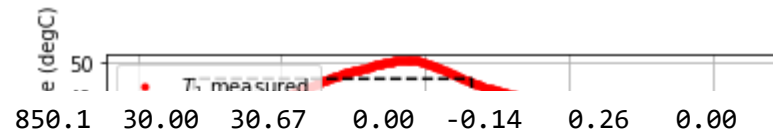


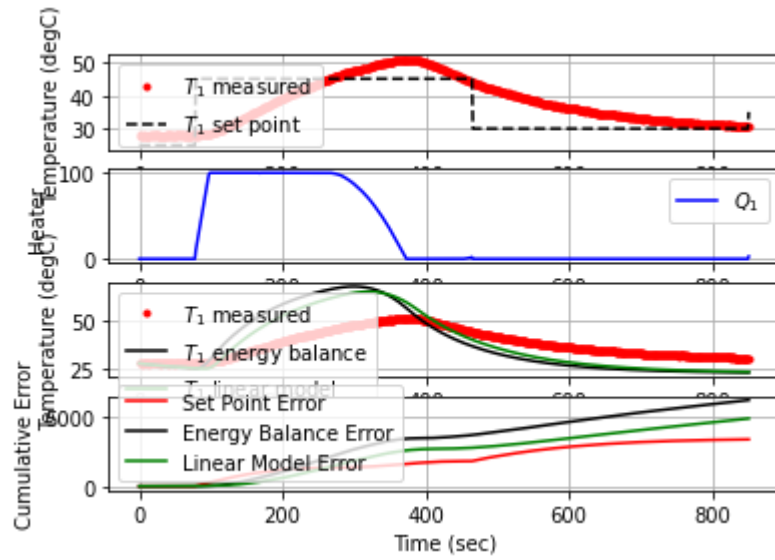
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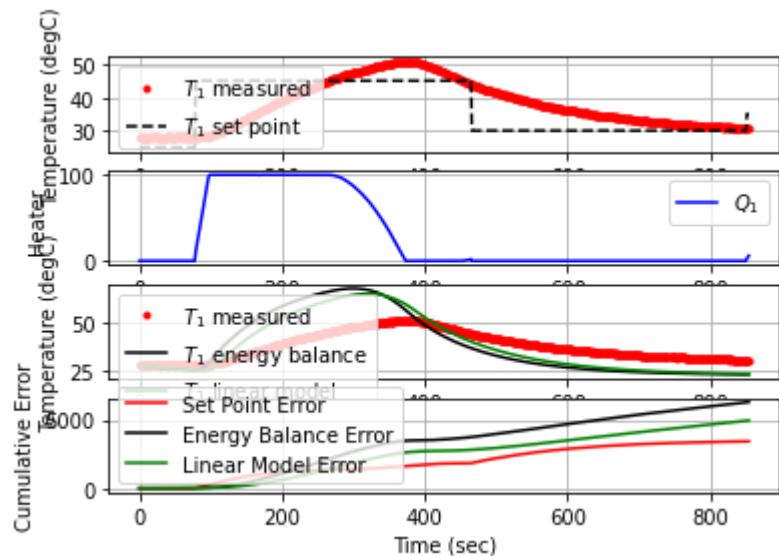
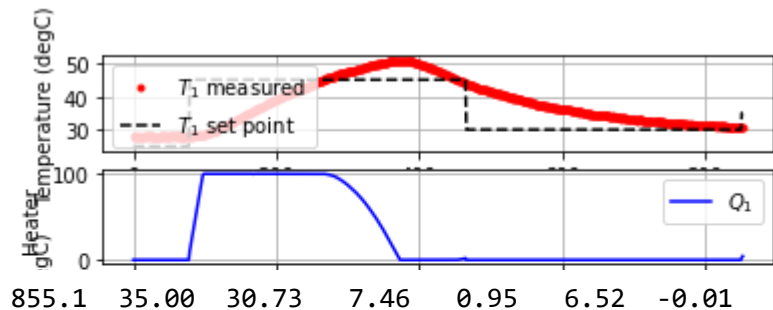
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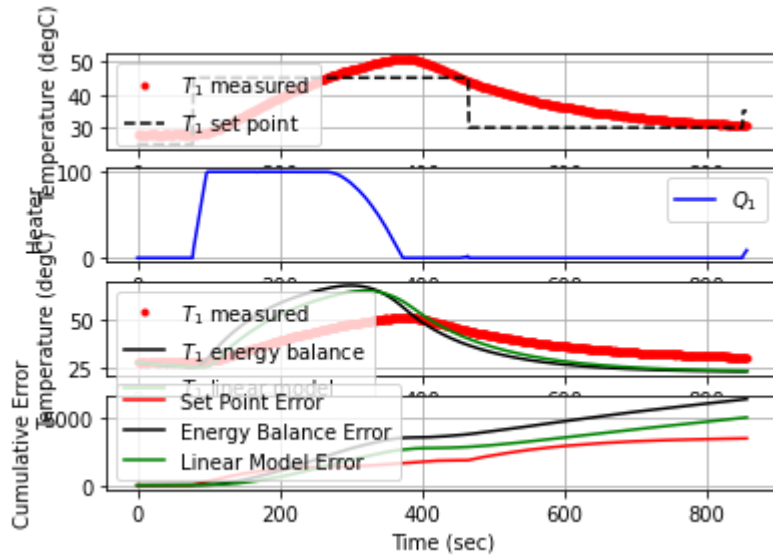
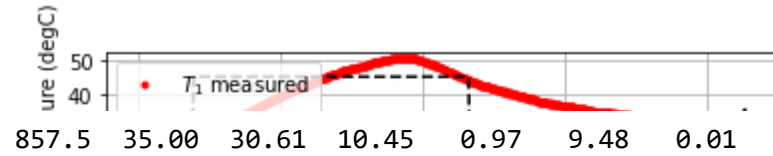




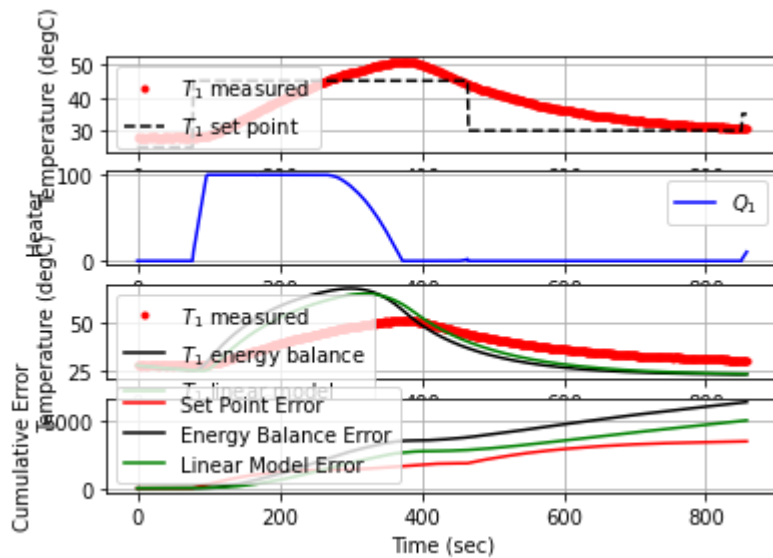
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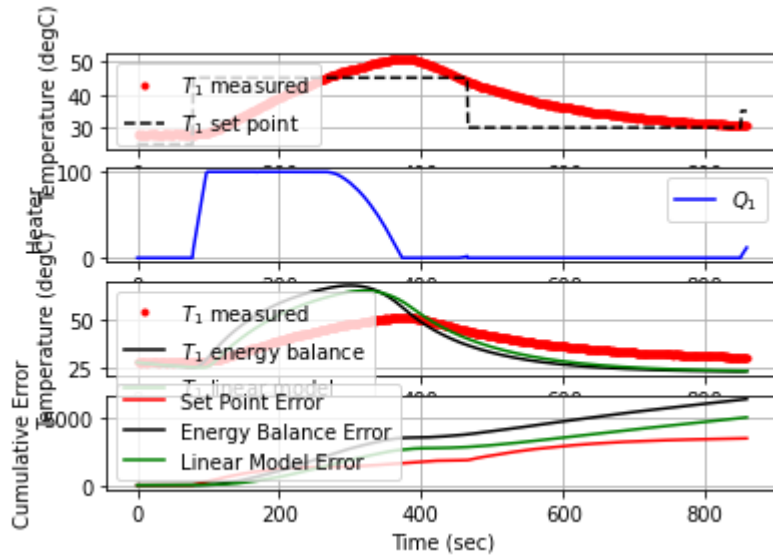




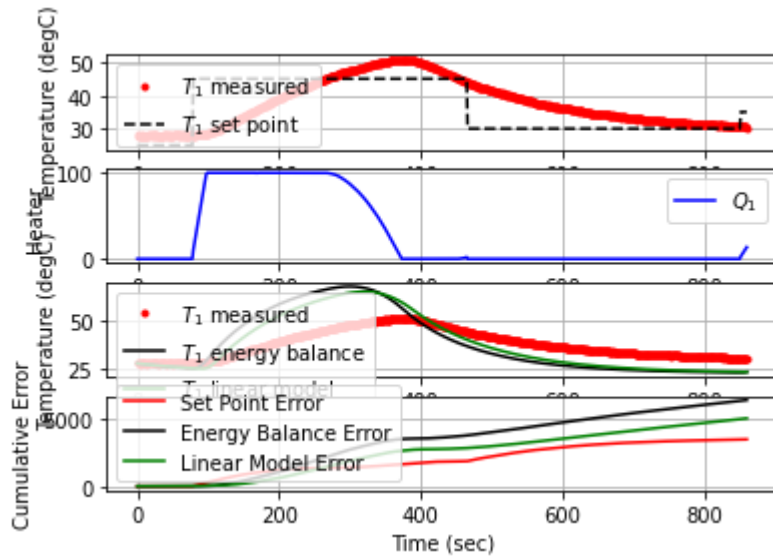
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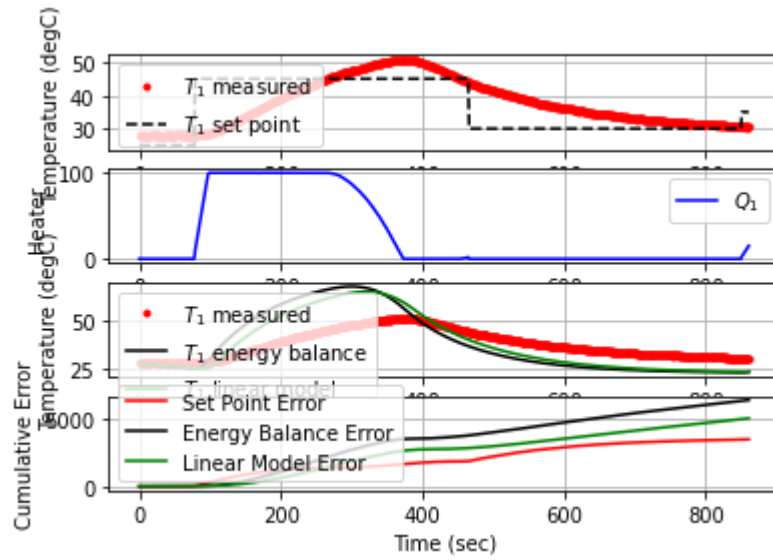
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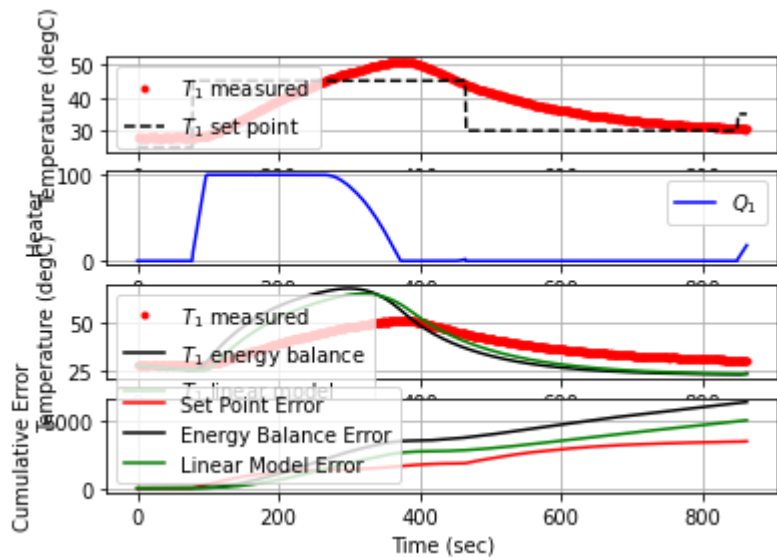
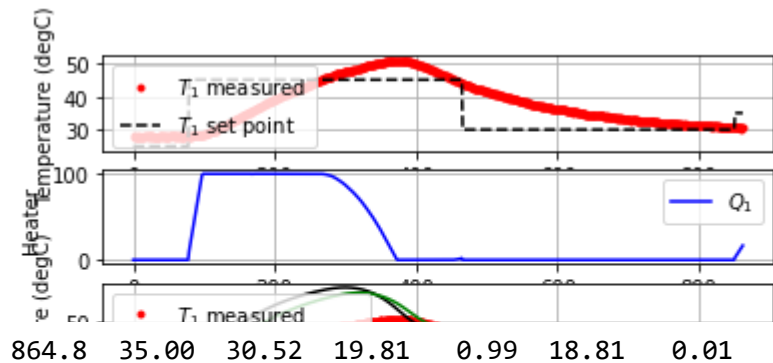
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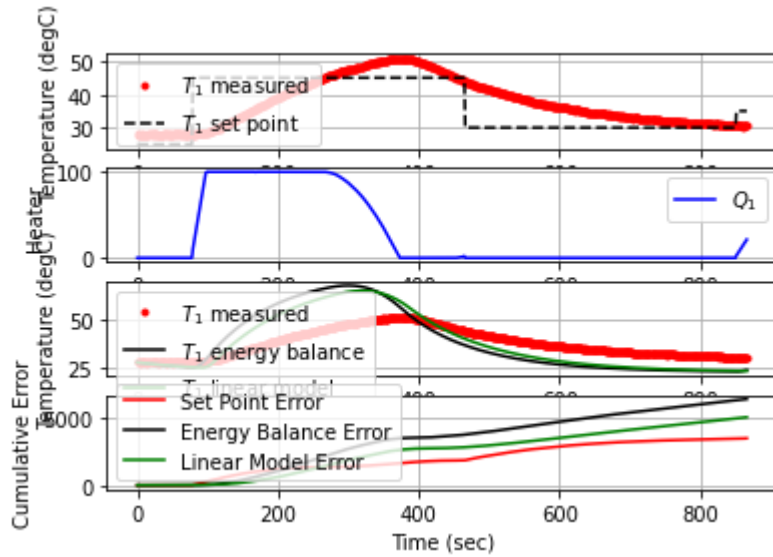
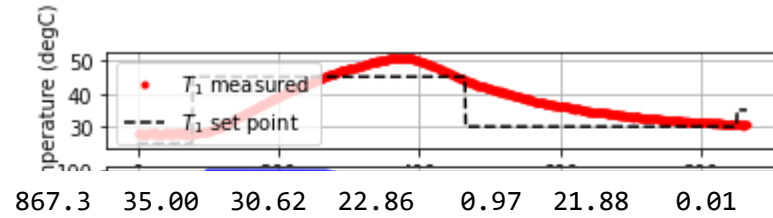
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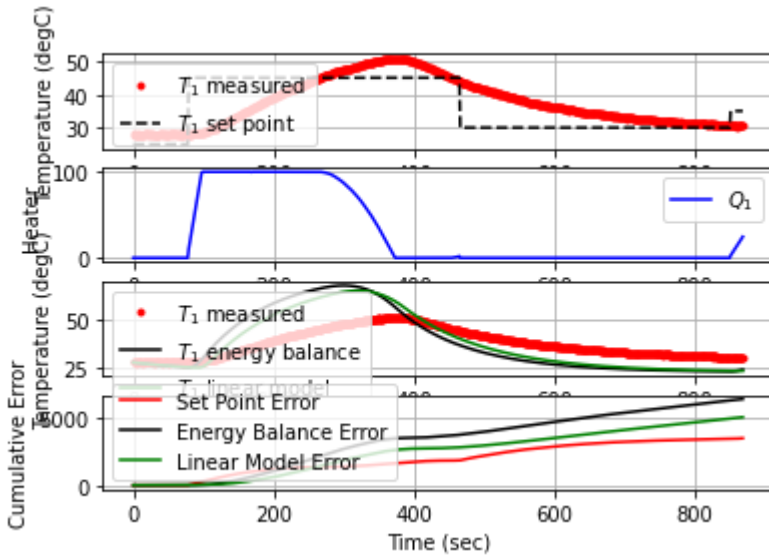
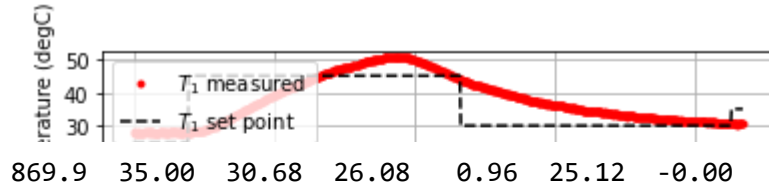
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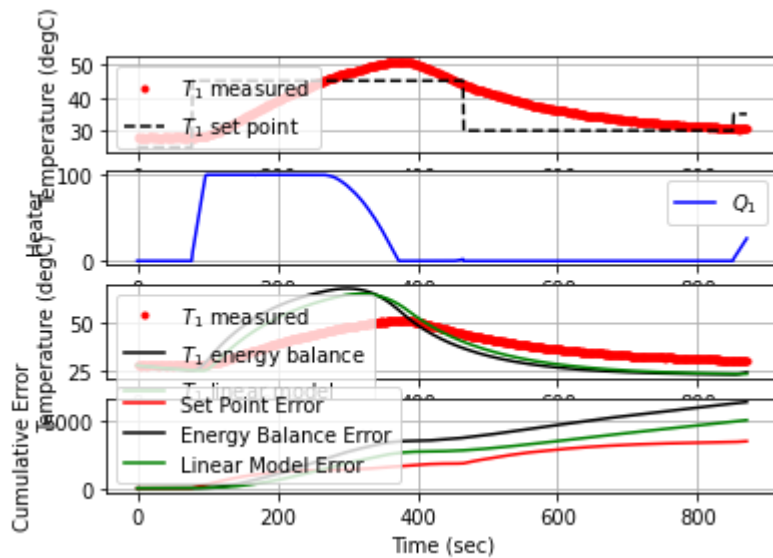
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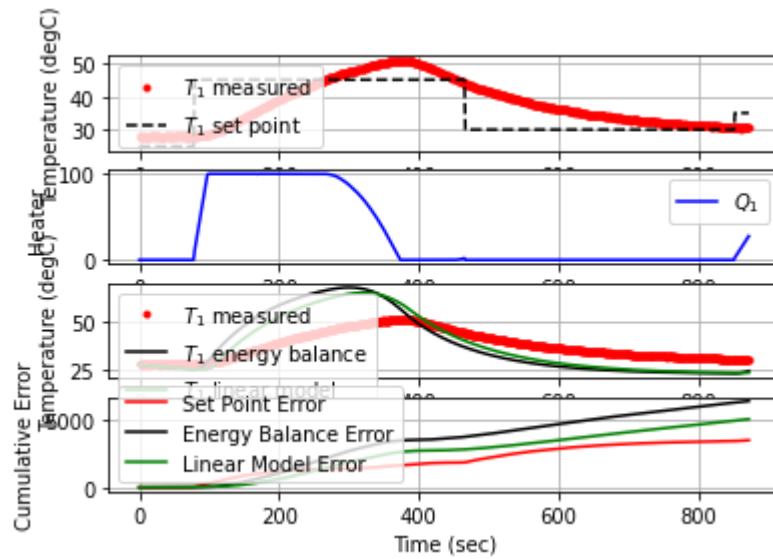
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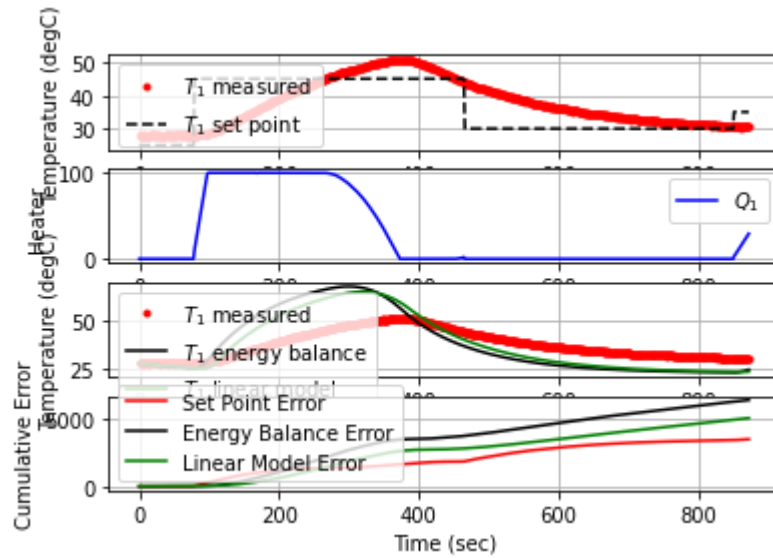
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872.4 35.00 30.78 29.18 0.93 28.25 -0.01

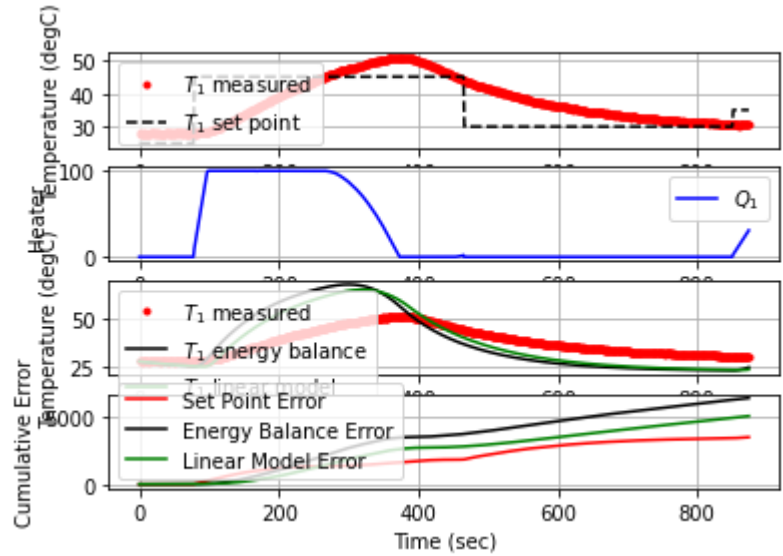


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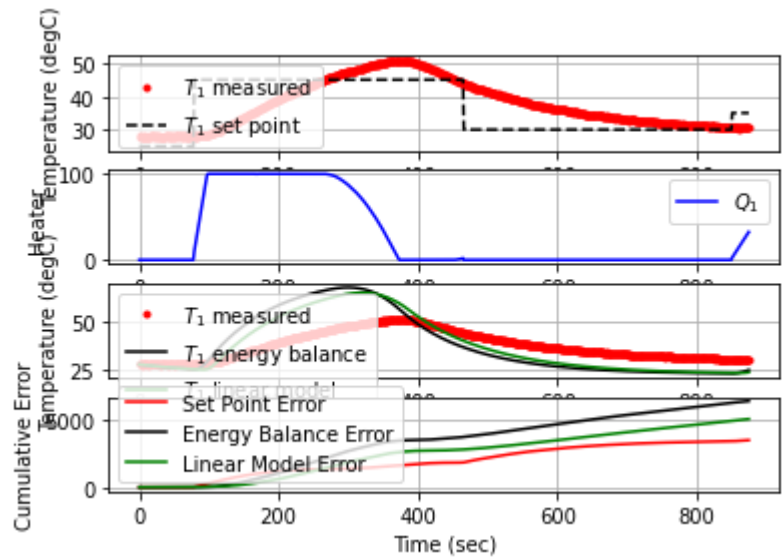


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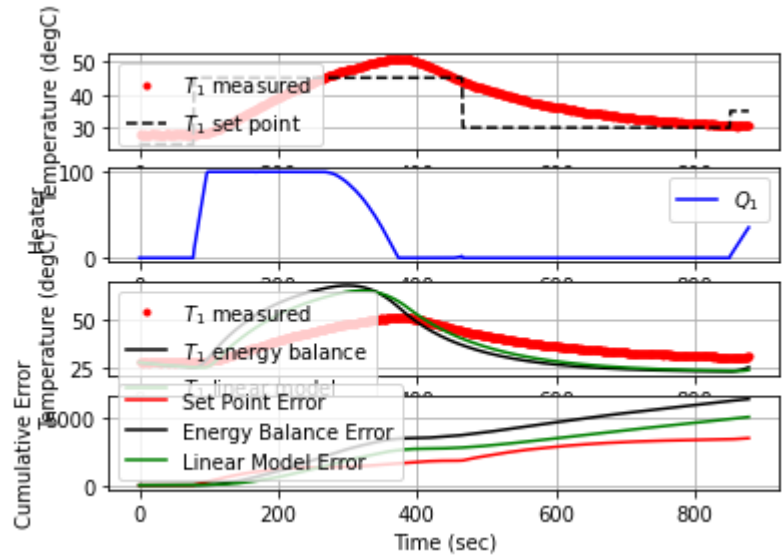
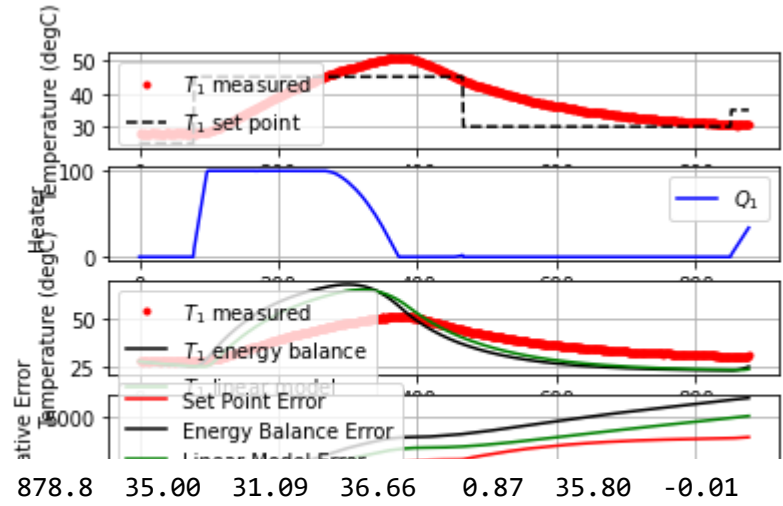




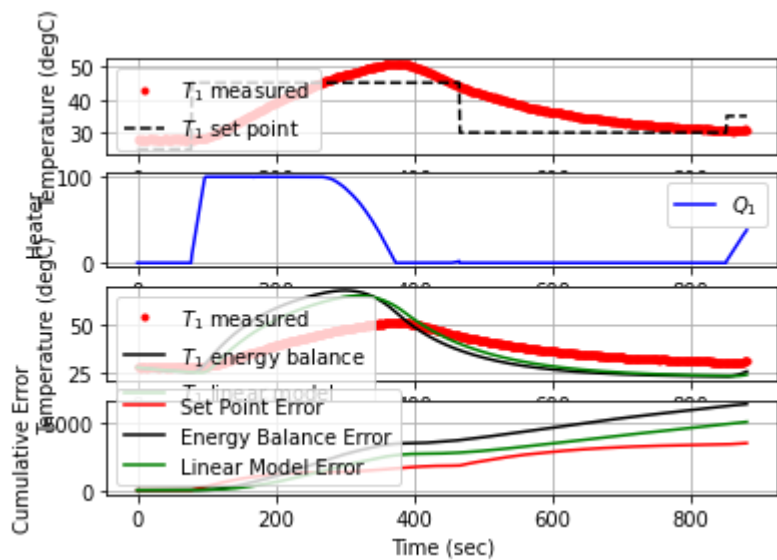
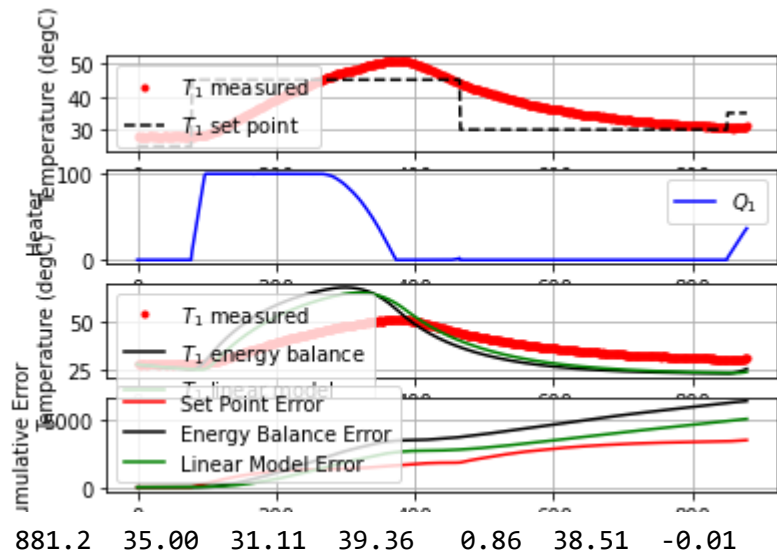
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877.6 35.00 30.97 35.32 0.89 34.43 -0.00

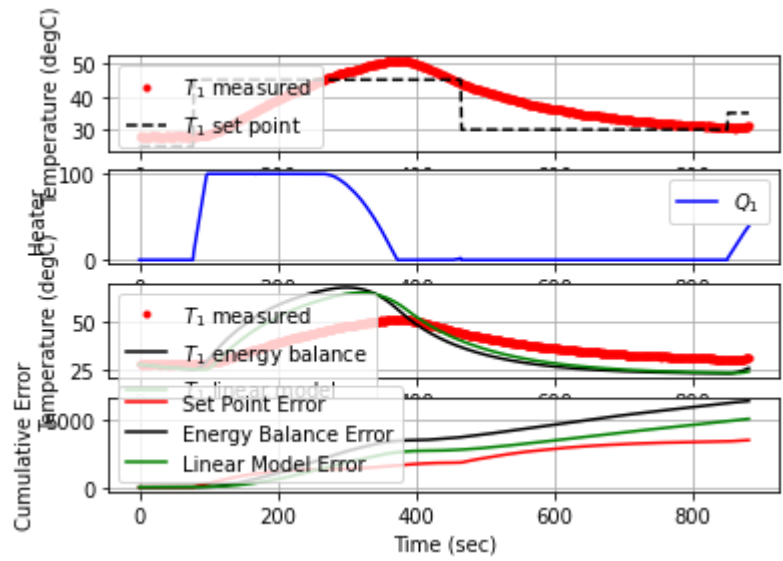


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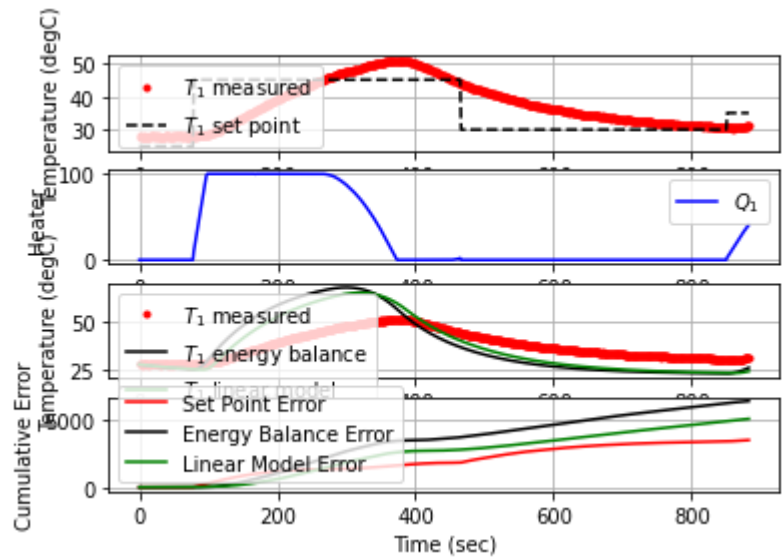




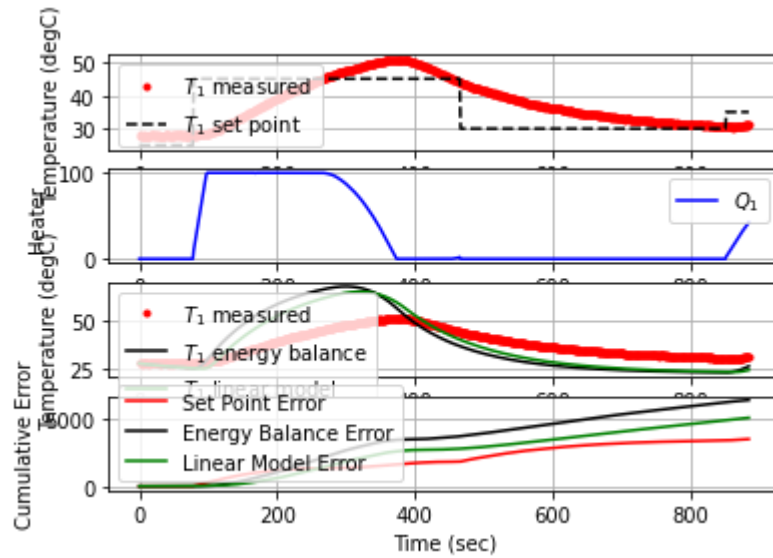
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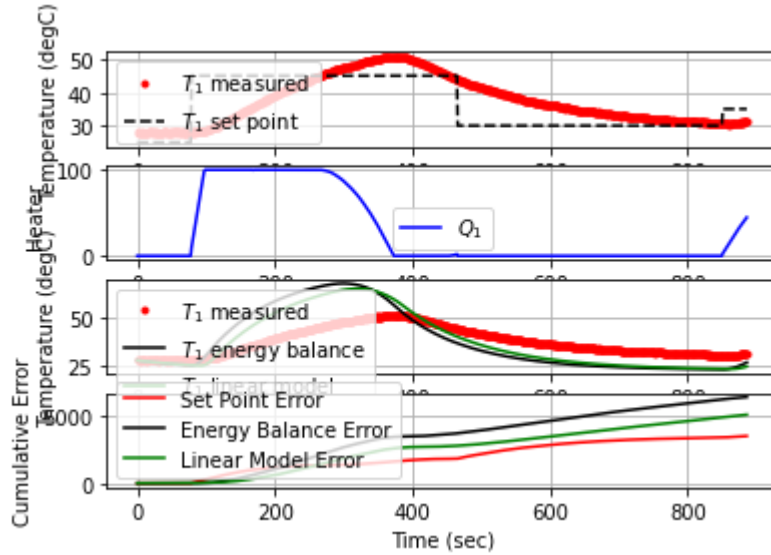
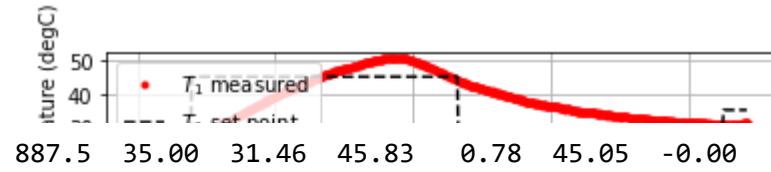
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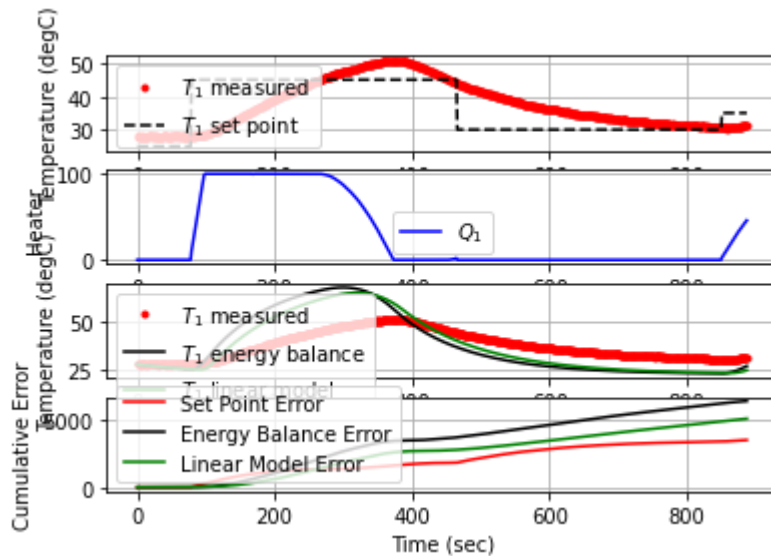
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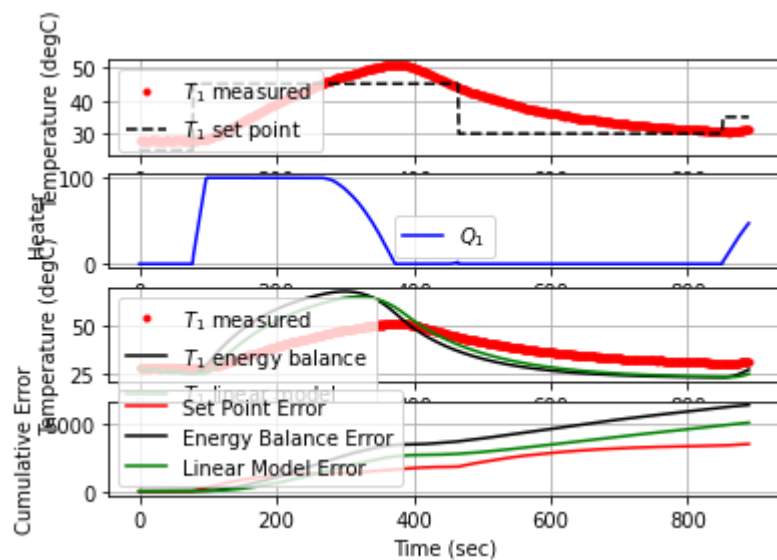
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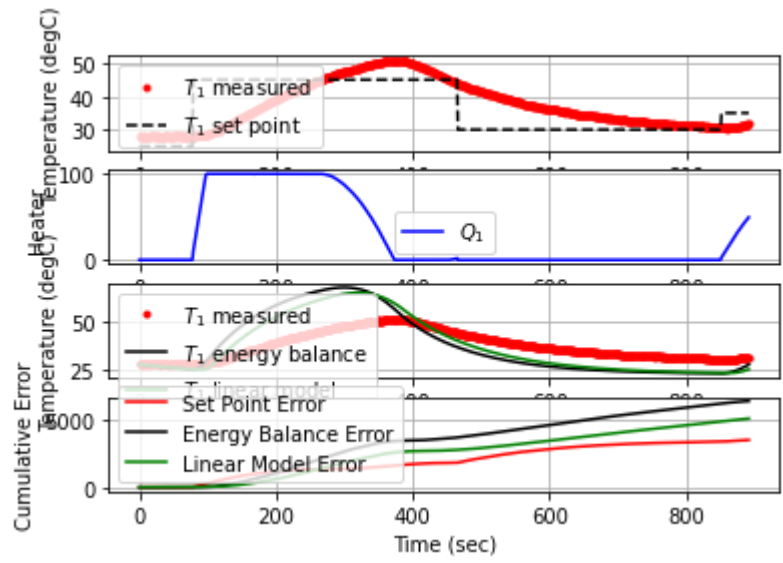
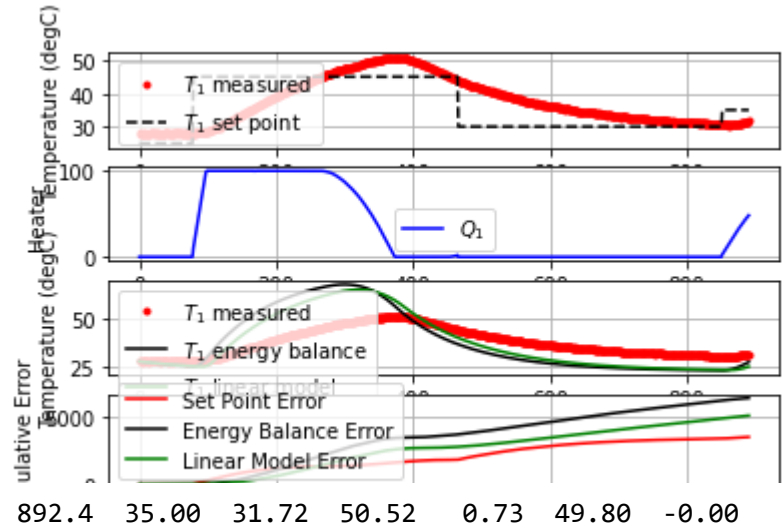
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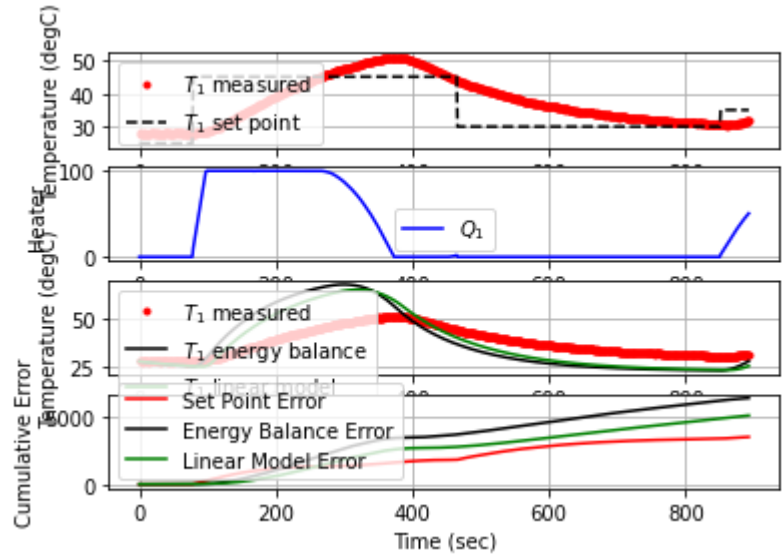
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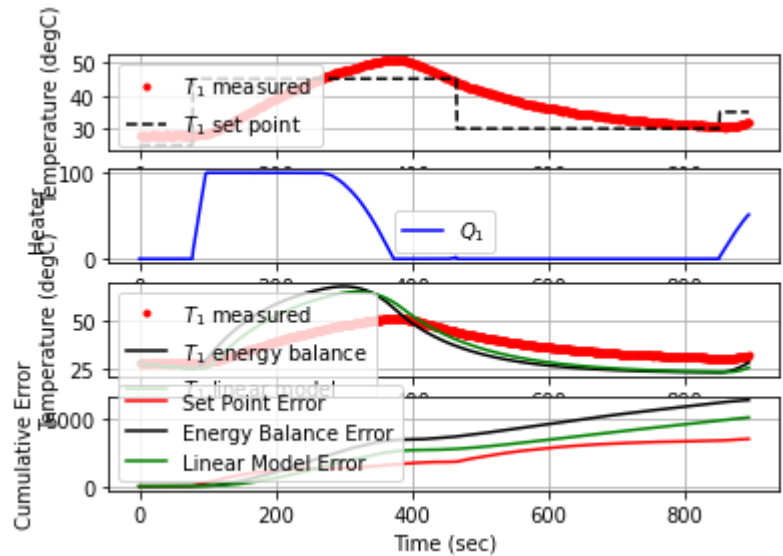
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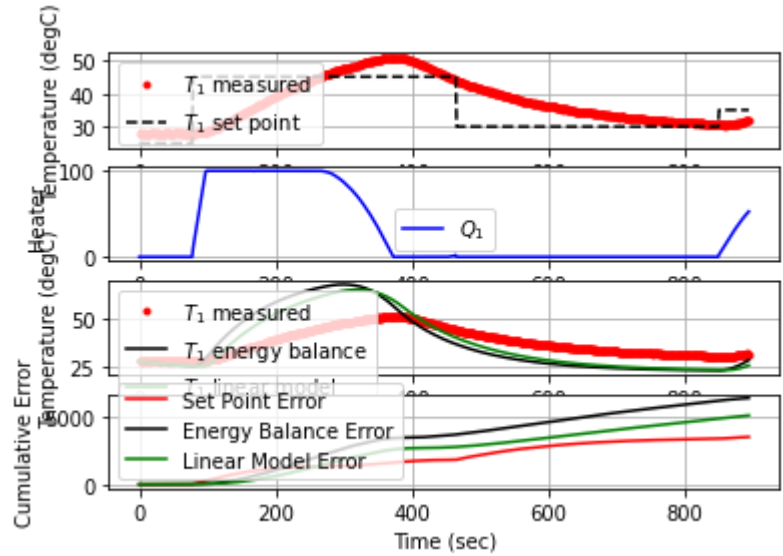




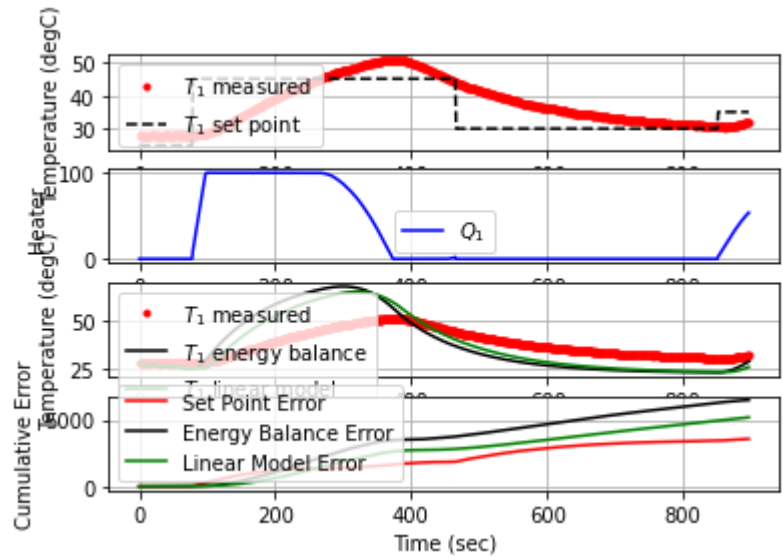
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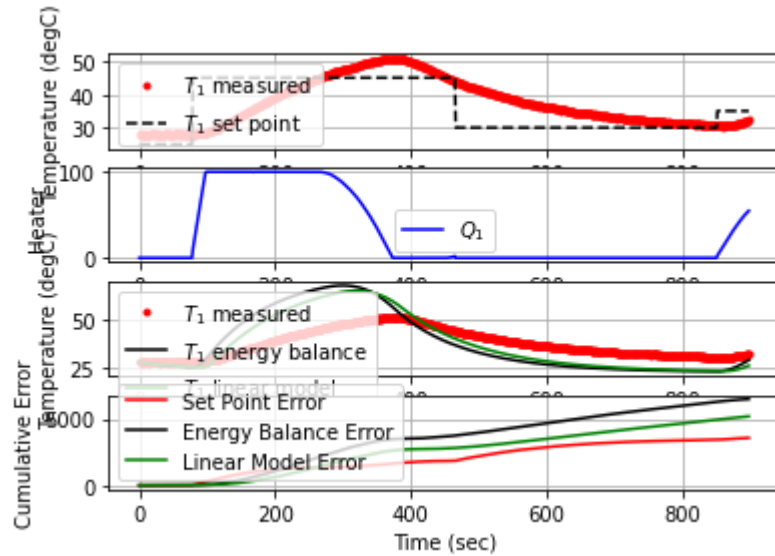
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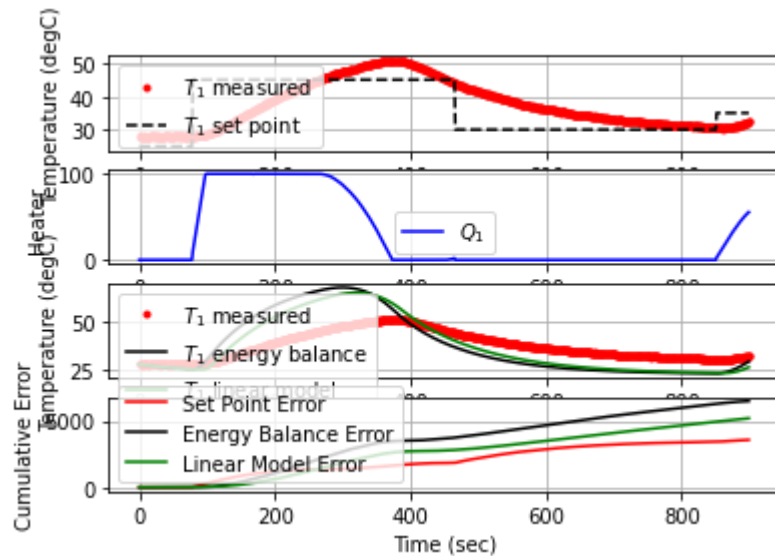
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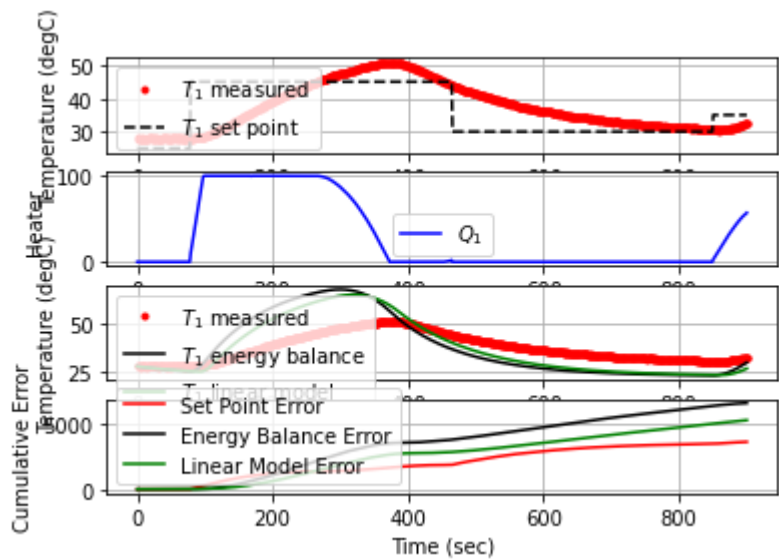
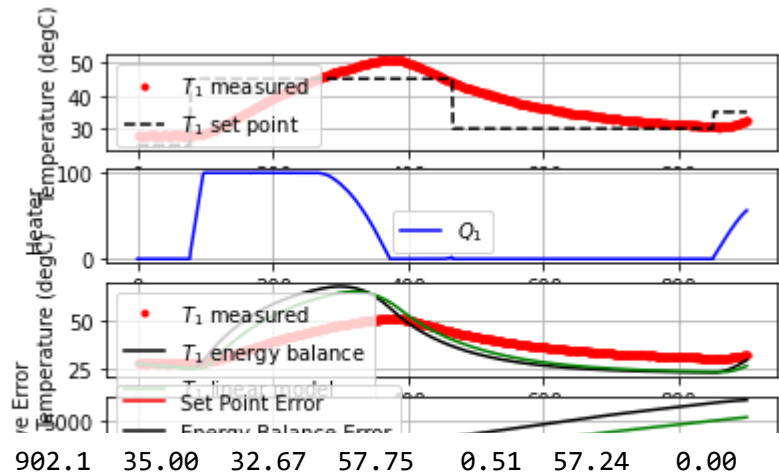
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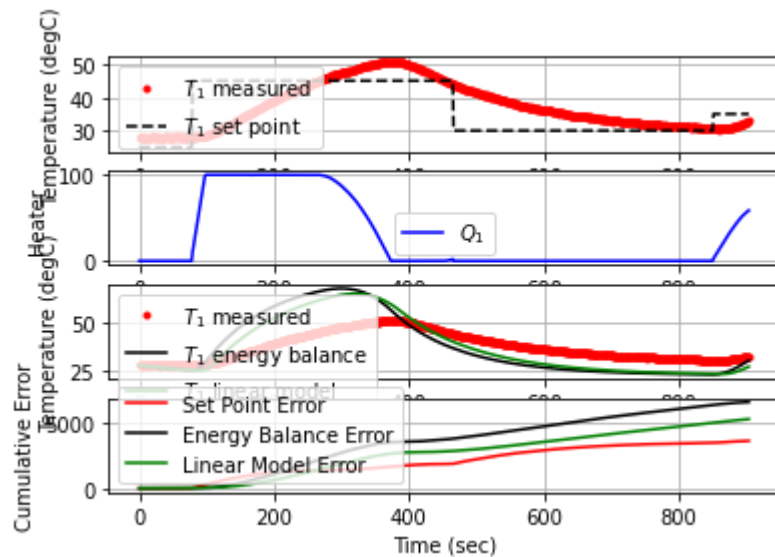
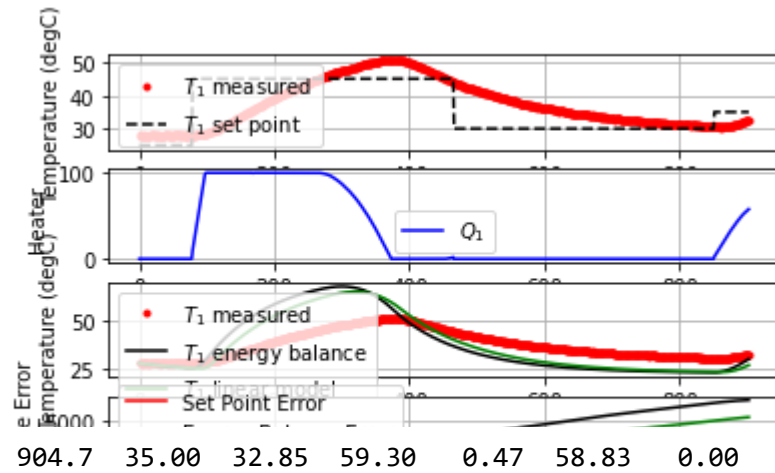


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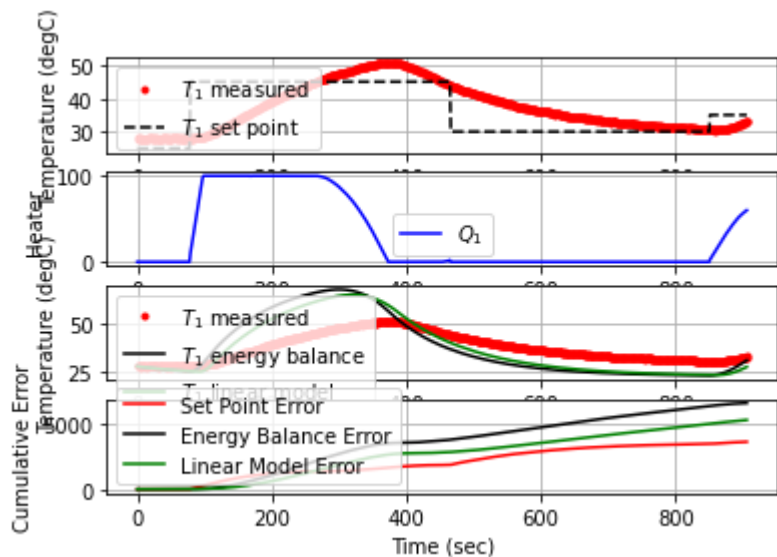
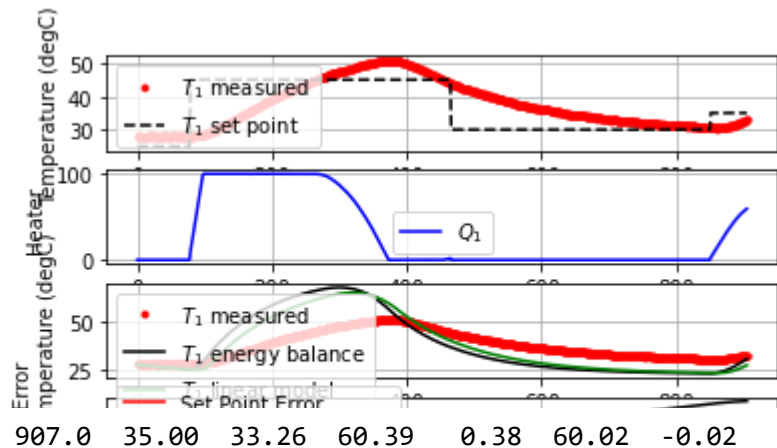


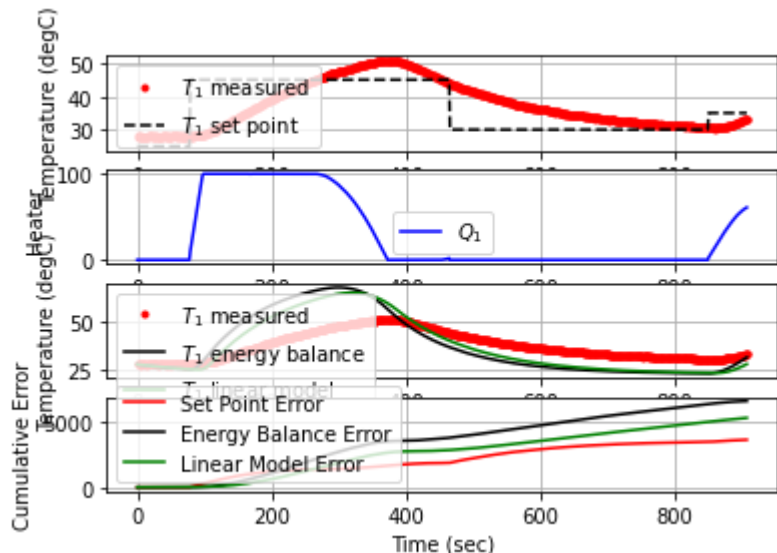
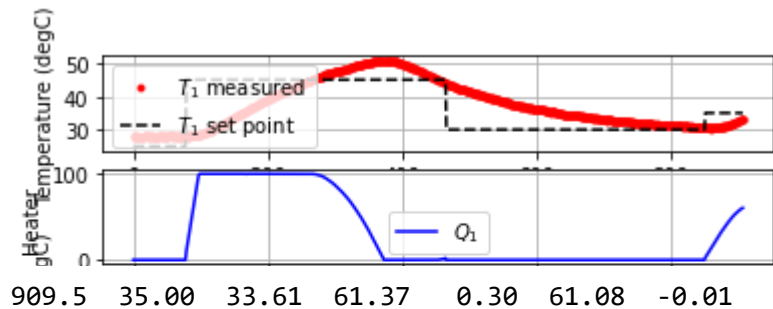
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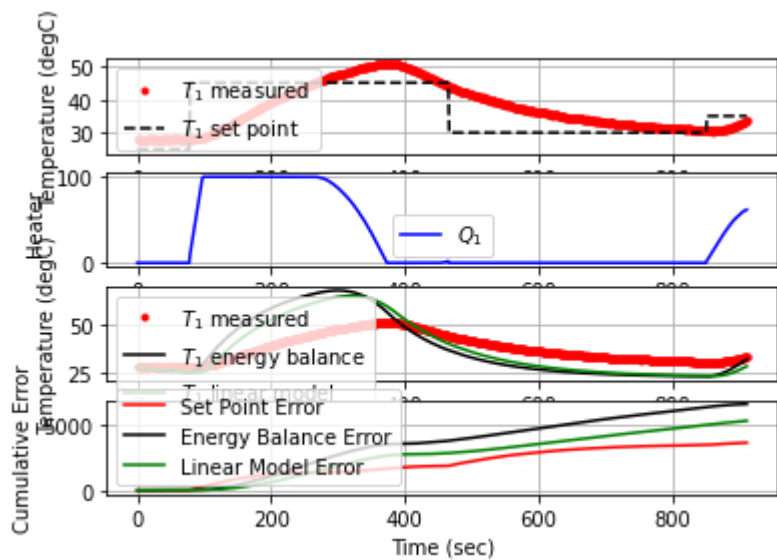
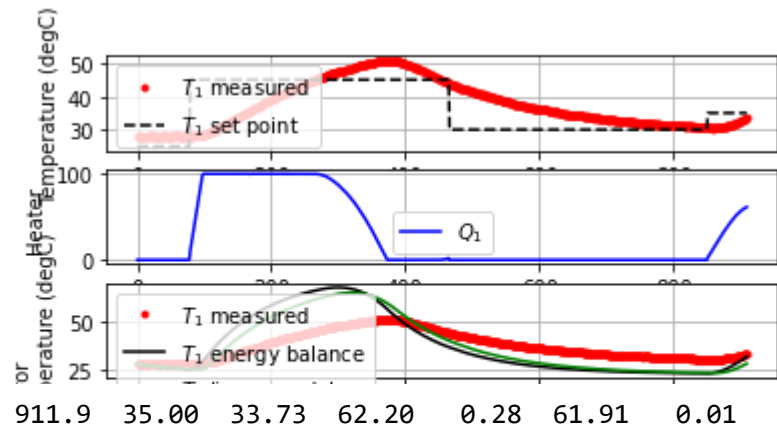


905.9 35.00 33.05 59.87 0.43 59.46 -0.01



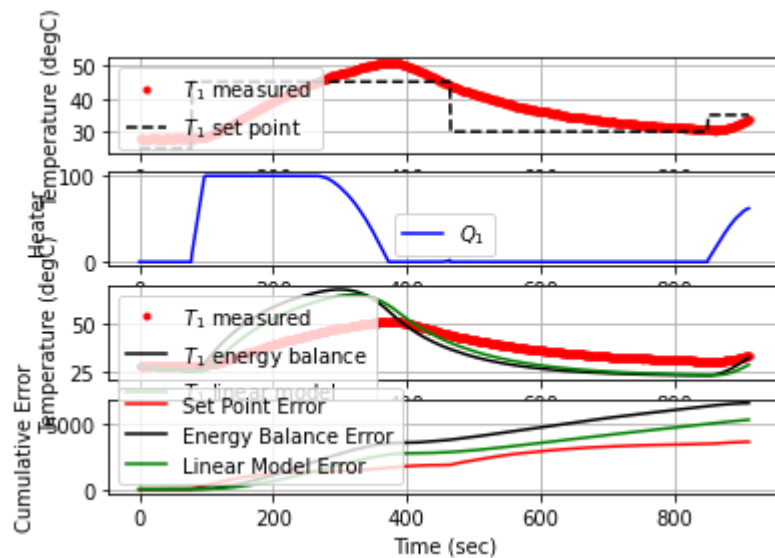


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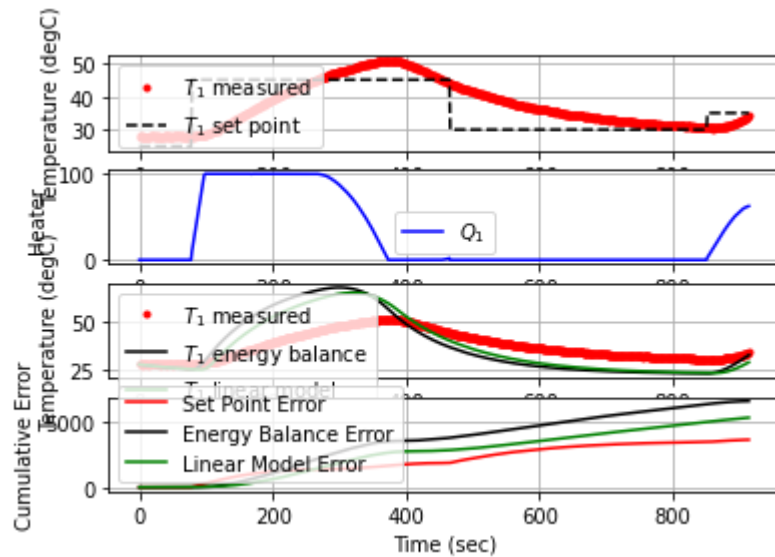




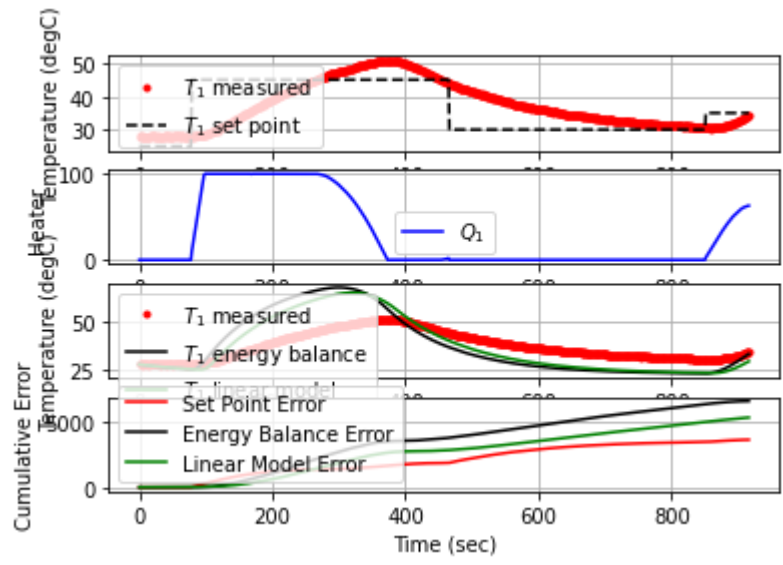
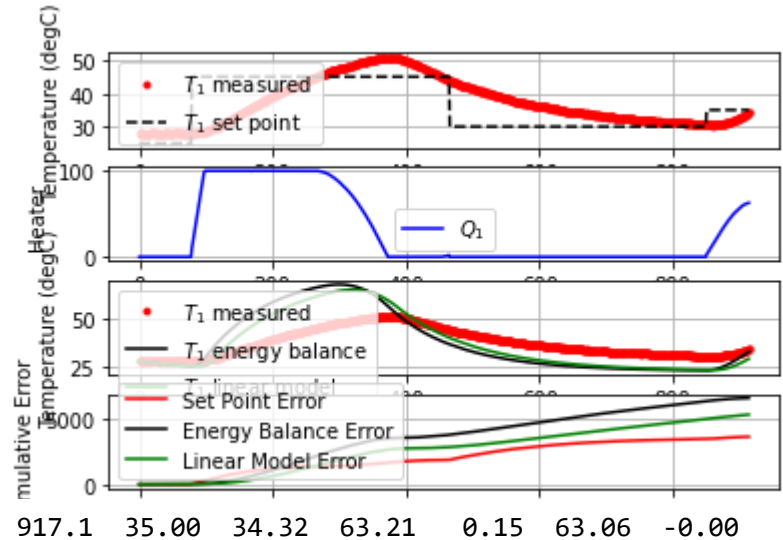
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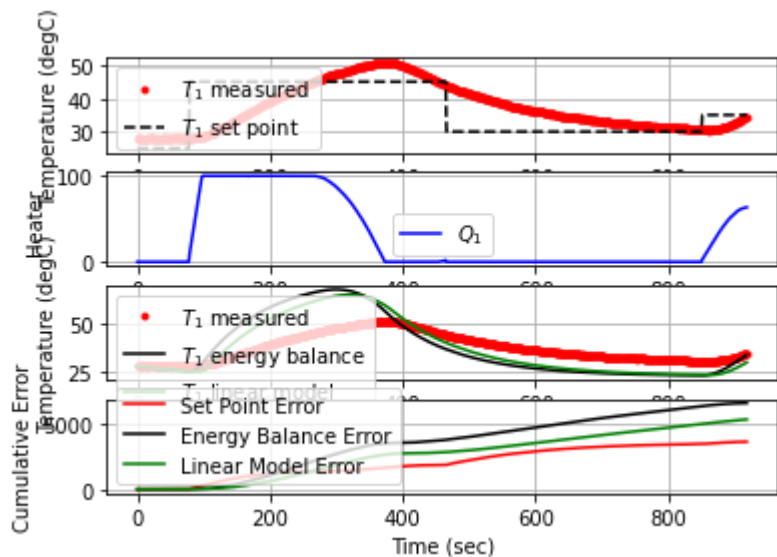
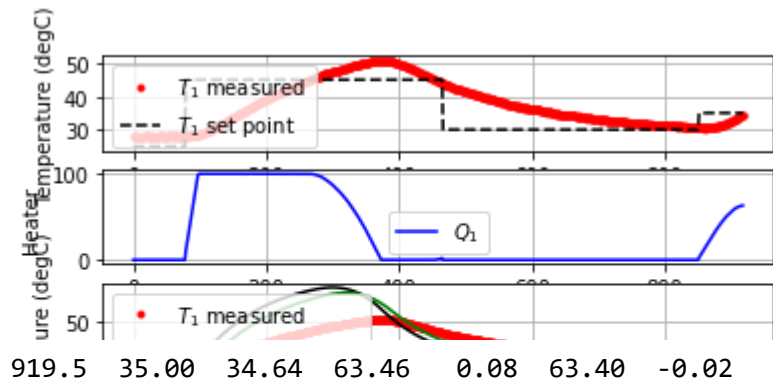


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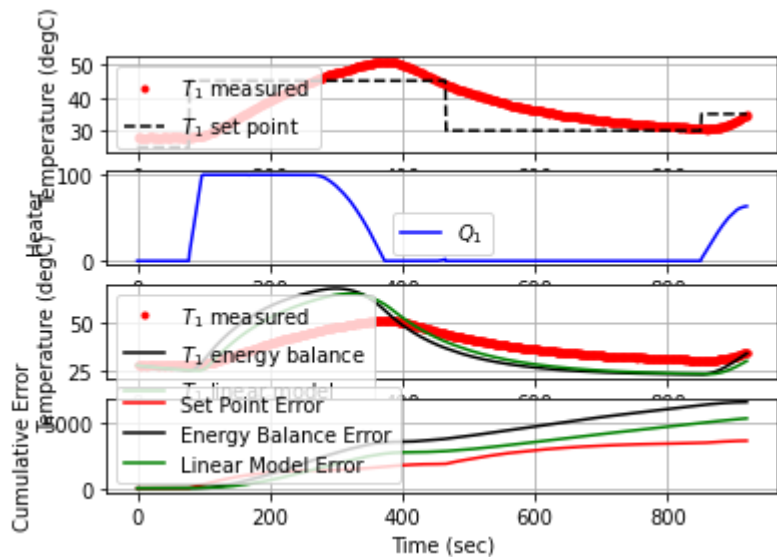


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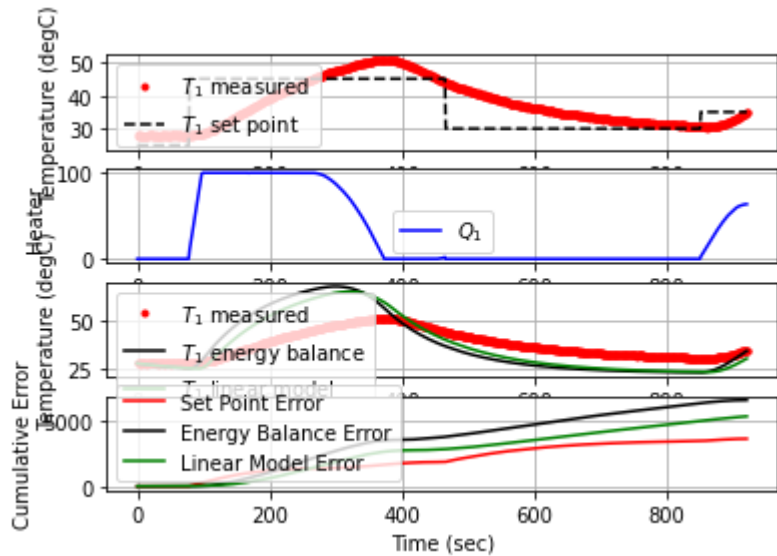




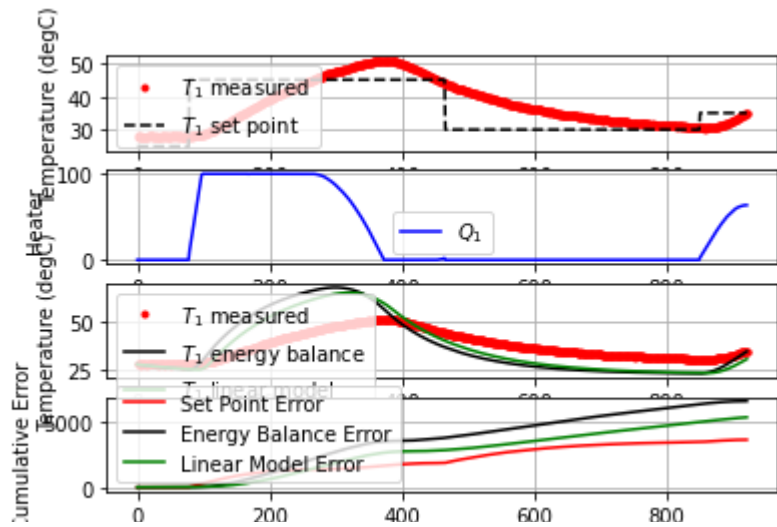
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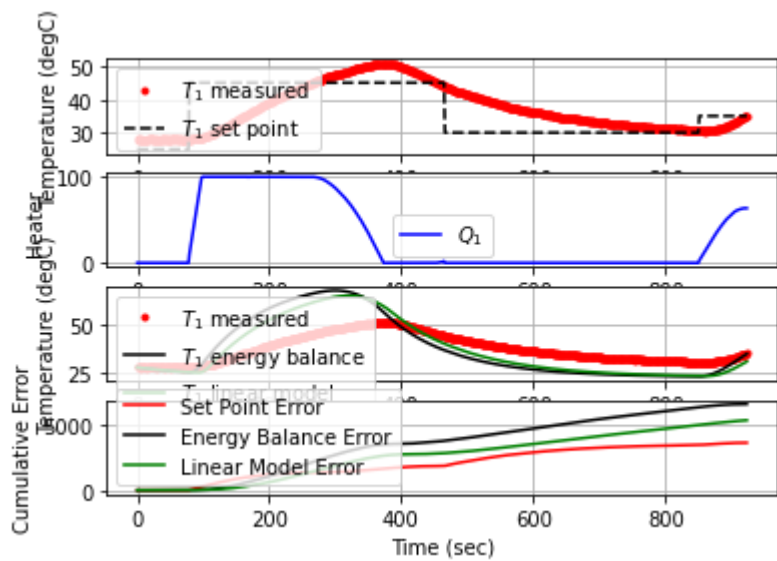
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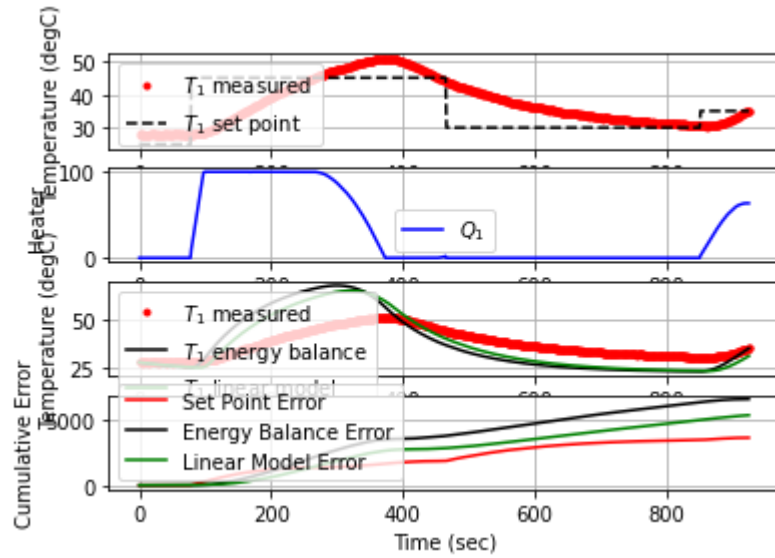
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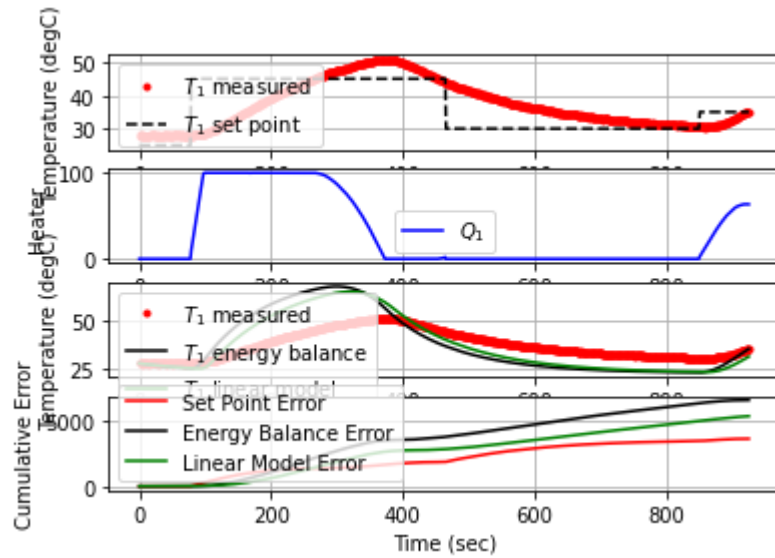
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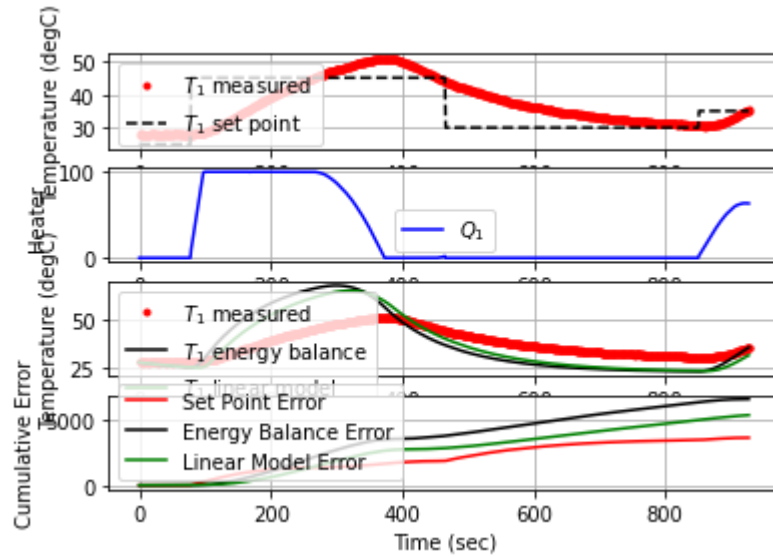
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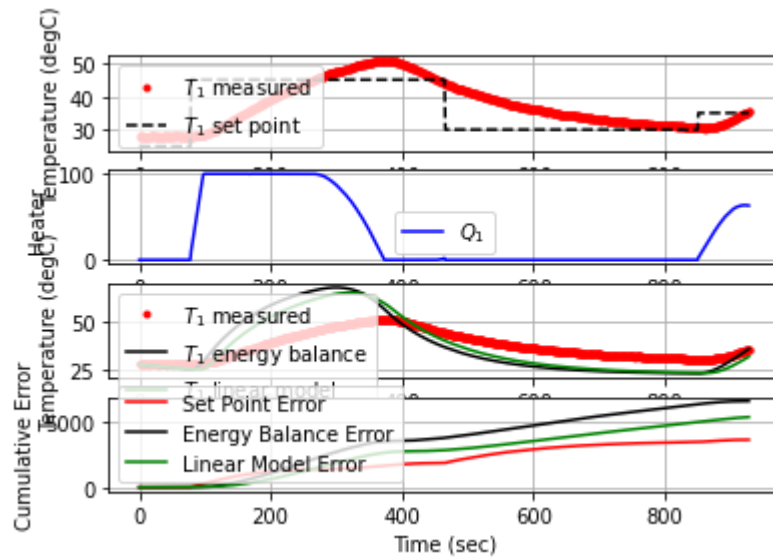
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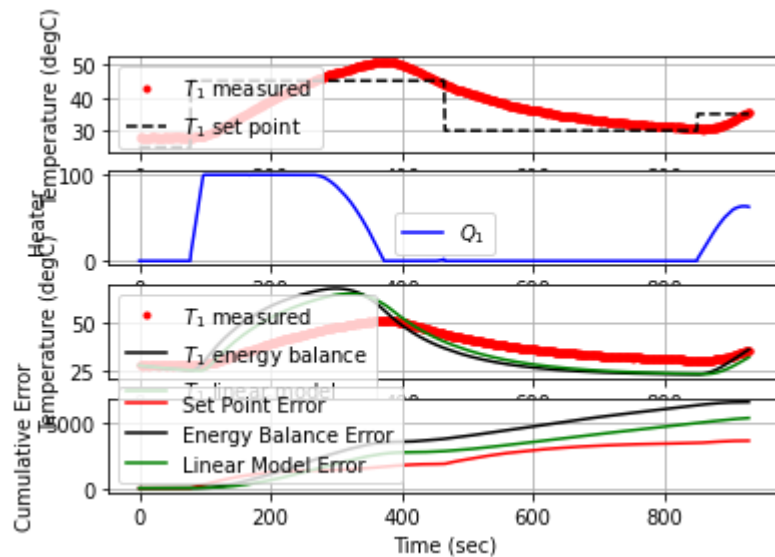
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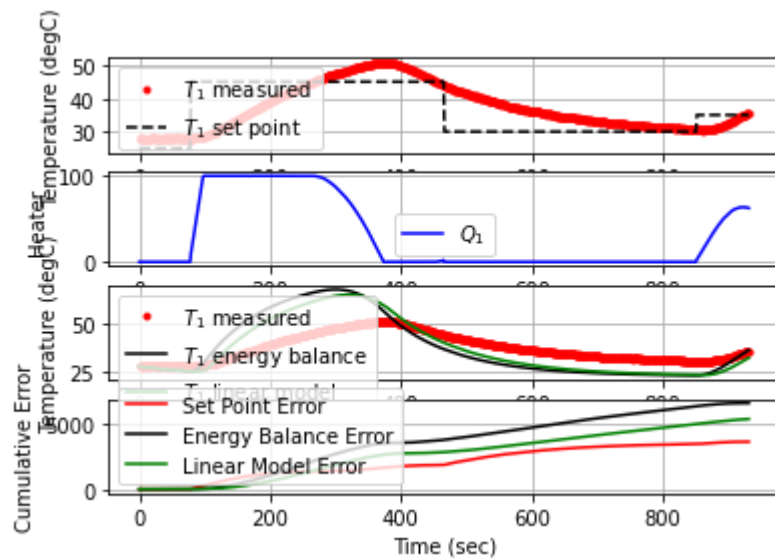
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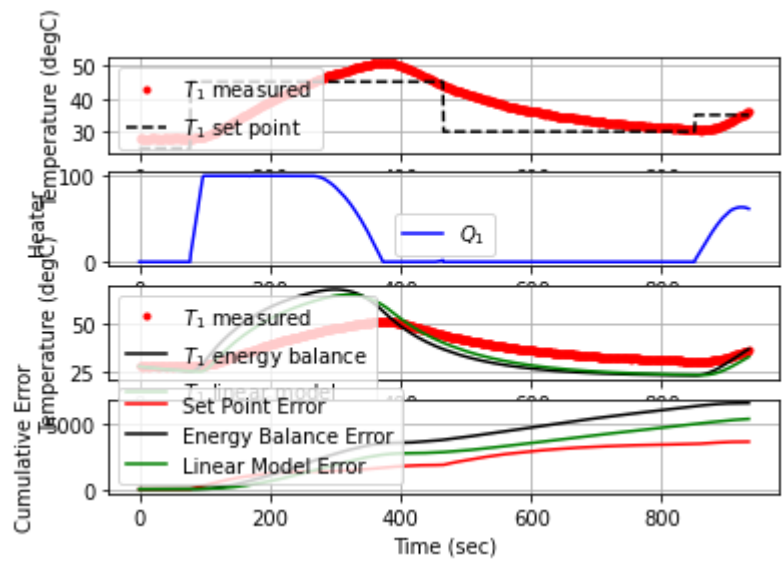
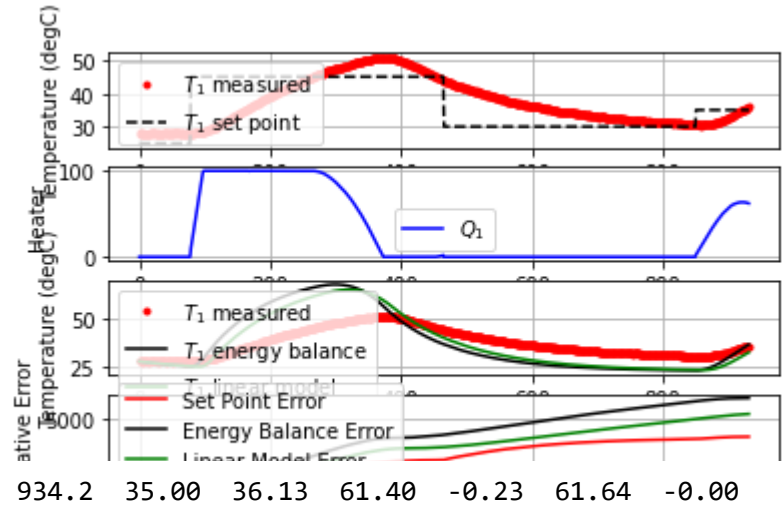


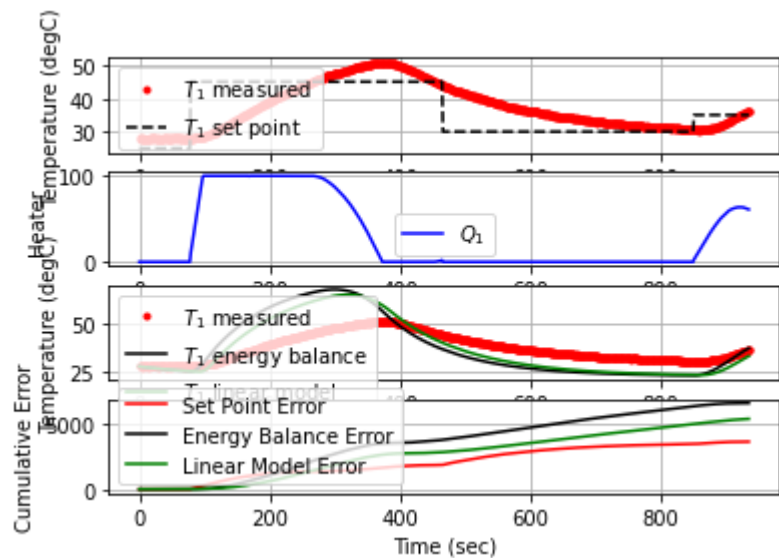
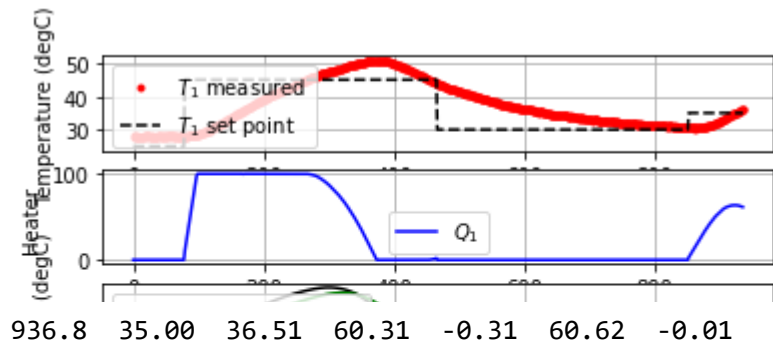
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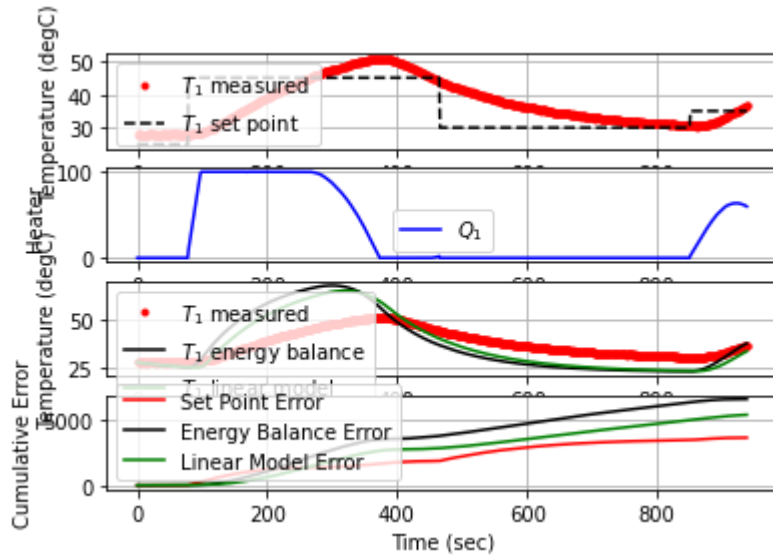
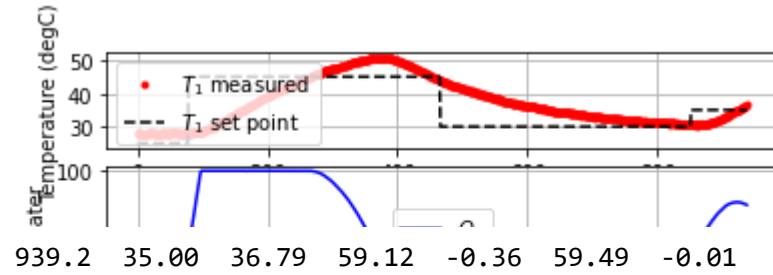


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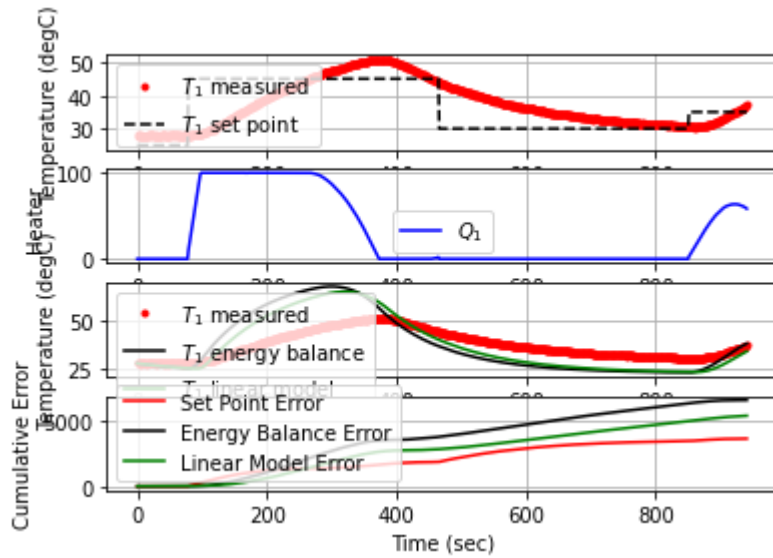
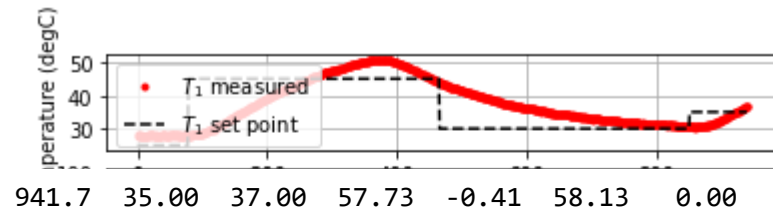




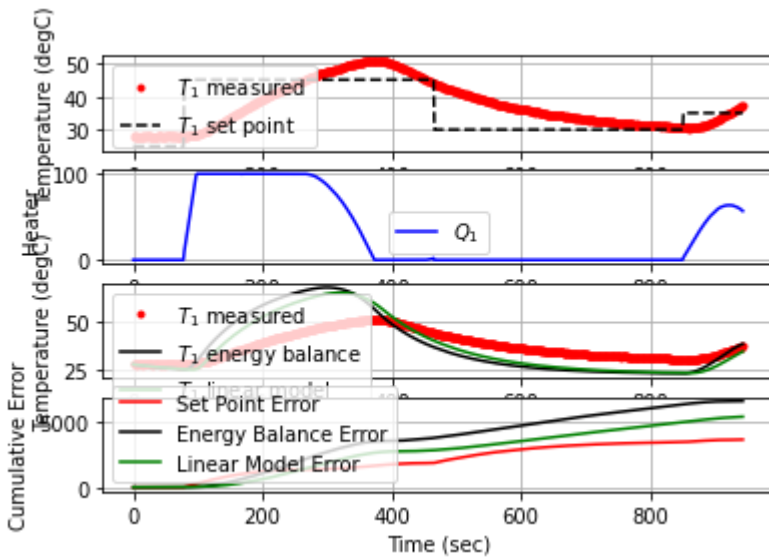
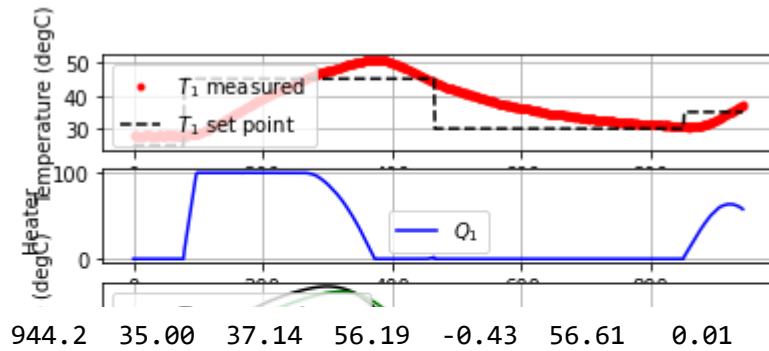




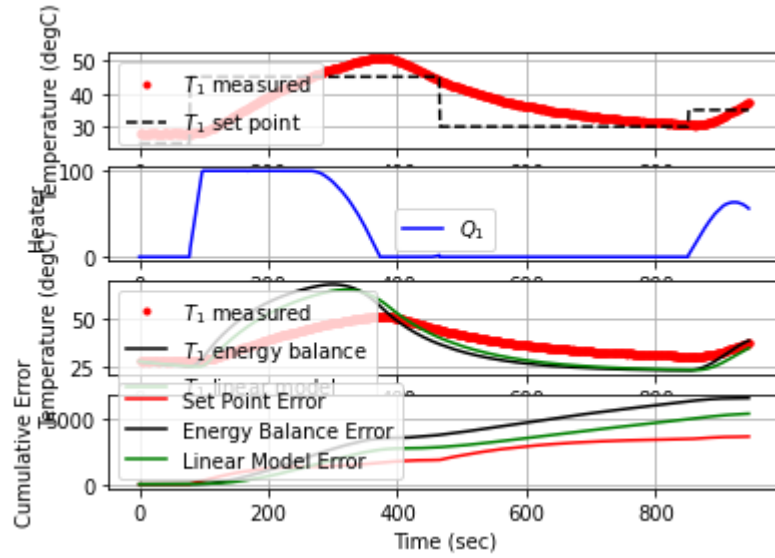
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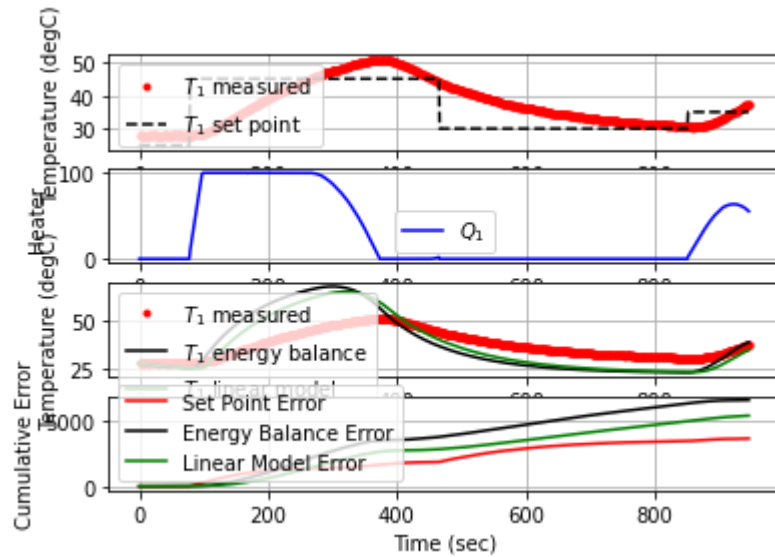
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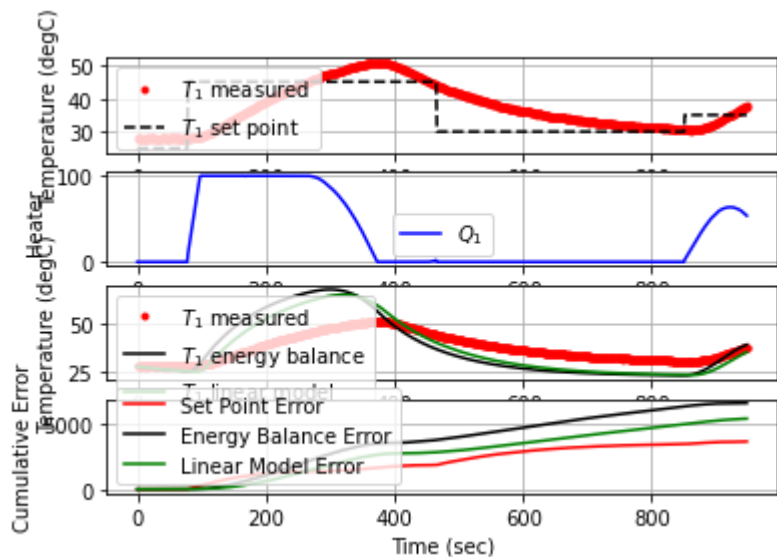
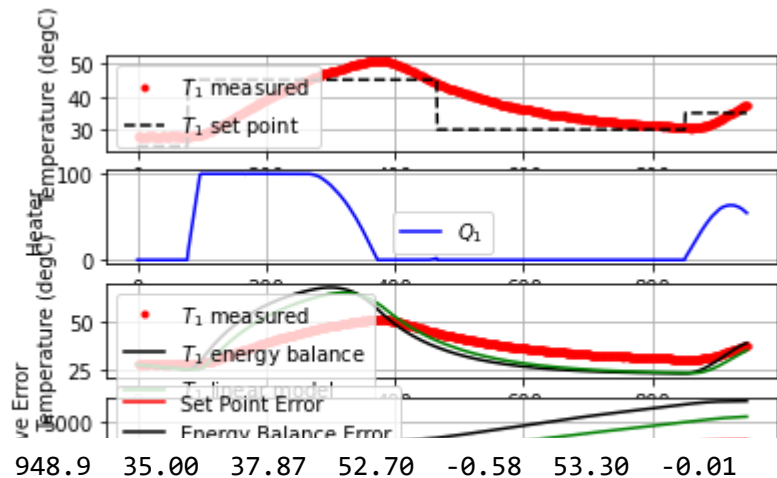
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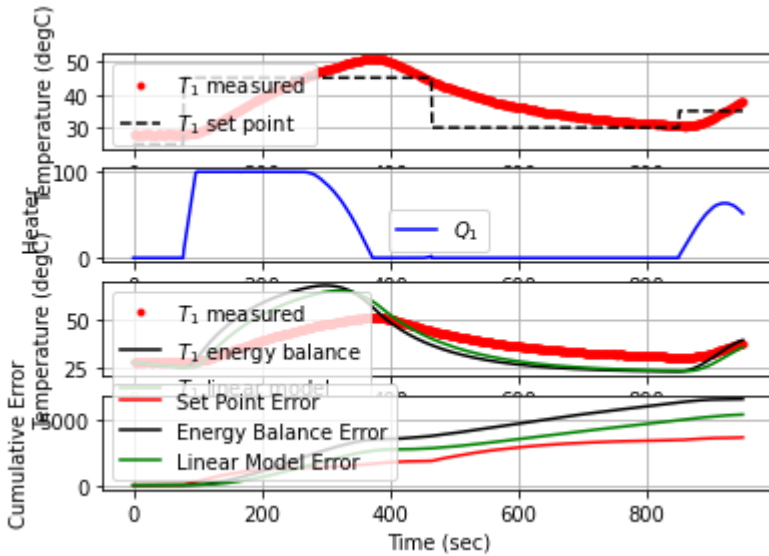
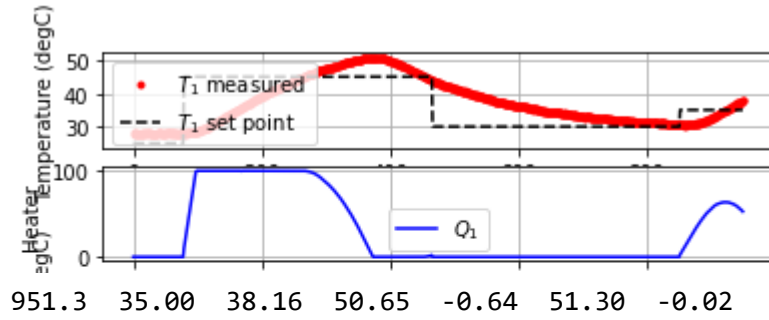


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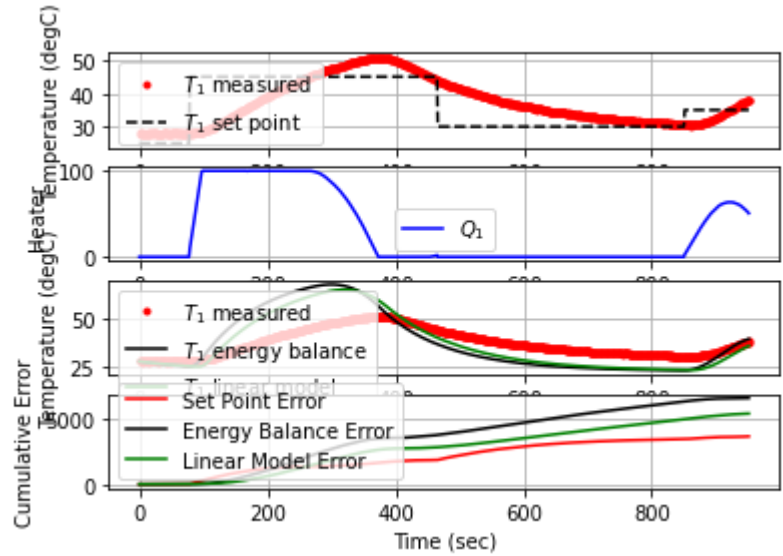
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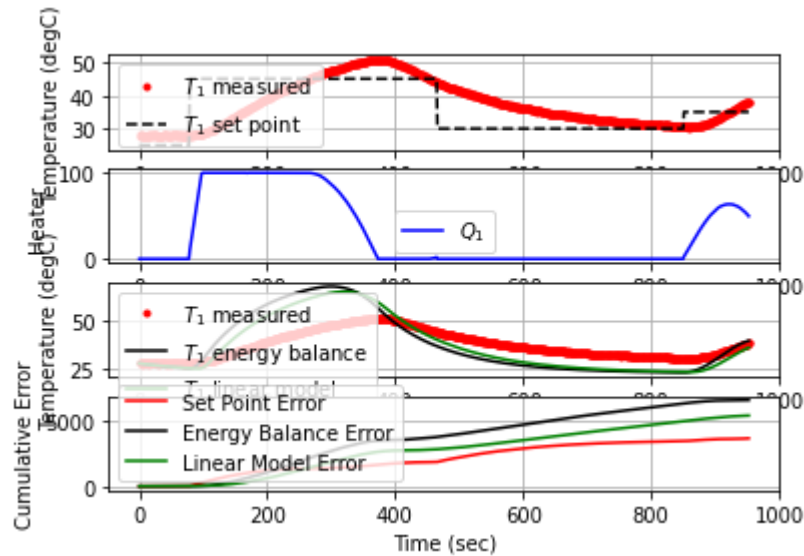


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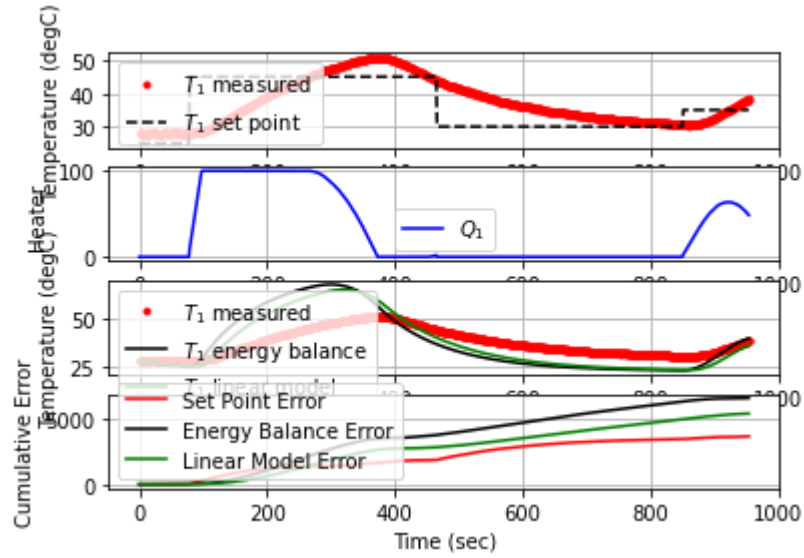




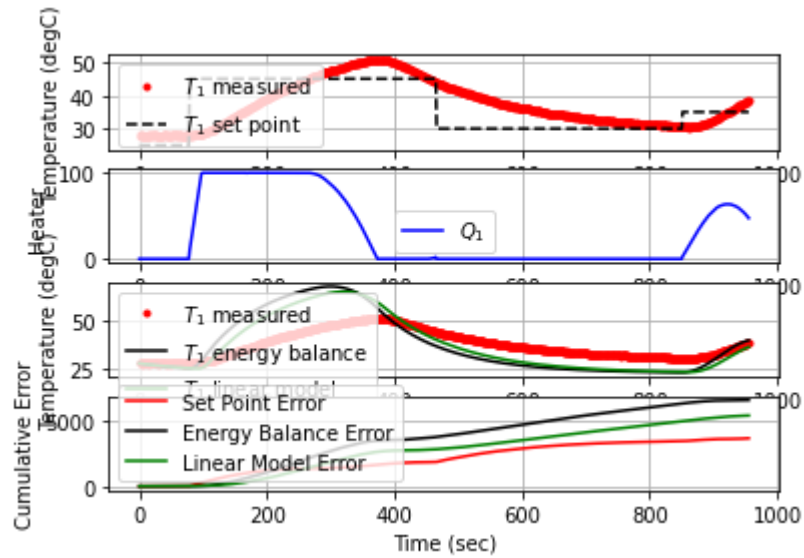
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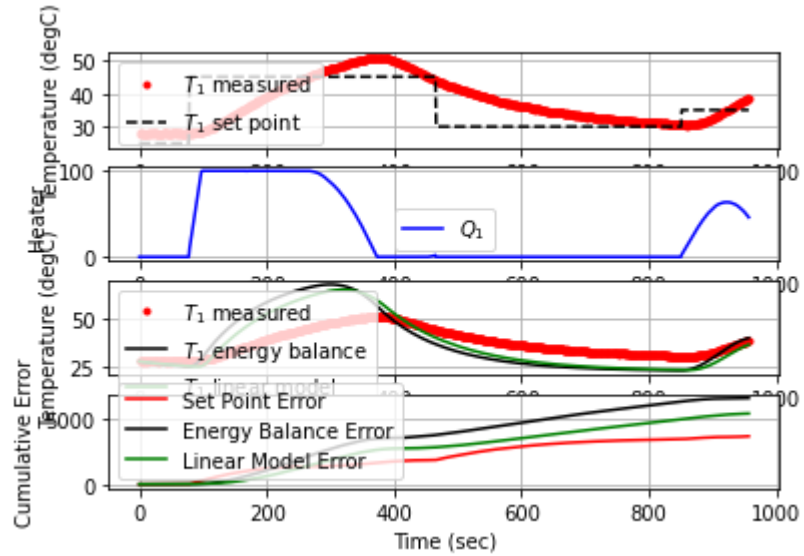
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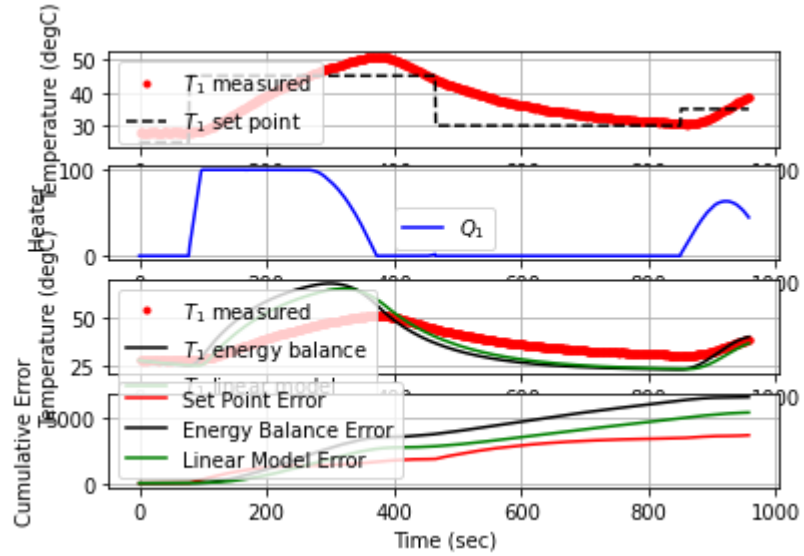
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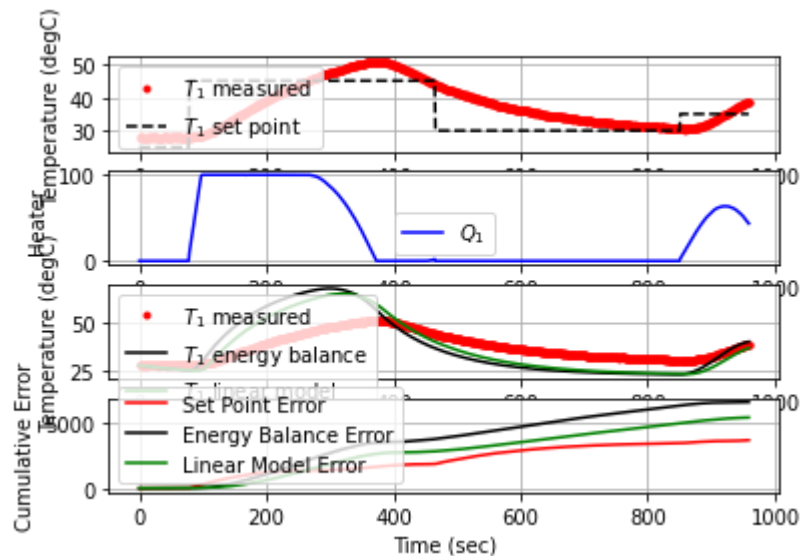
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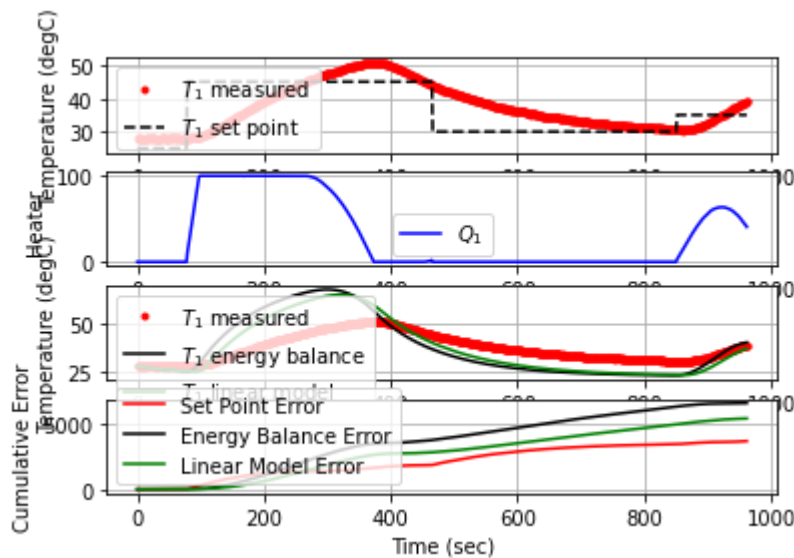
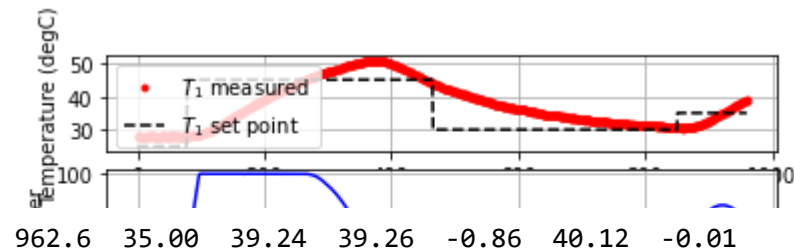
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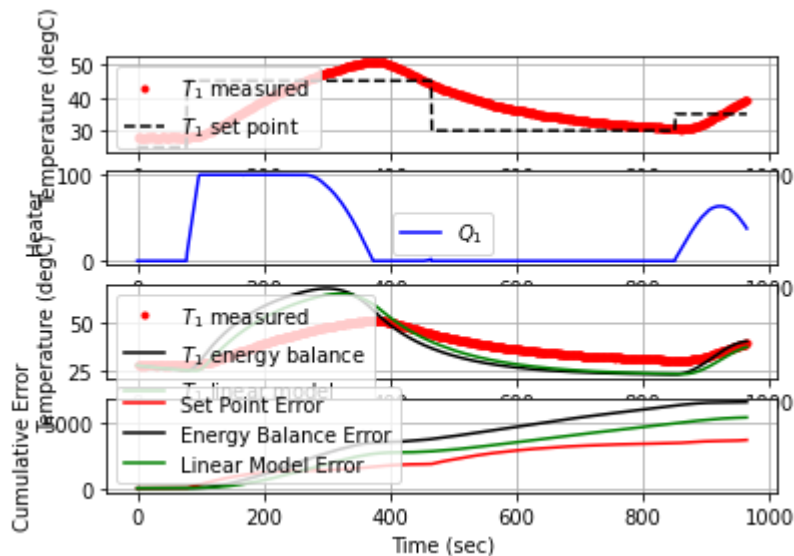
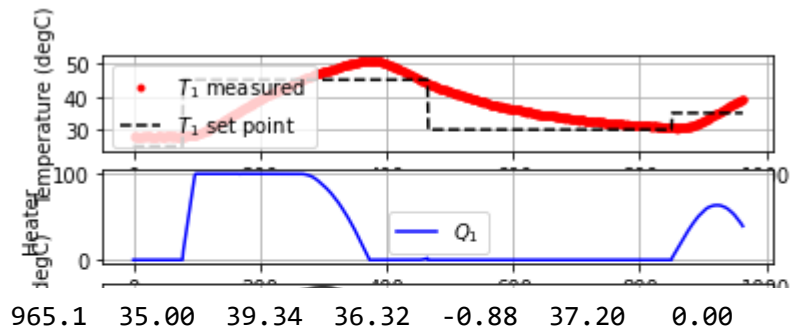


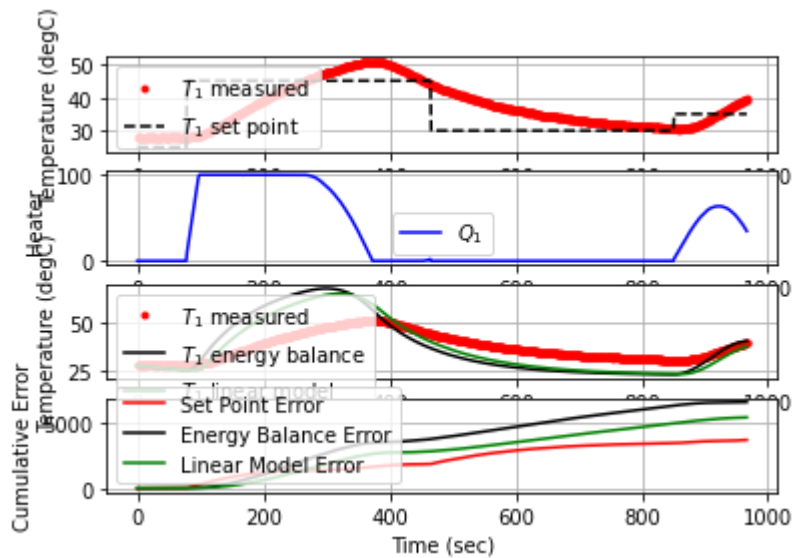
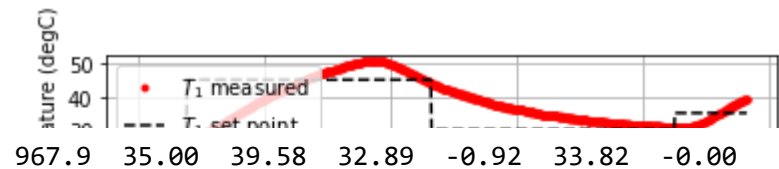
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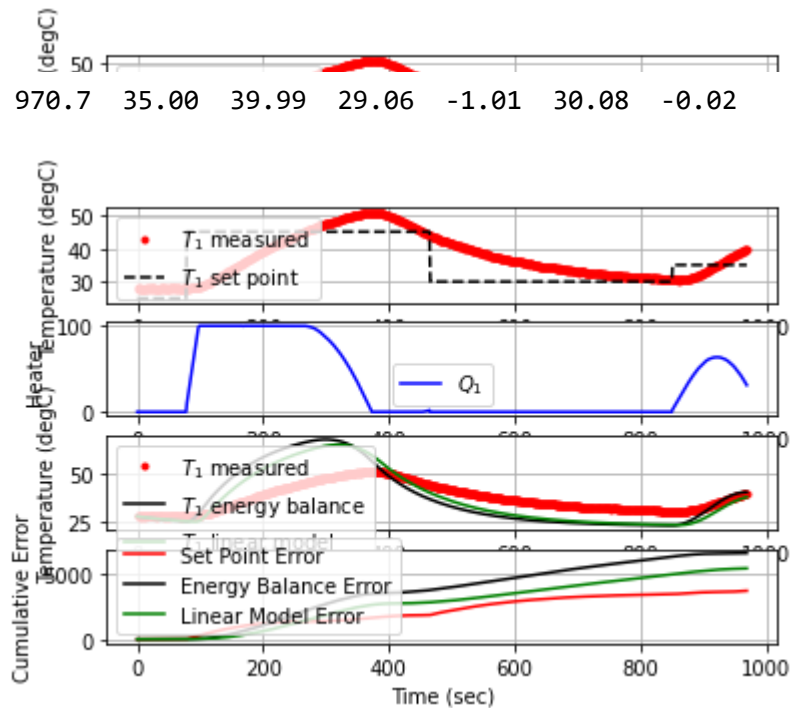
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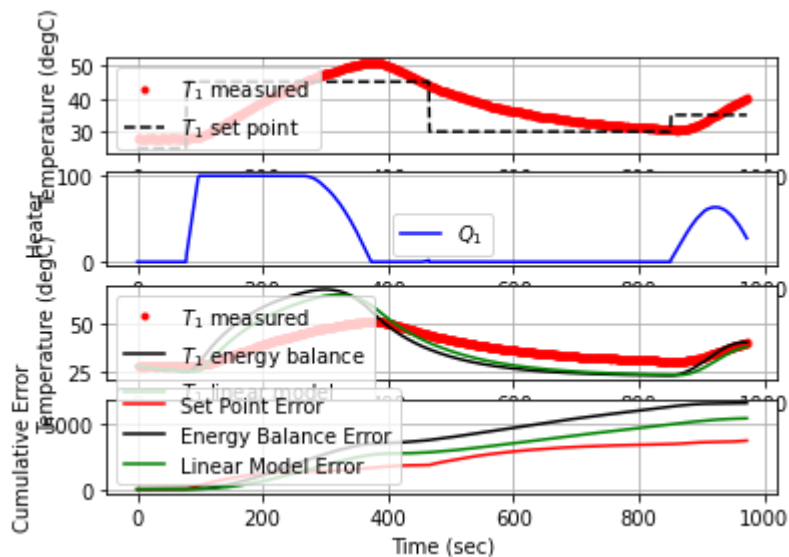
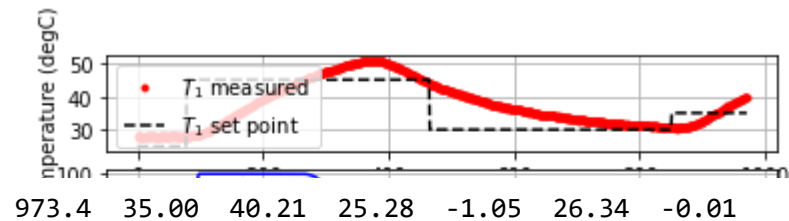


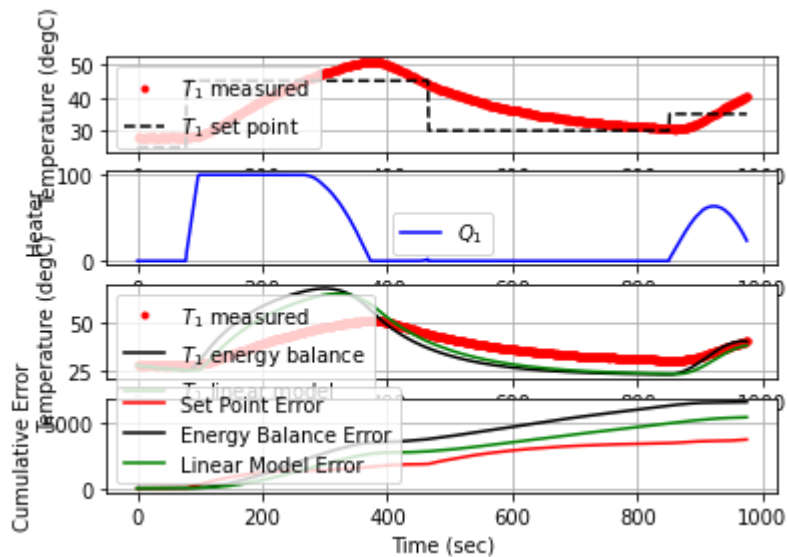
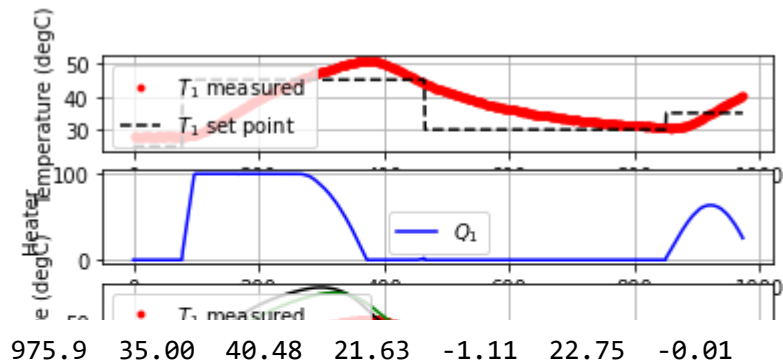
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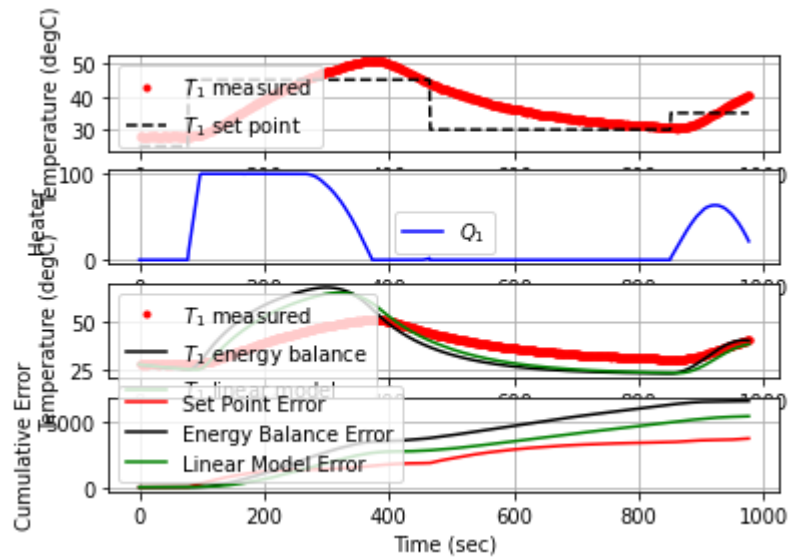


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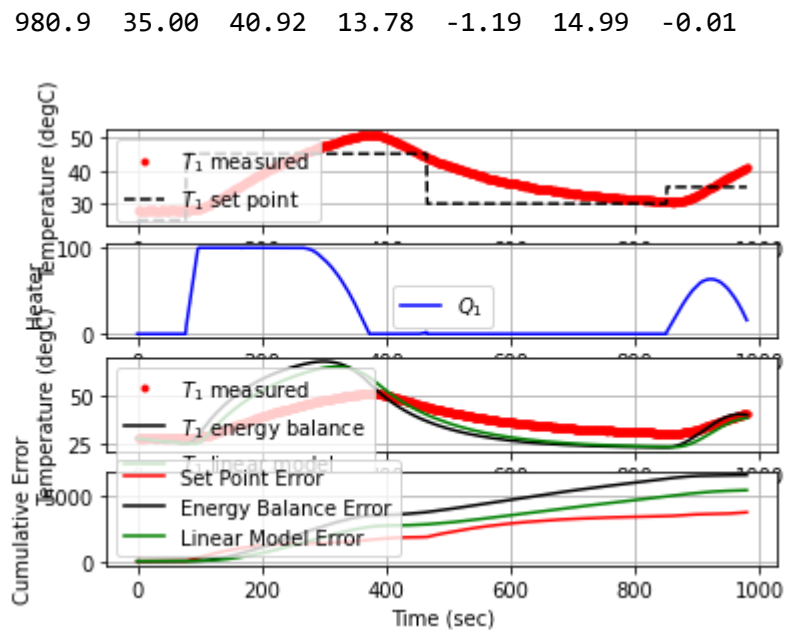
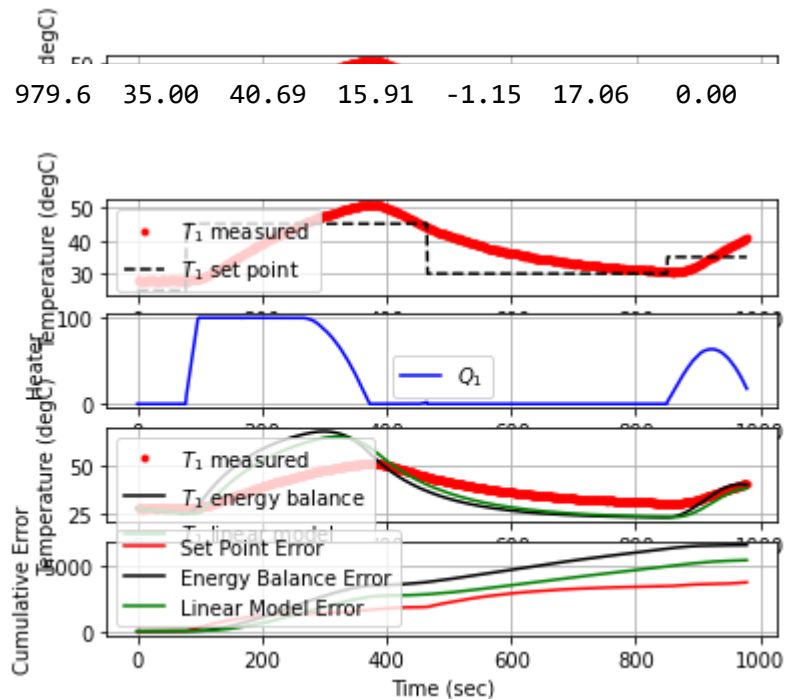




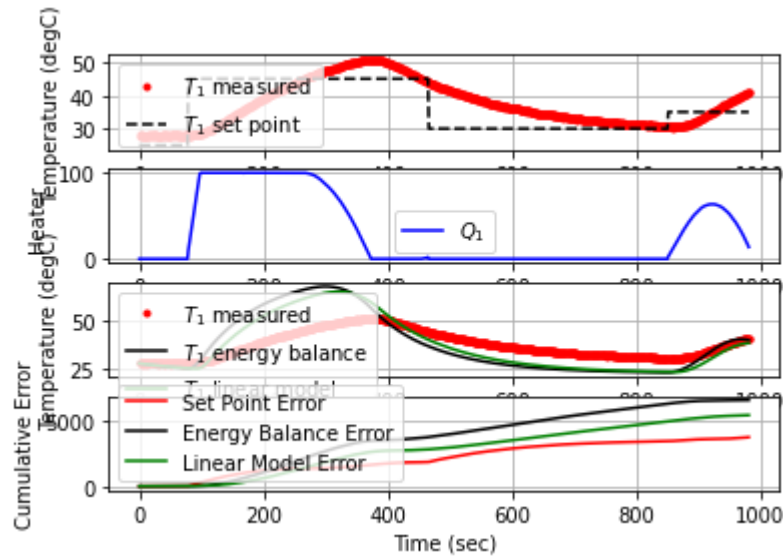




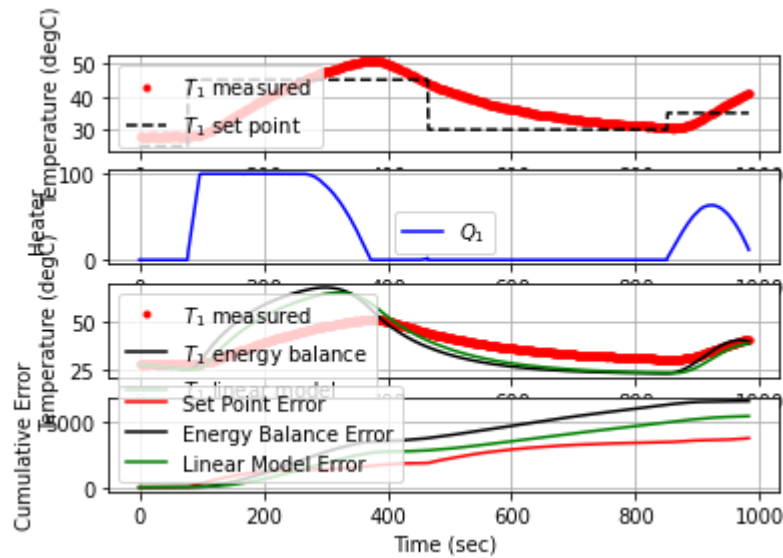
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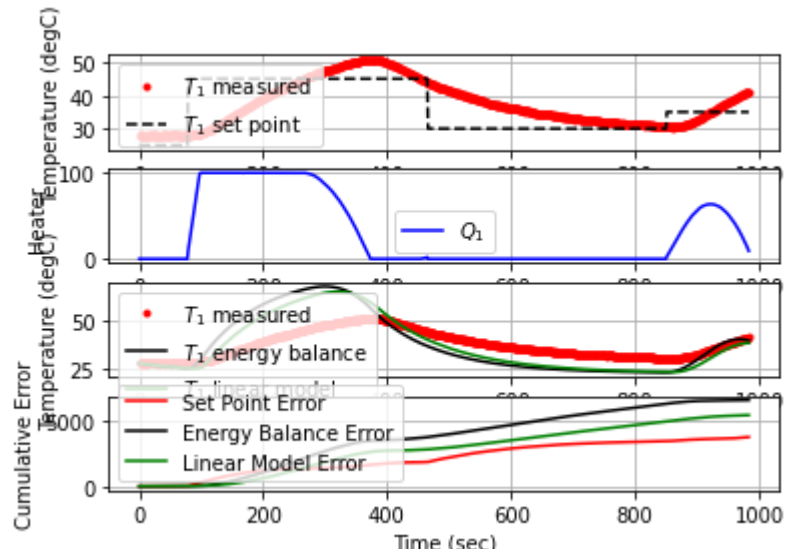
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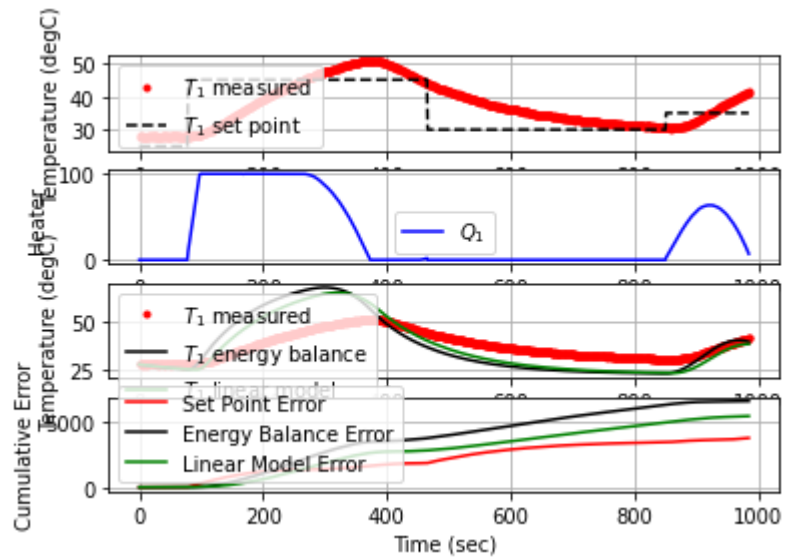
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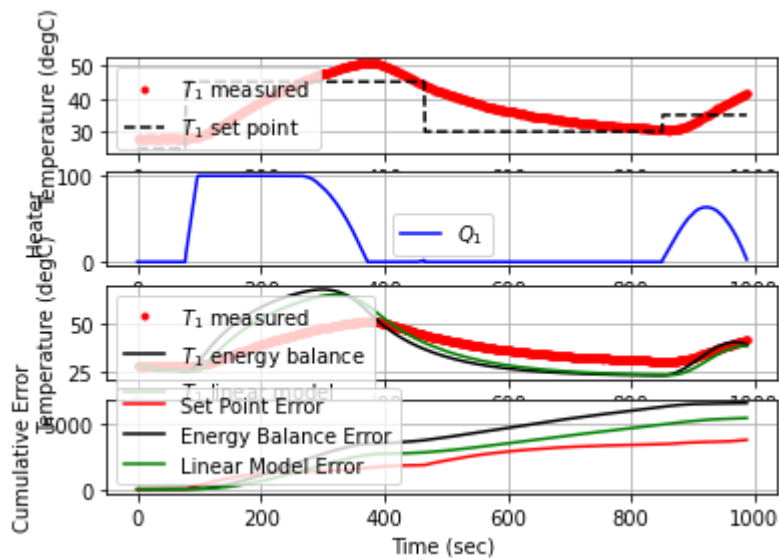
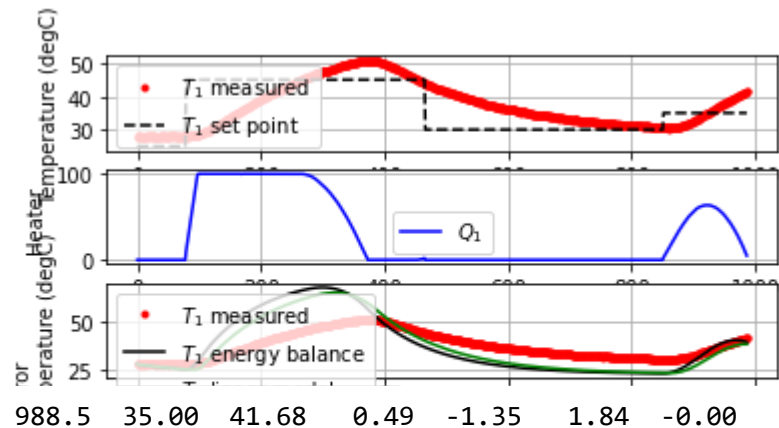
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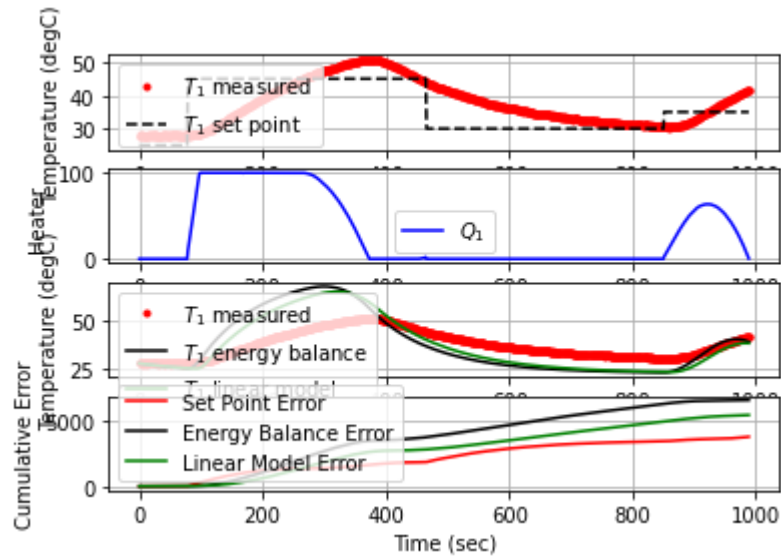


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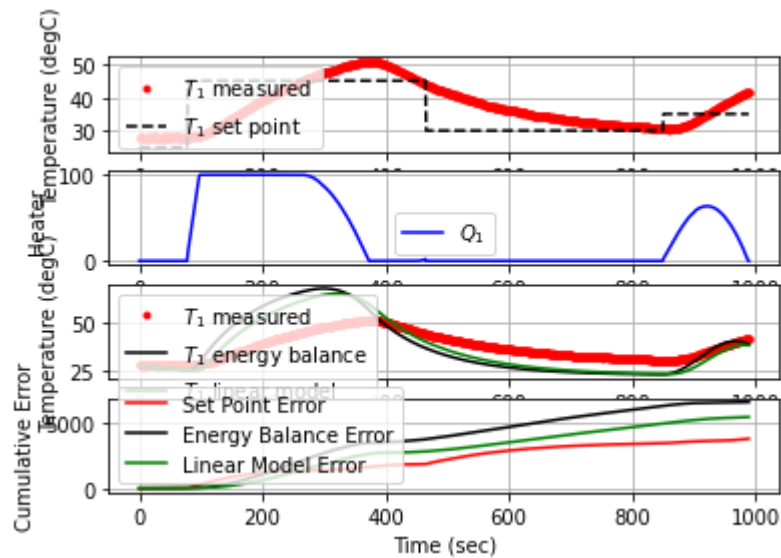


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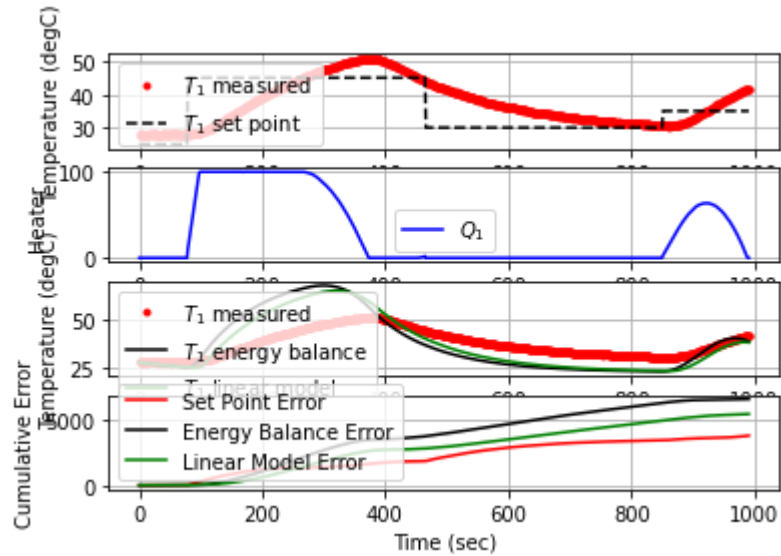


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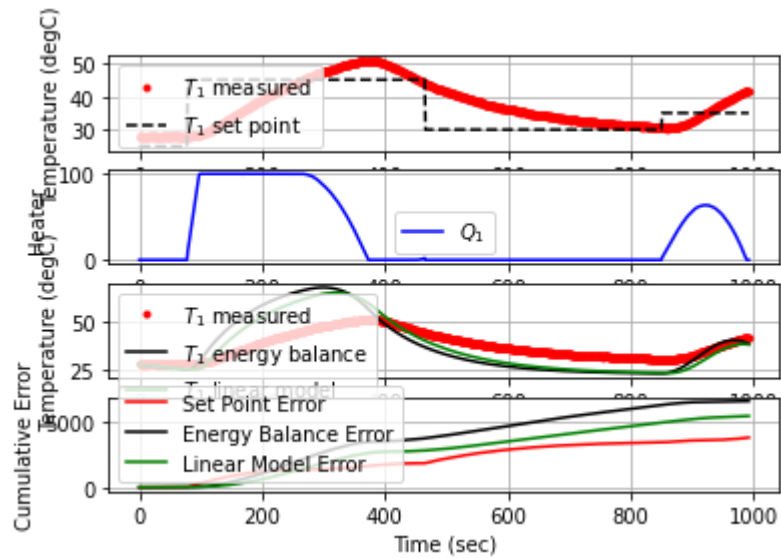


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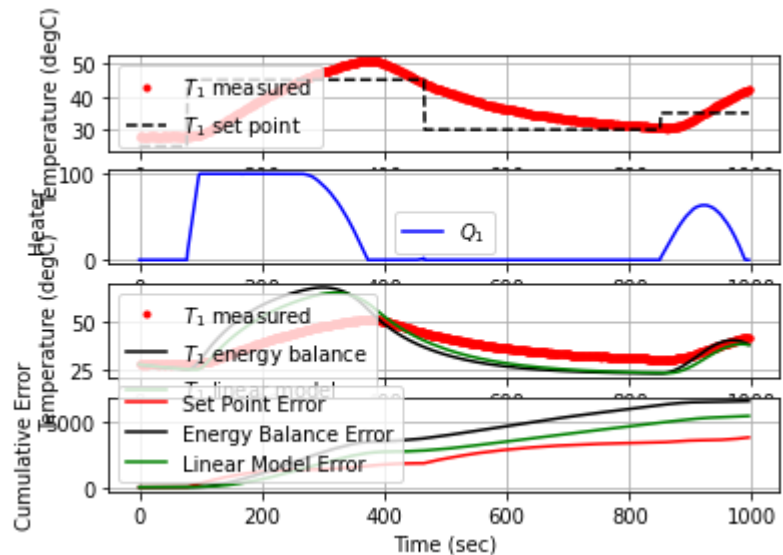
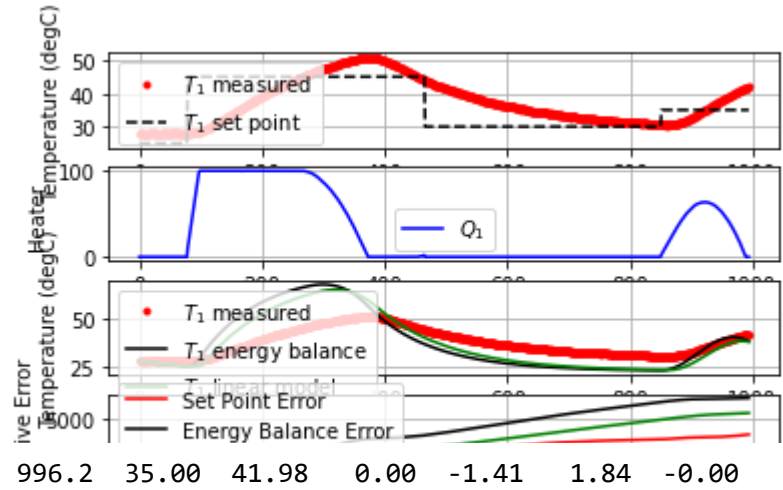


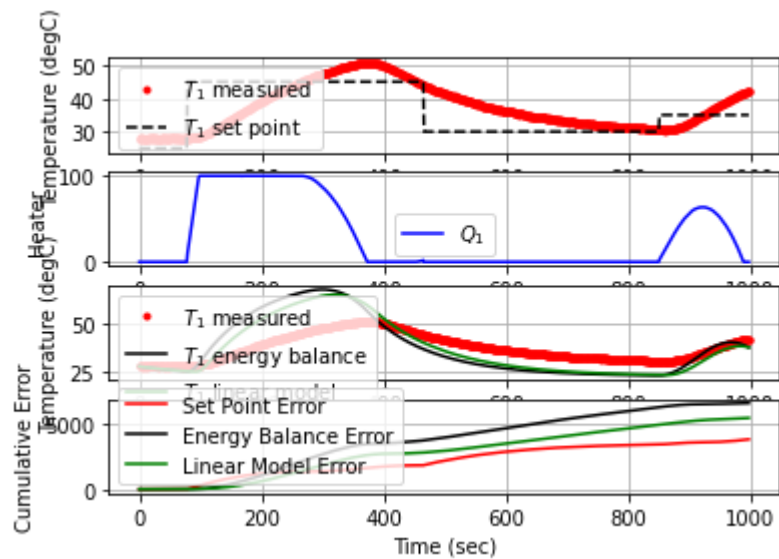
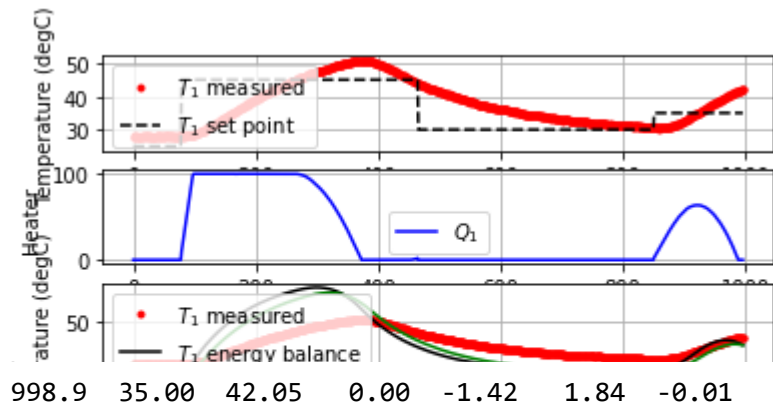


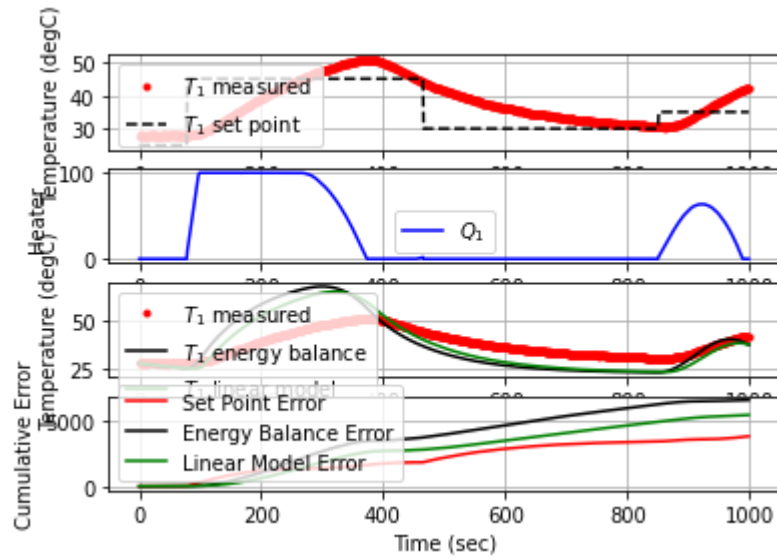
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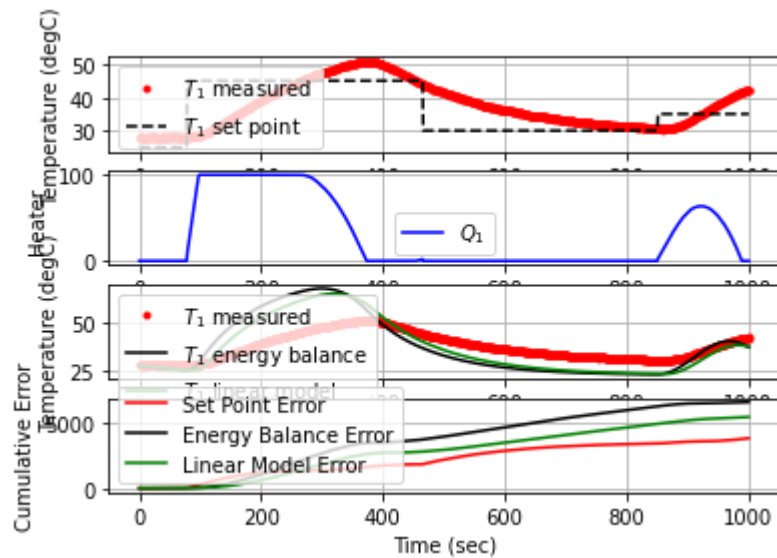
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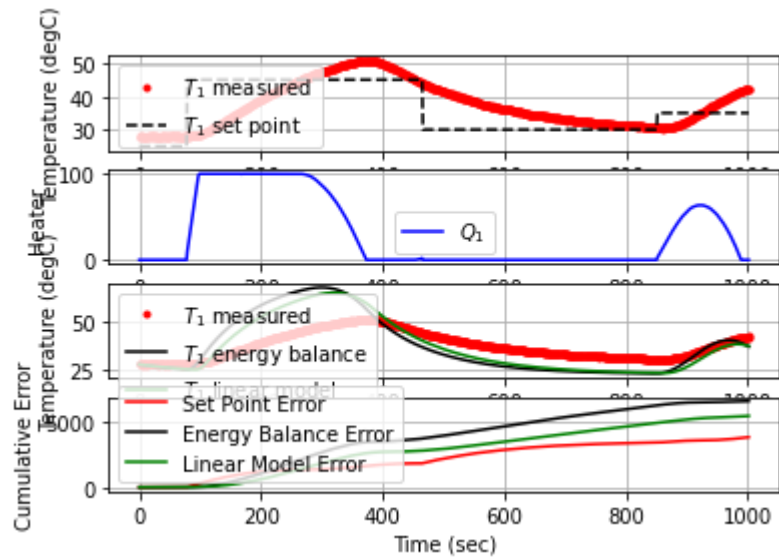




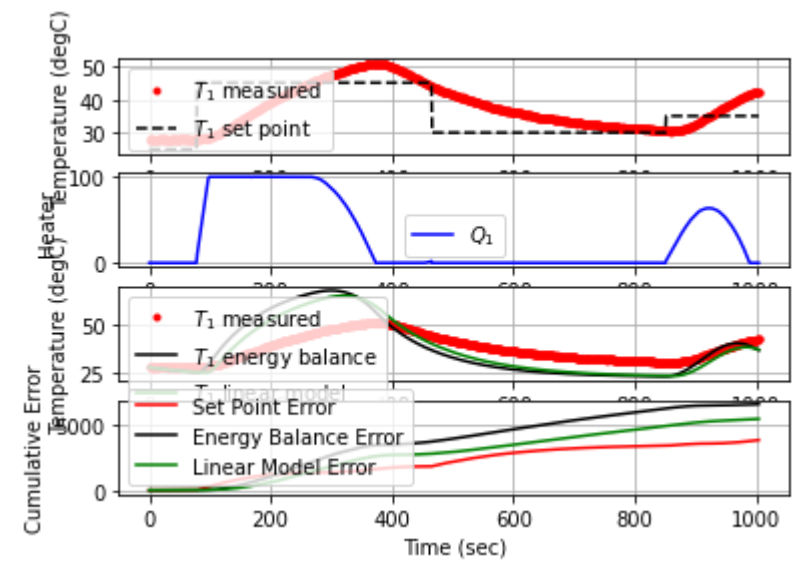
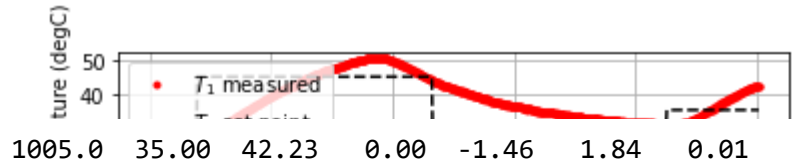
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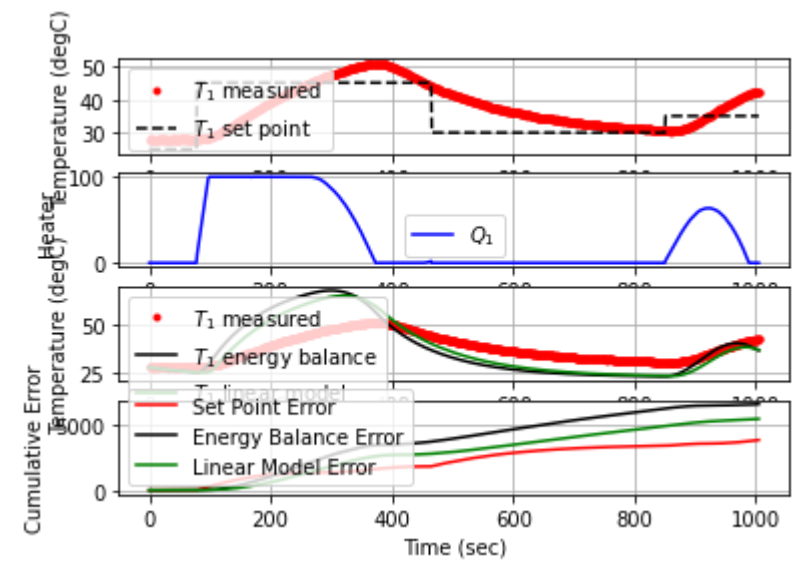
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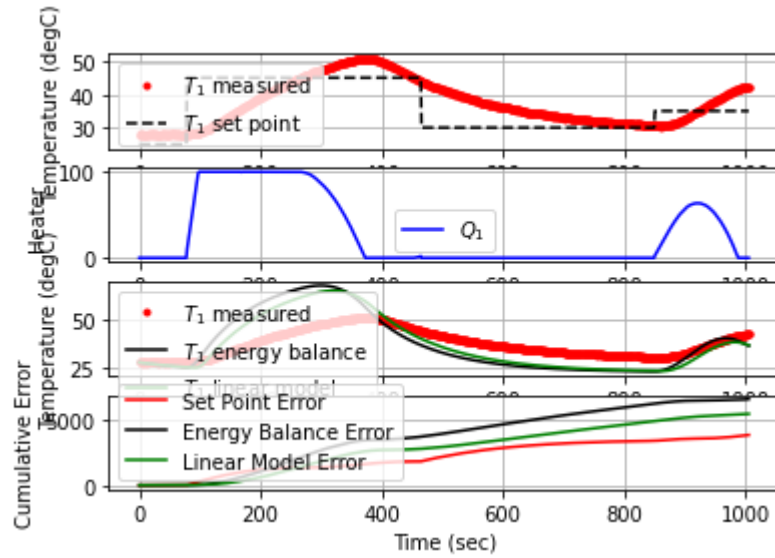
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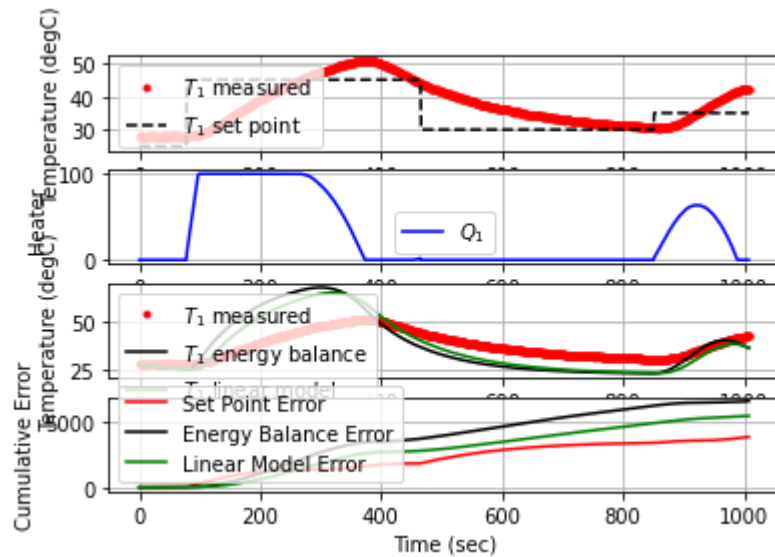
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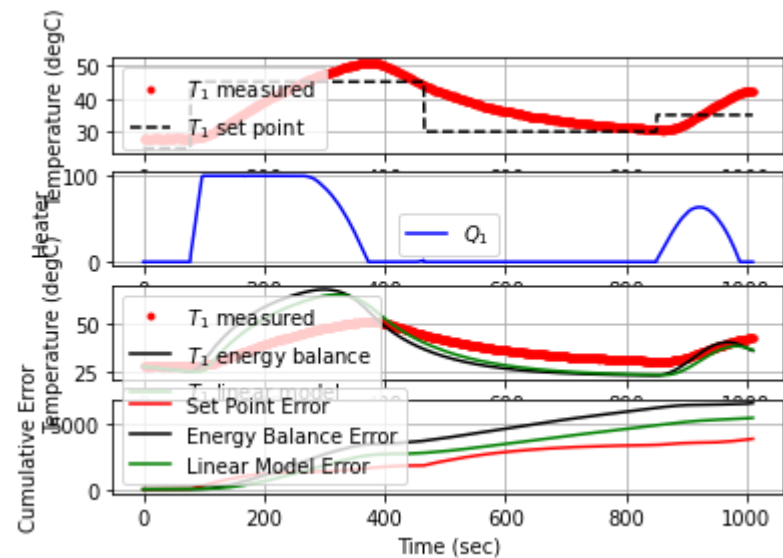
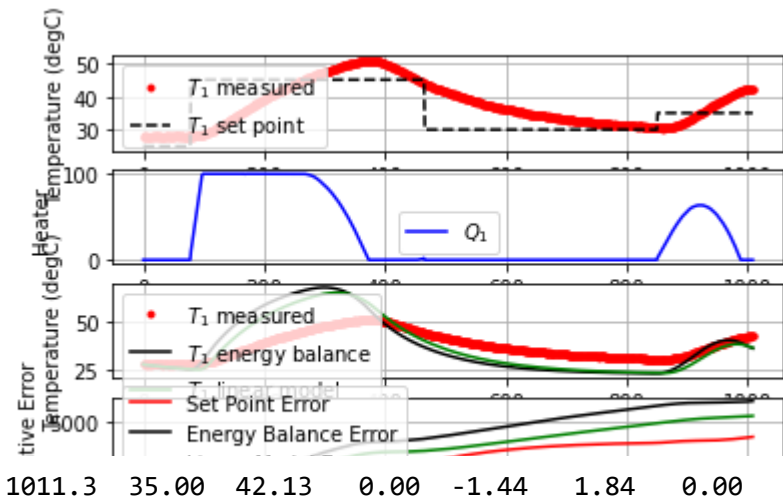
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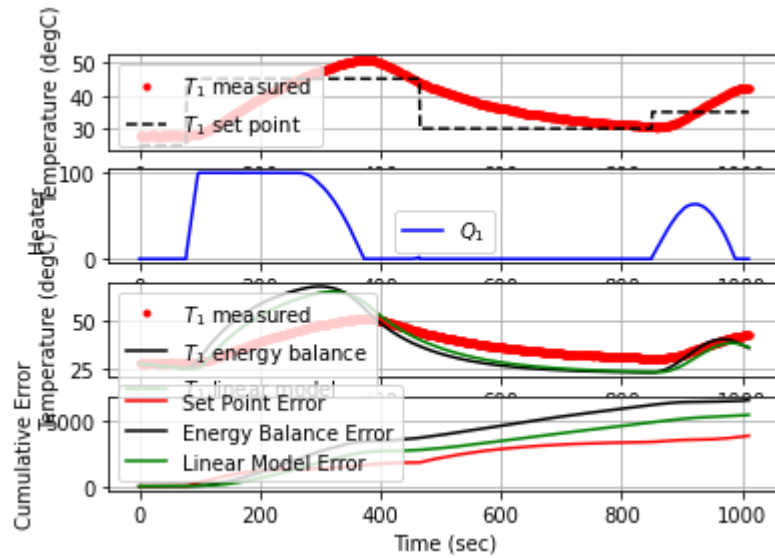
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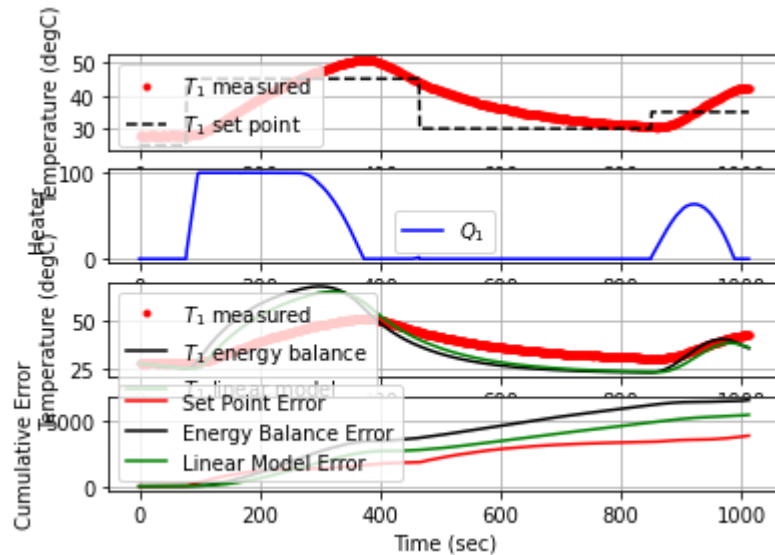
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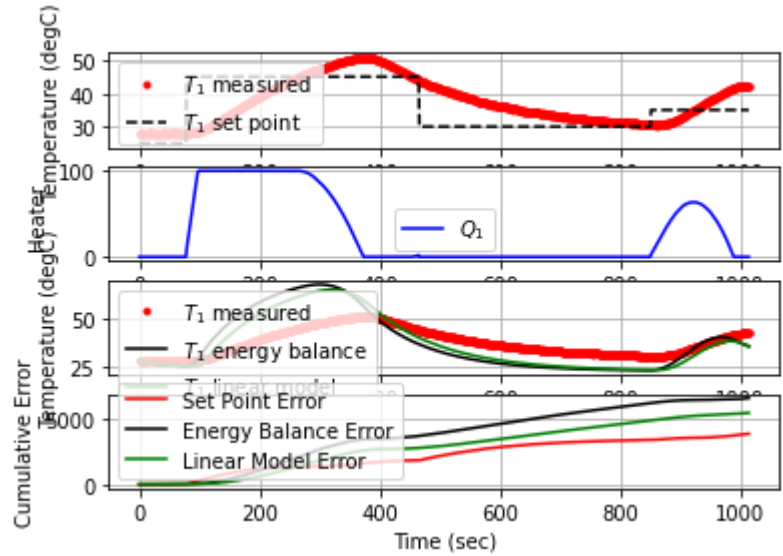




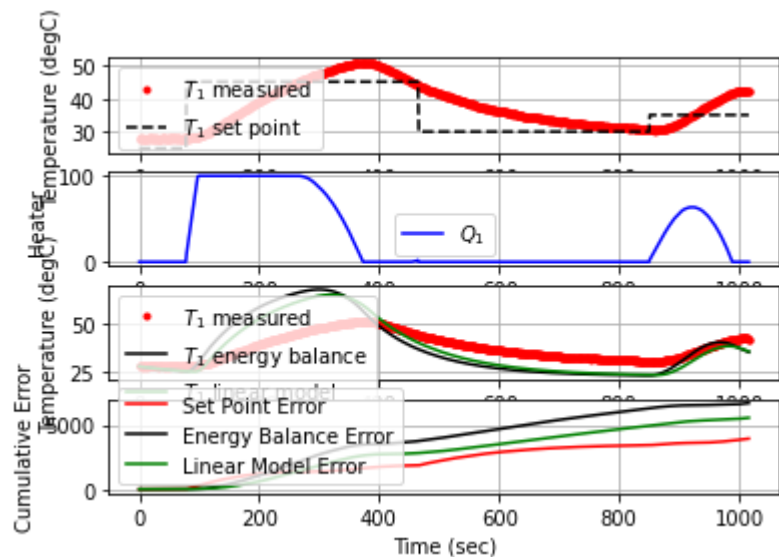
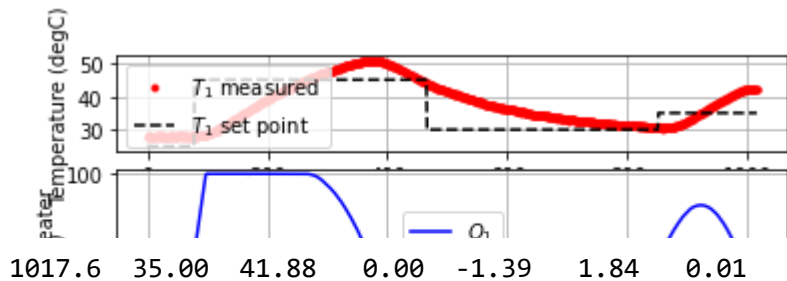
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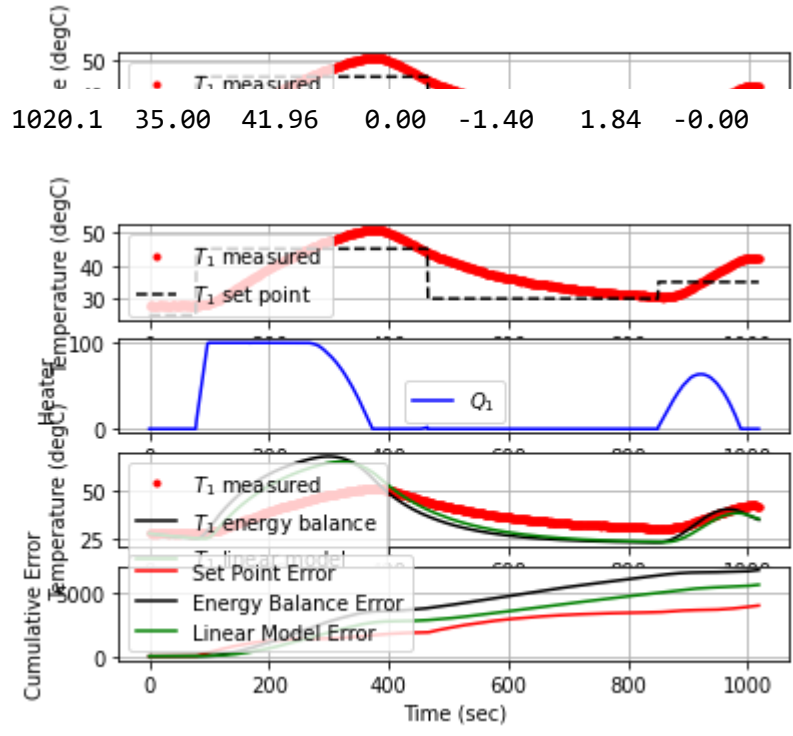


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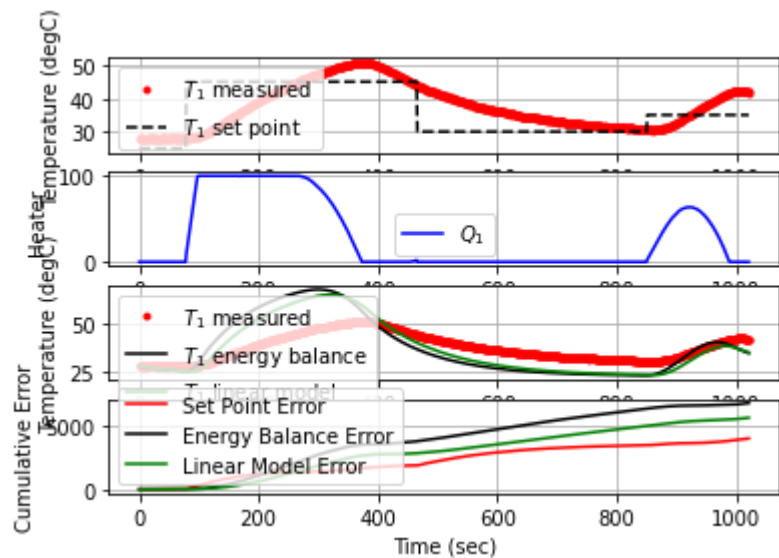
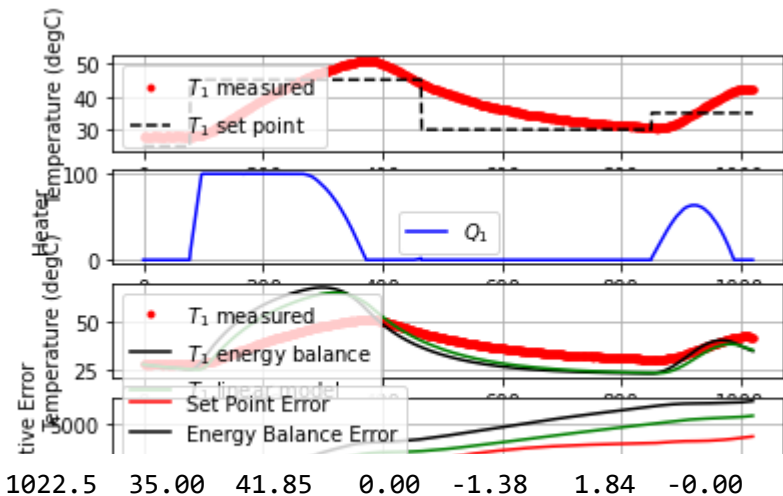


1016.3 35.00 41.98 0.00 -1.41 1.84 0.00

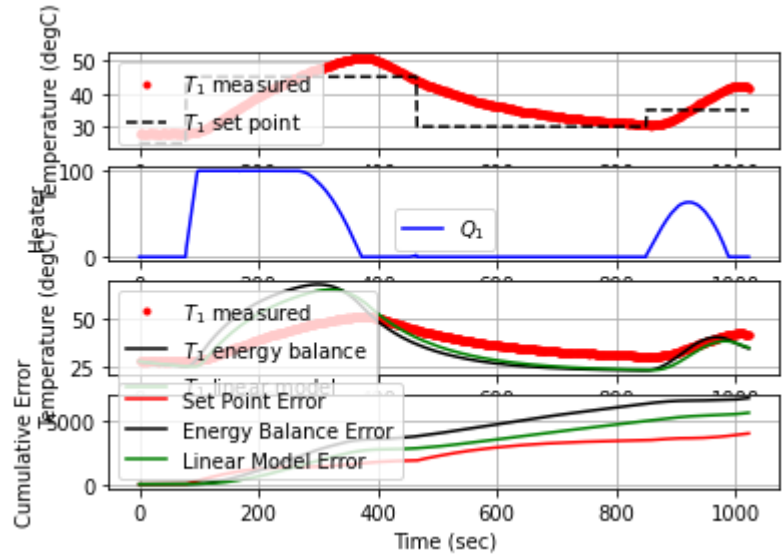




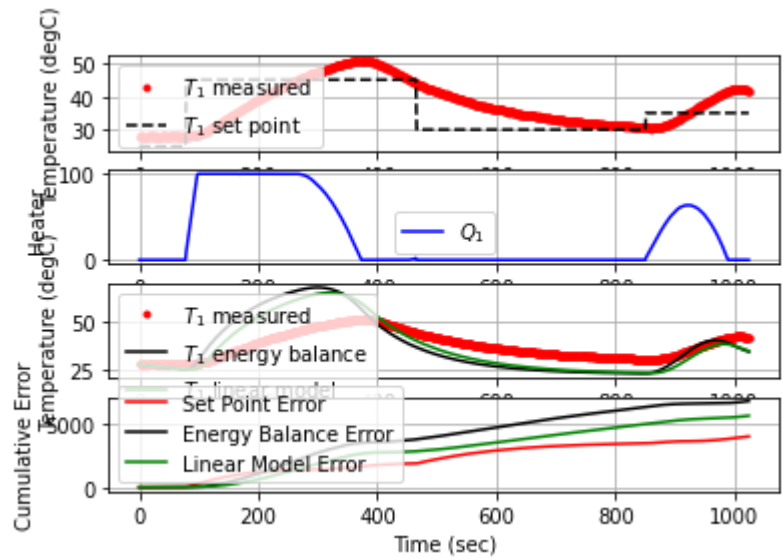
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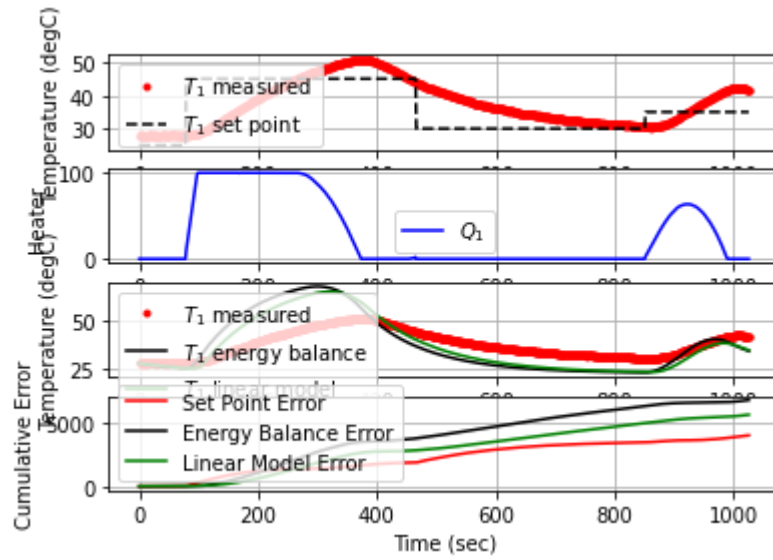
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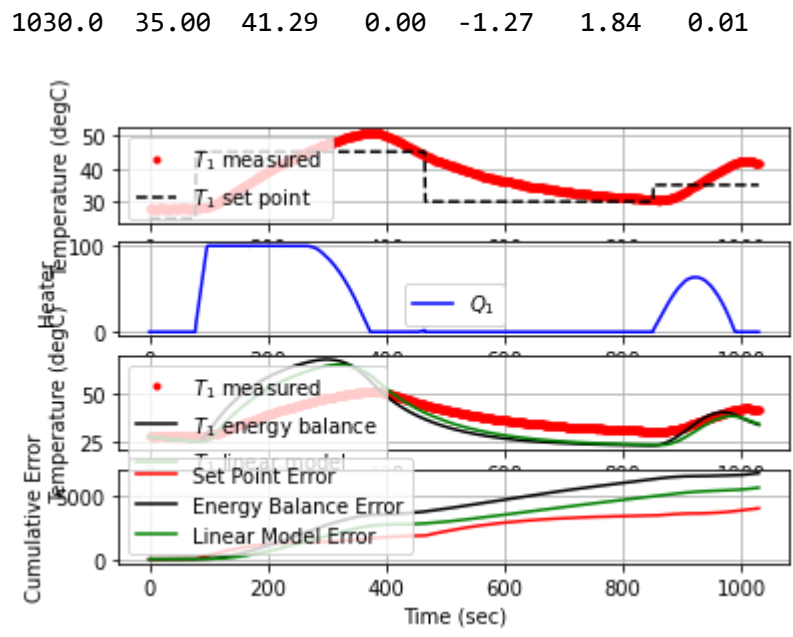
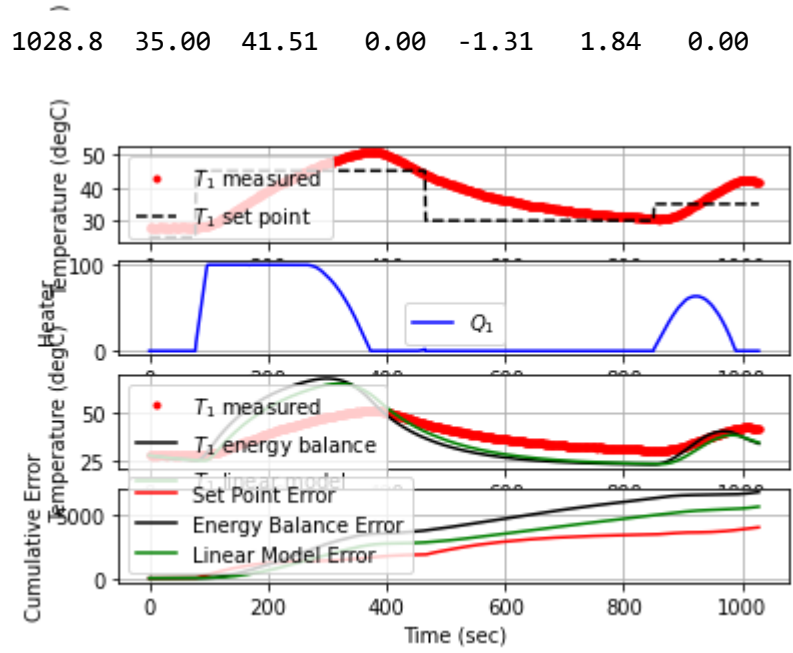
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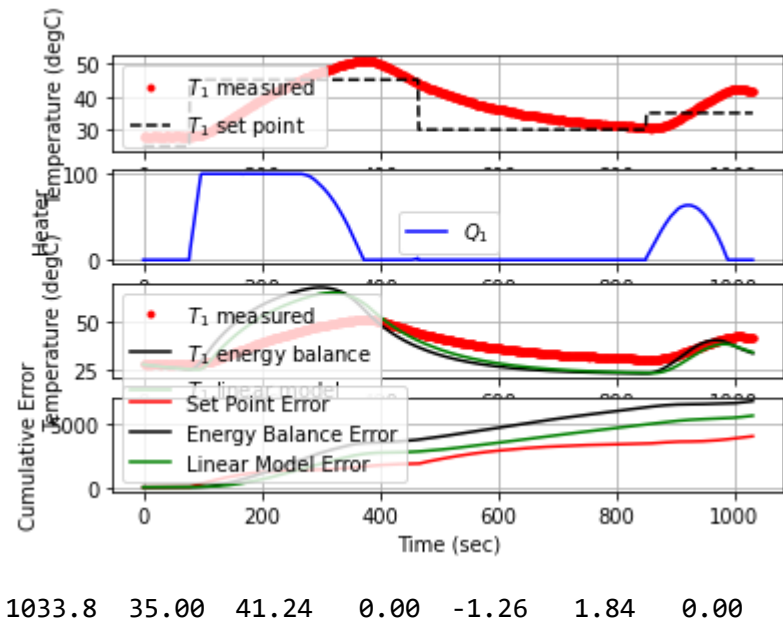
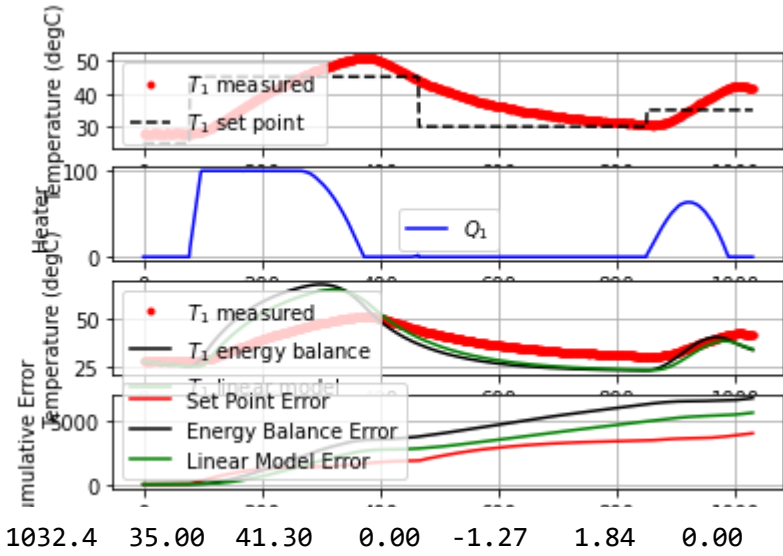


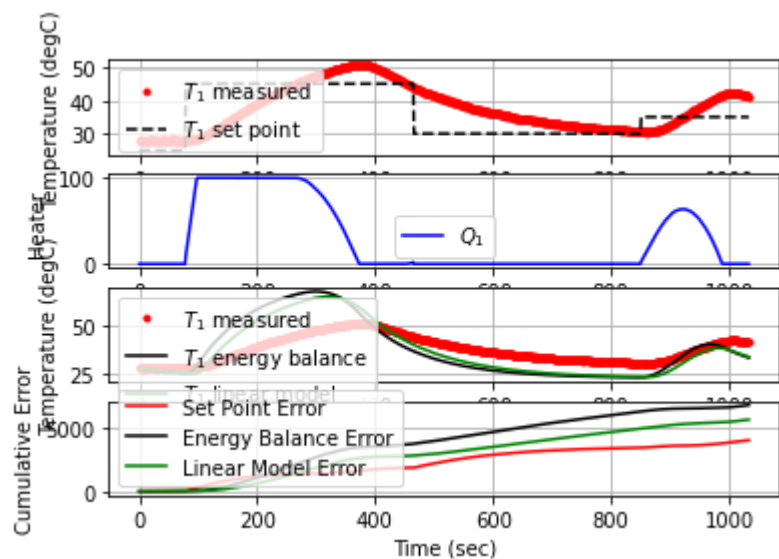
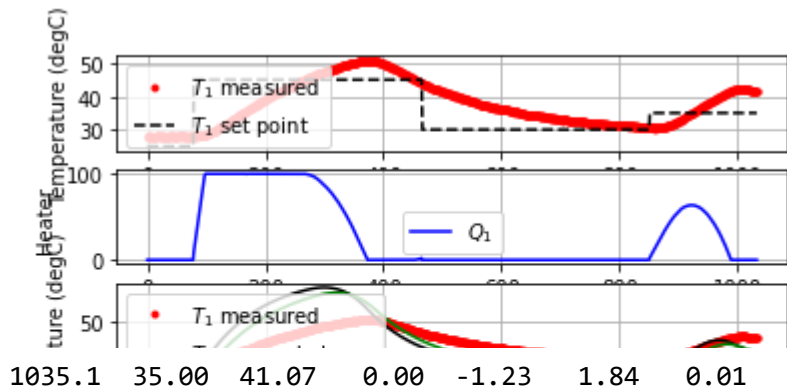
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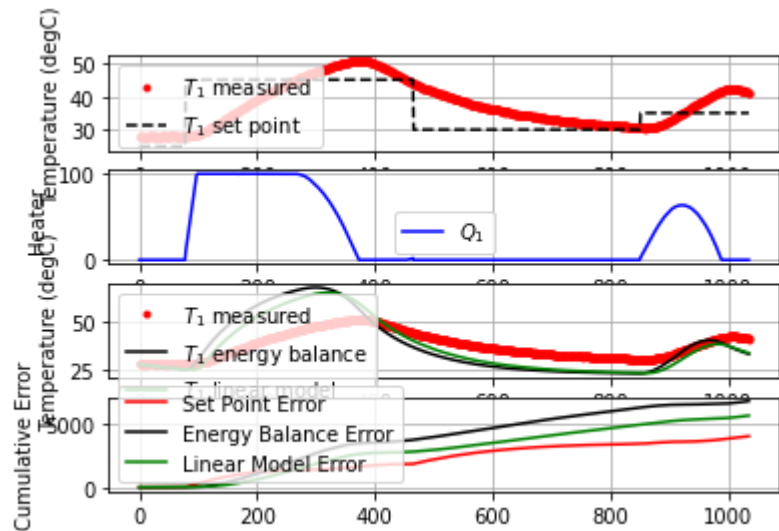
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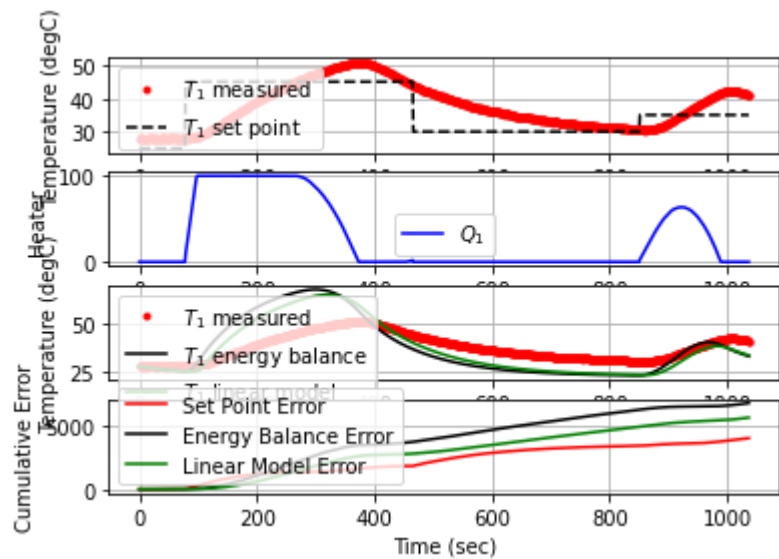




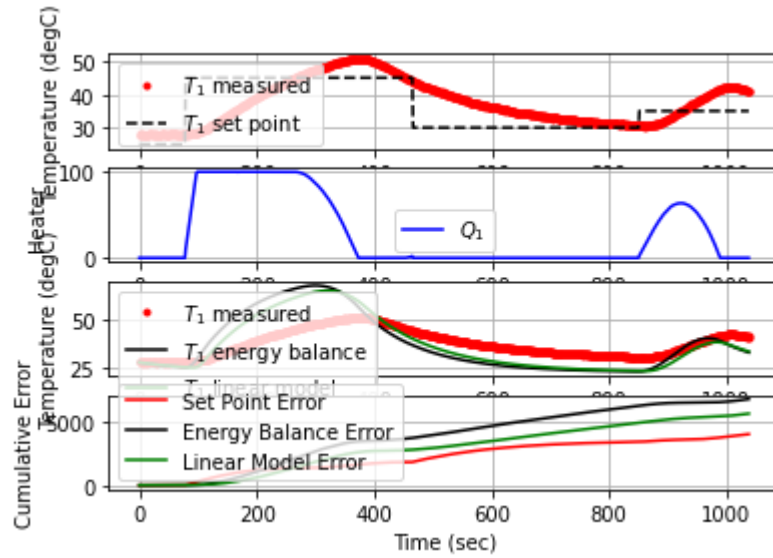
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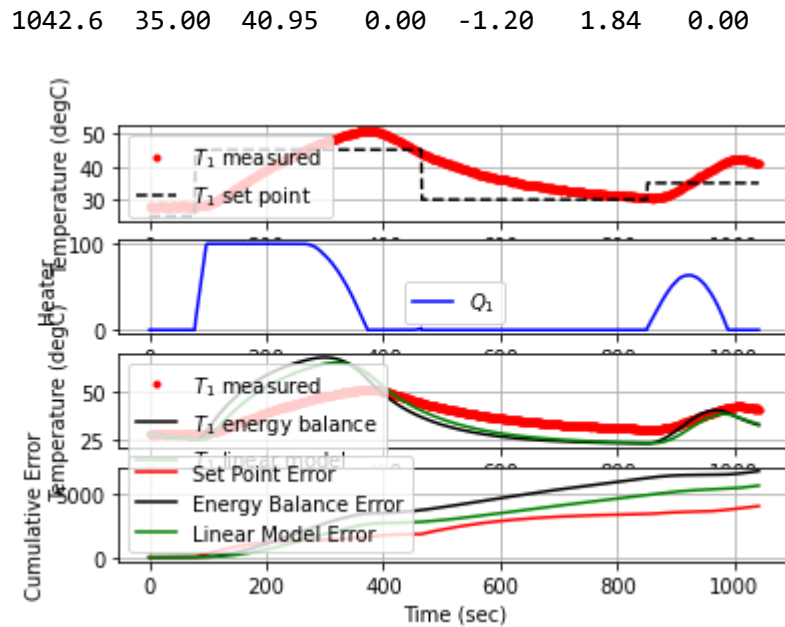
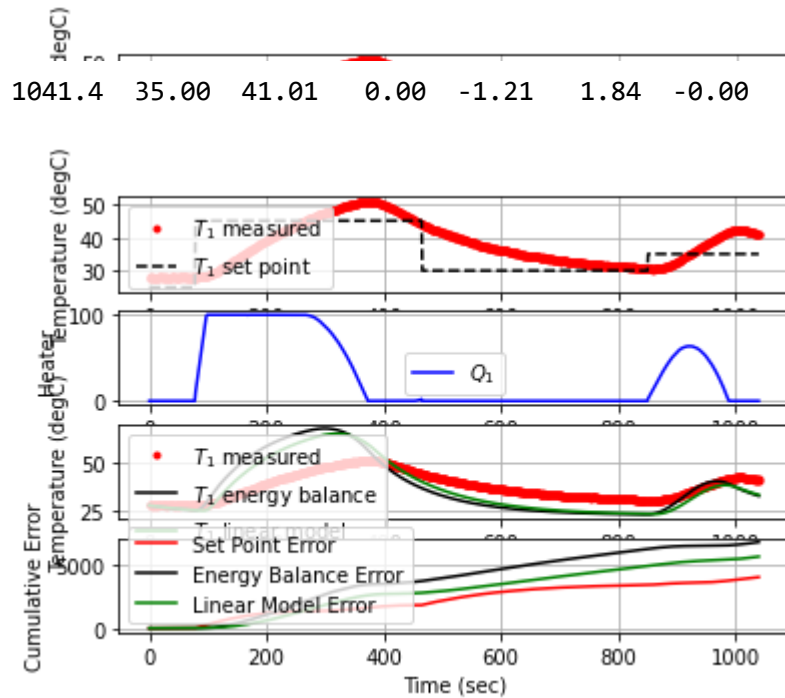
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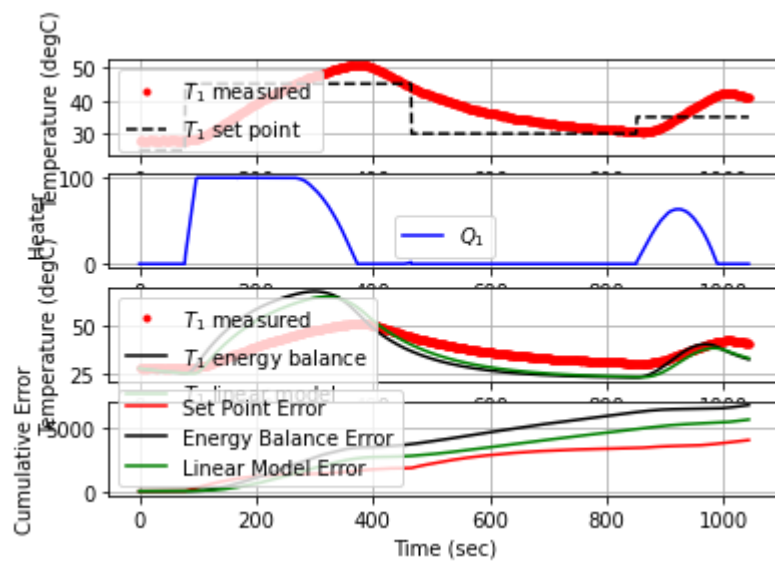
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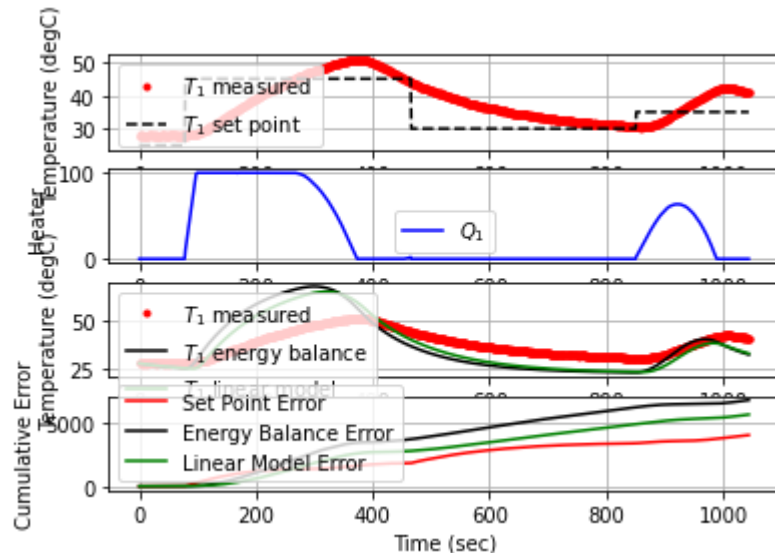
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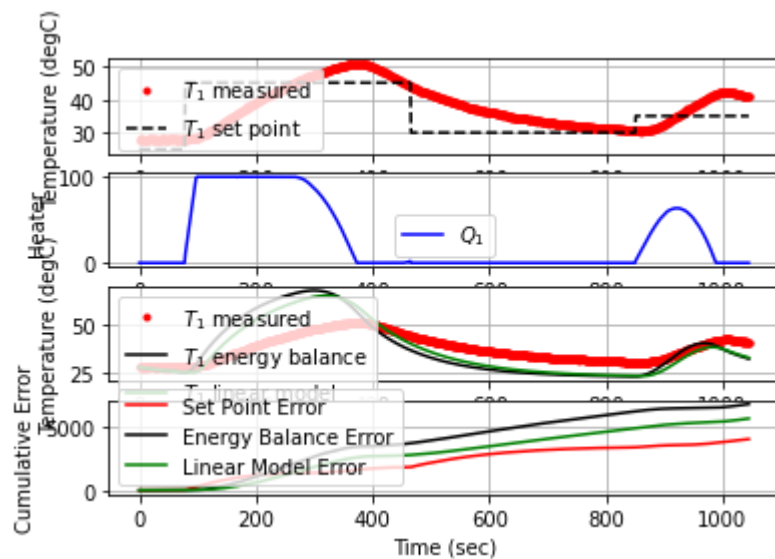
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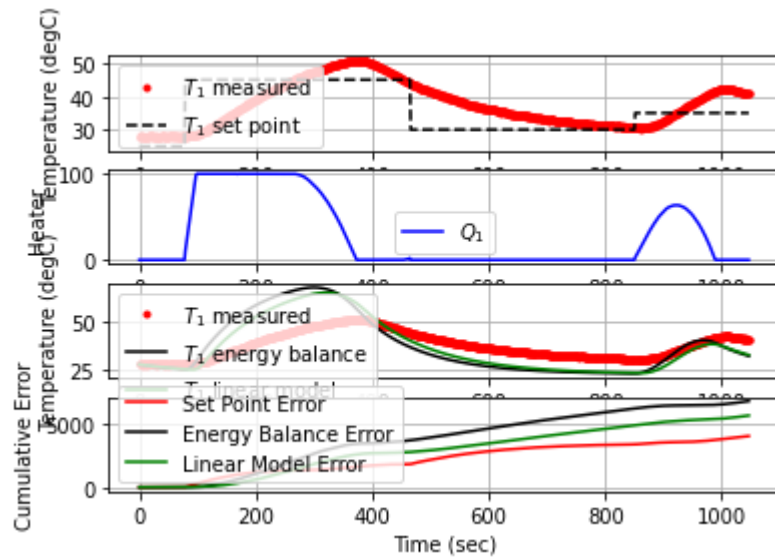
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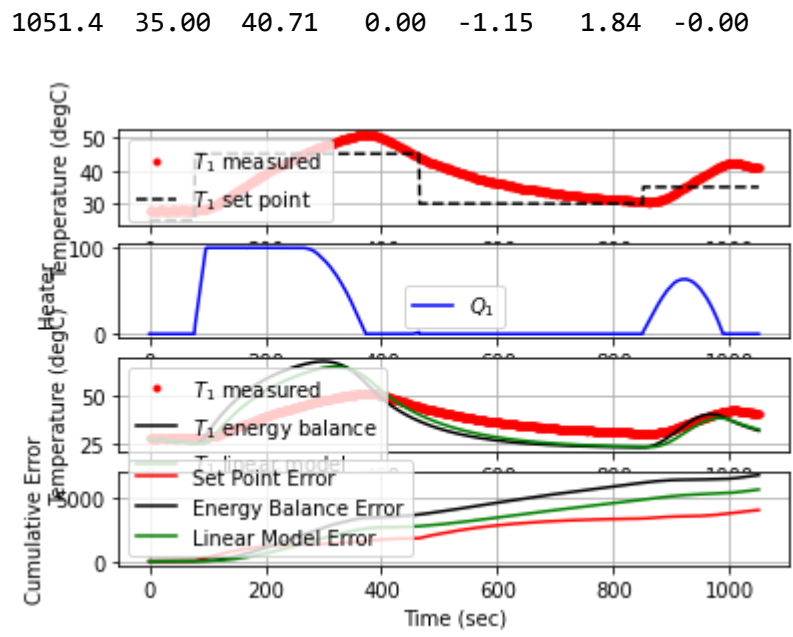
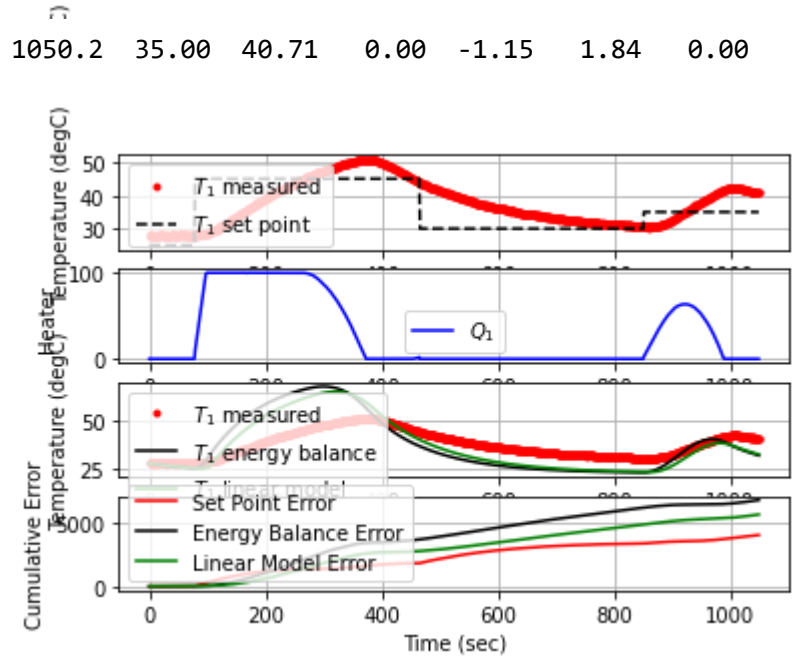


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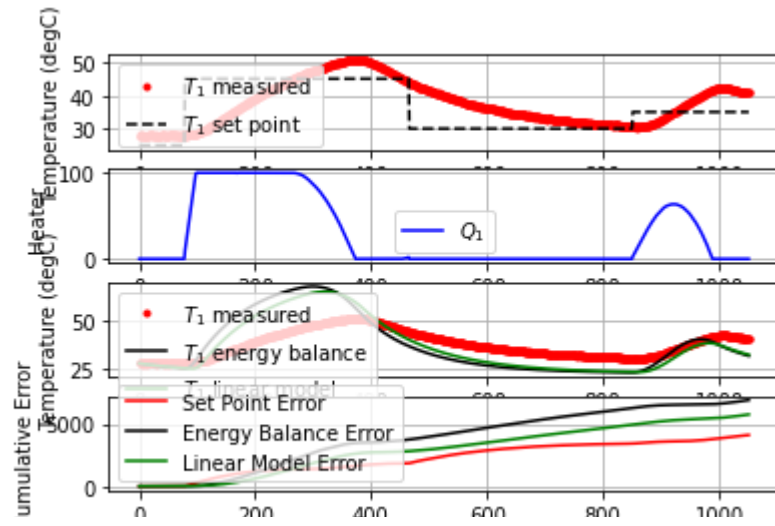


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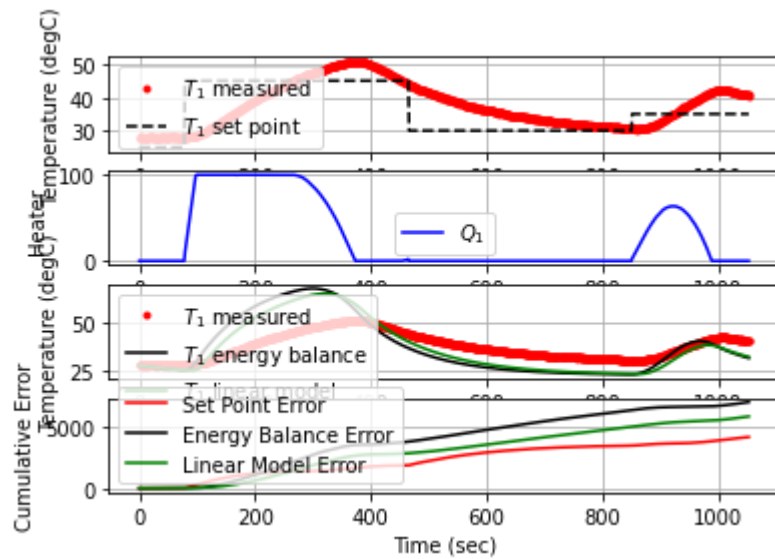




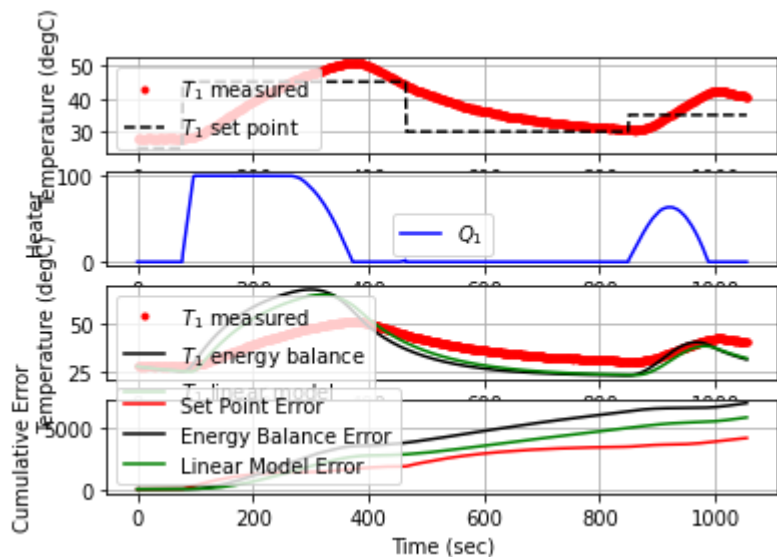
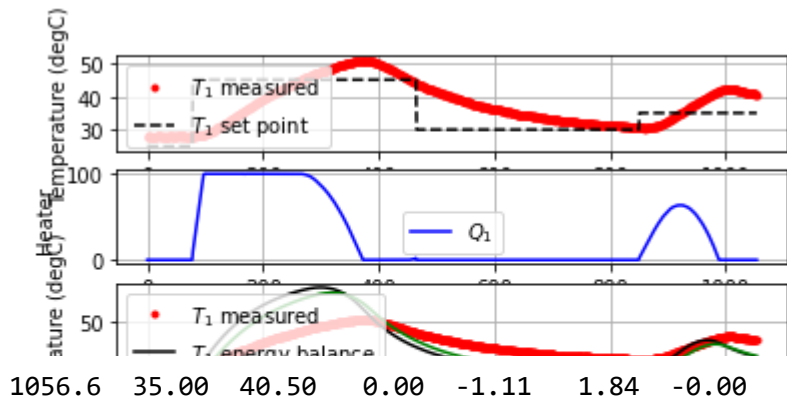
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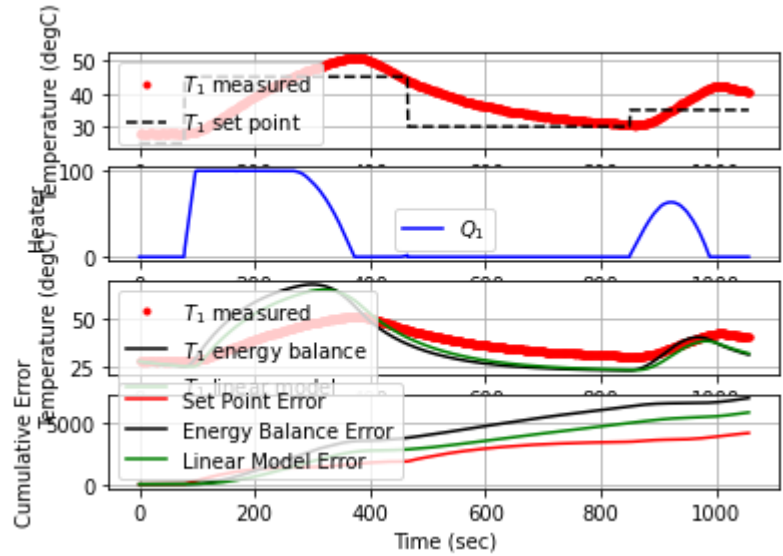


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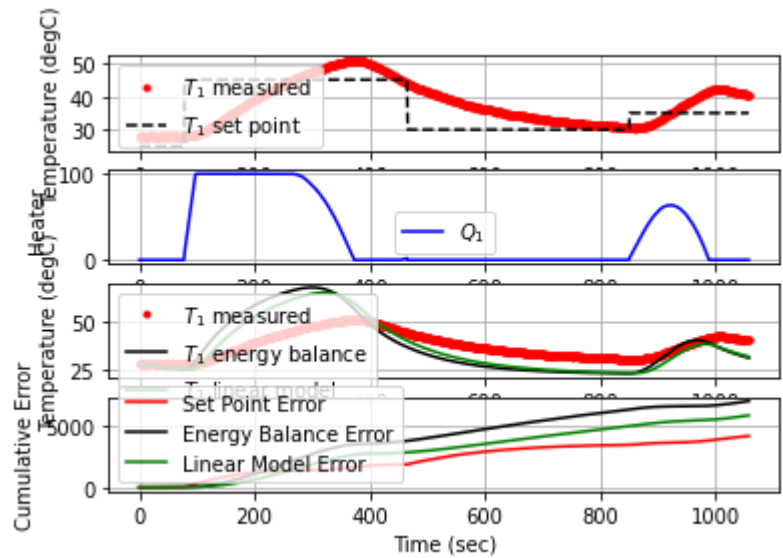


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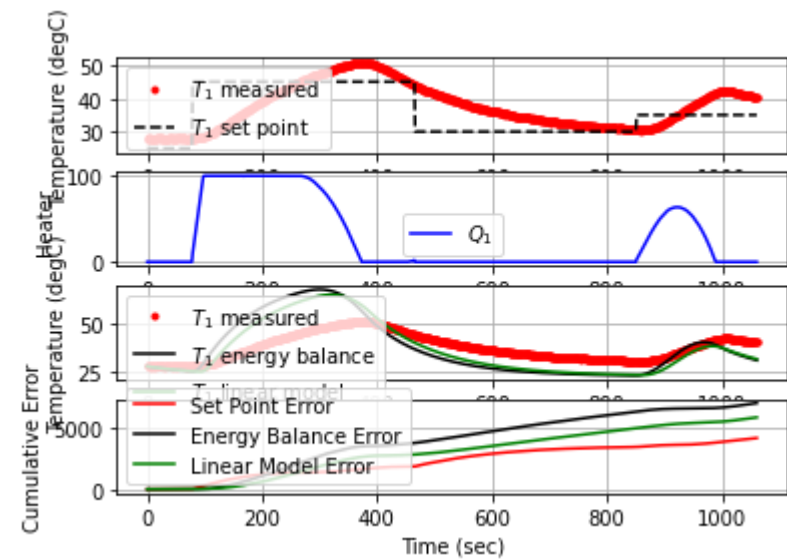
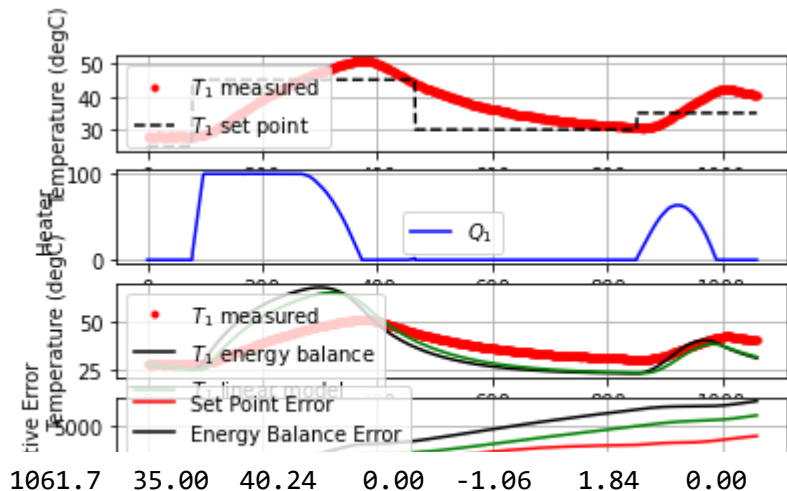


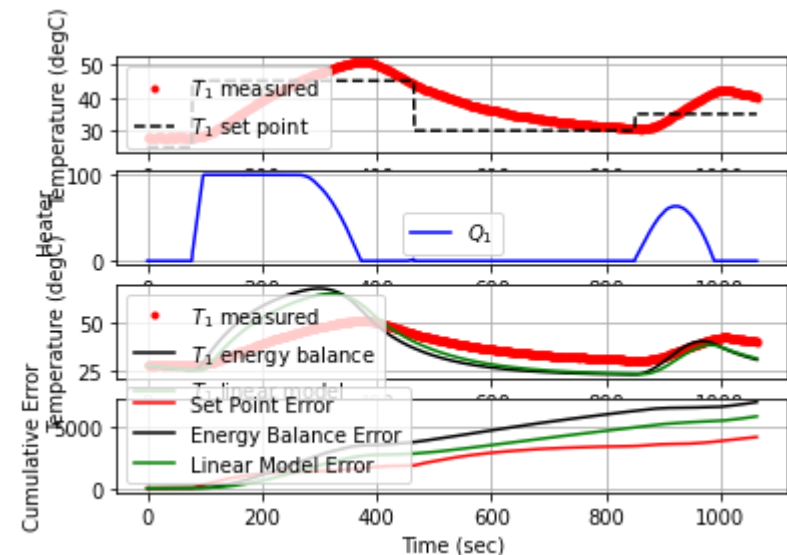
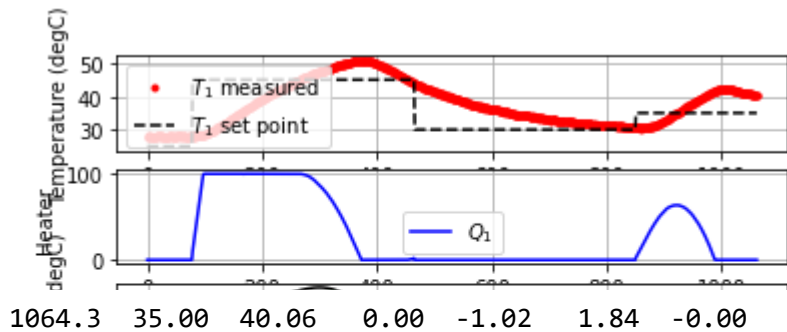


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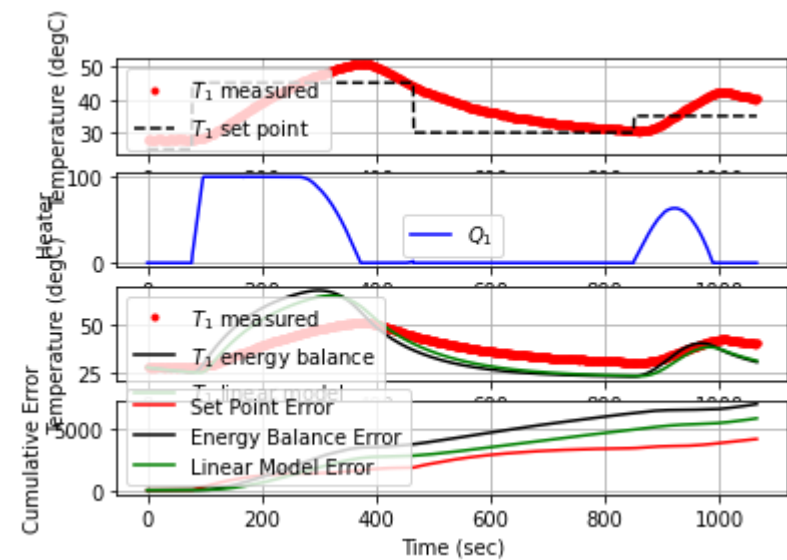
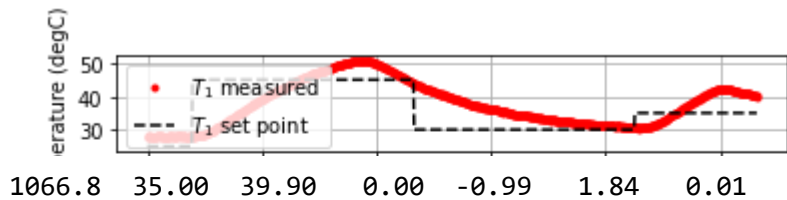


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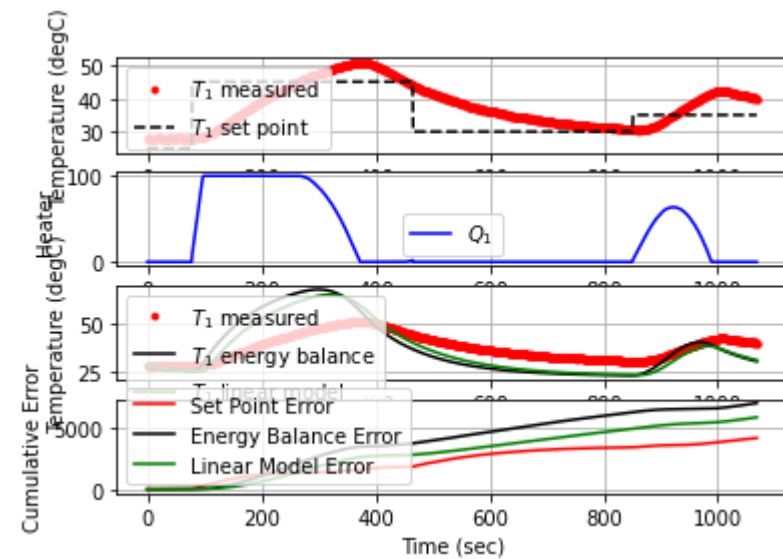
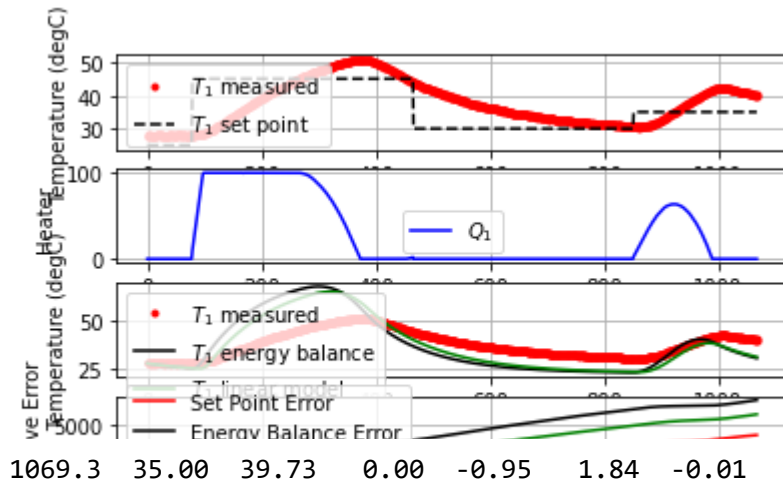




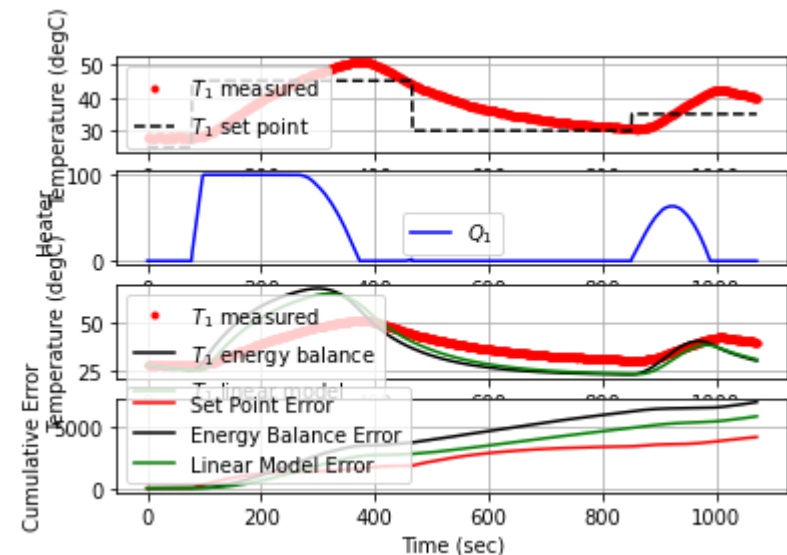
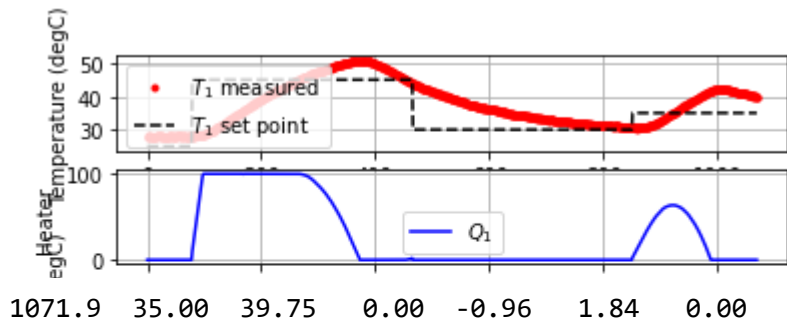
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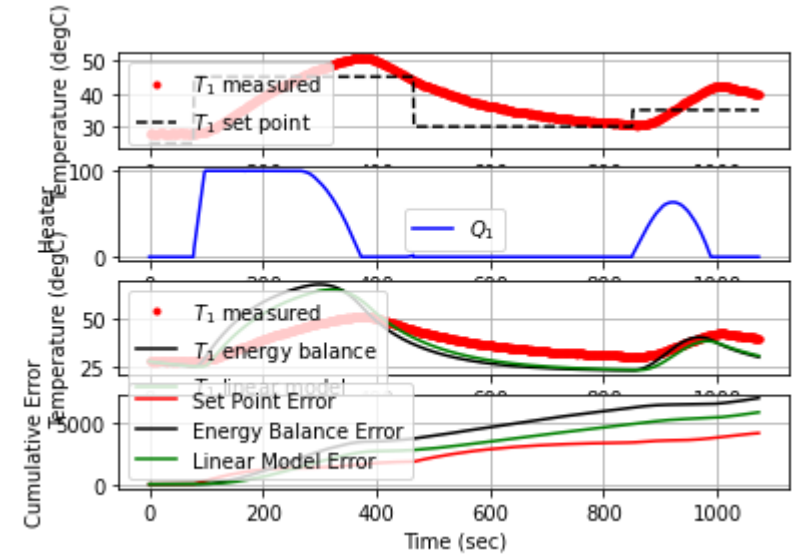
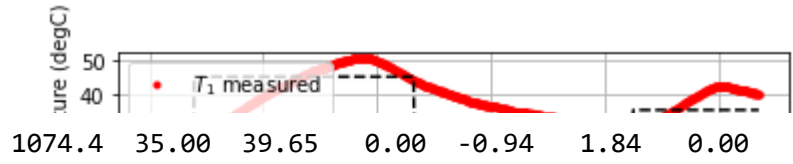
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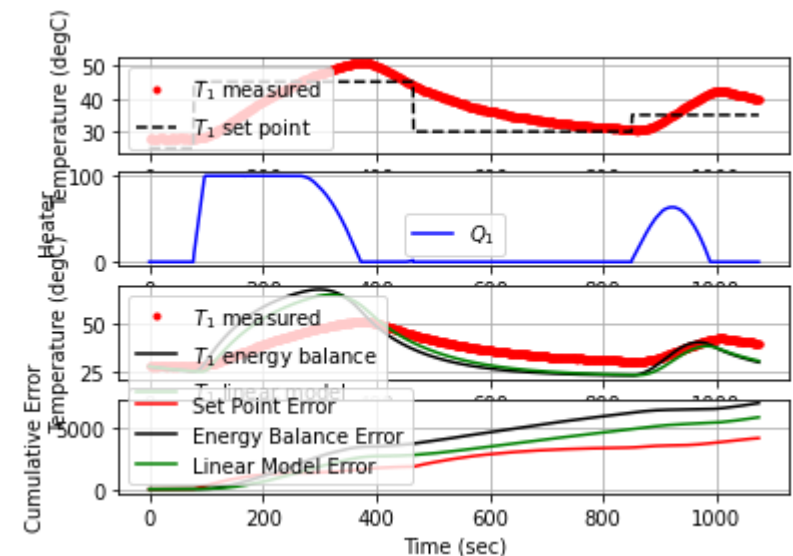




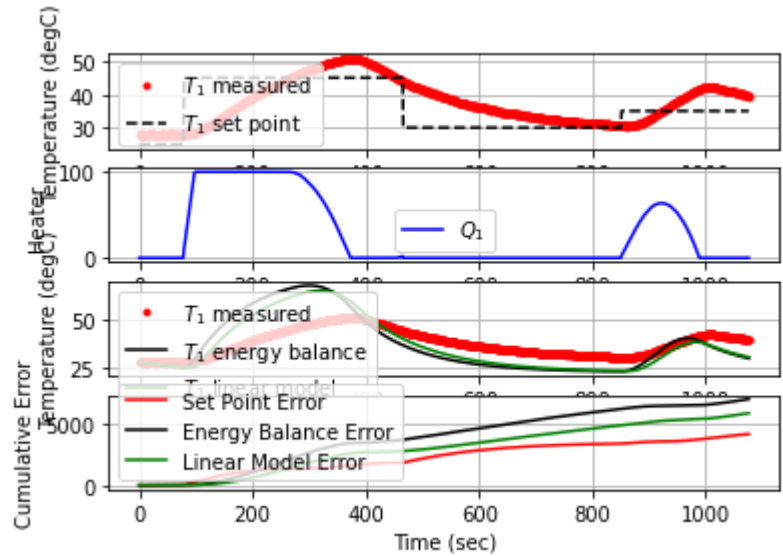
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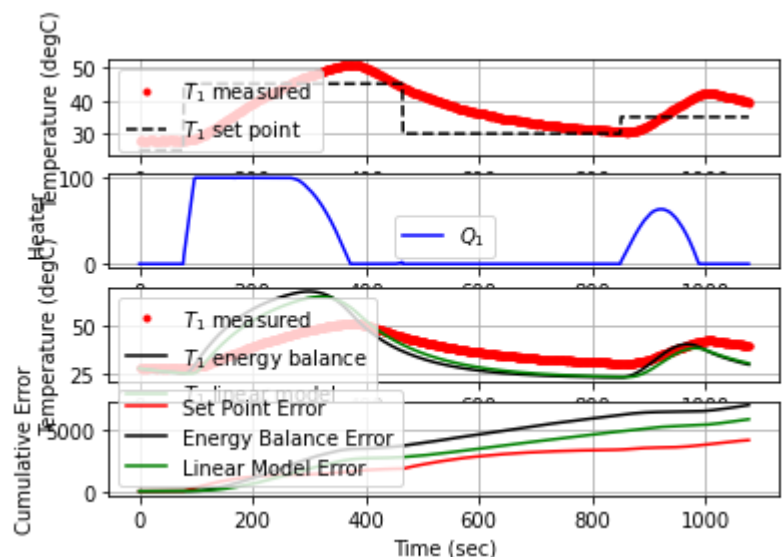
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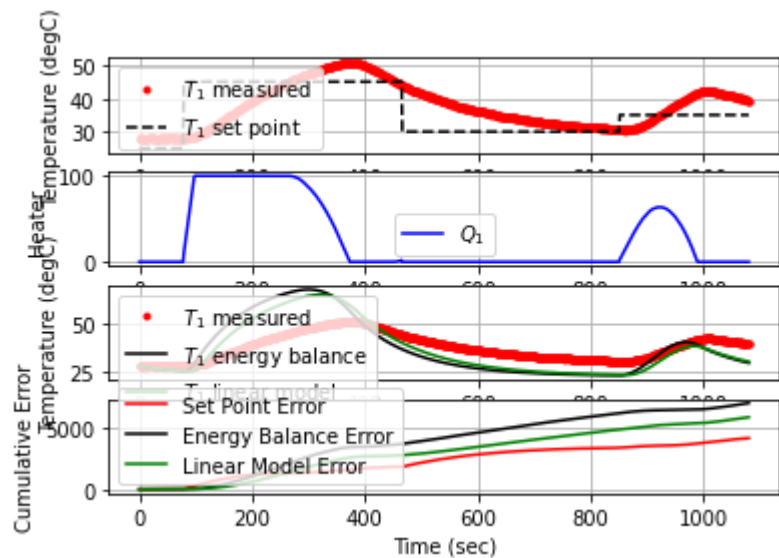
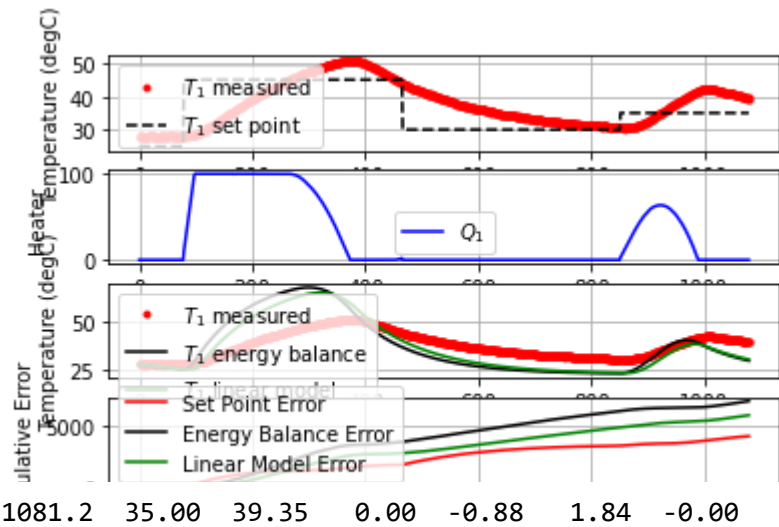
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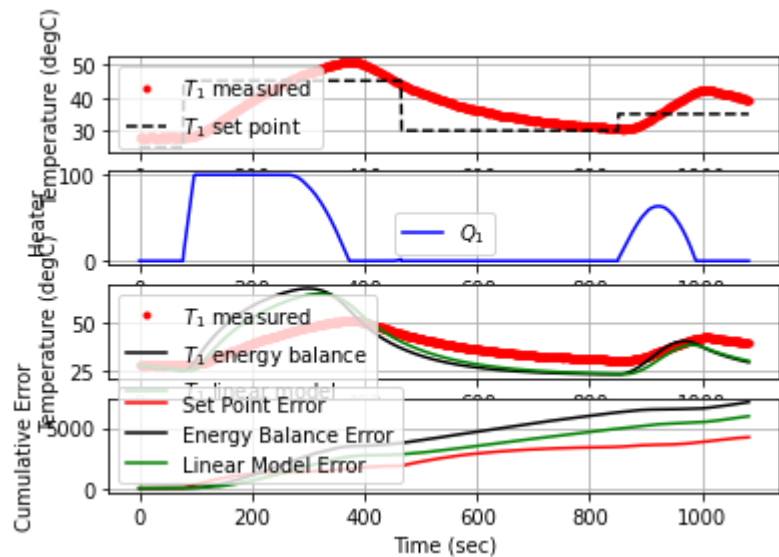
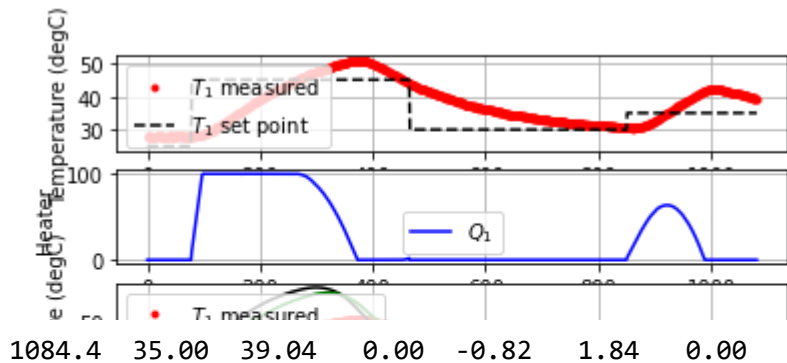


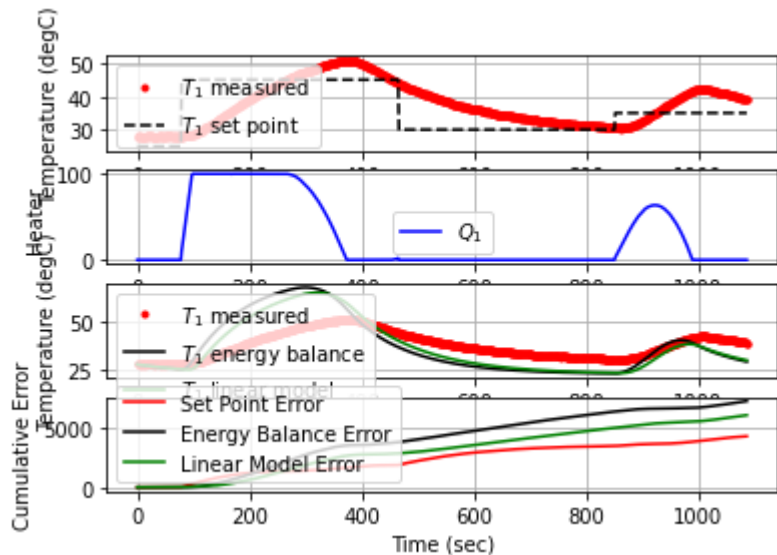
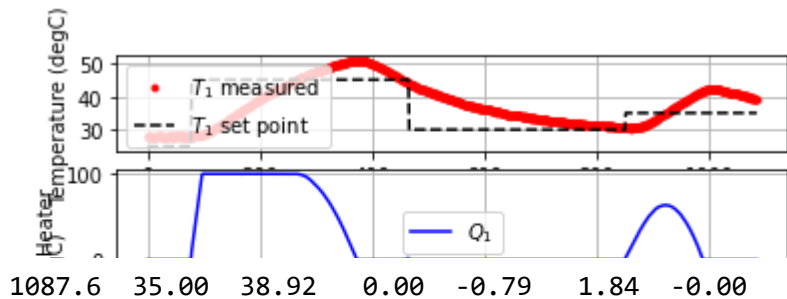
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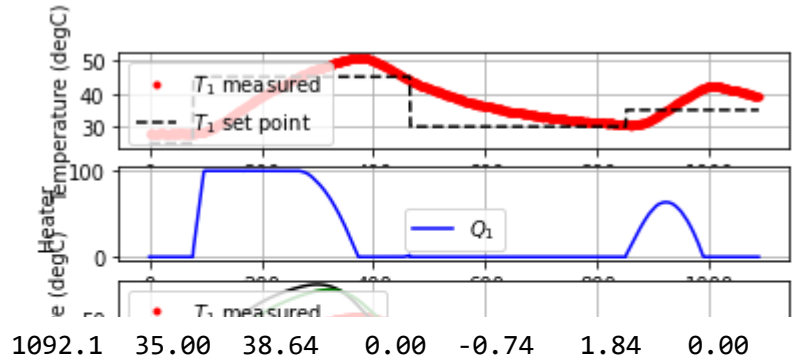
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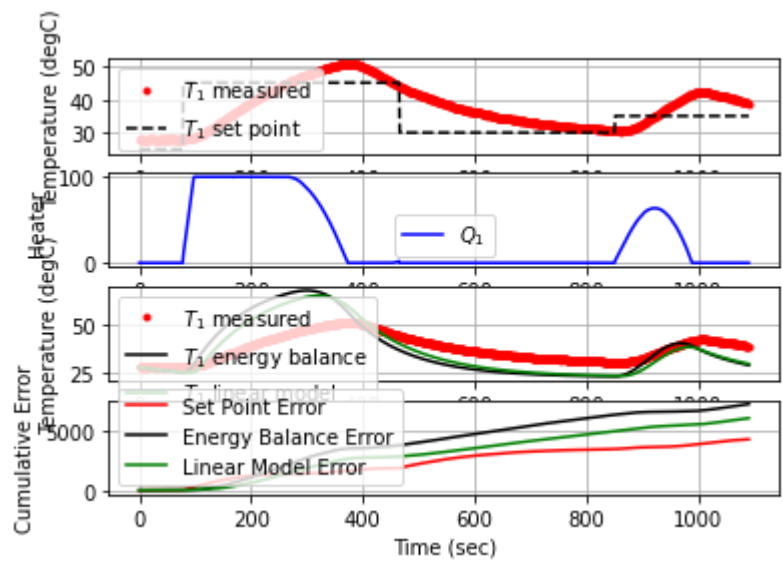




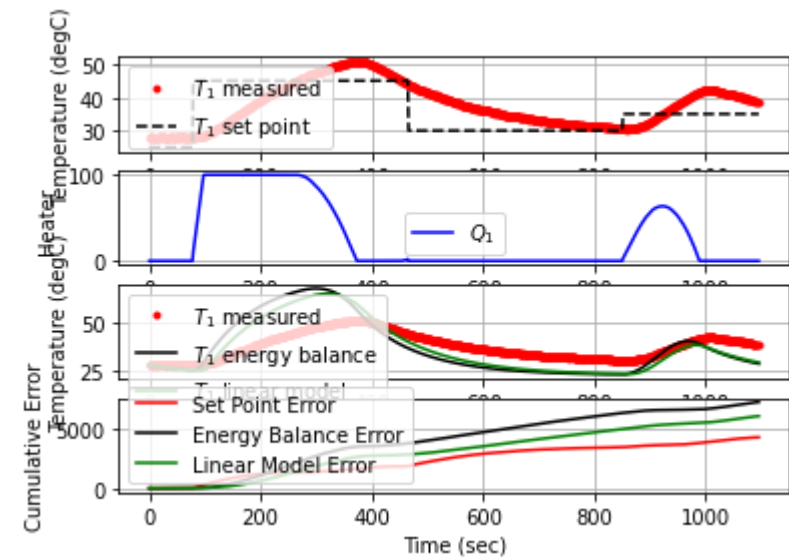
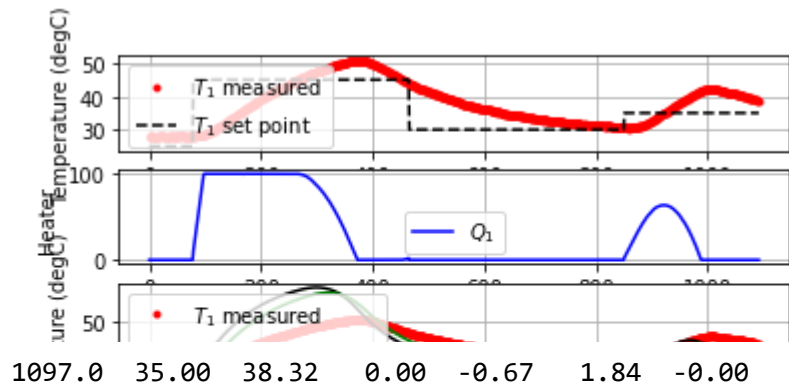
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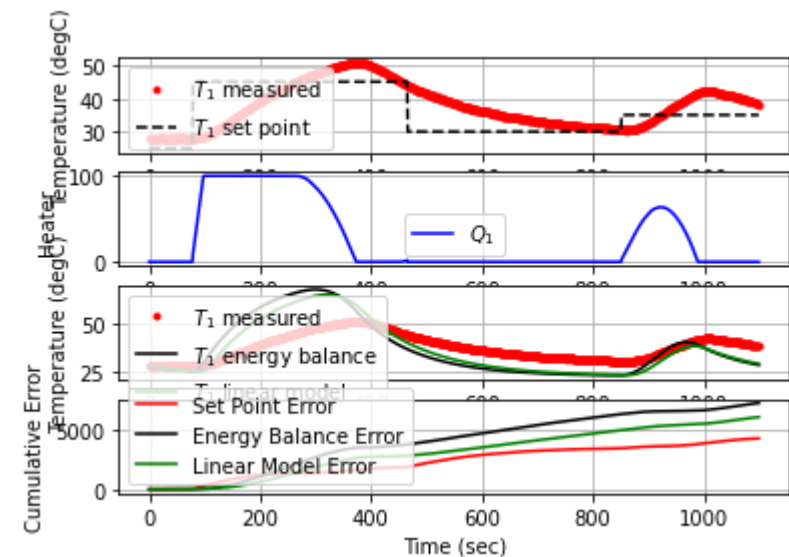
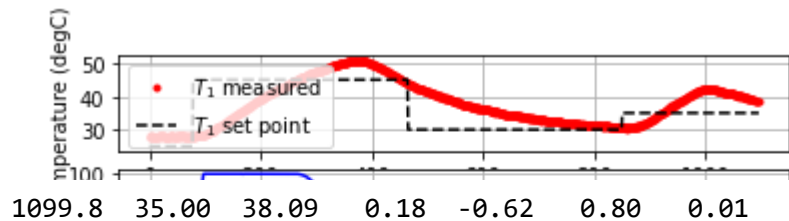
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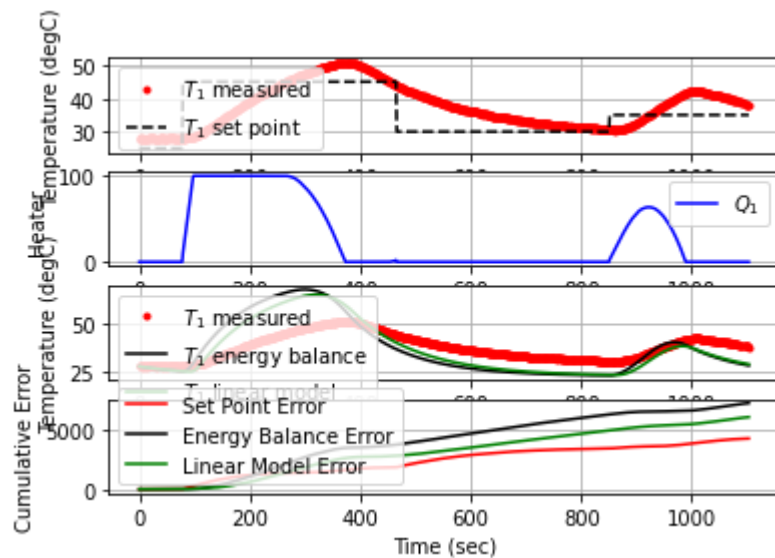
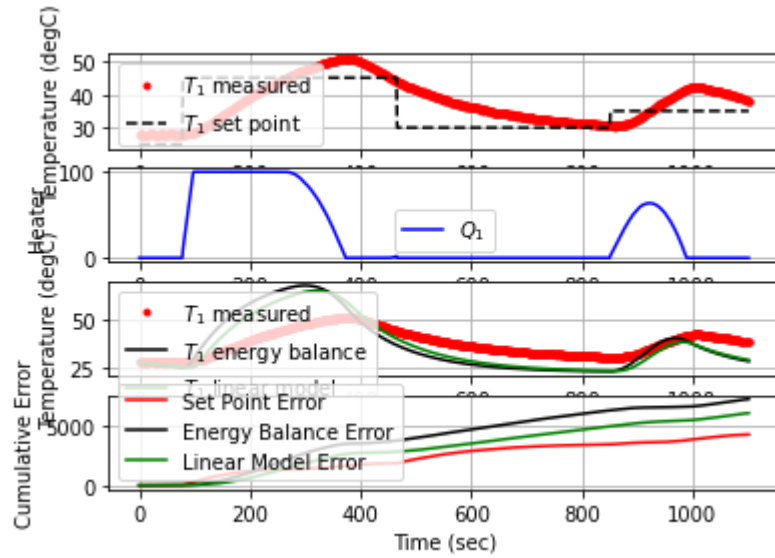
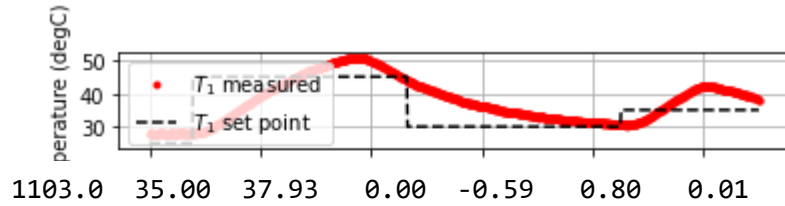
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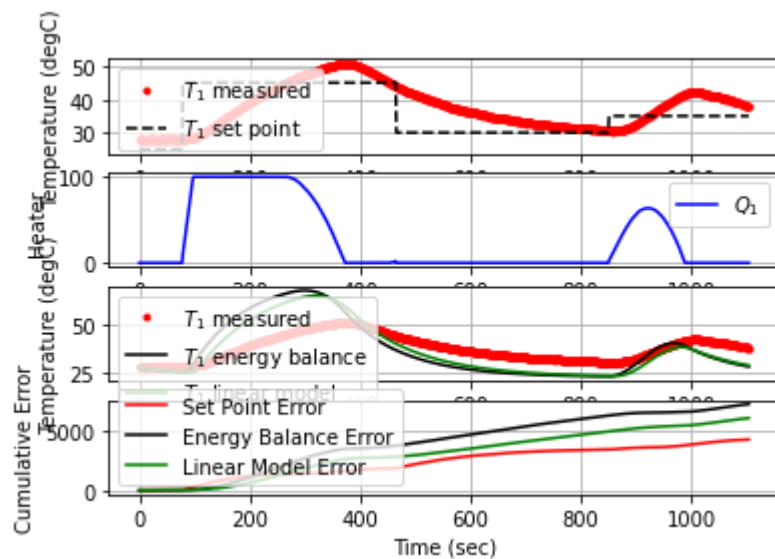




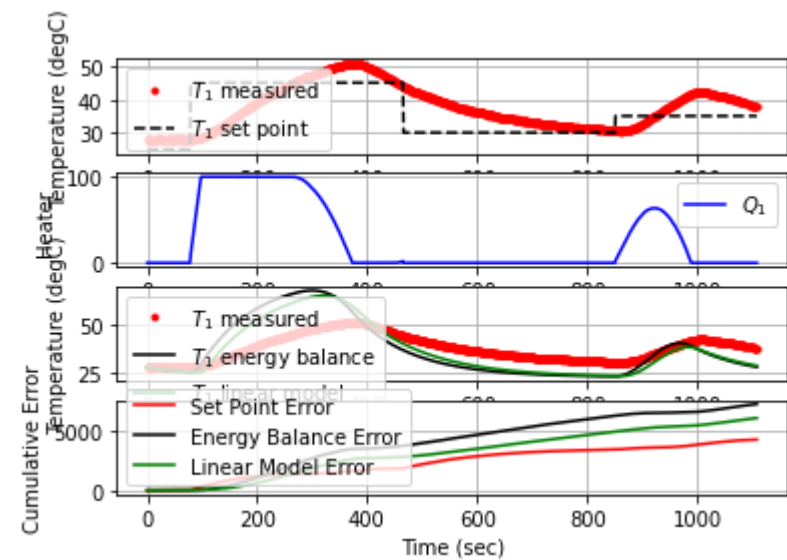
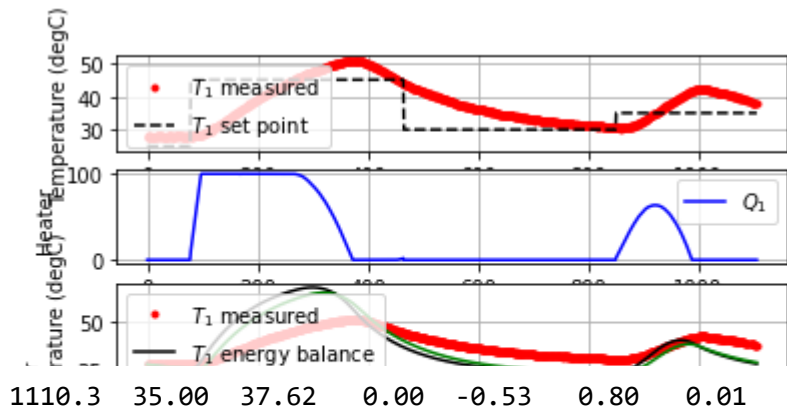
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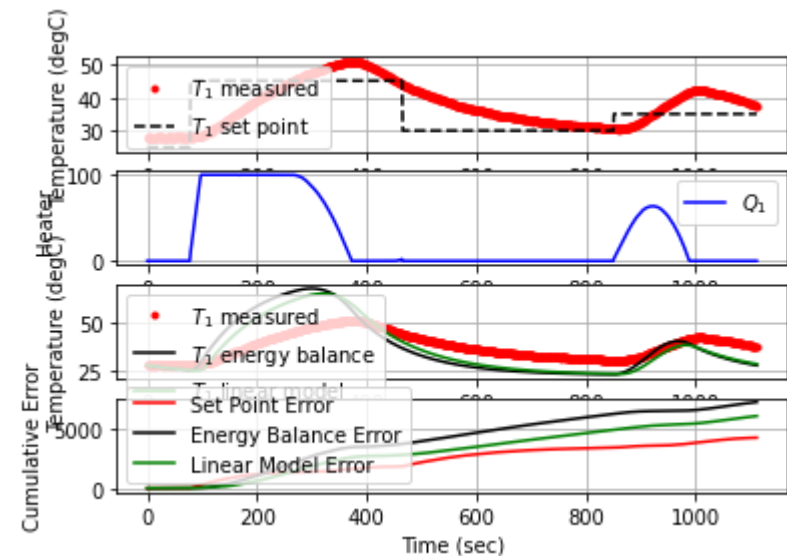
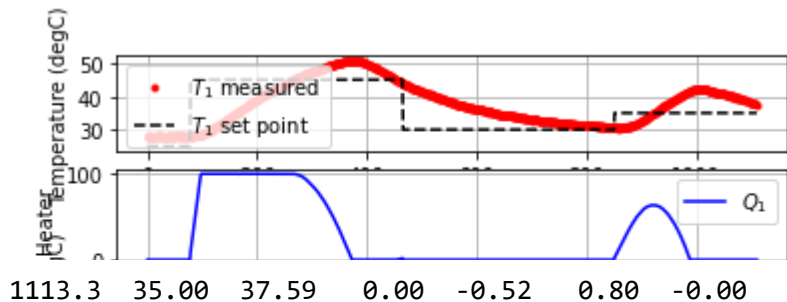


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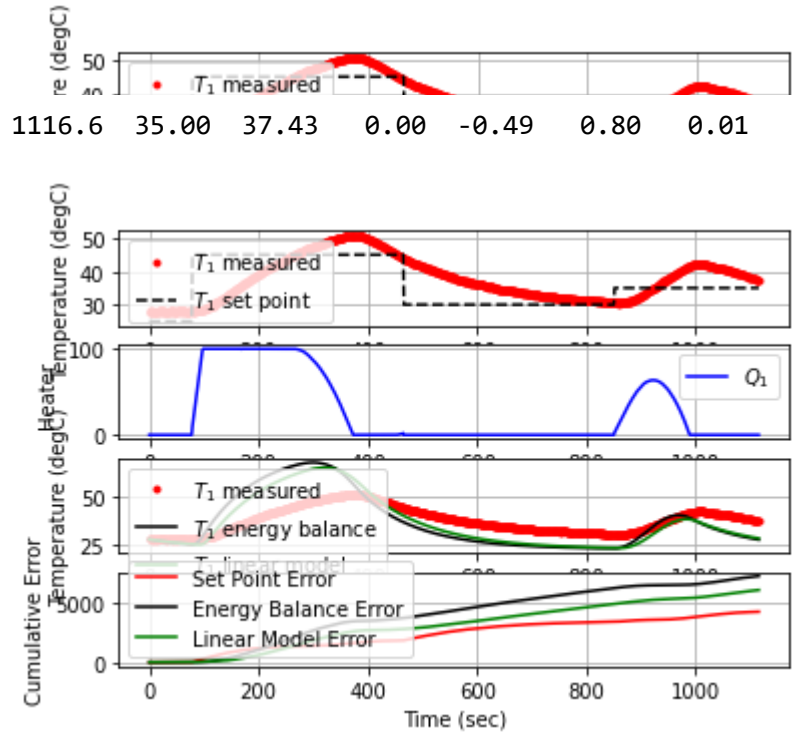


1108.0 35.00 37.83 0.00 -0.57 0.80 0.00

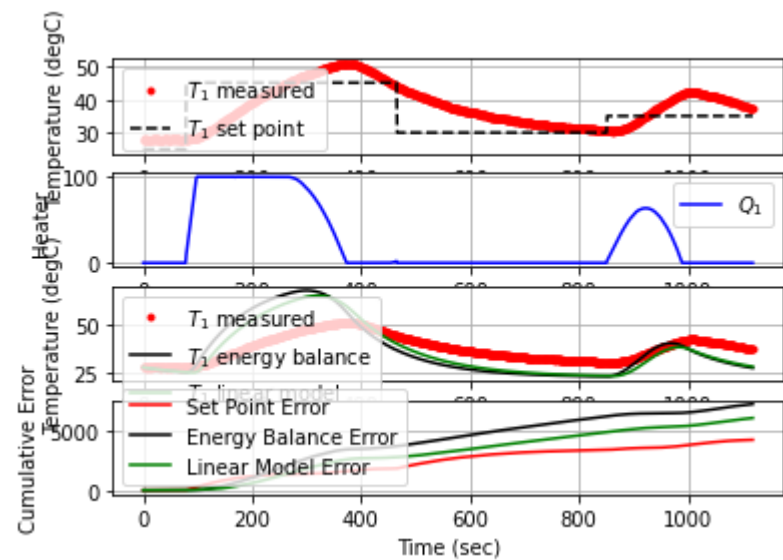
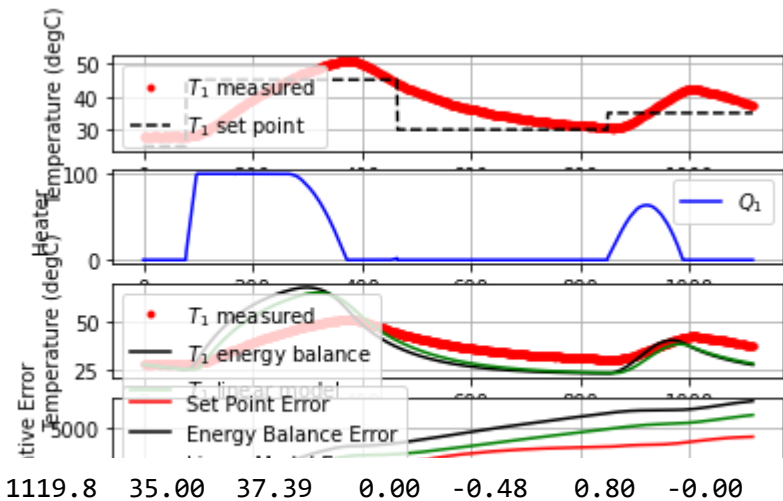


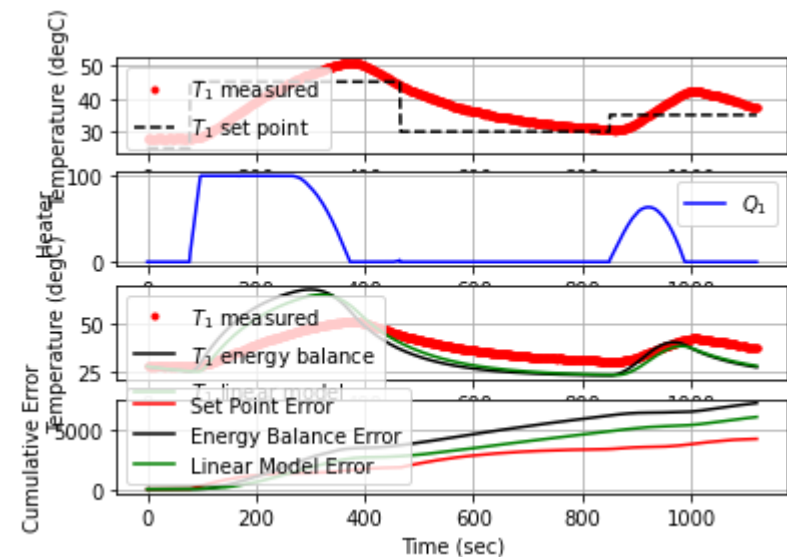
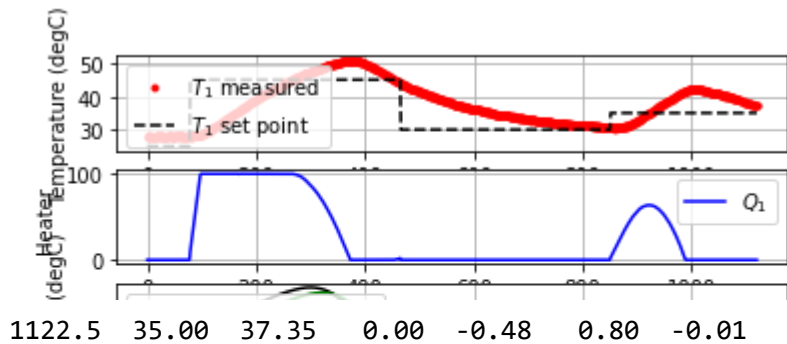


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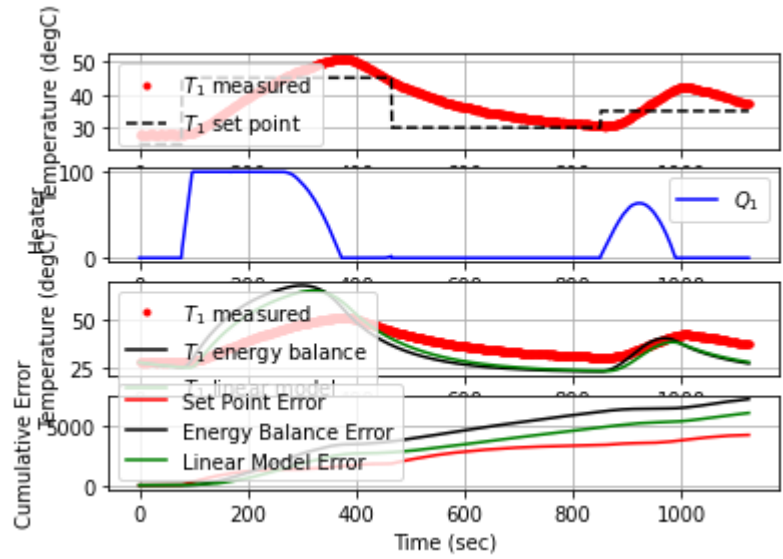
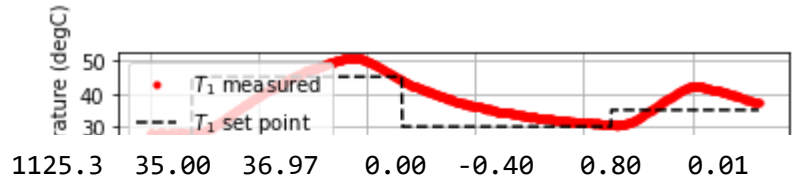
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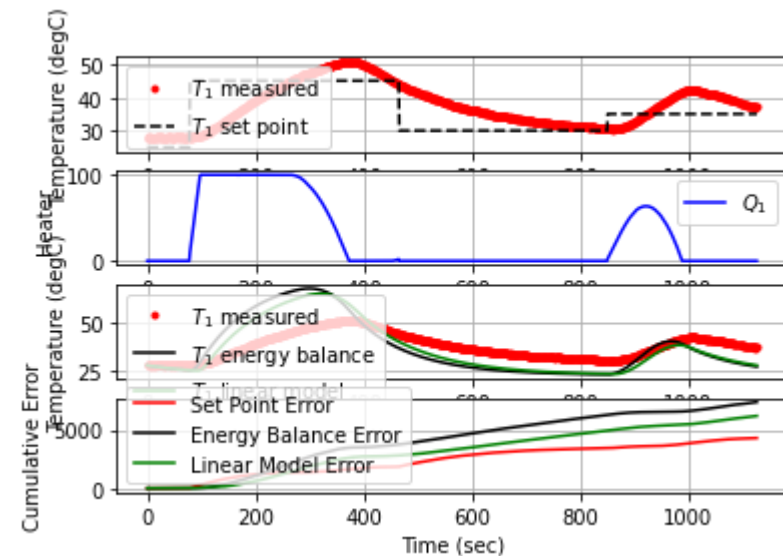
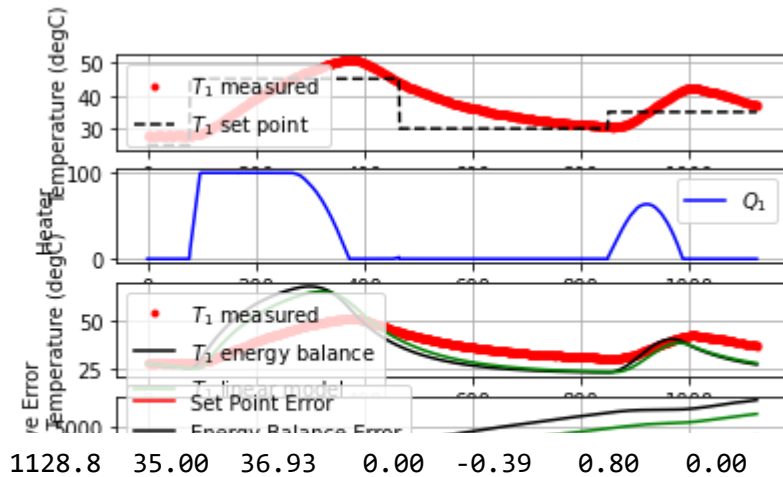


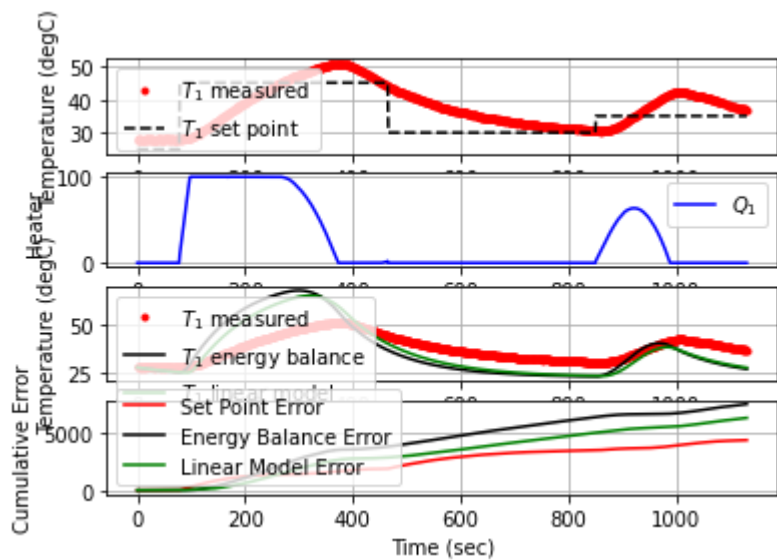
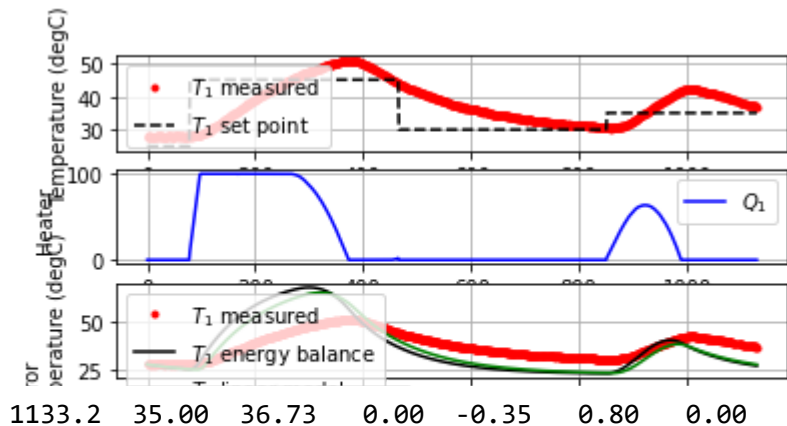
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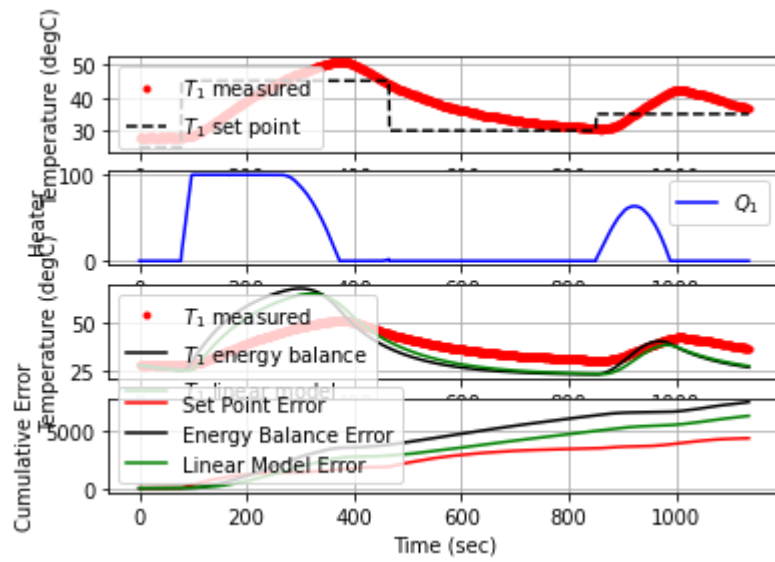
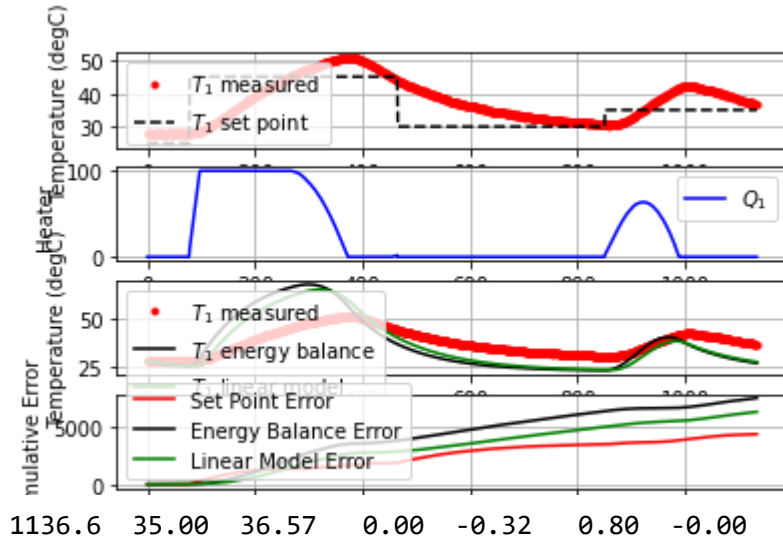


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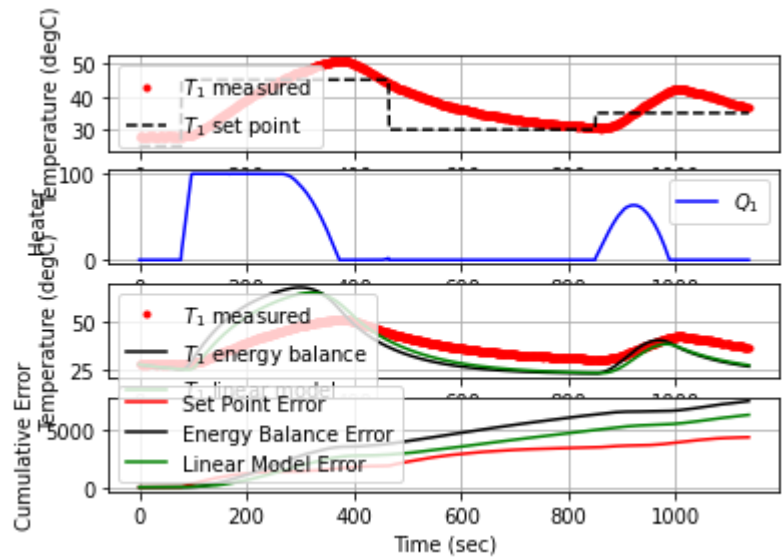




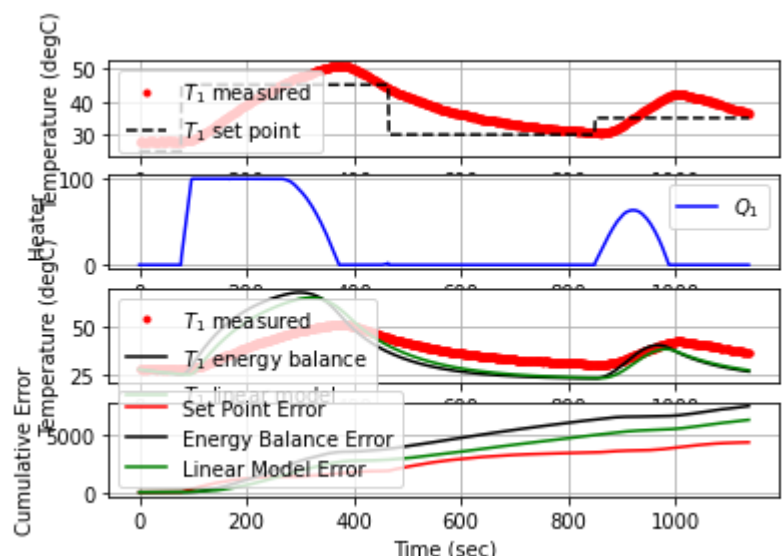
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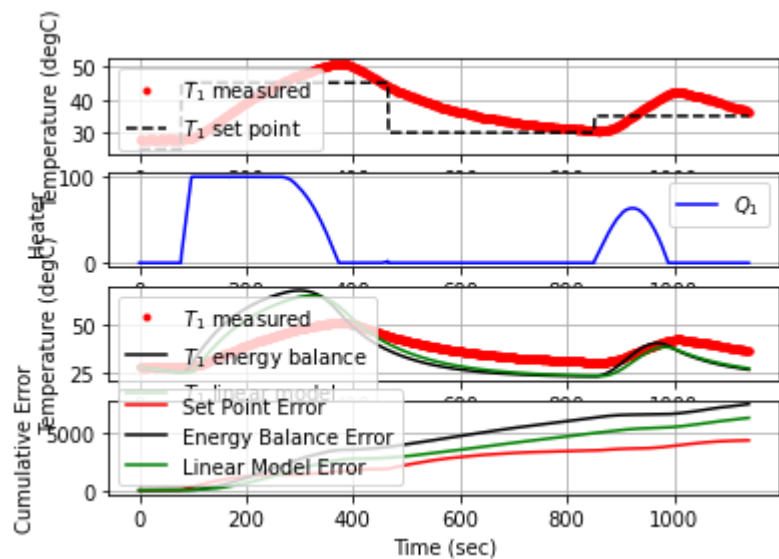
1138.0 35.00 36.44 0.00 -0.29 0.80 0.01



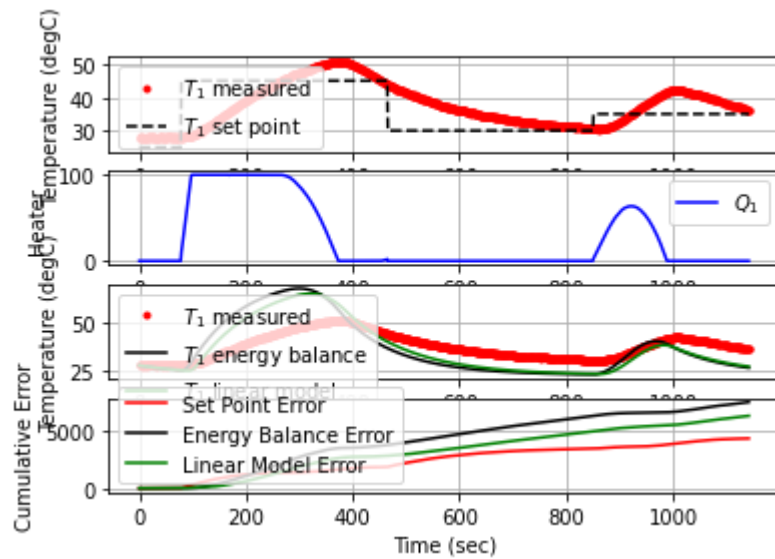
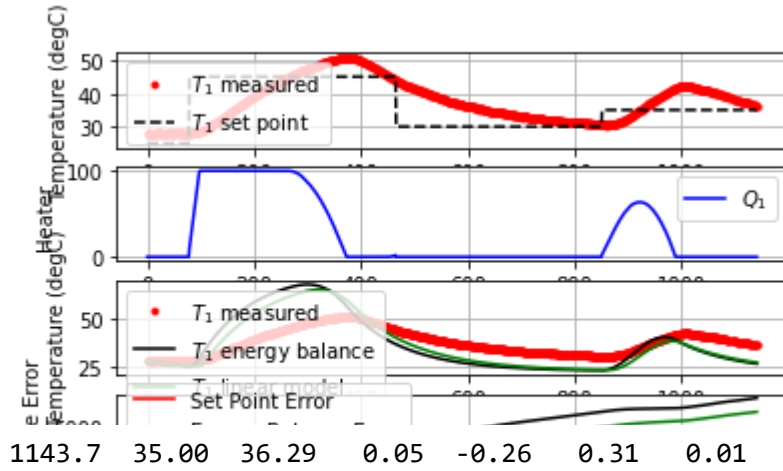
1139.4 35.00 36.39 0.00 -0.28 0.80 0.00



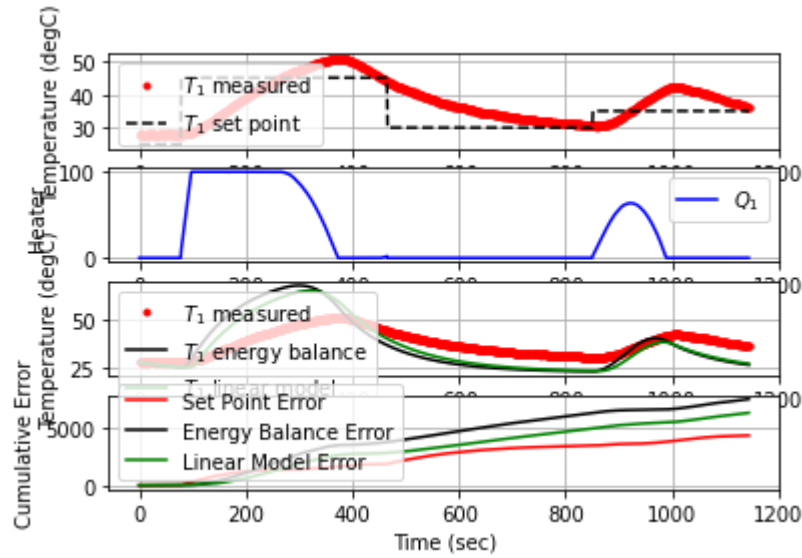
1140.9 35.00 36.40 0.00 -0.29 0.80 -0.00



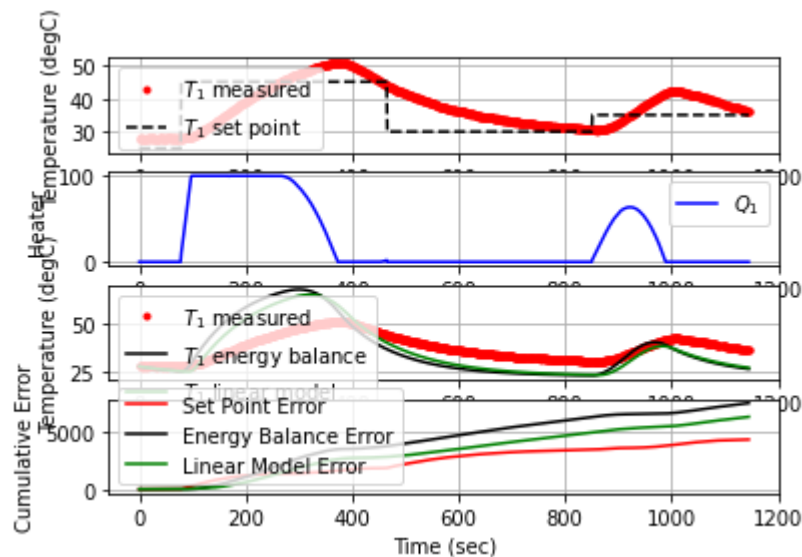
1142.3 35.00 36.40 0.00 -0.29 0.80 -0.00



1145.1 35.00 36.25 0.00 -0.26 0.31 0.00

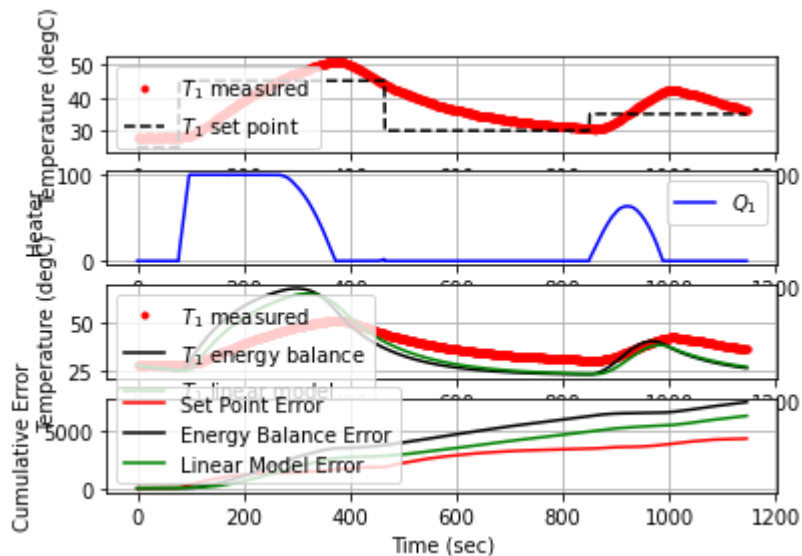


1146.6 35.00 36.29 0.00 -0.26 0.31 -0.00

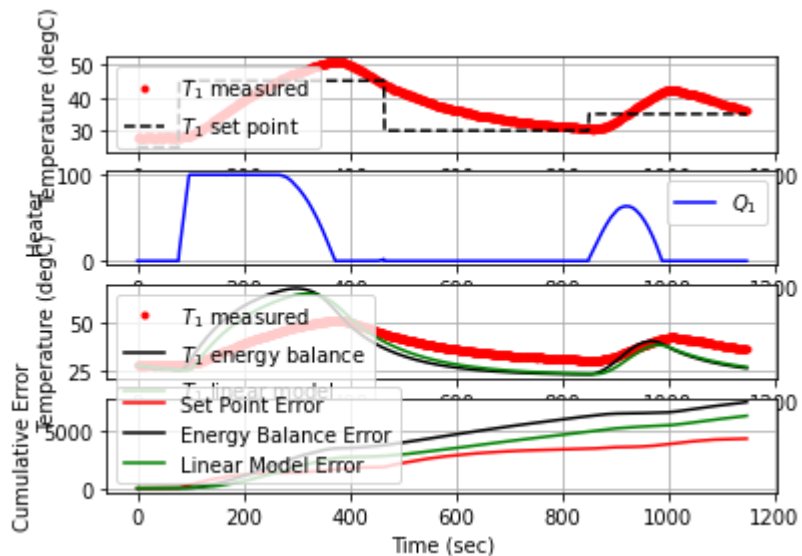




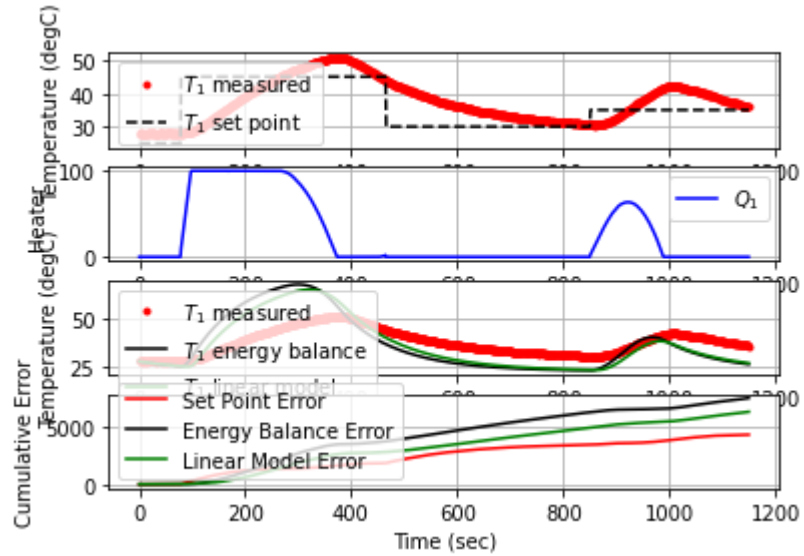
1148.4 35.00 36.14 0.00 -0.23 0.31 0.01



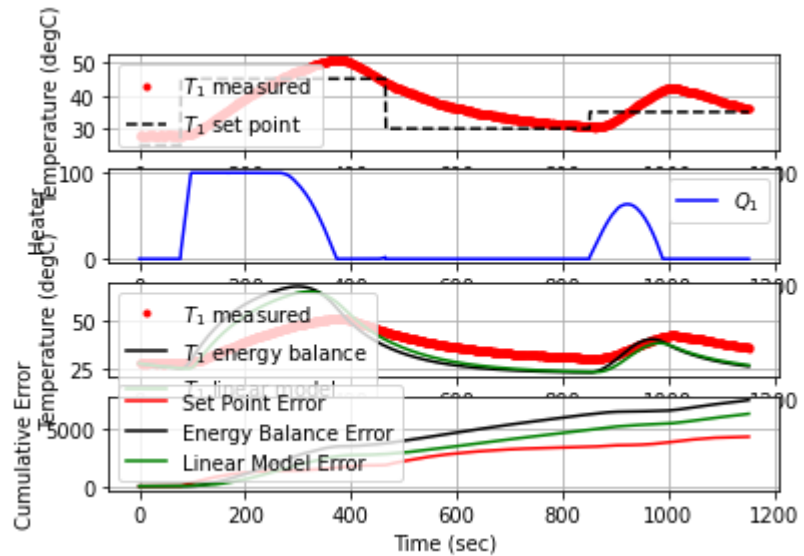
1150.0 35.00 35.97 0.00 -0.20 0.31 0.01



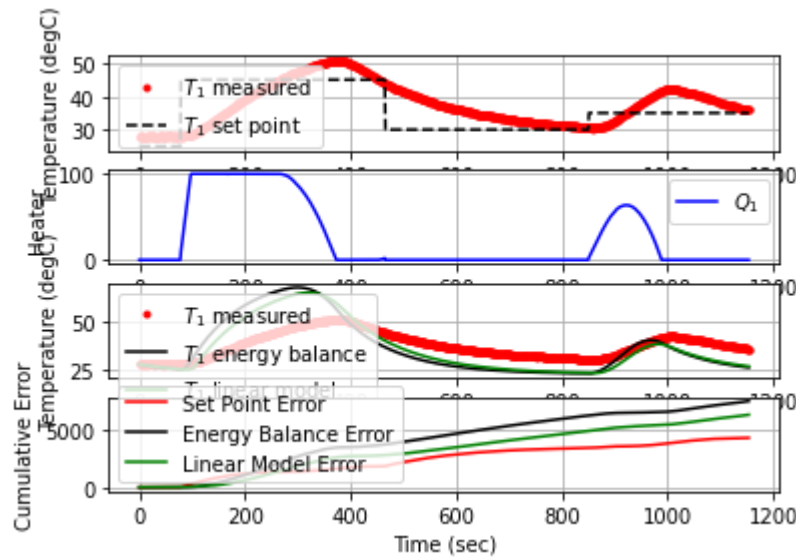
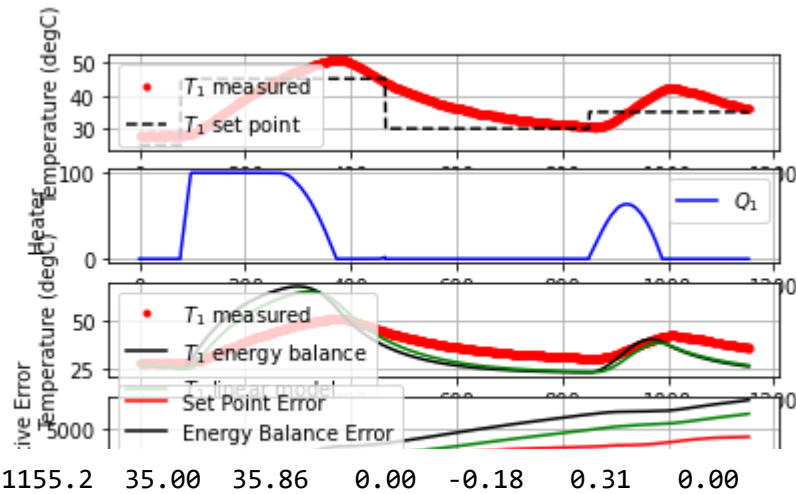
1151.3 35.00 36.12 0.00 -0.23 0.31 -0.01

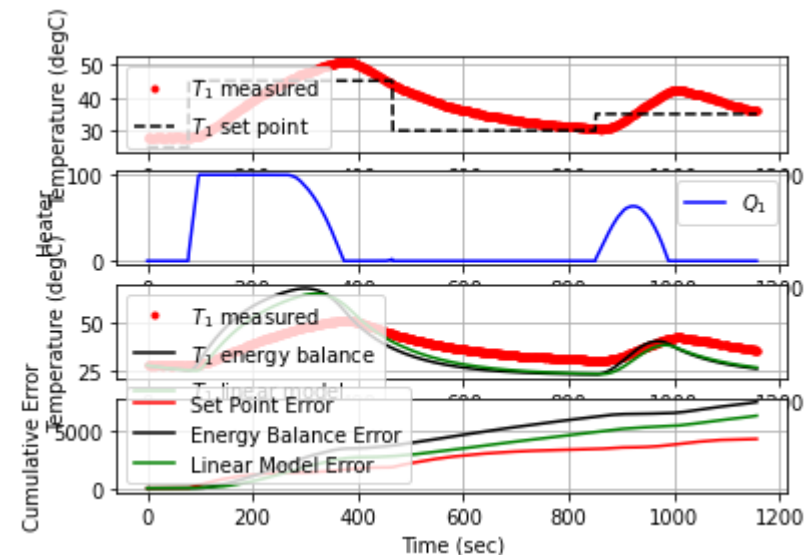
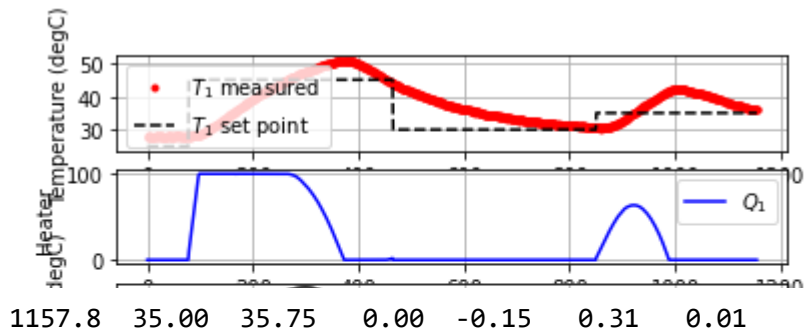


1152.5 35.00 35.86 0.00 -0.18 0.31 0.02

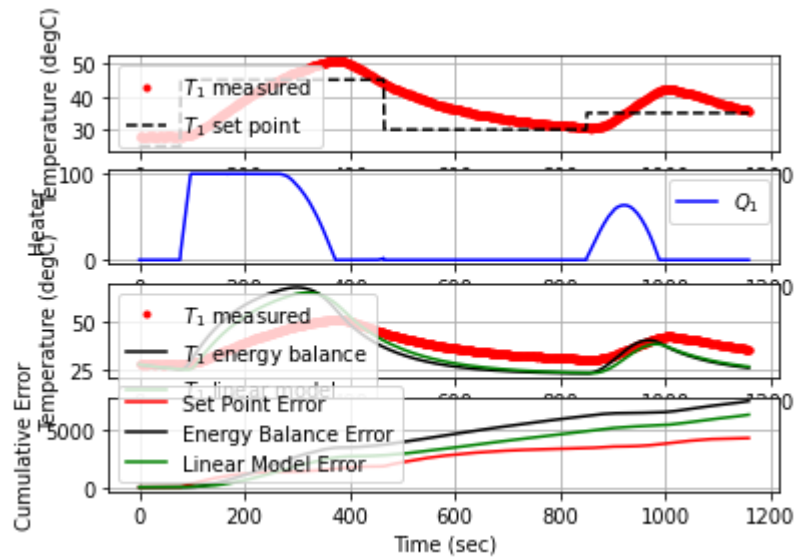
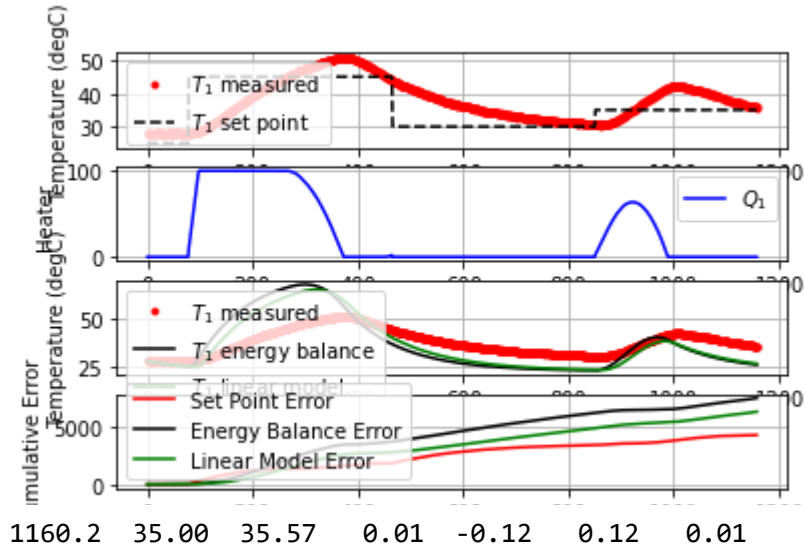


1153.9 35.00 35.94 0.00 -0.19 0.31 -0.00

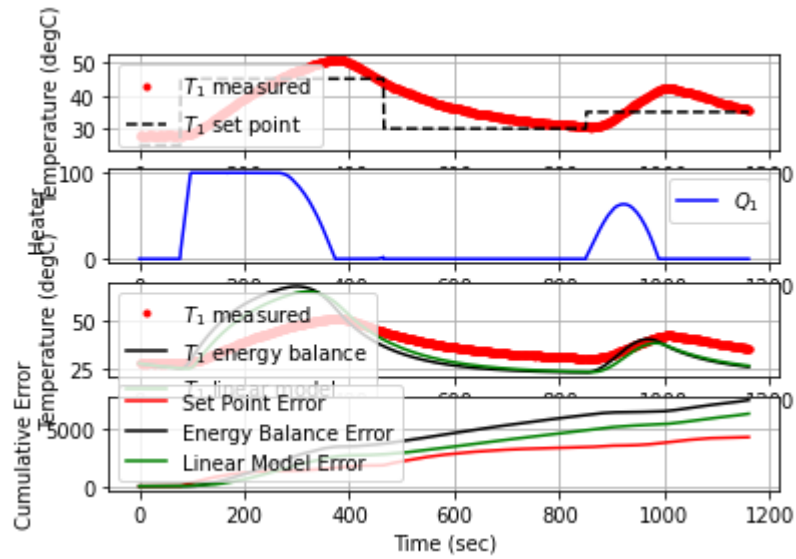




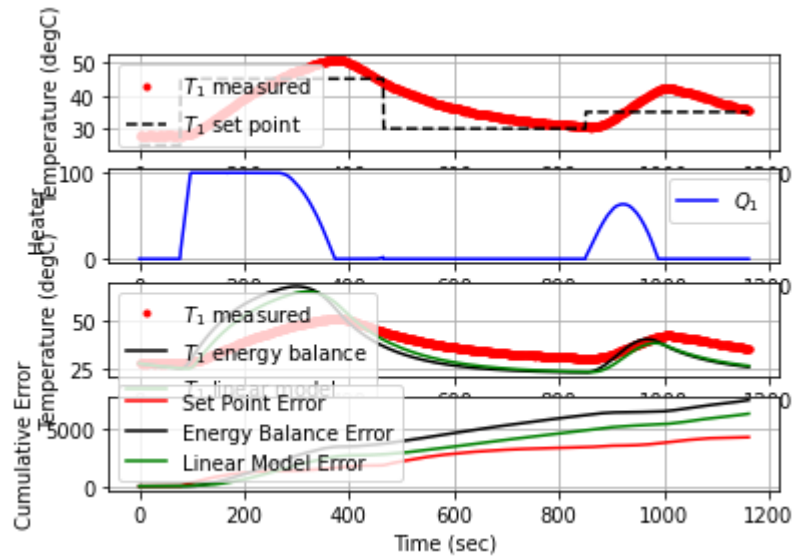
1159.0 35.00 35.79 0.00 -0.16 0.31 -0.00



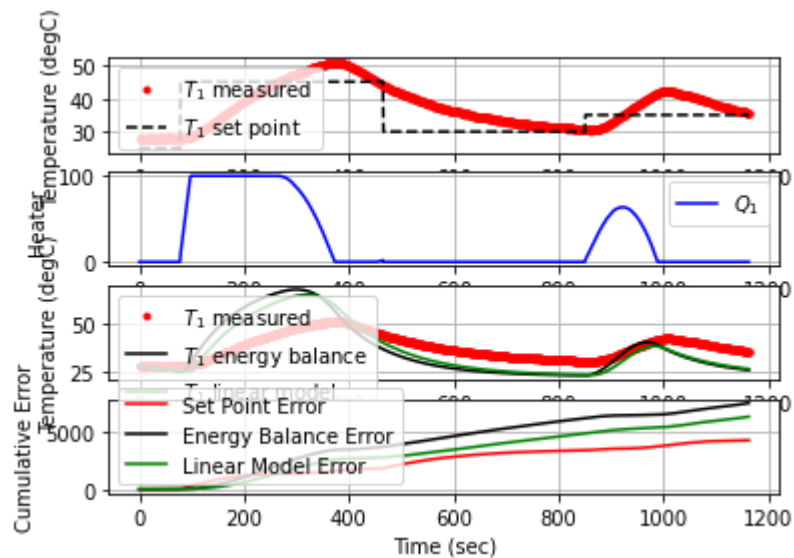
1161.6 35.00 35.66 0.00 -0.14 0.12 -0.00



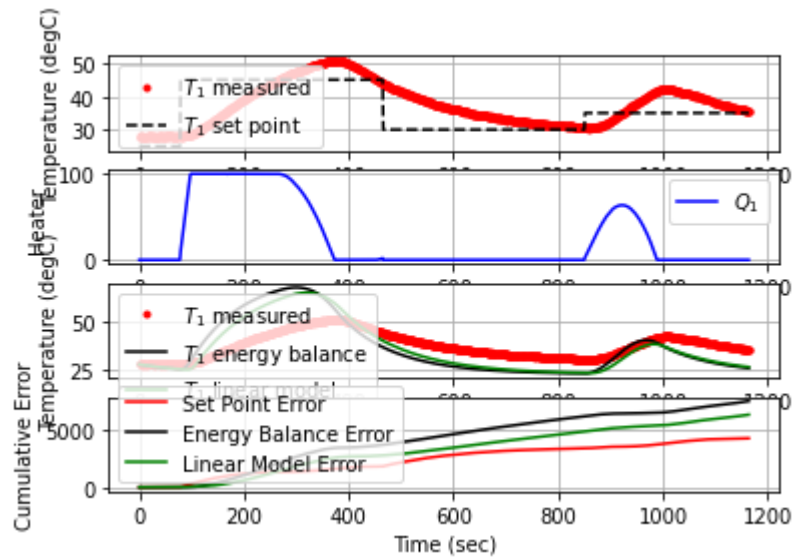
1162.9 35.00 35.60 0.00 -0.12 0.12 0.00



1164.1 35.00 35.58 0.00 -0.12 0.12 0.00

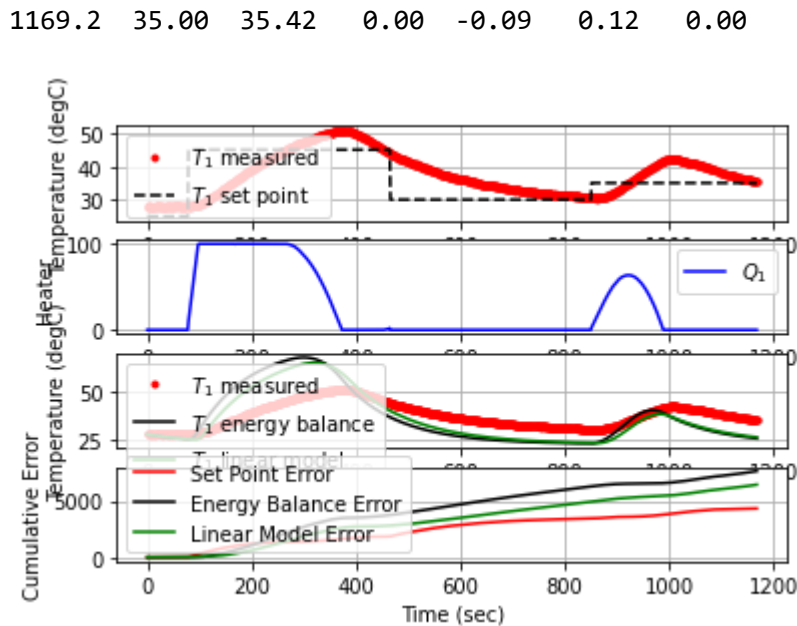
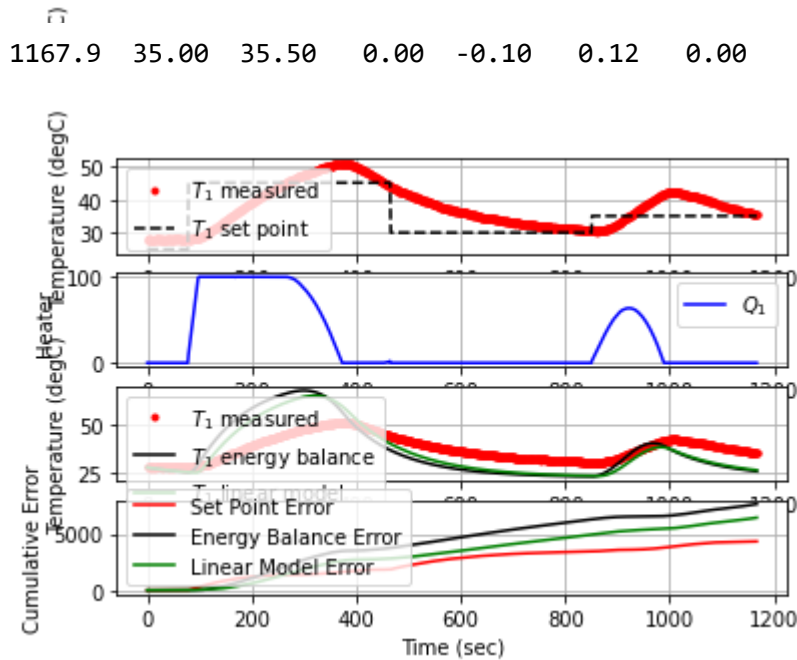


1165.3 35.00 35.54 0.00 -0.11 0.12 0.00



1166.6 35.00 35.51 0.00 -0.11 0.12 0.00





Arduino disconnected successfully

Out[11]: True

<Figure size 432x288 with 0 Axes>

In [12]: `a.close()`

Arduino disconnected successfully

Out[12]: True

In [ ]: