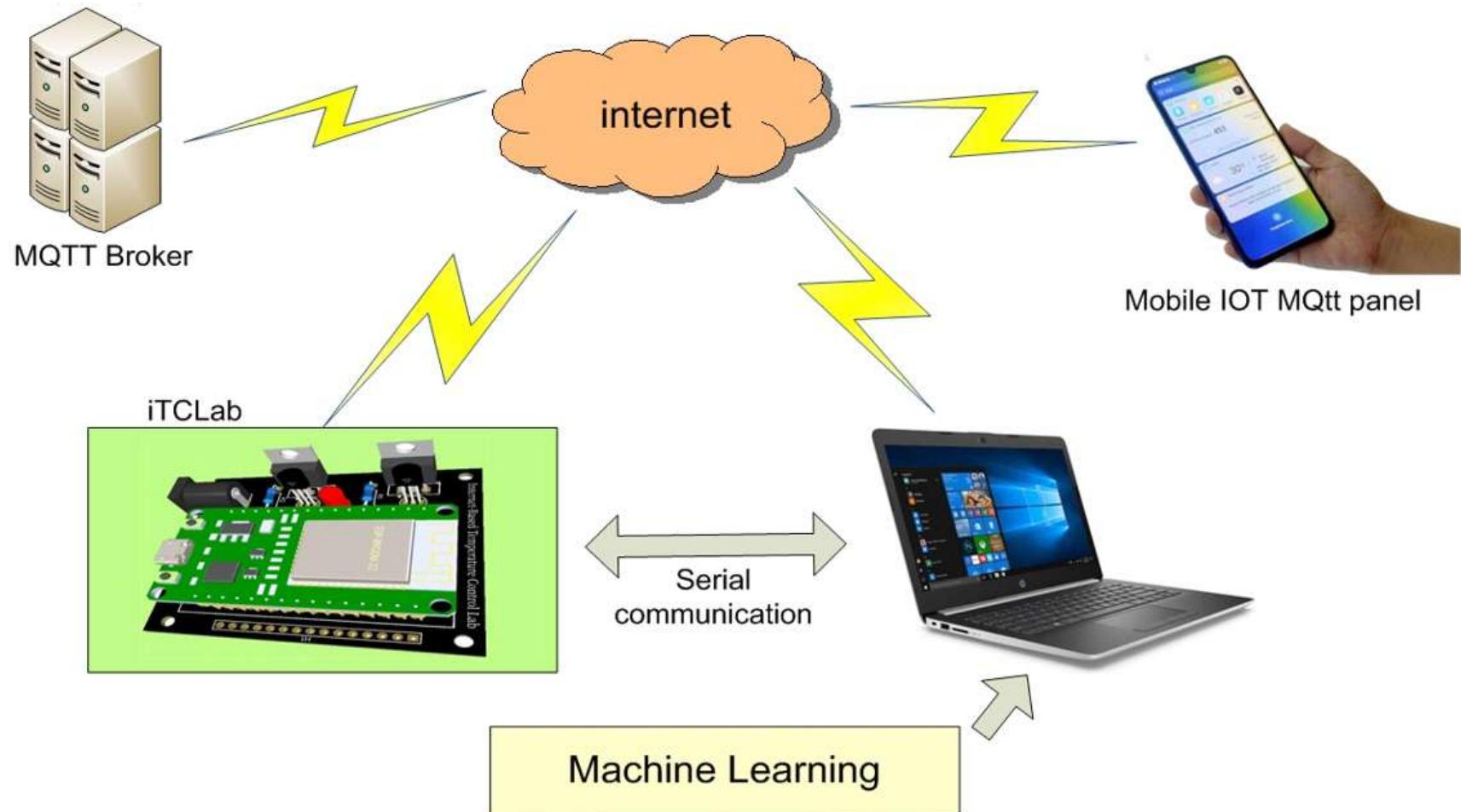


Penalaan Parameter PID Menggunakan Deep Learning pada Kit iTCLab dan Pemantauannya Menggunakan Internet of Things (IoT)

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



Proses penalaan nilai K_c , τ_I dan τ_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
    opl0 = 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 < opl0 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 #####
# 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 #####
# 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 Choose
# [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} '.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_dl.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_dl.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_dl.png')
    raise
```

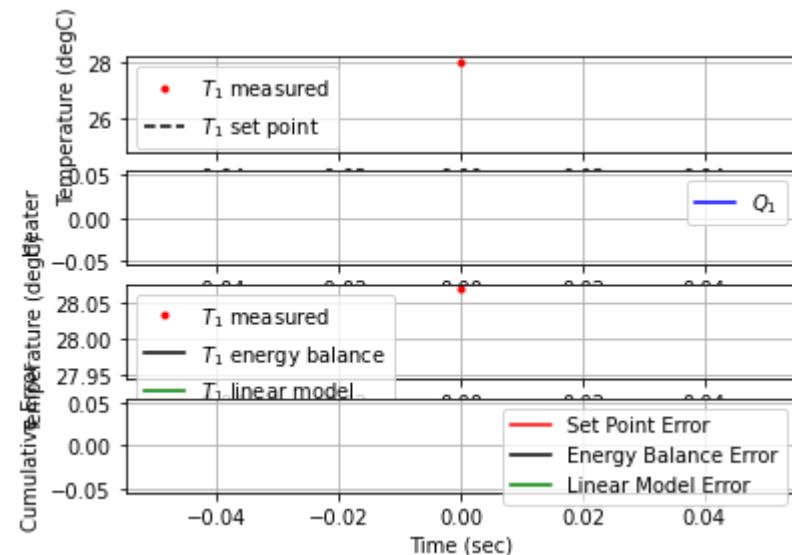
```
a.close()
```

```
Opening connection  
iTCLab connected via Arduino on port COM3  
LED On  
Running Main Loop. Ctrl-C to end.
```

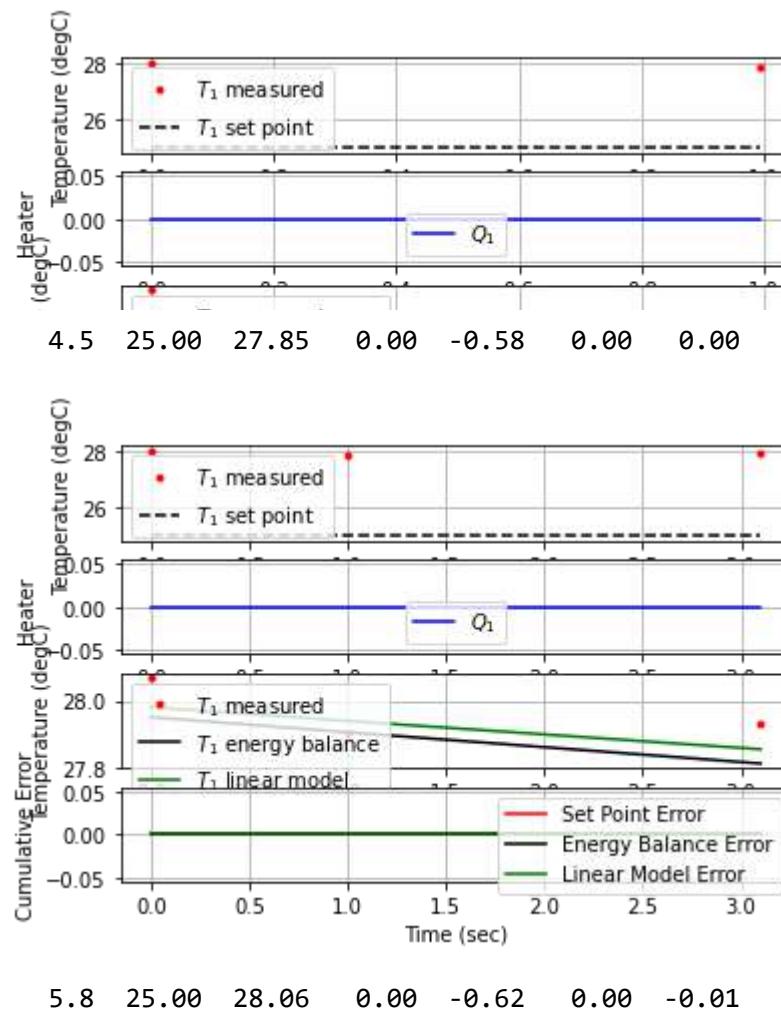
| Time | SP | PV | Q1 | = | P | + | I | + | D |
|------|-------|-------|------|---|------|---|------|---|------|
| 0.0 | 25.00 | 28.07 | 0.00 | | 0.00 | | 0.00 | | 0.00 |

```
<Figure size 720x504 with 0 Axes>
```

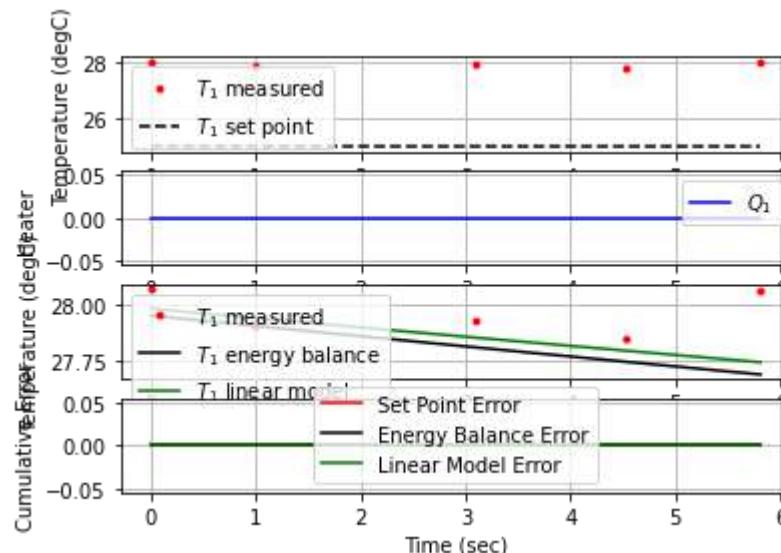
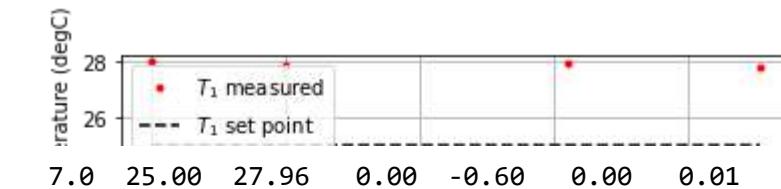
| | | | | | | |
|-----|-------|-------|------|-------|------|------|
| 1.0 | 25.00 | 27.90 | 0.00 | -0.59 | 0.00 | 0.01 |
|-----|-------|-------|------|-------|------|------|



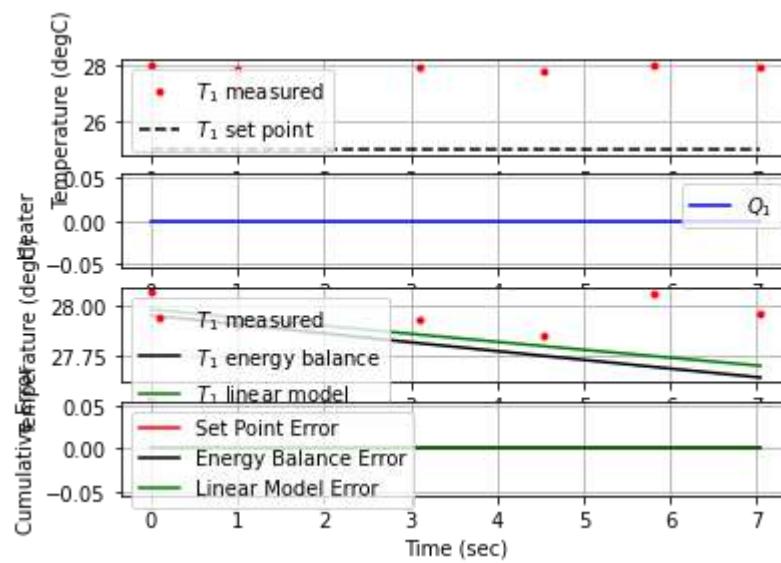
| | | | | | | |
|-----|-------|-------|------|-------|------|-------|
| 3.1 | 25.00 | 27.93 | 0.00 | -0.59 | 0.00 | -0.00 |
|-----|-------|-------|------|-------|------|-------|



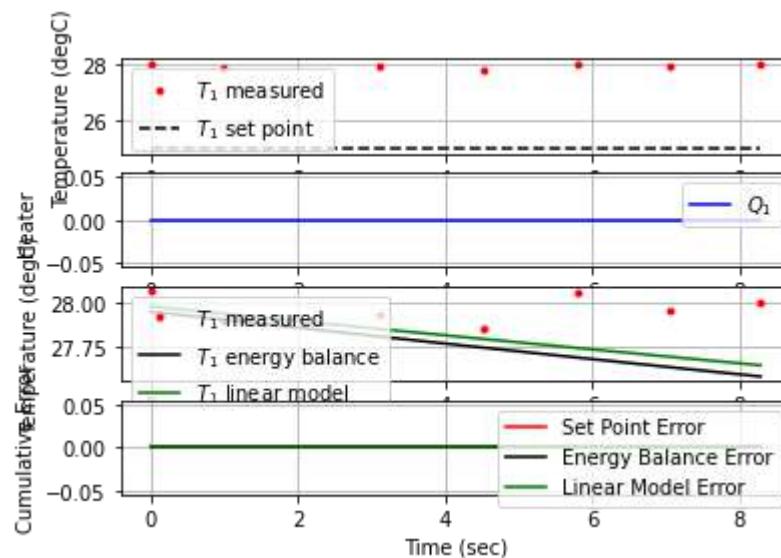
5.8 25.00 28.06 0.00 -0.62 0.00 -0.01



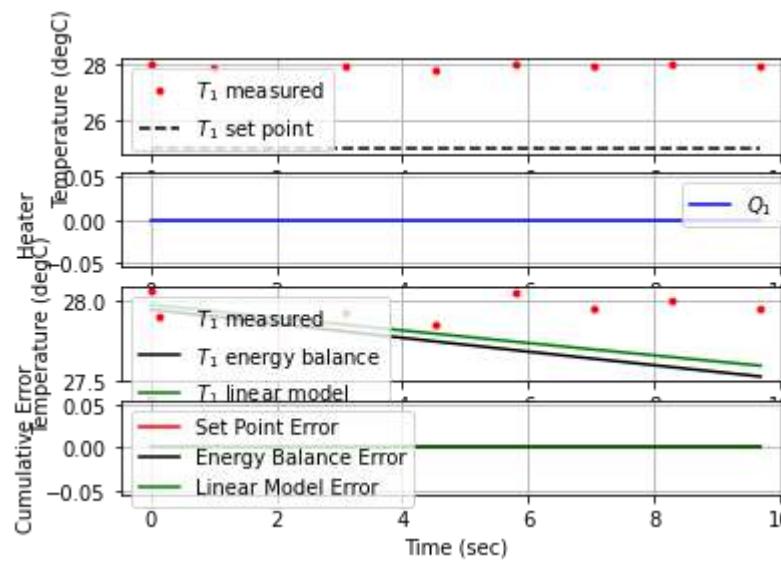
8.3 25.00 28.00 0.00 -0.61 0.00 -0.00



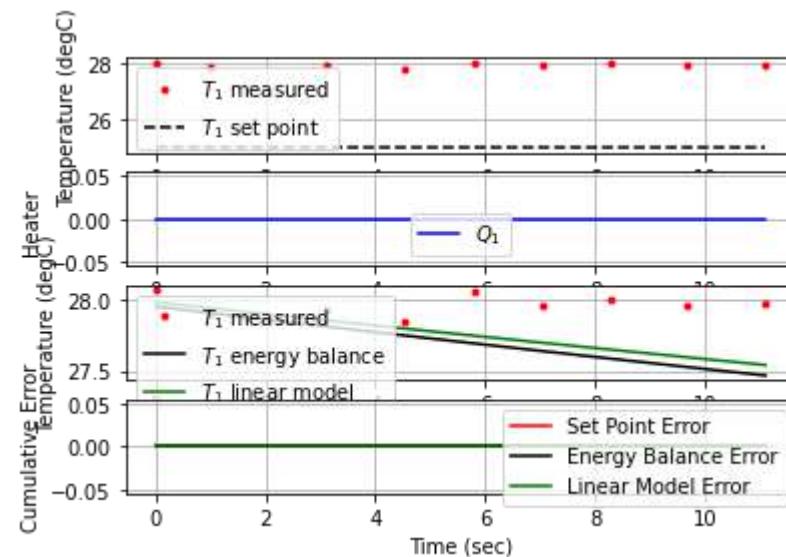
9.7 25.00 27.96 0.00 -0.60 0.00 0.00



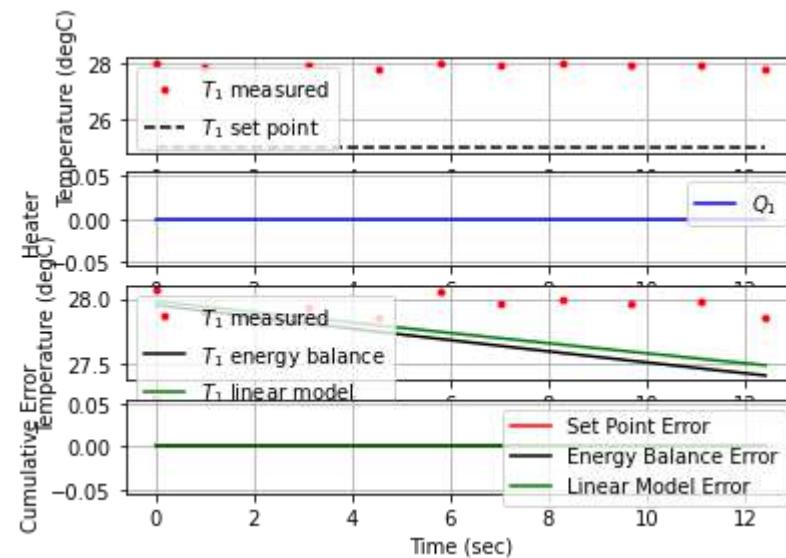
11.1 25.00 27.97 0.00 -0.60 0.00 -0.00



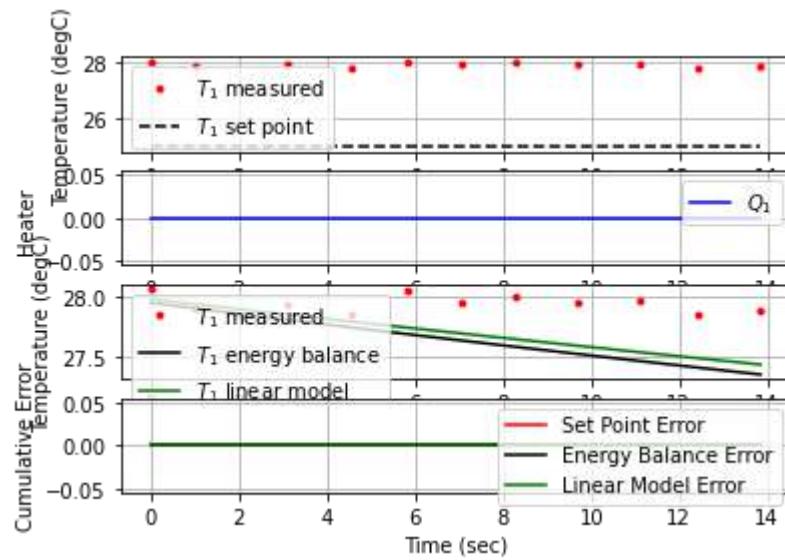
12.4 25.00 27.85 0.00 -0.58 0.00 0.01



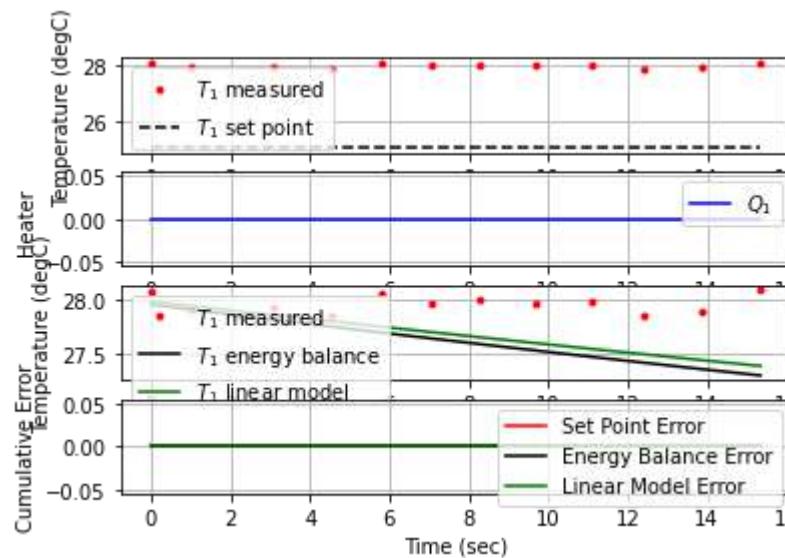
13.8 25.00 27.89 0.00 -0.58 0.00 -0.00



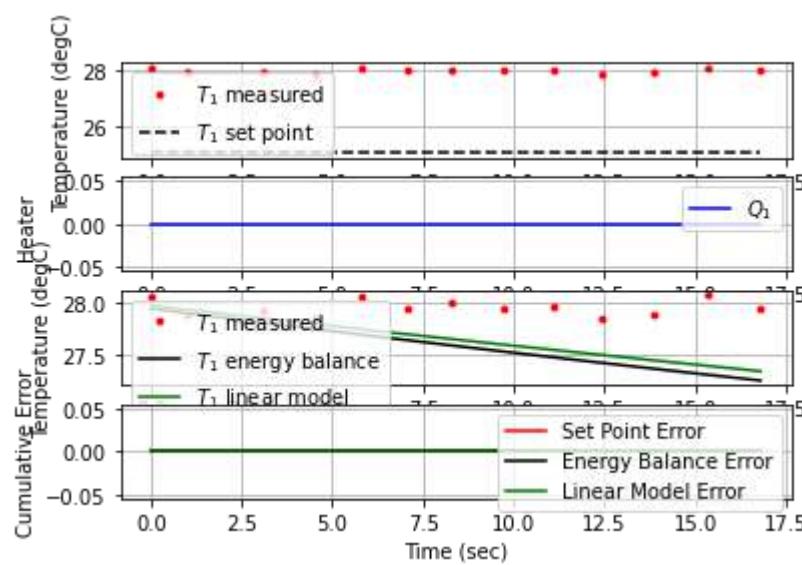
15.3 25.00 28.09 0.00 -0.62 0.00 -0.01



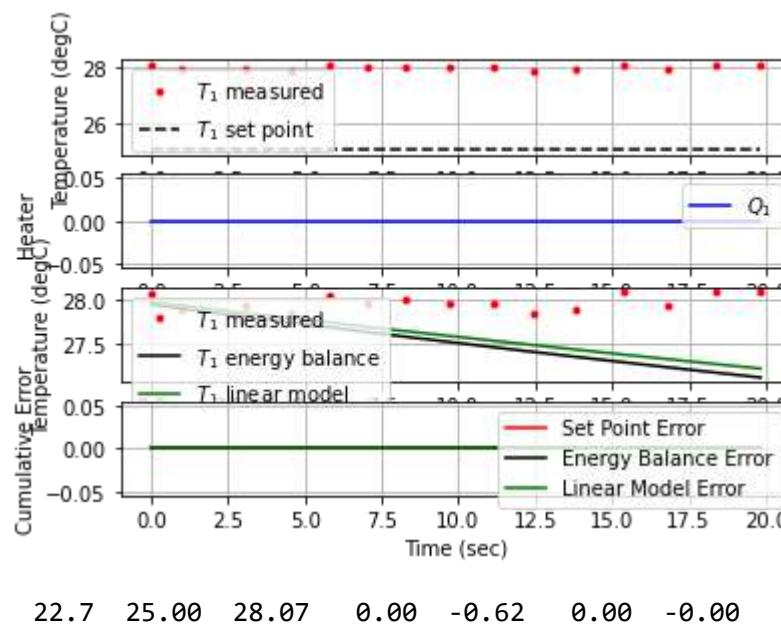
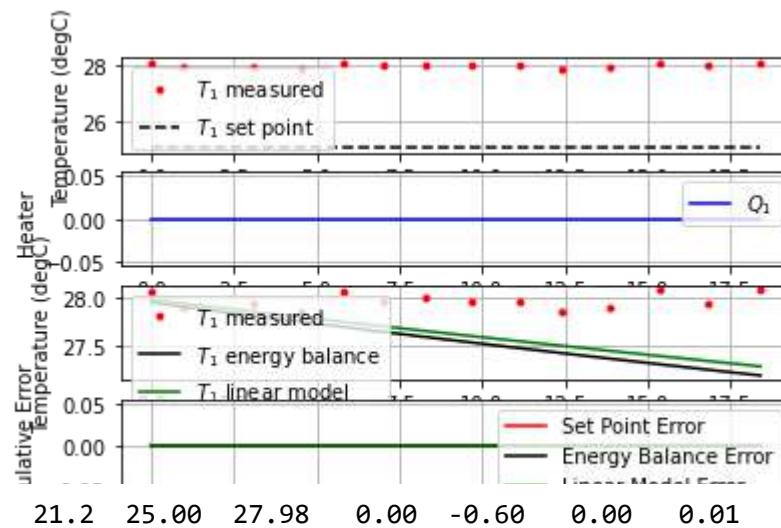
16.8 25.00 27.95 0.00 -0.60 0.00 0.01

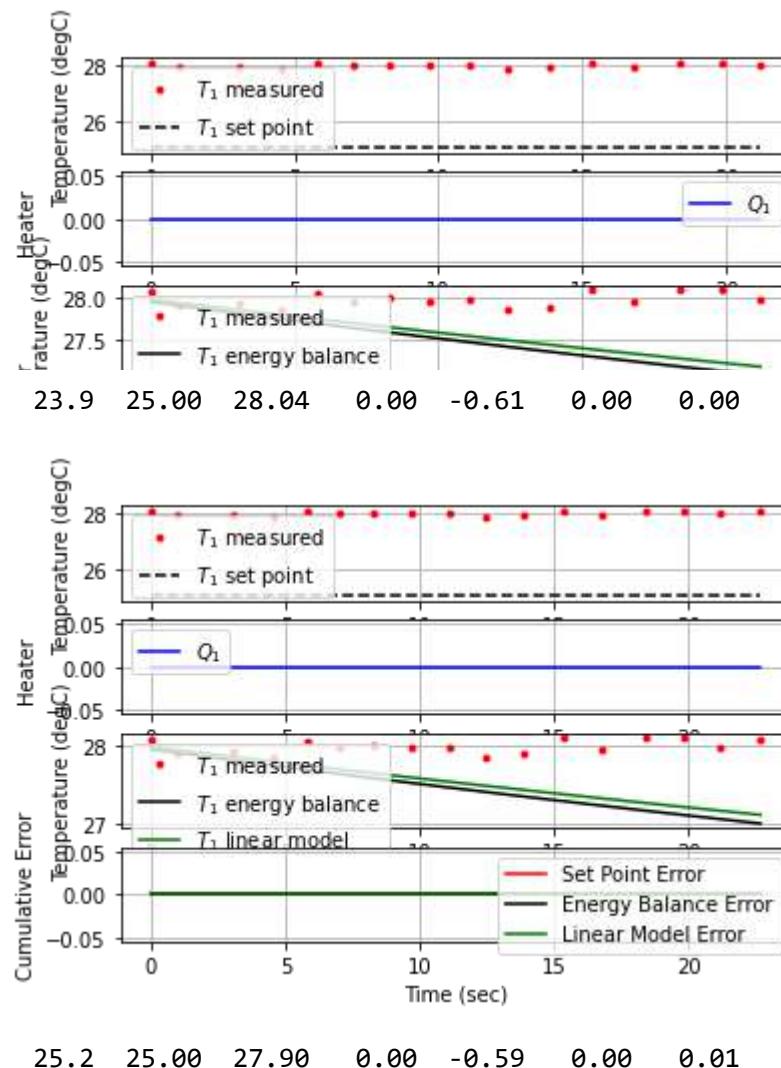


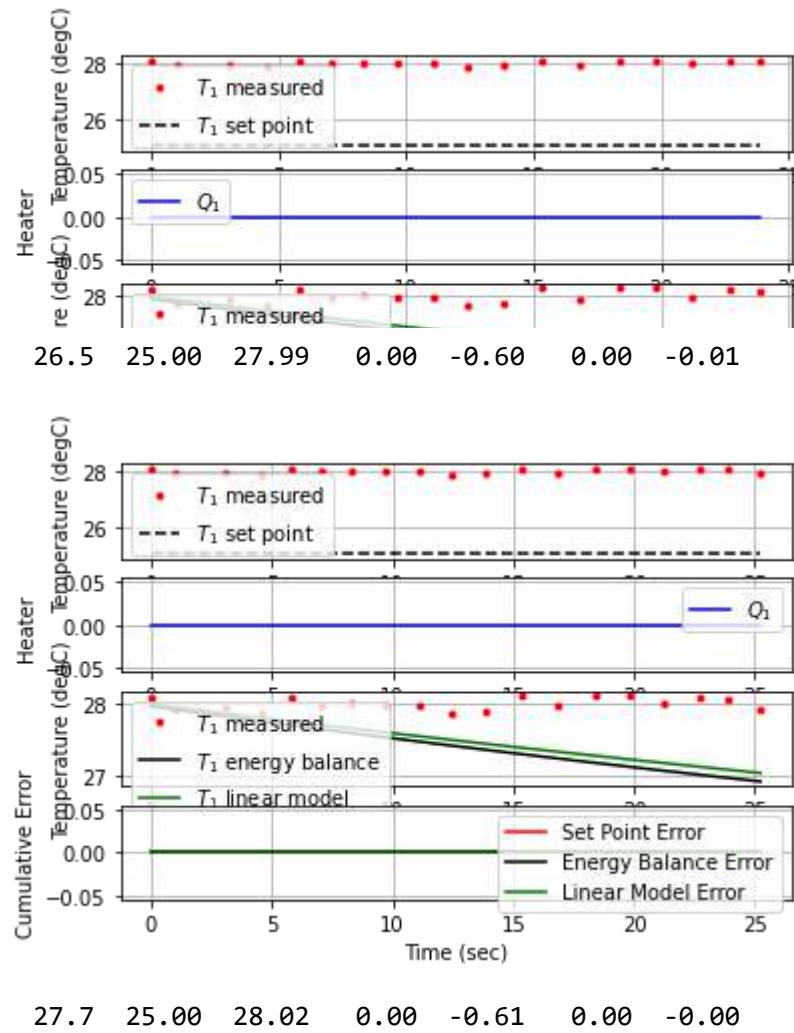
18.4 25.00 28.09 0.00 -0.62 0.00 -0.01

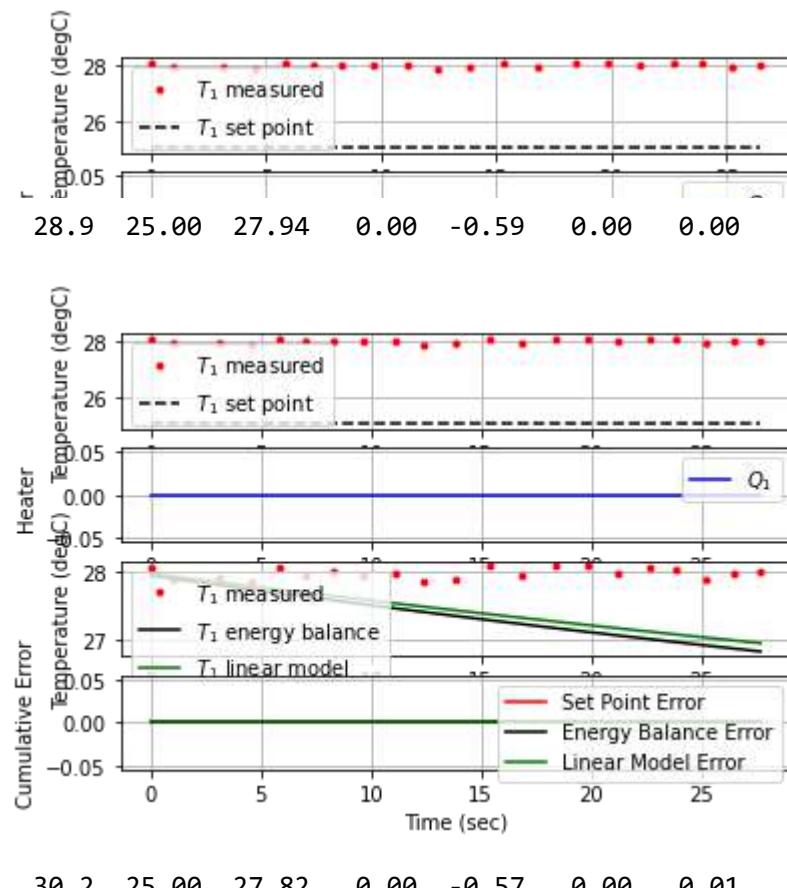


19.8 25.00 28.10 0.00 -0.63 0.00 -0.00

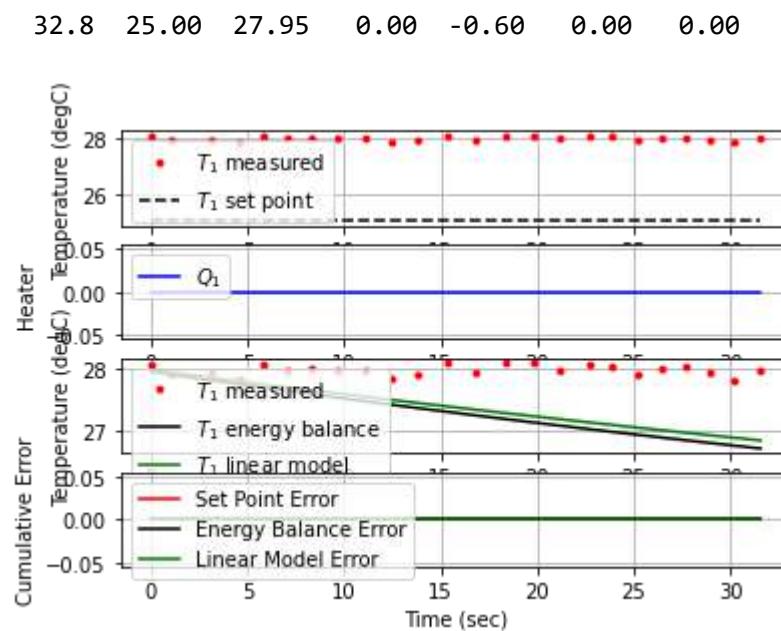
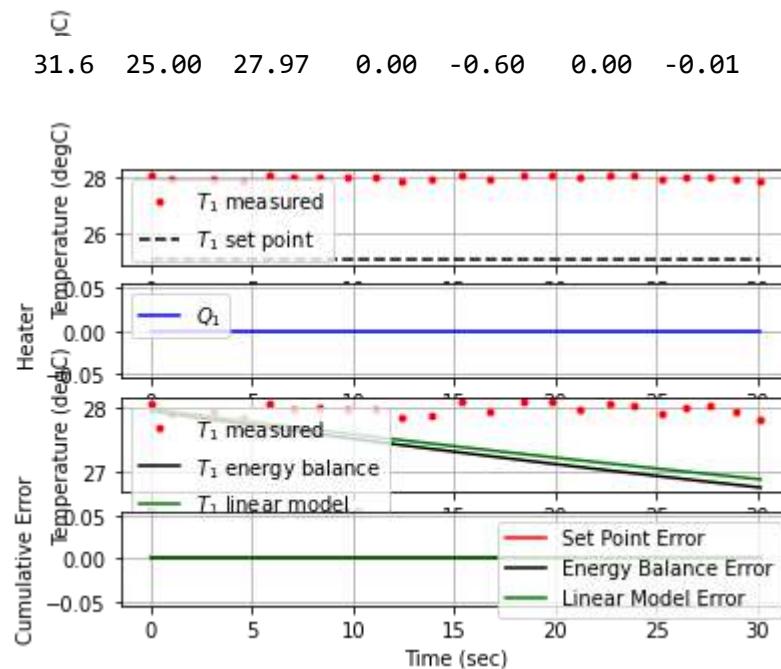




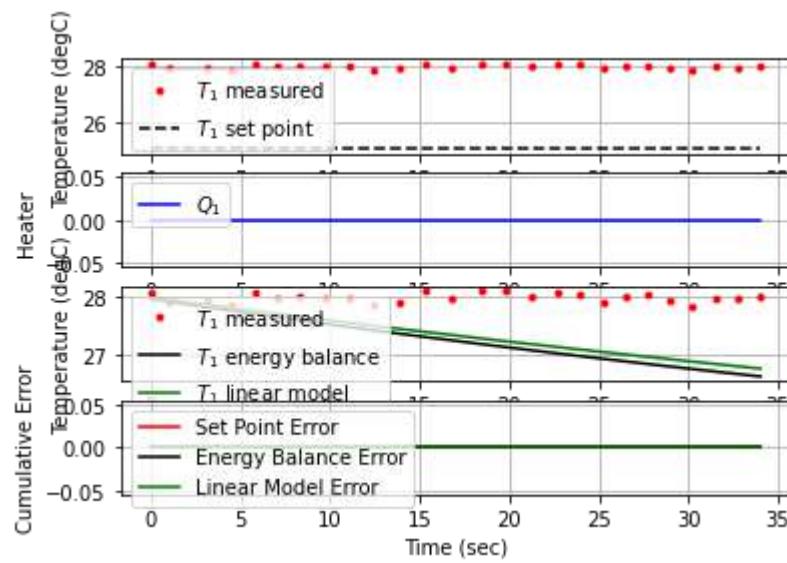
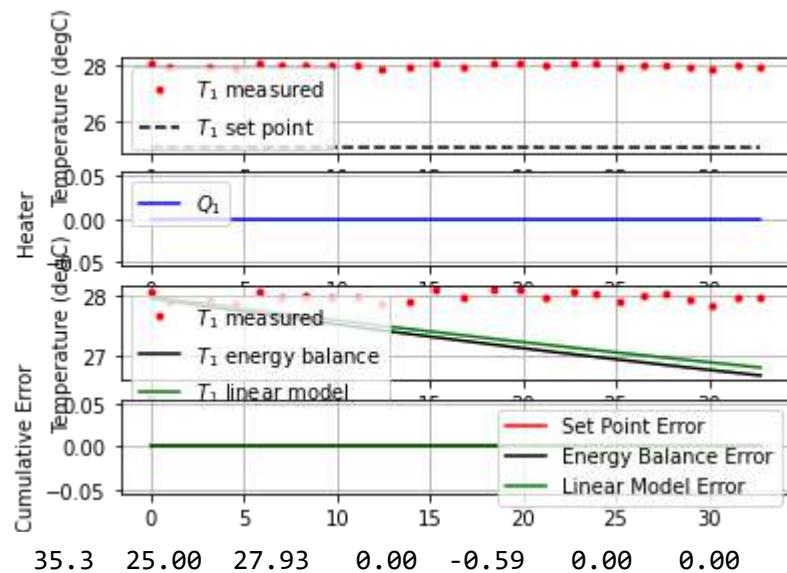




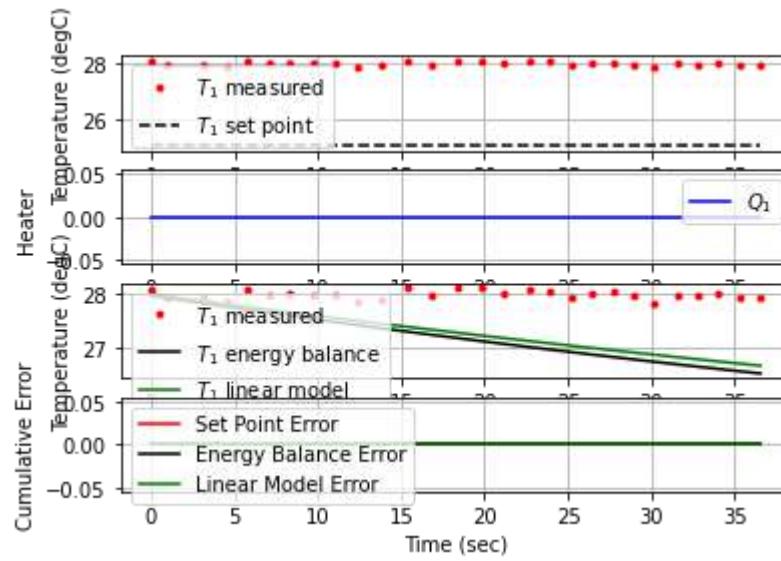
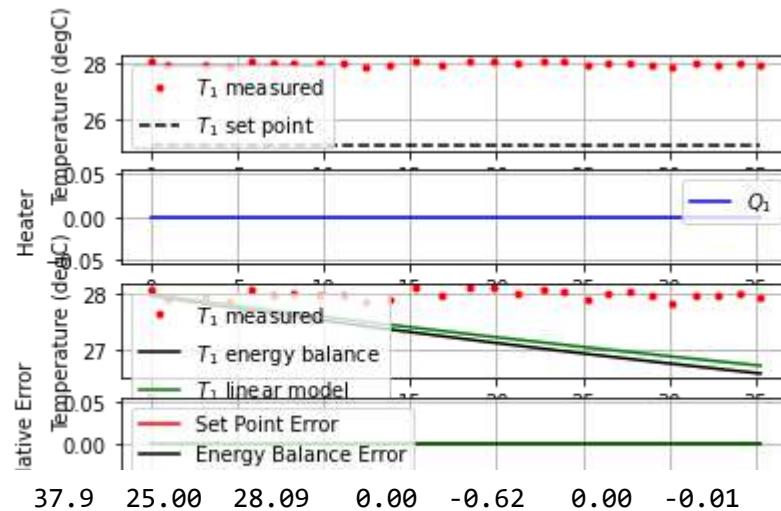
30.2 25.00 27.82 0.00 -0.57 0.00 0.01



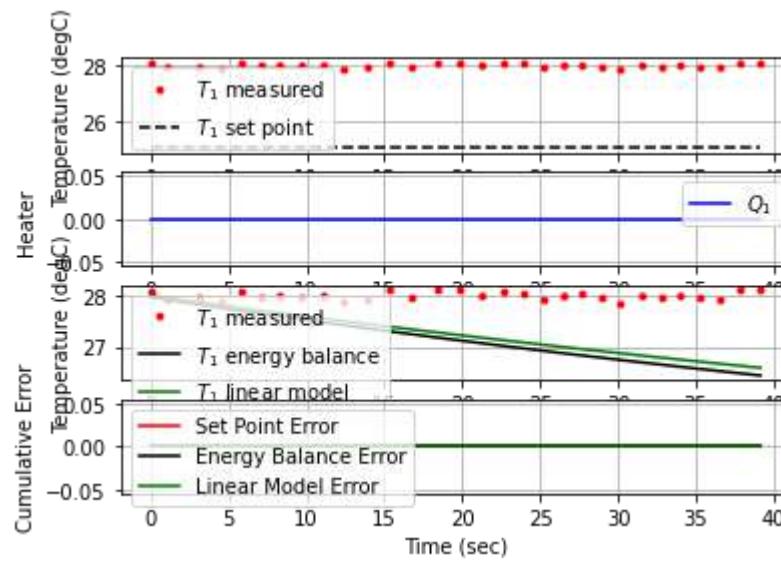
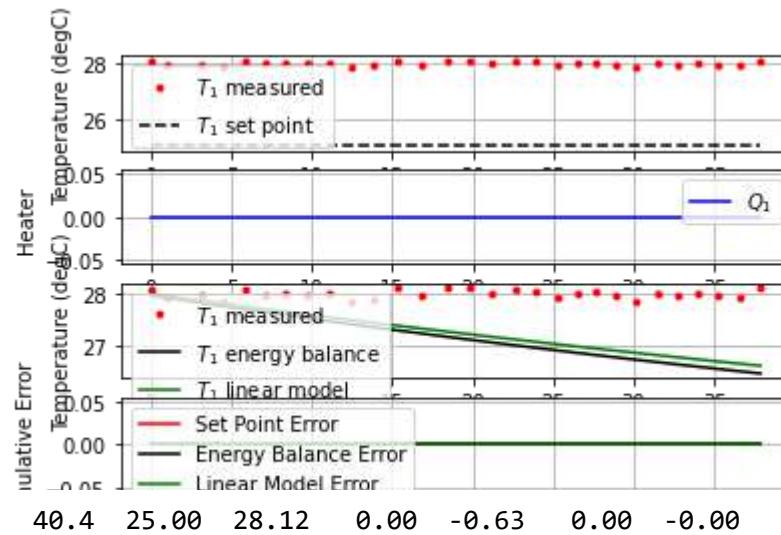
34.0 25.00 27.99 0.00 -0.60 0.00 -0.00

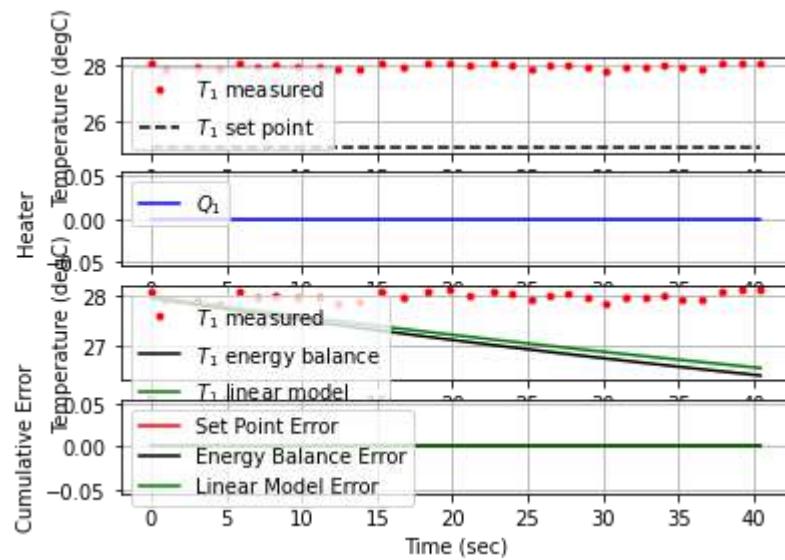


36.5 25.00 27.90 0.00 -0.59 0.00 0.00

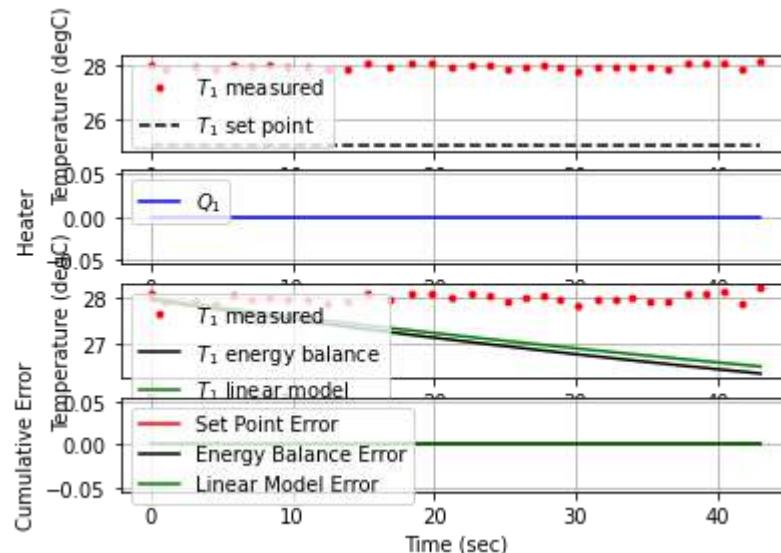
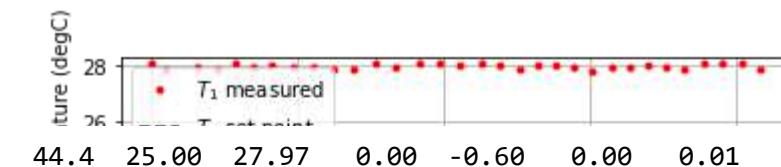


39.2 25.00 28.10 0.00 -0.63 0.00 -0.00

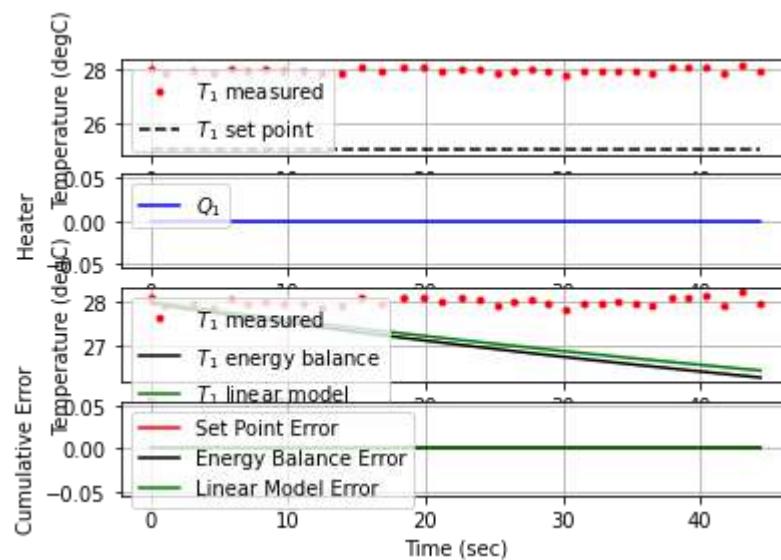




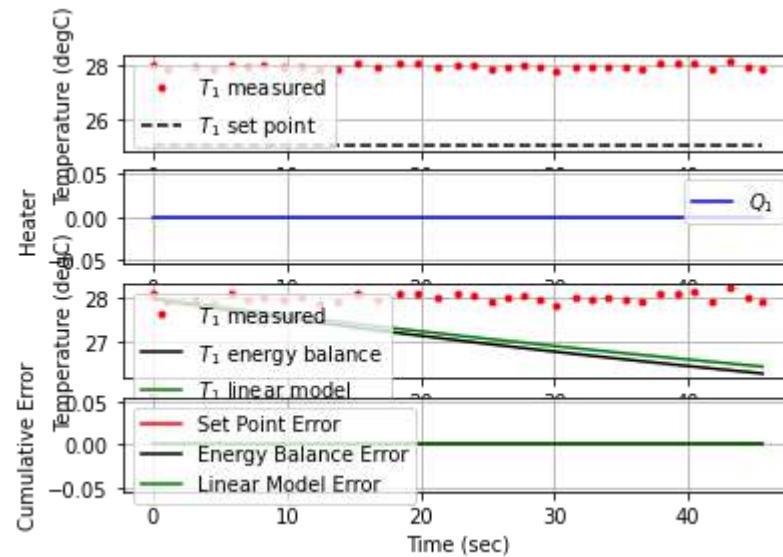
43.1 25.00 28.22 0.00 -0.65 0.00 -0.02



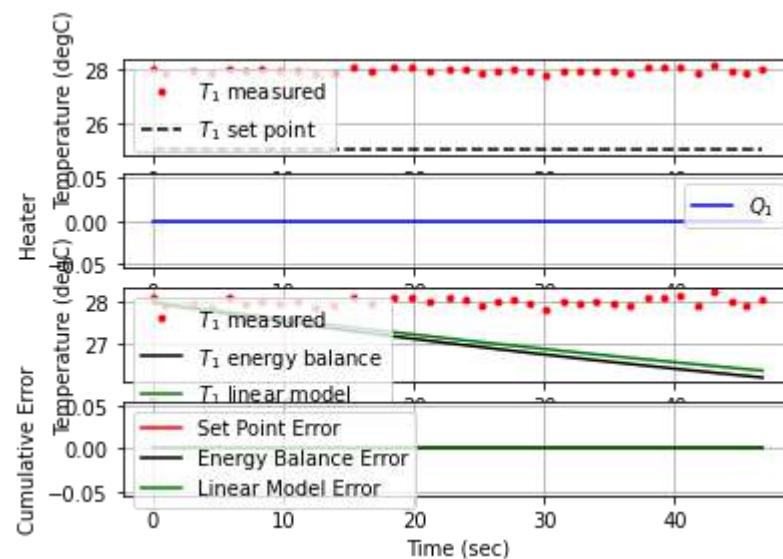
45.5 25.00 27.90 0.00 -0.59 0.00 0.00



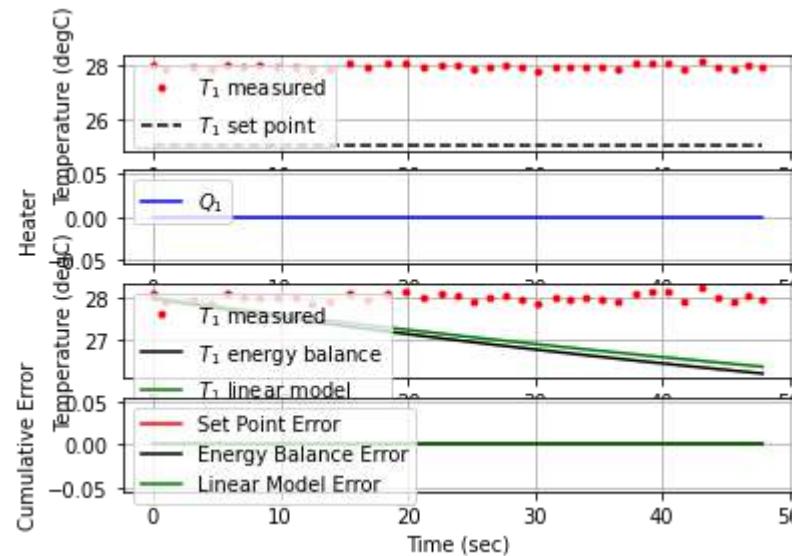
46.7 25.00 28.05 0.00 -0.62 0.00 -0.01



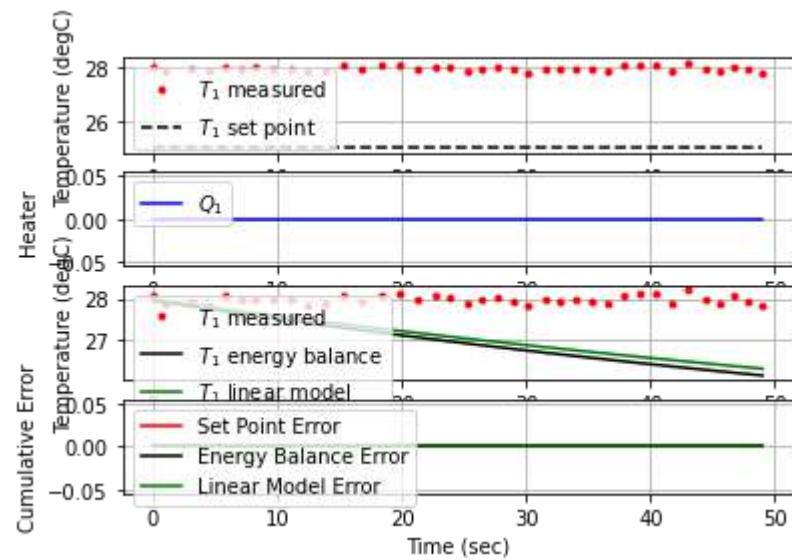
47.9 25.00 27.95 0.00 -0.60 0.00 0.01



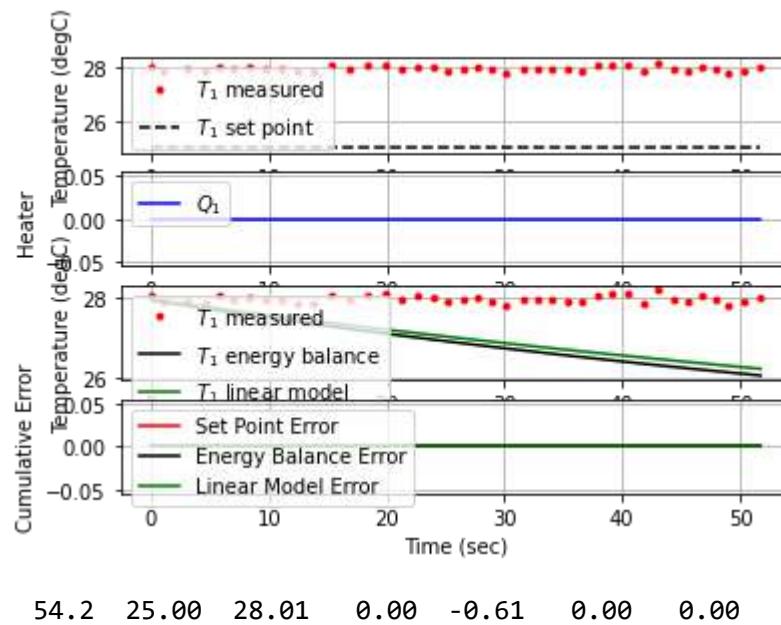
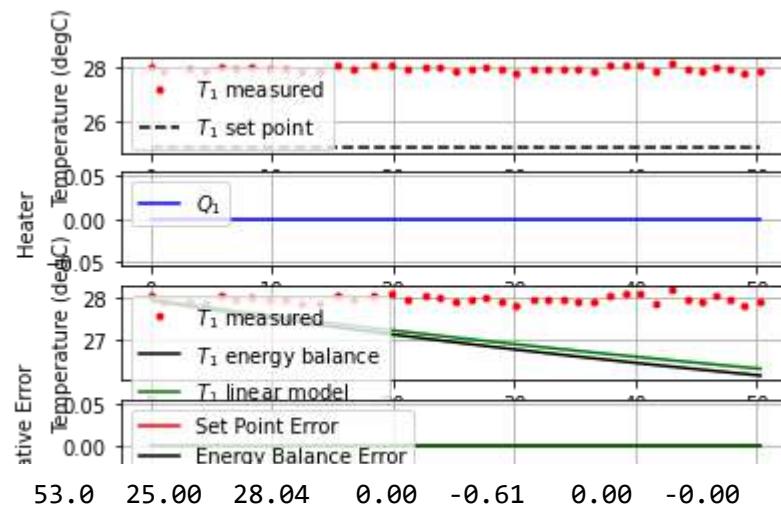
49.0 25.00 27.84 0.00 -0.57 0.00 0.01

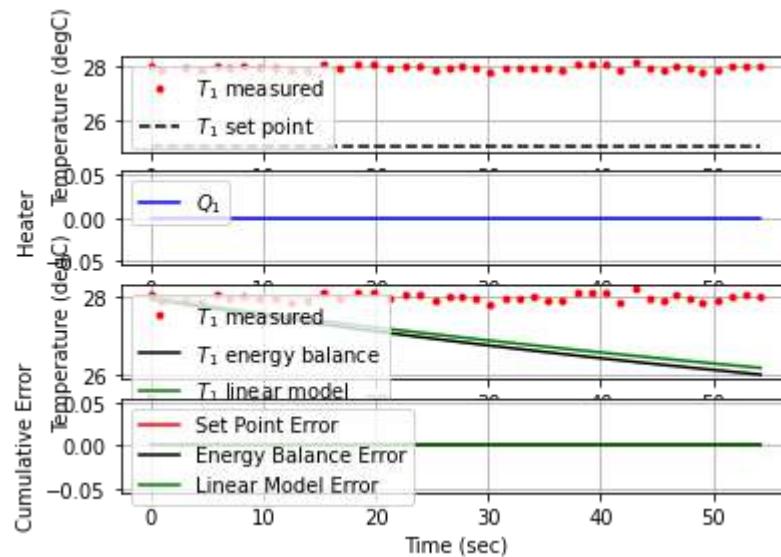
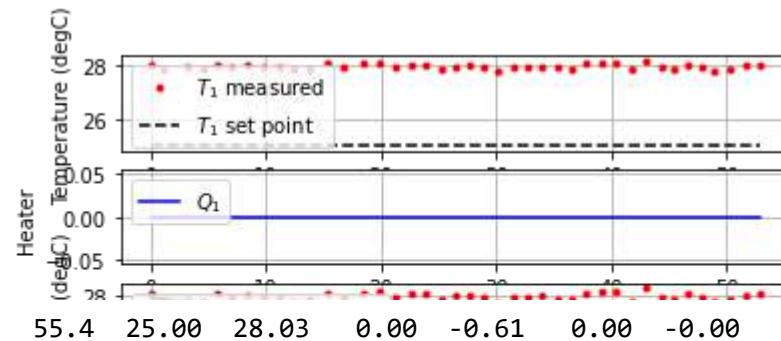


50.4 25.00 27.90 0.00 -0.59 0.00 -0.00

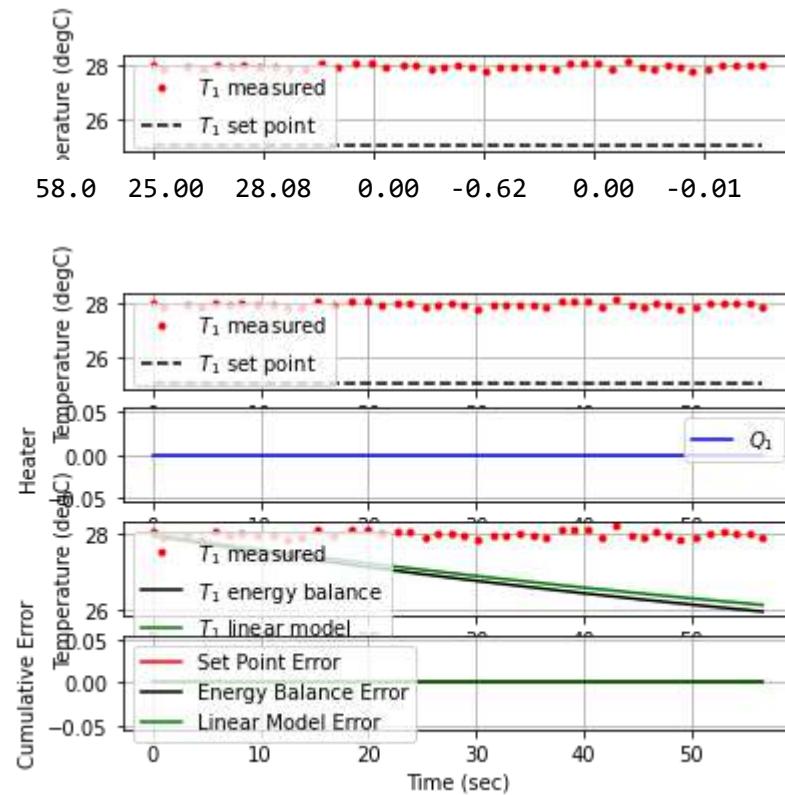


51.7 25.00 28.01 0.00 -0.61 0.00 -0.01

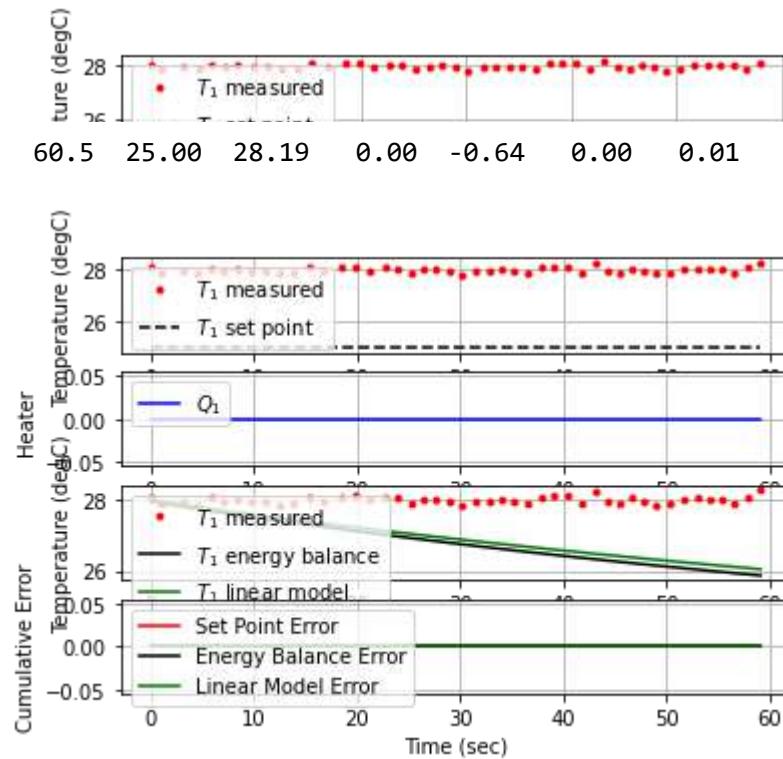




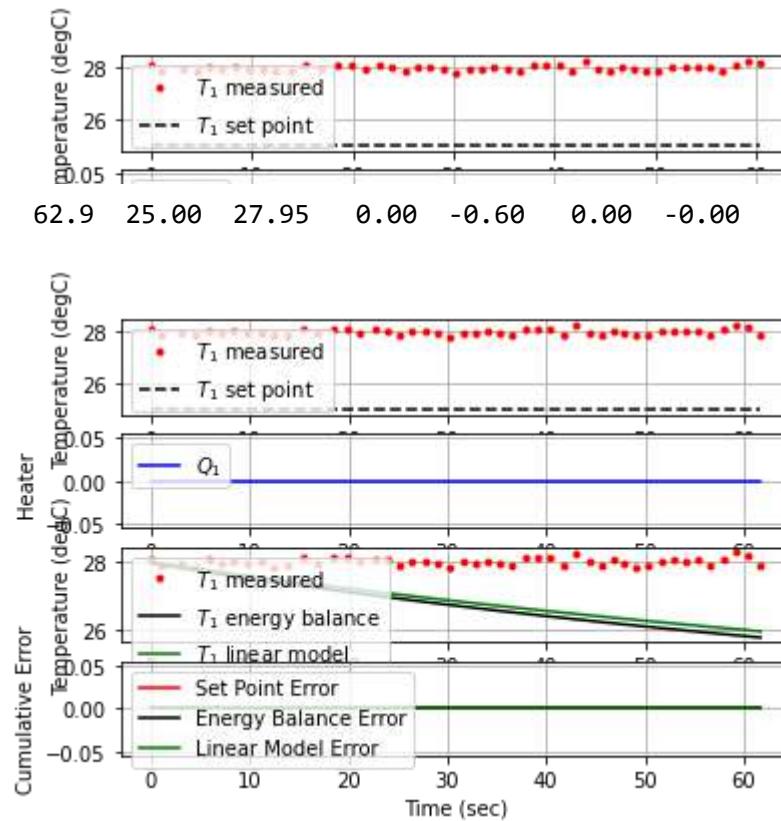
56.6 25.00 27.90 0.00 -0.59 0.00 0.01



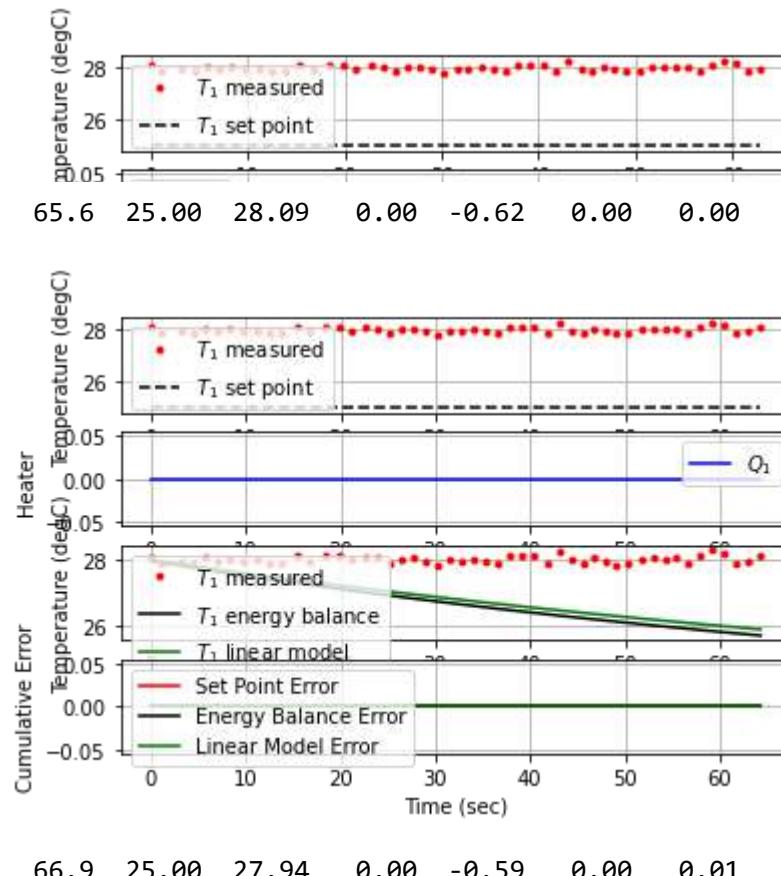
59.1 25.00 28.29 0.00 -0.66 0.00 -0.01



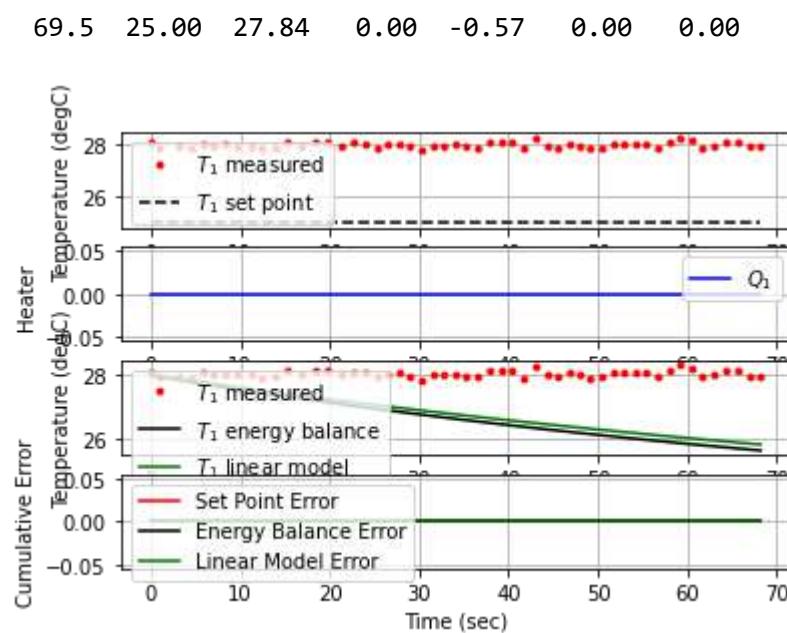
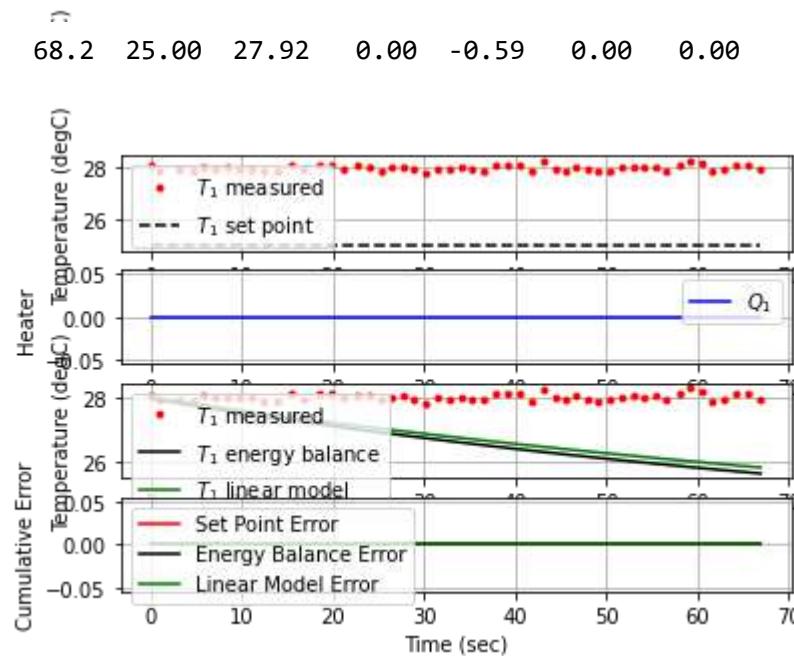
61.7 25.00 27.89 0.00 -0.58 0.00 0.02

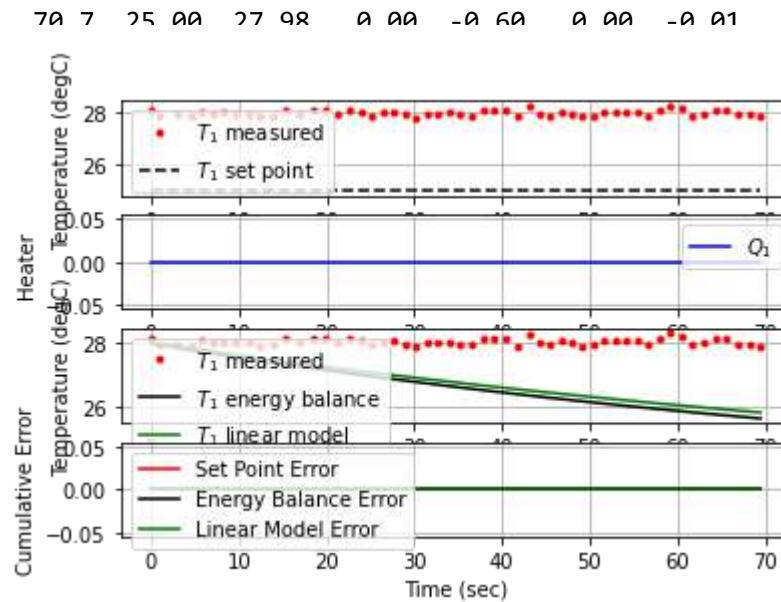


64.3 25.00 28.10 0.00 -0.63 0.00 -0.01

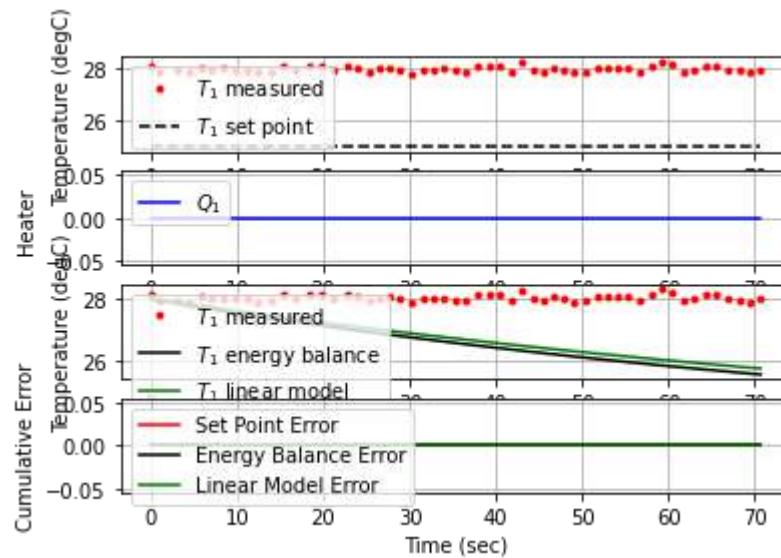


66.9 25.00 27.94 0.00 -0.59 0.00 0.01

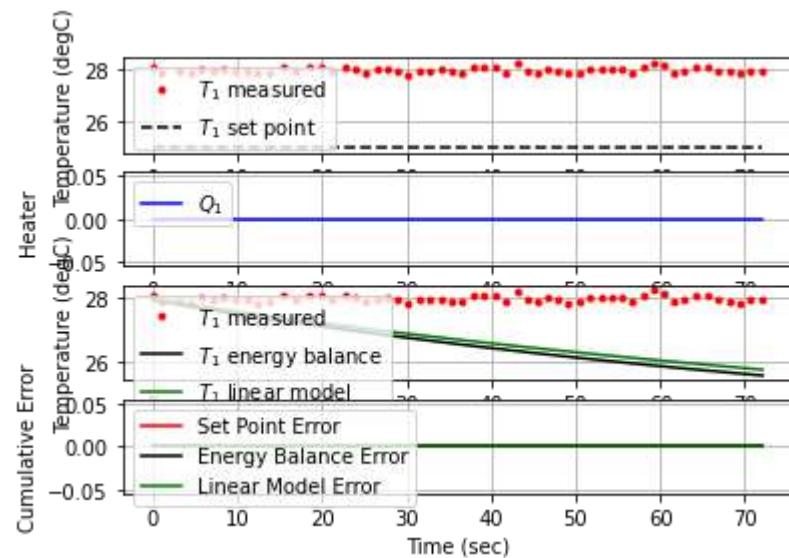




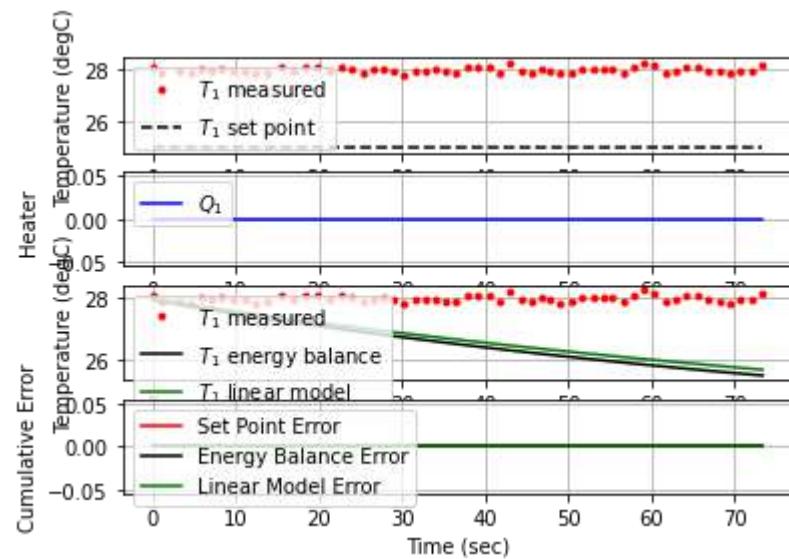
72.1 25.00 27.95 0.00 -0.60 0.00 0.00



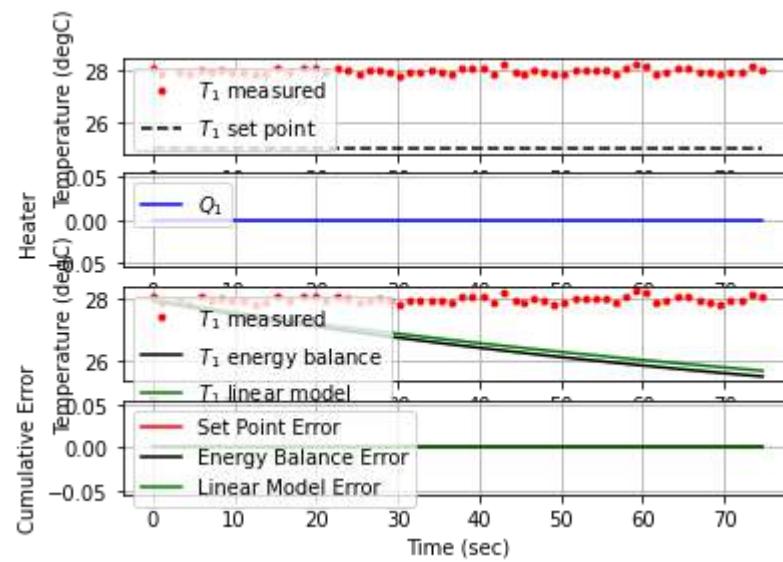
73.4 25.00 28.14 0.00 -0.63 0.00 -0.01



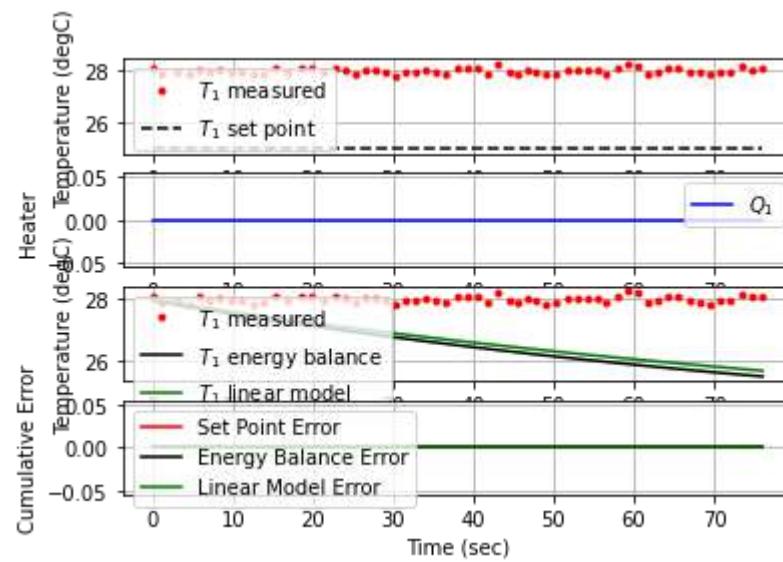
74.7 25.00 28.06 0.00 -0.62 0.00 0.00



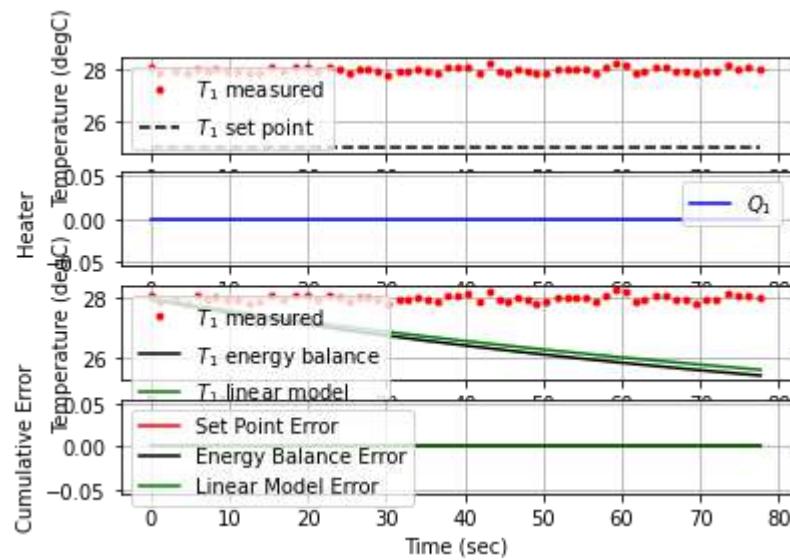
76.1 25.00 28.08 0.00 -0.62 0.00 -0.00



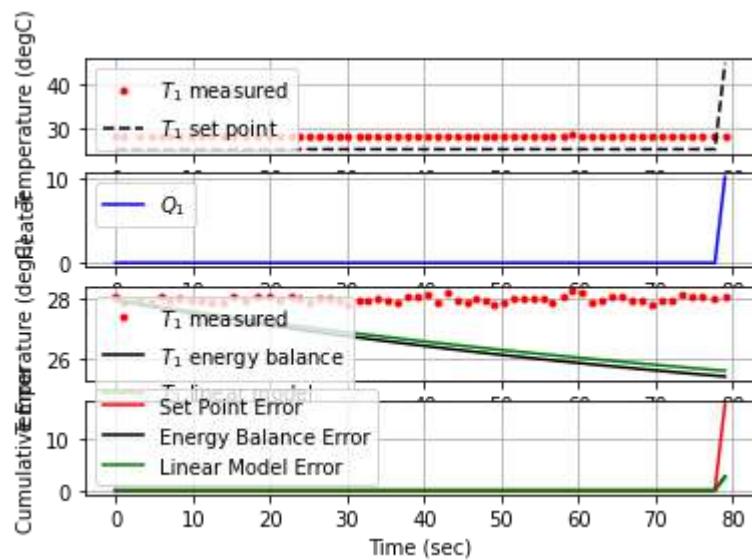
77.7 25.00 27.99 0.00 -0.60 0.00 0.00



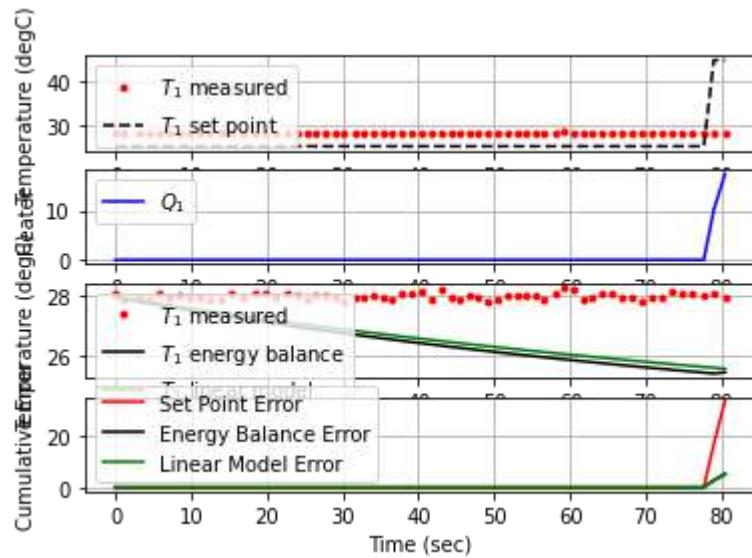
79.0 45.00 28.10 10.11 3.74 6.37 -0.01



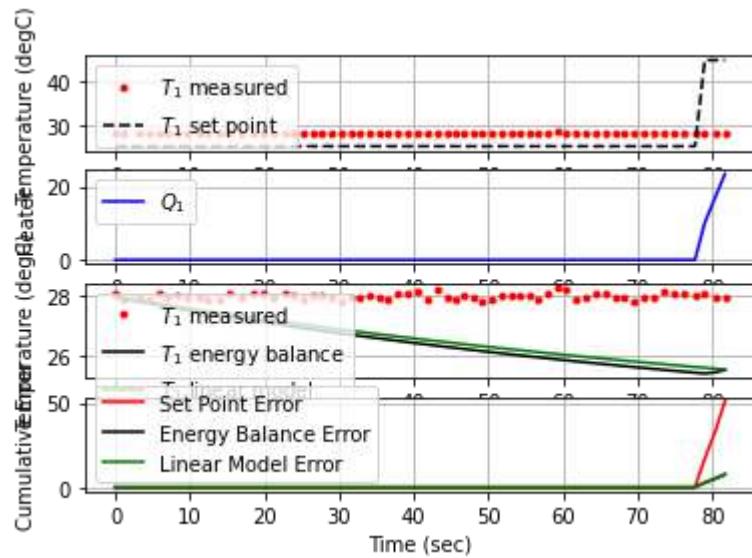
80.5 45.00 27.95 17.41 3.78 13.62 0.01



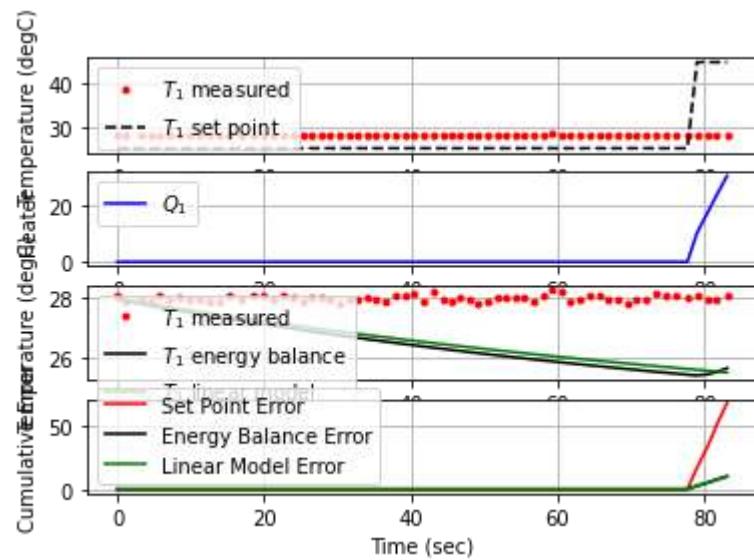
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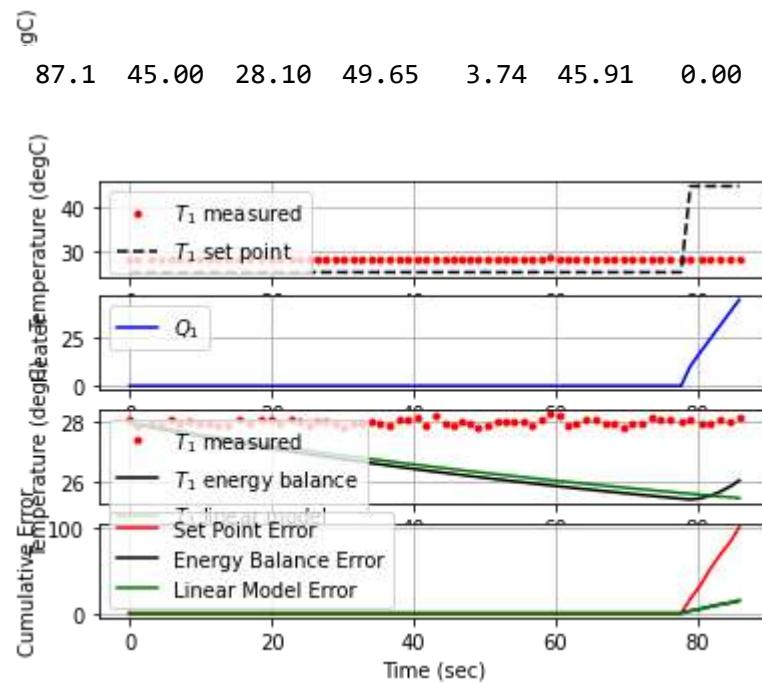
83.1 45.00 28.08 30.07 3.75 26.33 -0.01



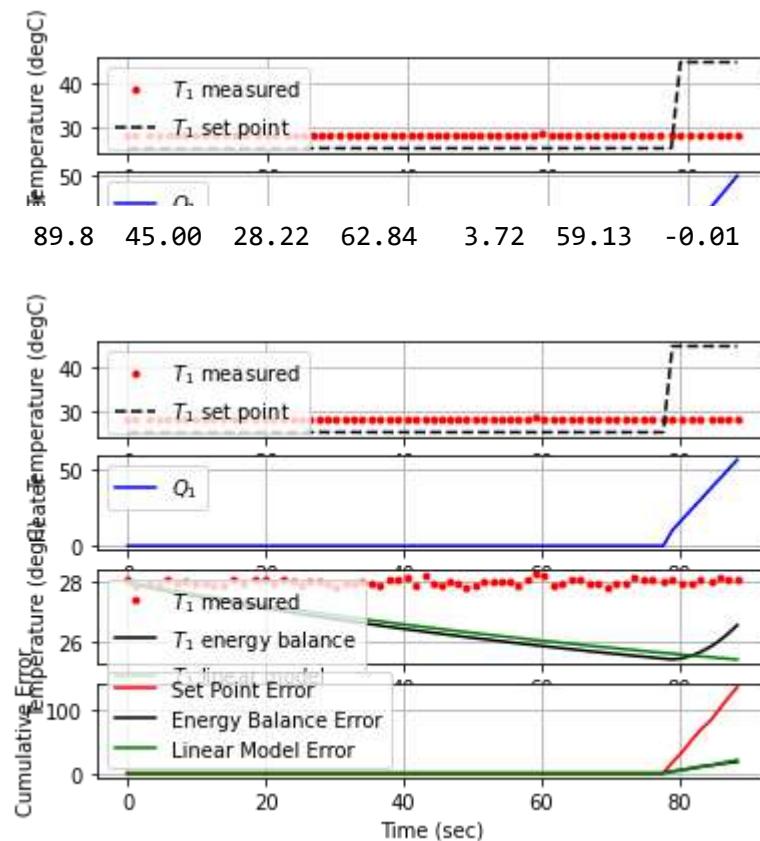
84.7 45.00 28.05 37.93 3.75 34.17 0.00



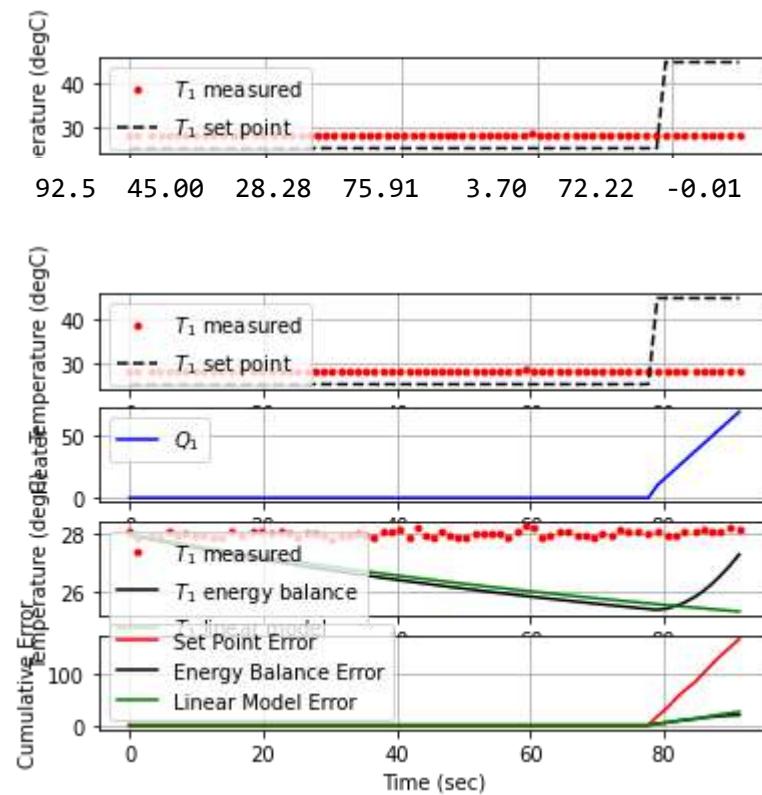
85.9 45.00 28.16 43.63 3.73 39.91 -0.01



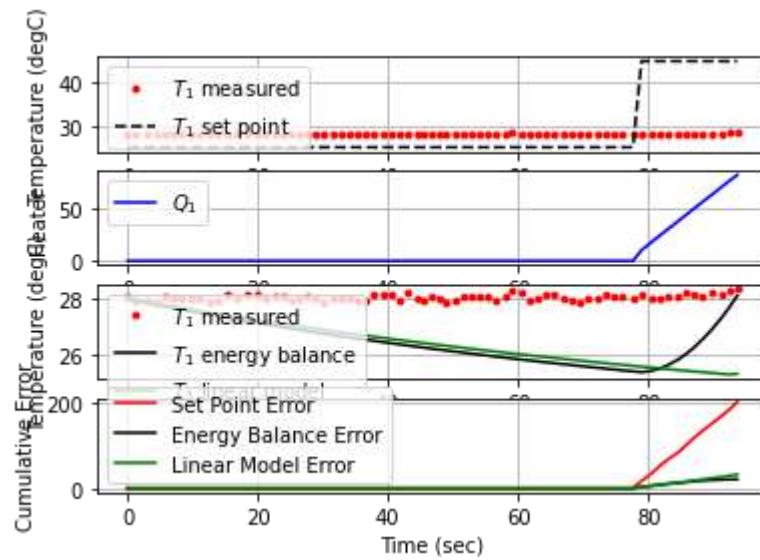
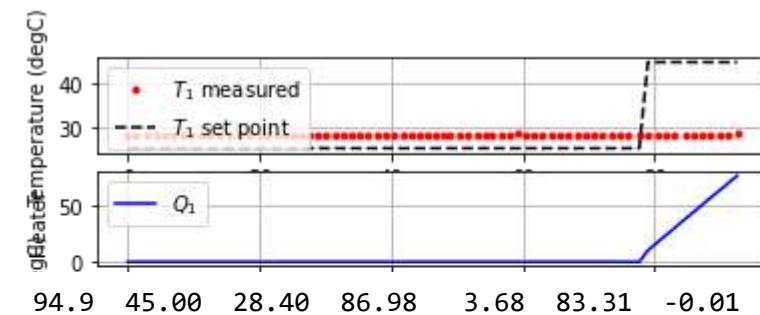
88.4 45.00 28.07 55.95 3.75 52.20 0.00



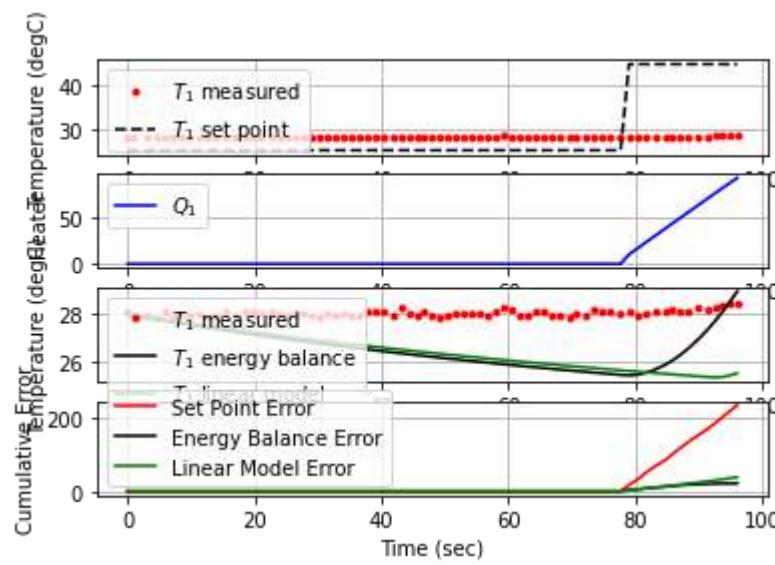
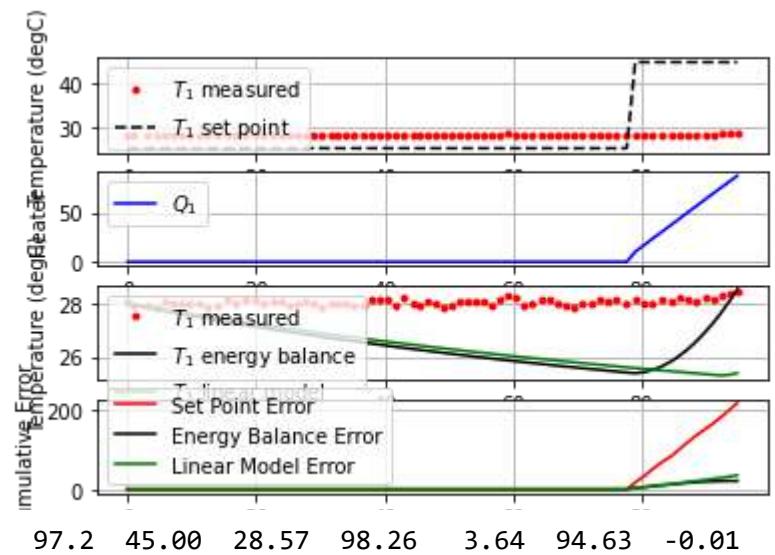
91.3 45.00 28.15 69.81 3.73 66.08 0.00



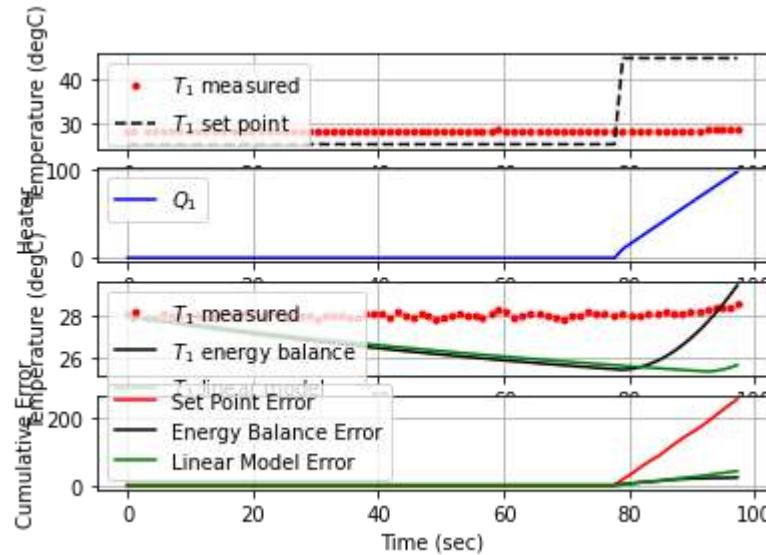
93.7 45.00 28.33 81.42 3.69 77.73 -0.00



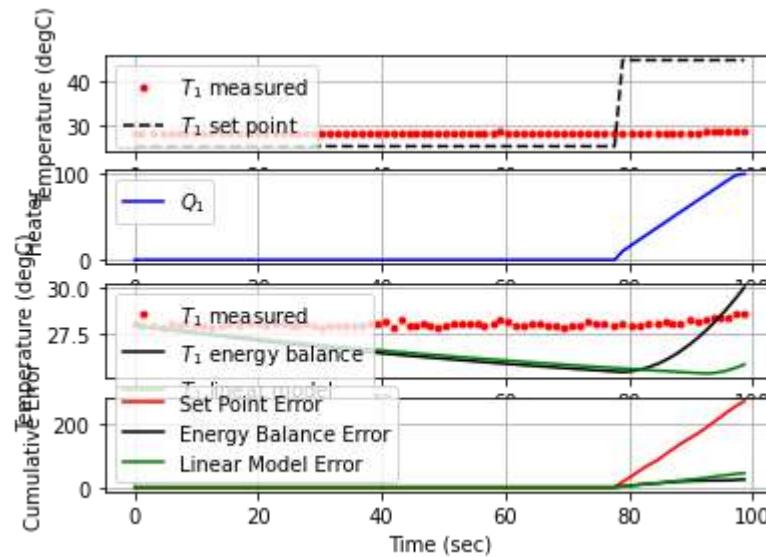
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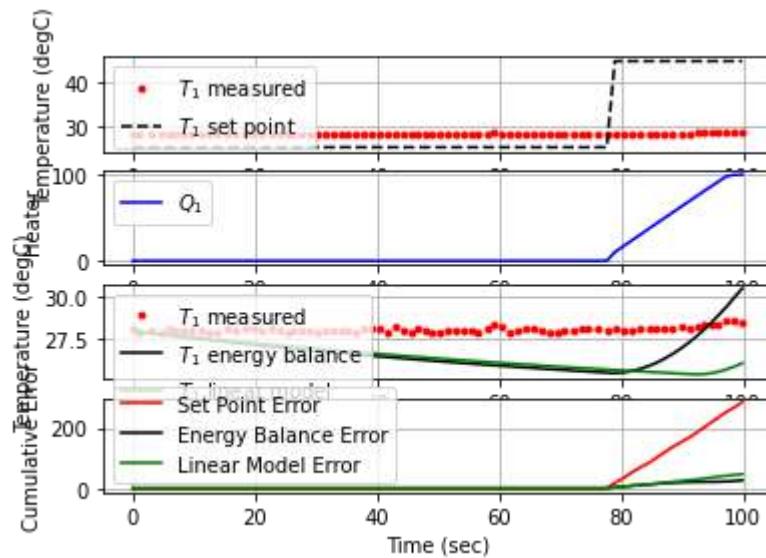
98.7 45.00 28.55 100.00 3.64 94.63 0.00



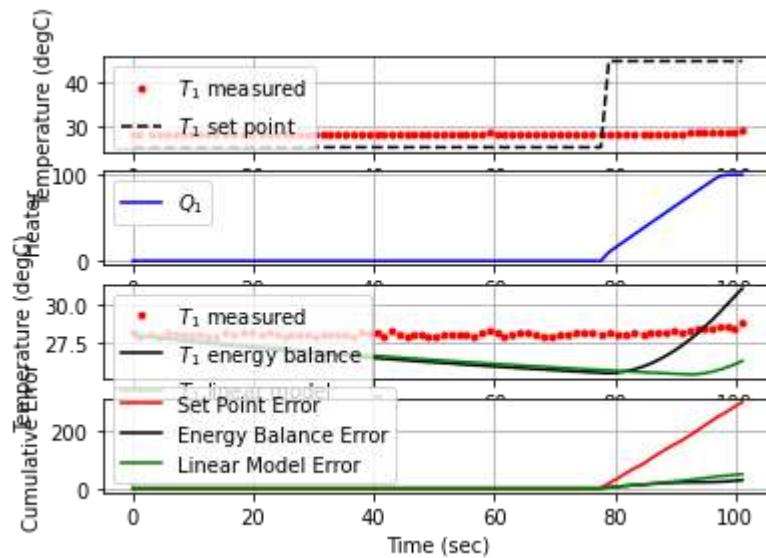
99.9 45.00 28.44 100.00 3.67 94.63 0.01



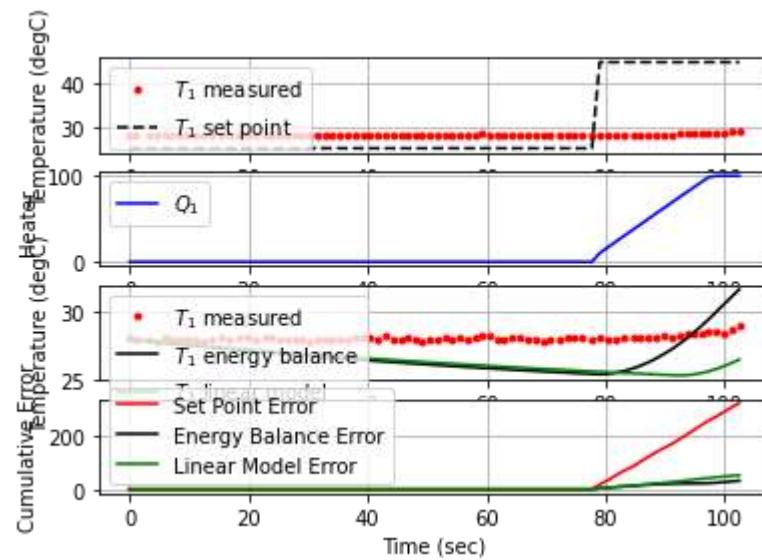
101.1 45.00 28.73 100.00 3.60 94.63 -0.02



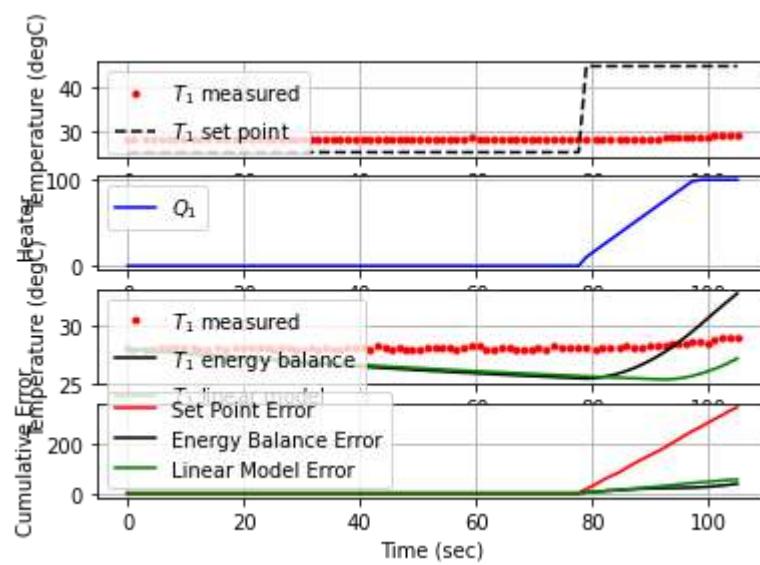
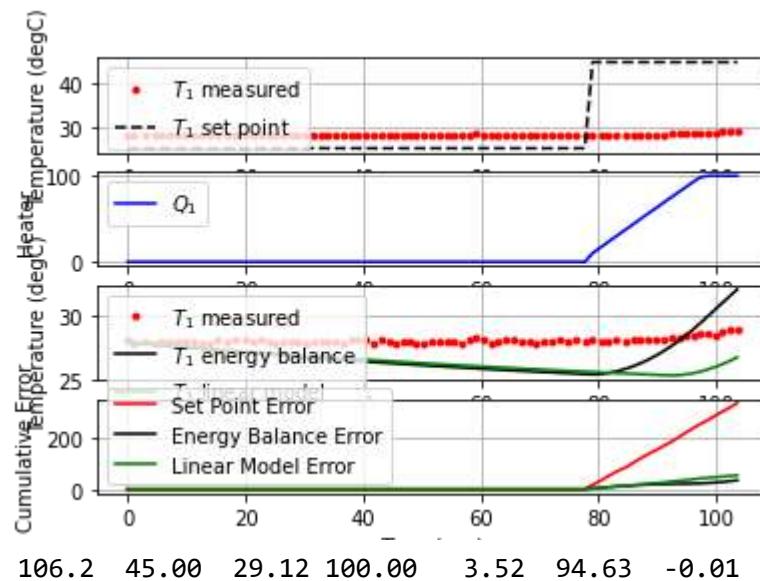
102.4 45.00 28.92 100.00 3.56 94.63 -0.01

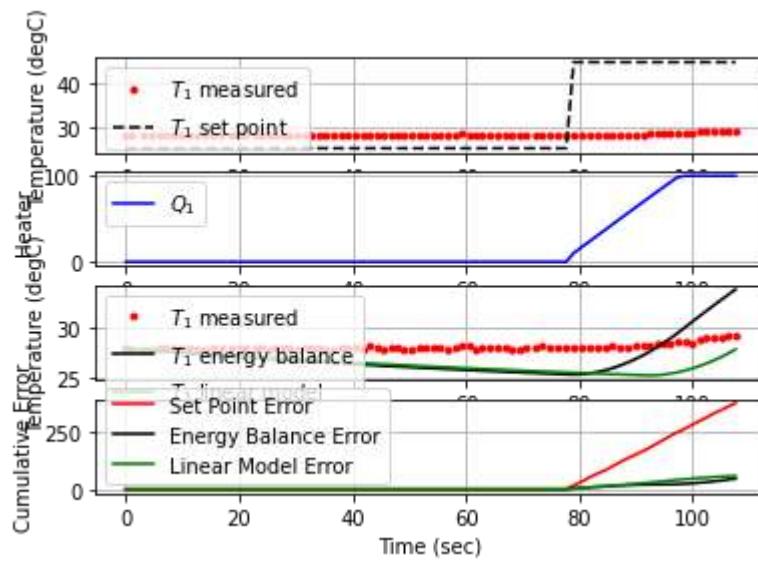
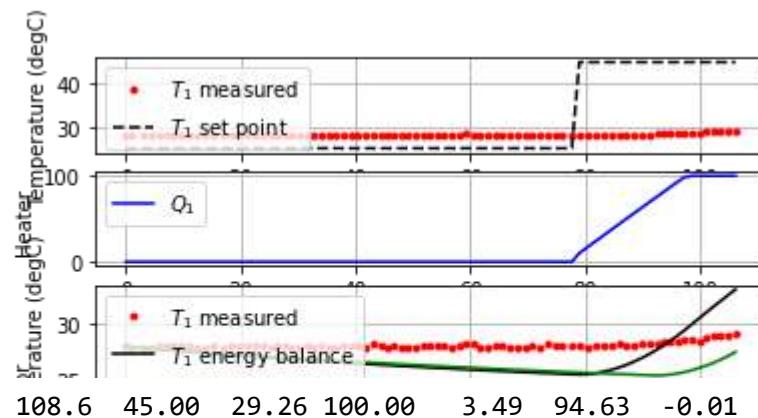


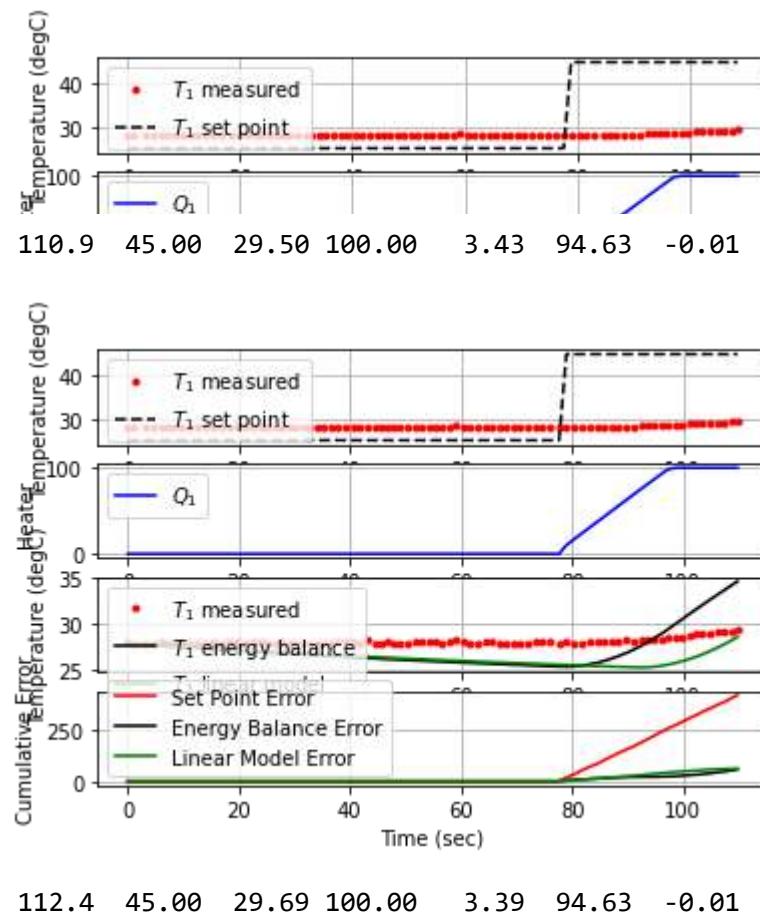
103.6 45.00 28.98 100.00 3.55 94.63 -0.00

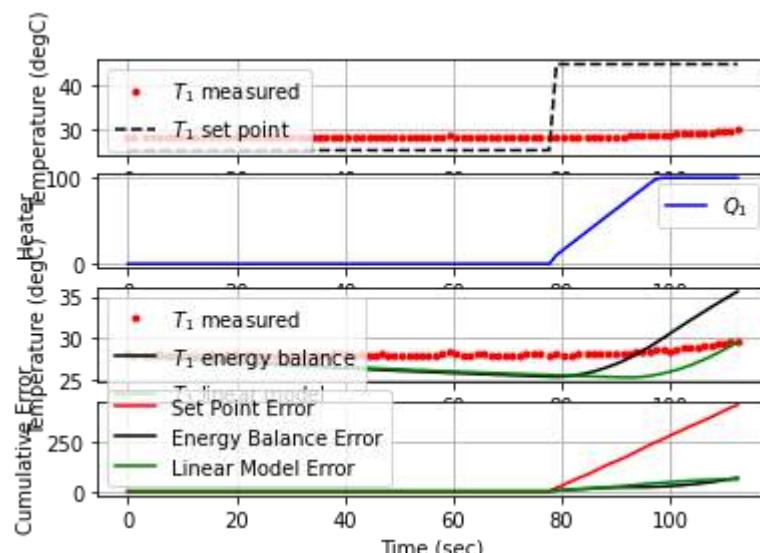
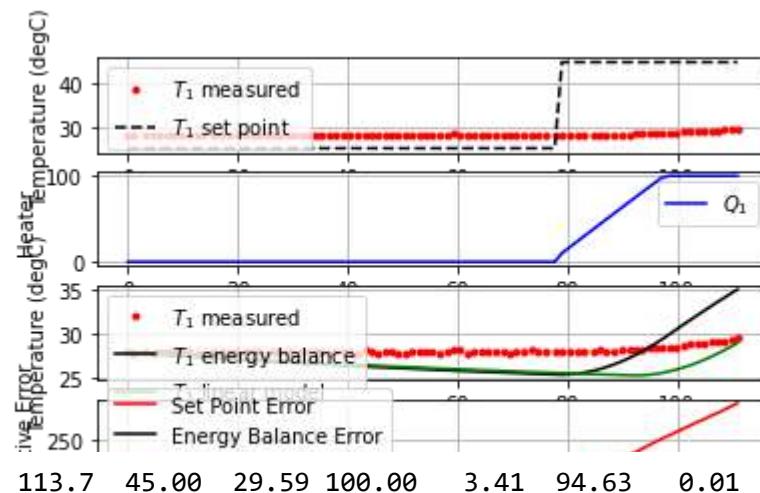


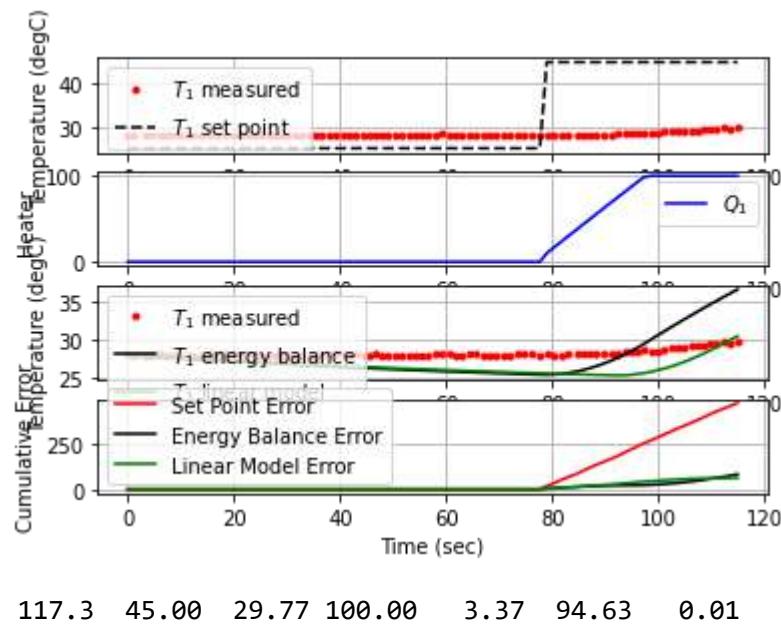
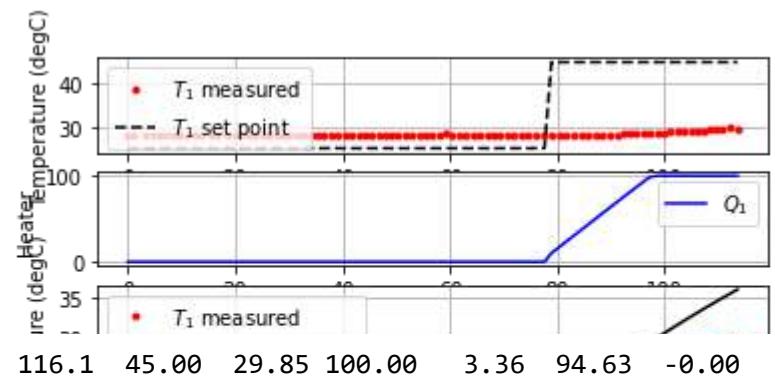
105.0 45.00 28.94 100.00 3.56 94.63 0.00

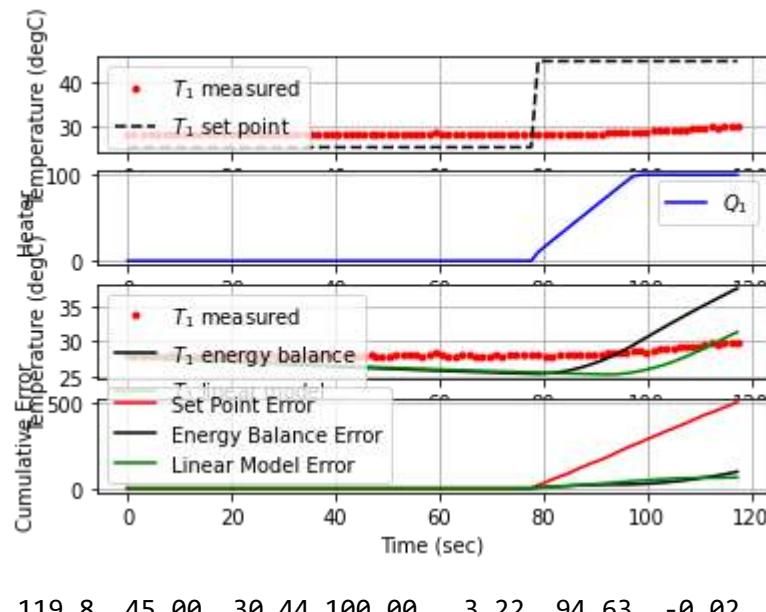
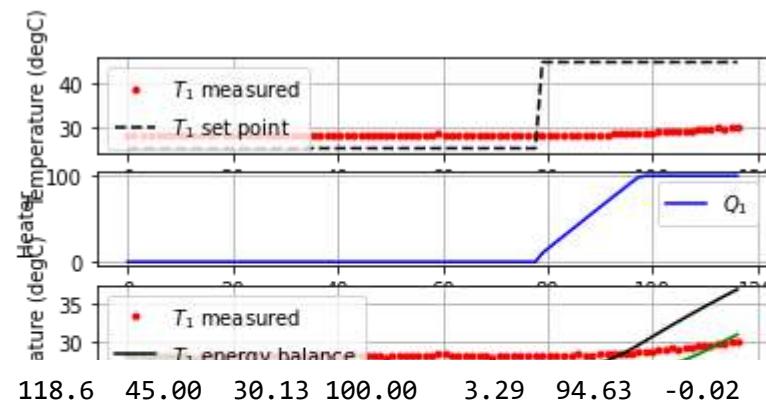


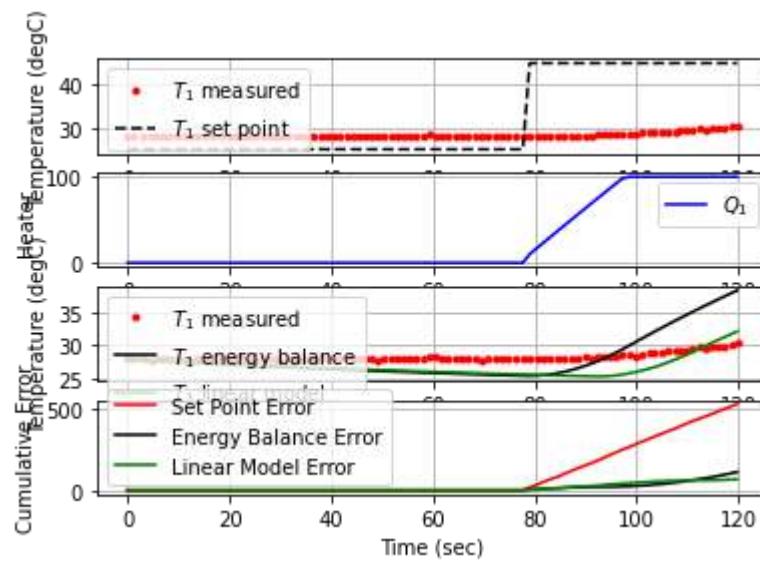
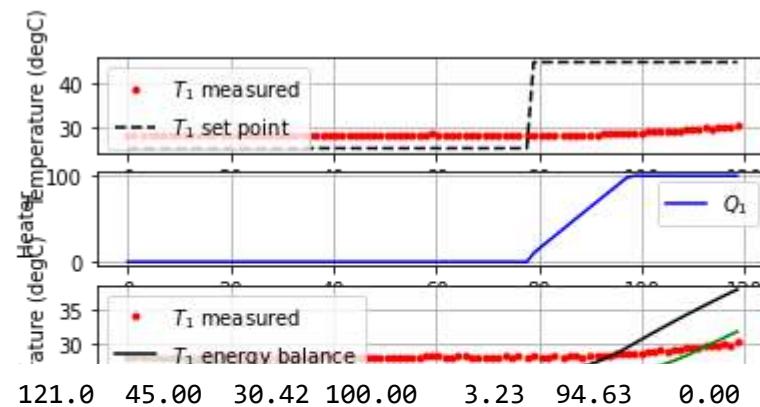


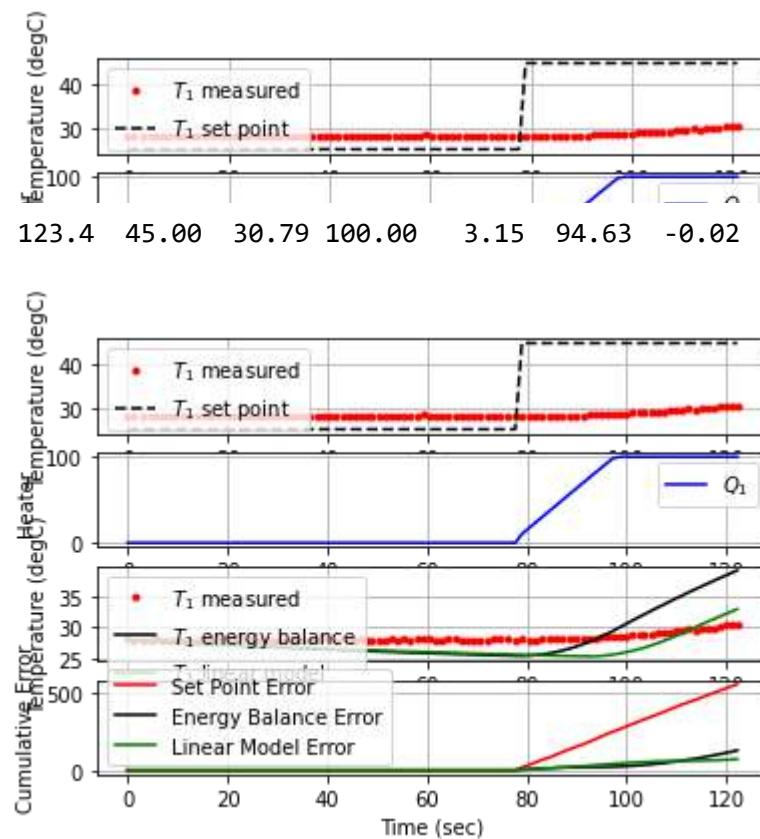




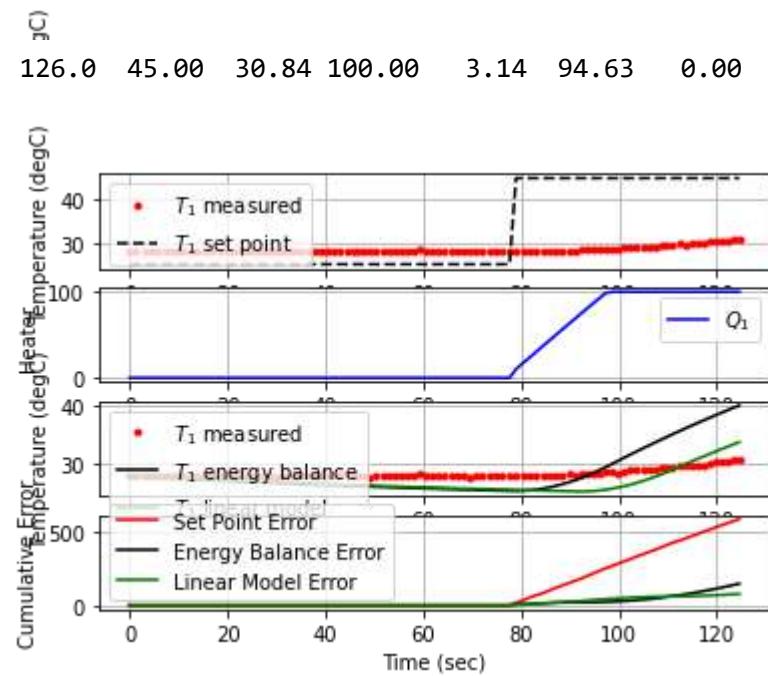




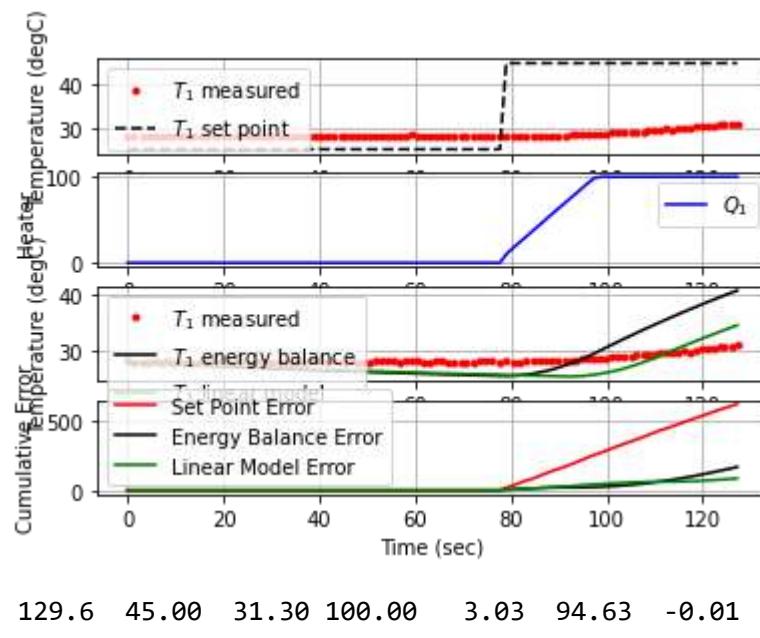
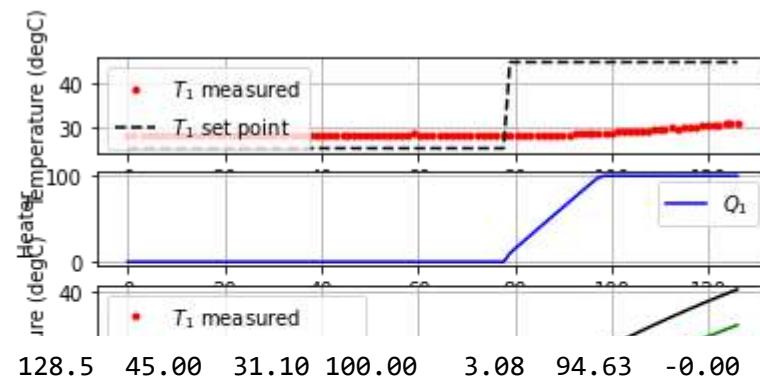


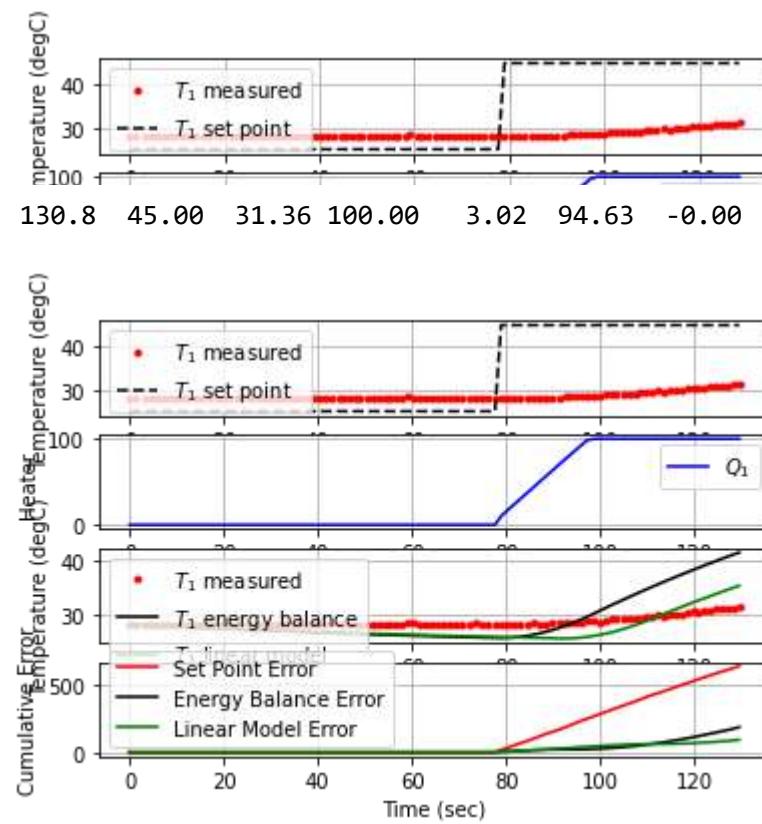


124.6 45.00 30.88 100.00 3.13 94.63 -0.01



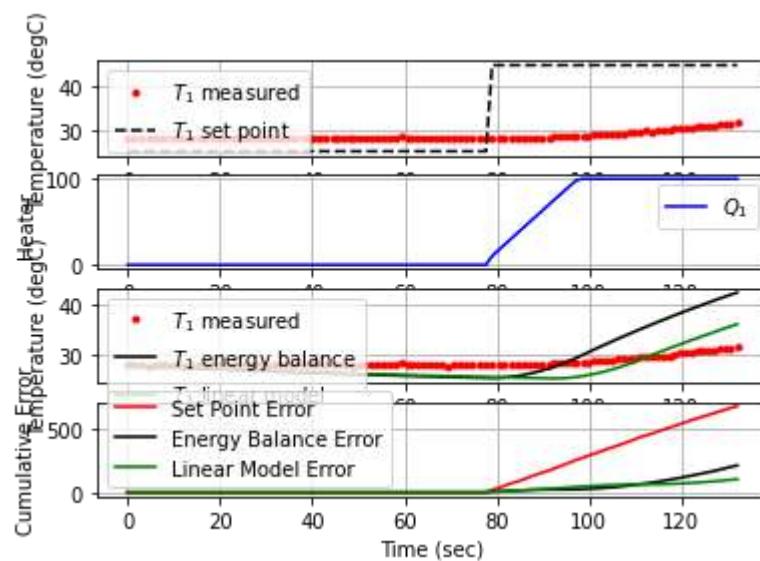
127.2 45.00 31.03 100.00 3.09 94.63 -0.01



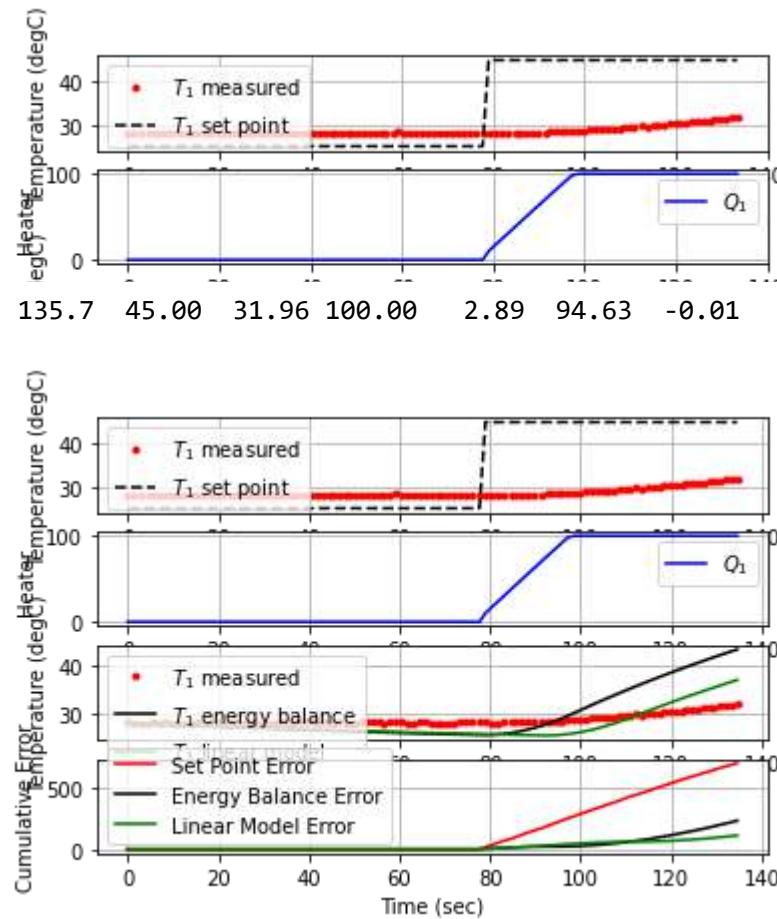


132.1 45.00 31.61 100.00 2.97 94.63 -0.02

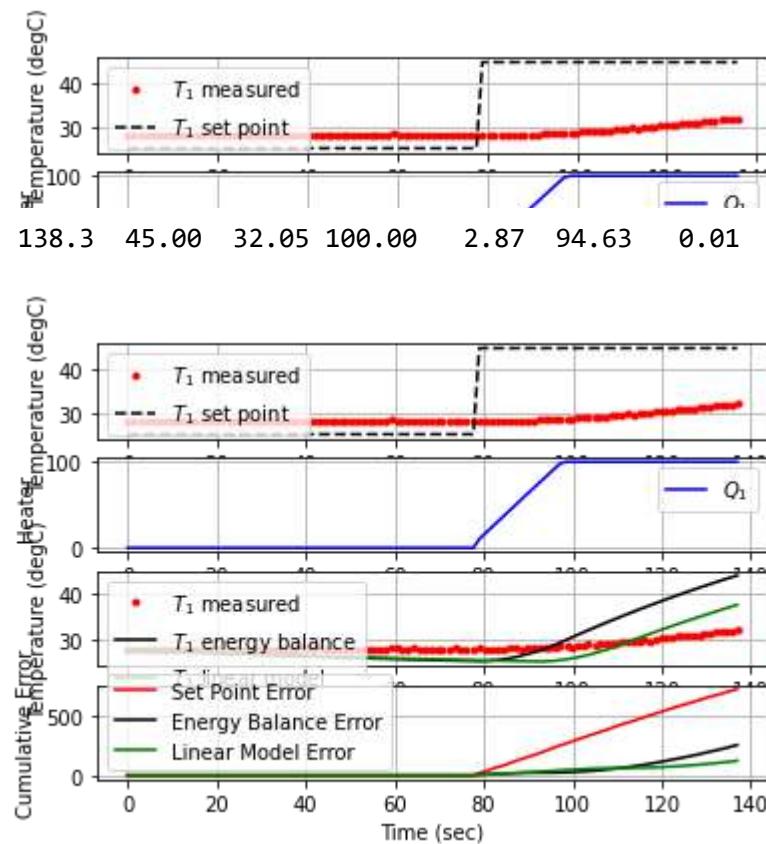
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133.4 45.00 31.70 100.00 2.95 94.63 -0.01
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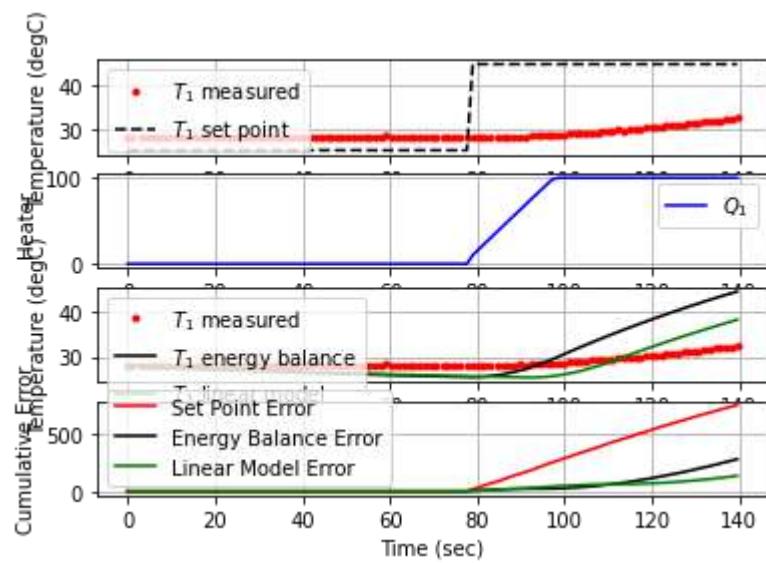
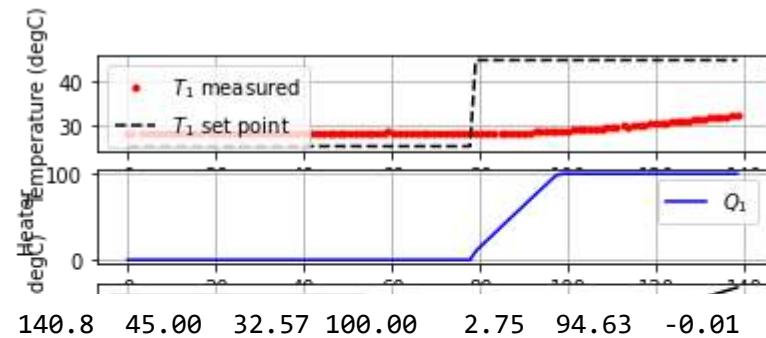
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134.6 45.00 31.88 100.00 2.91 94.63 -0.01
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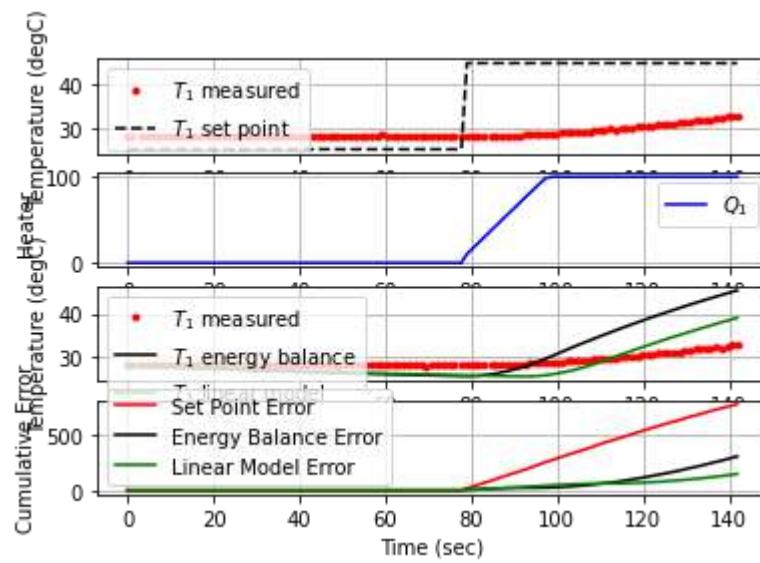
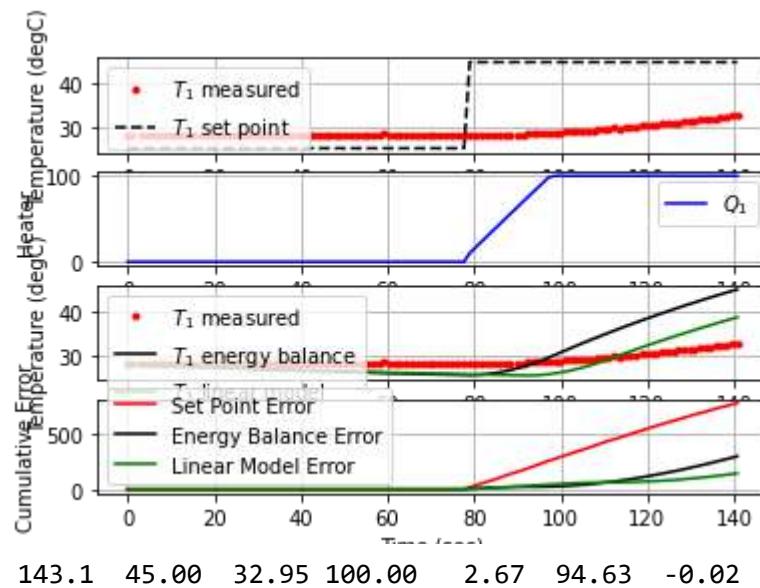
137.0 45.00 32.13 100.00 2.85 94.63 -0.01



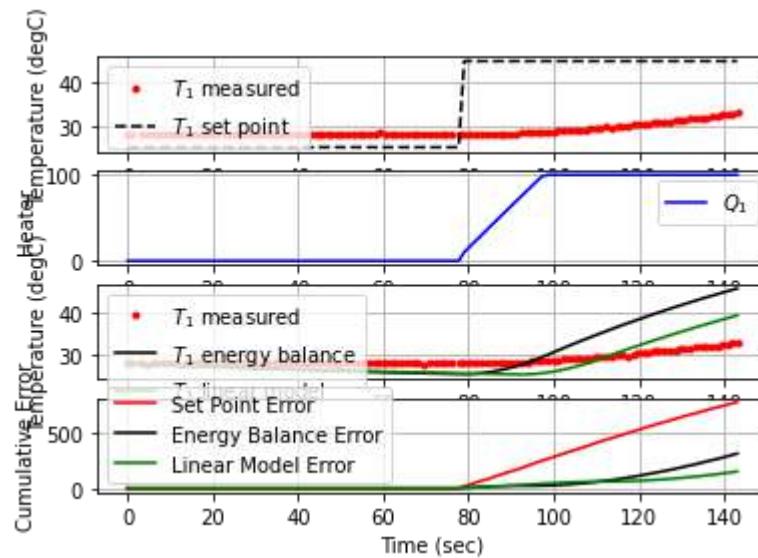
139.5 45.00 32.44 100.00 2.78 94.63 -0.03



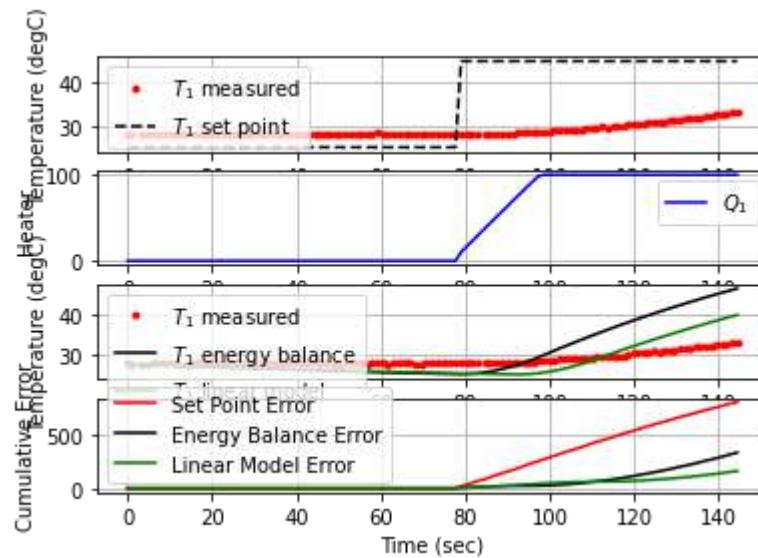
141.9 45.00 32.69 100.00 2.73 94.63 -0.01

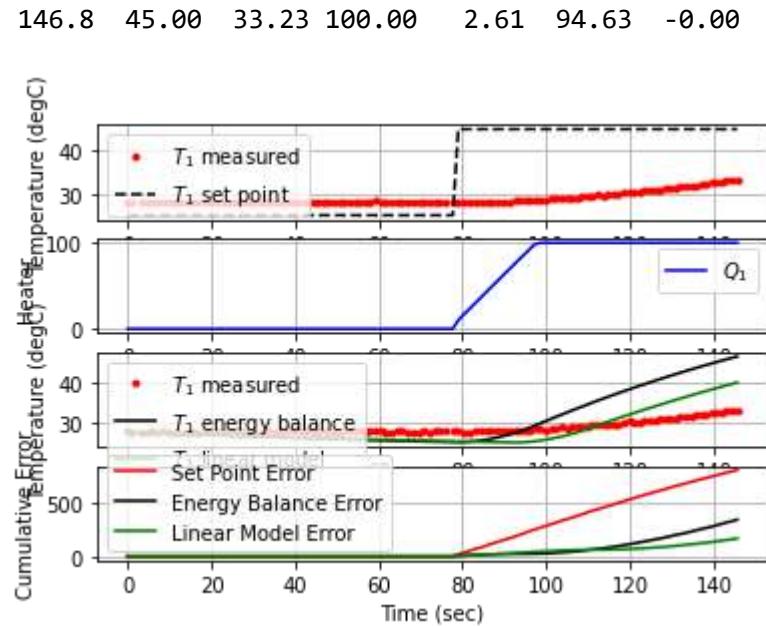


144.4 45.00 32.92 100.00 2.68 94.63 0.00

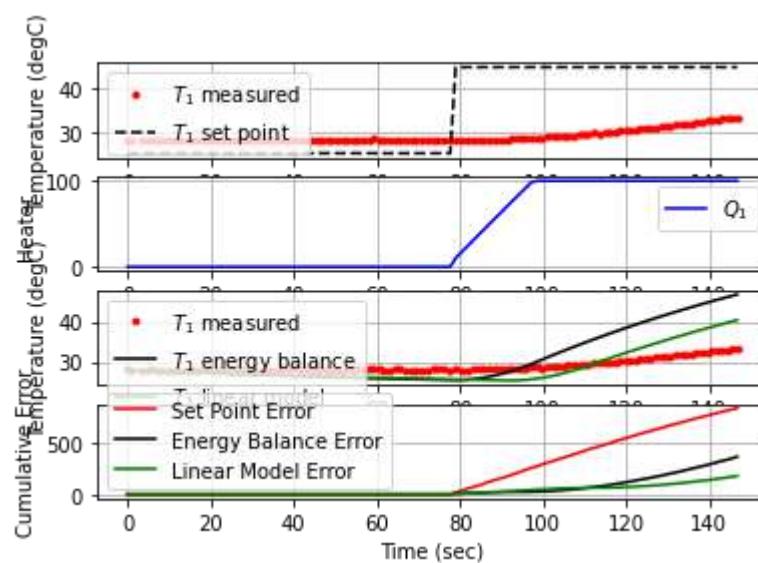


145.6 45.00 33.17 100.00 2.62 94.63 -0.02

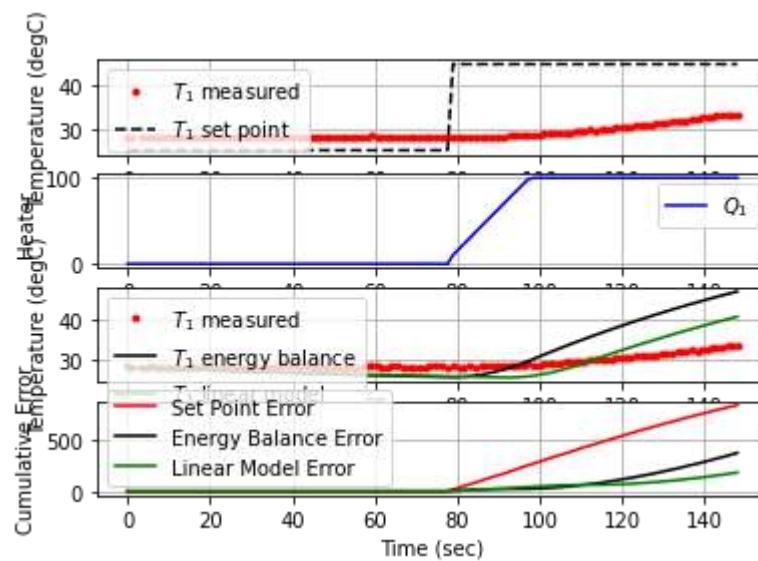




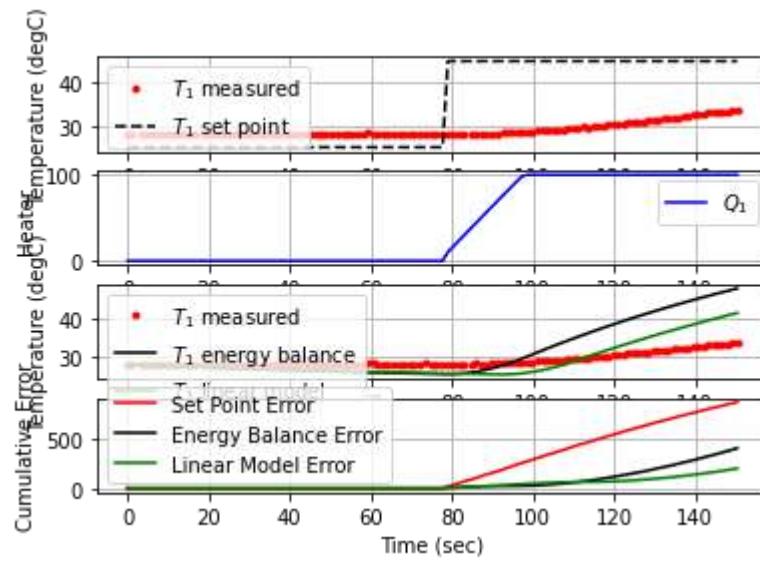
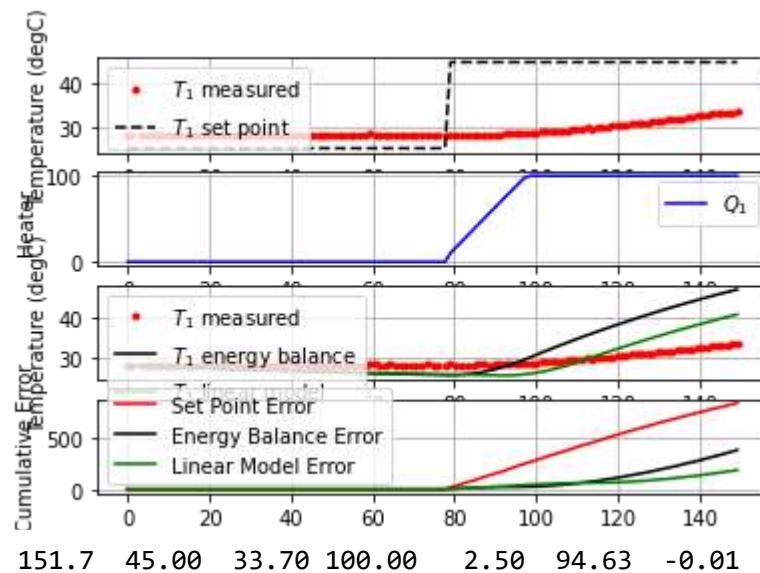
148.0 45.00 33.30 100.00 2.59 94.63 -0.00

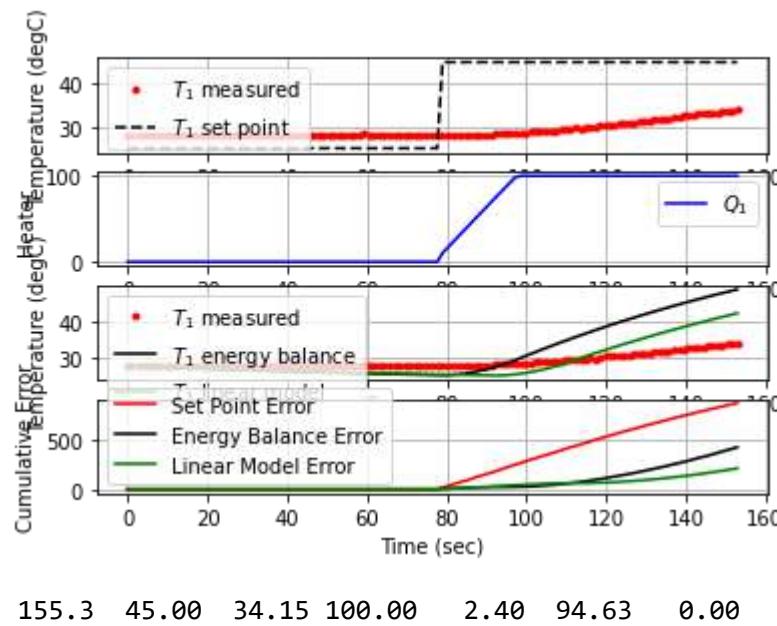
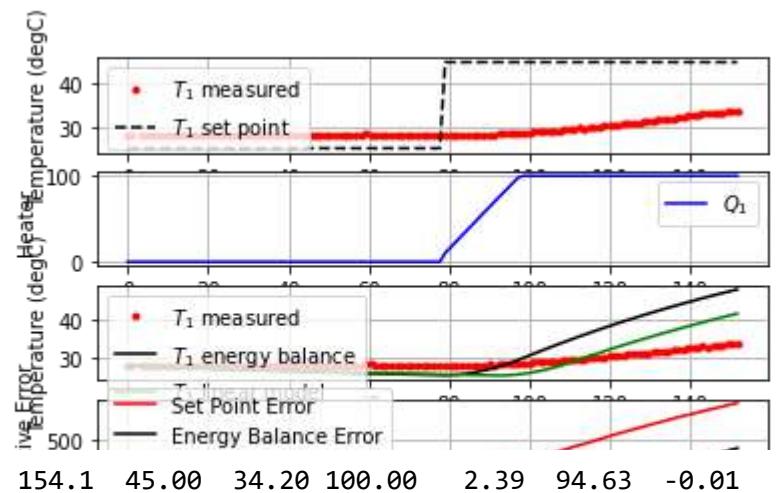


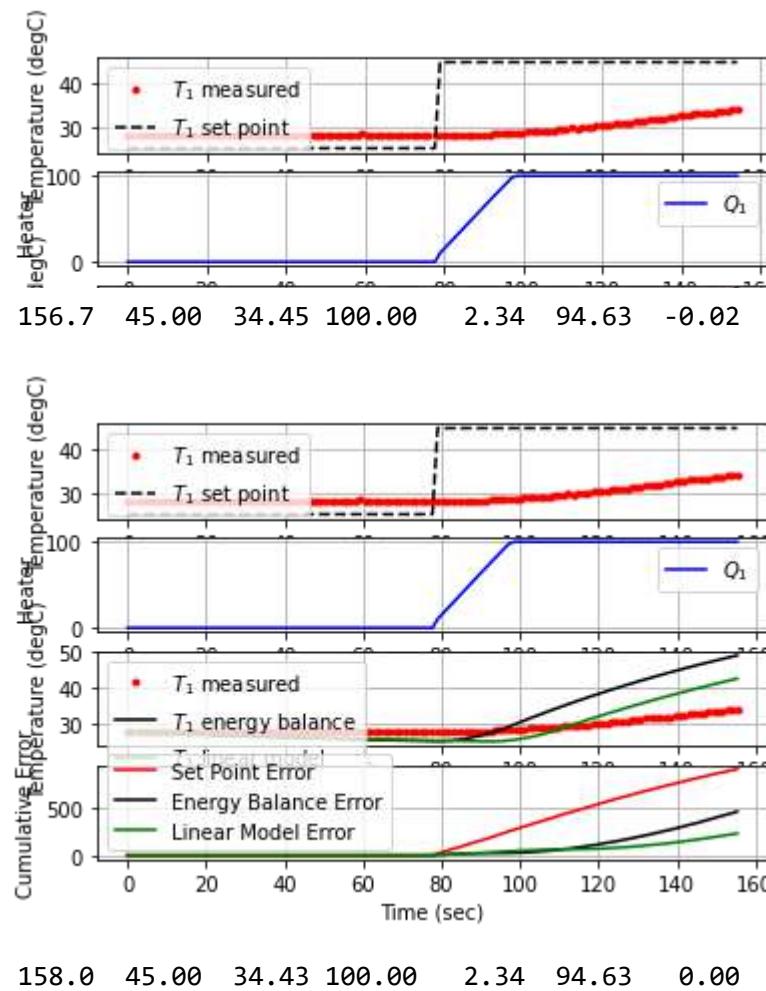
149.2 45.00 33.54 100.00 2.54 94.63 -0.02

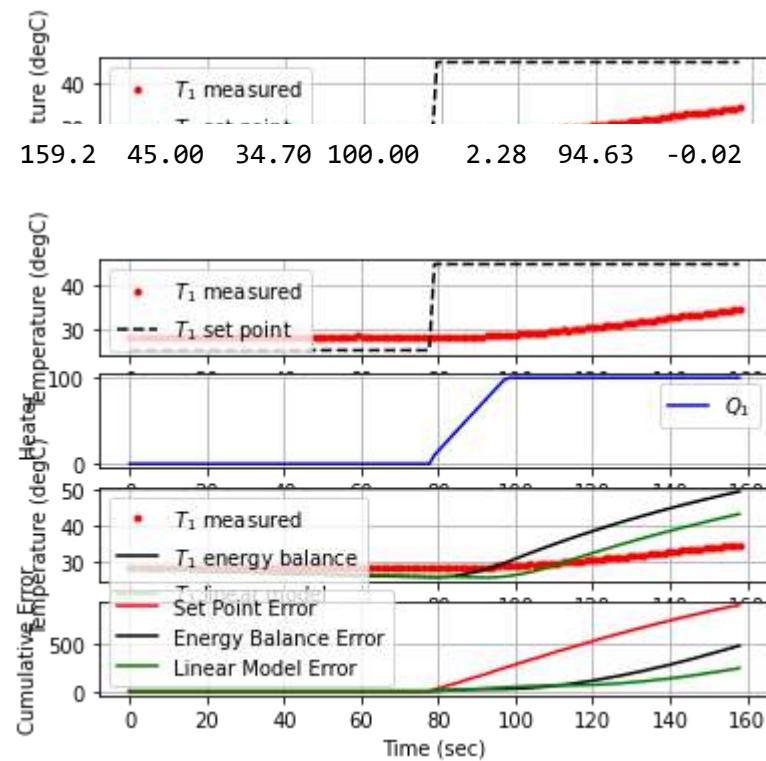


150.4 45.00 33.62 100.00 2.52 94.63 -0.01

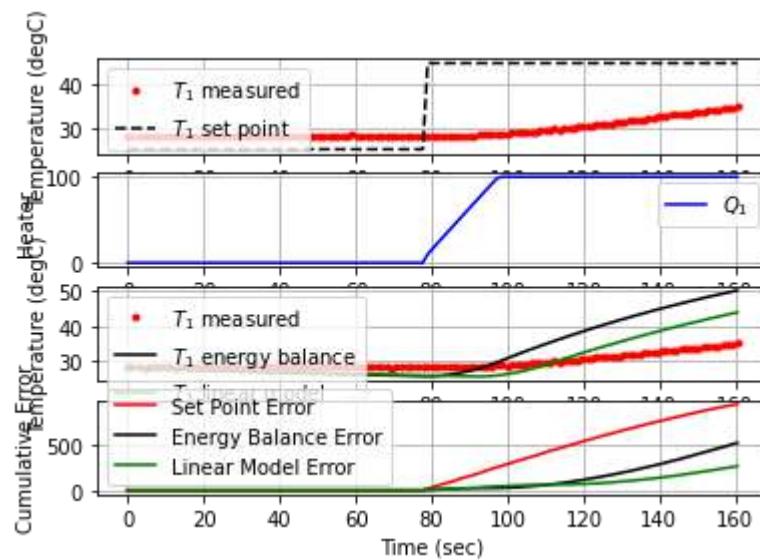
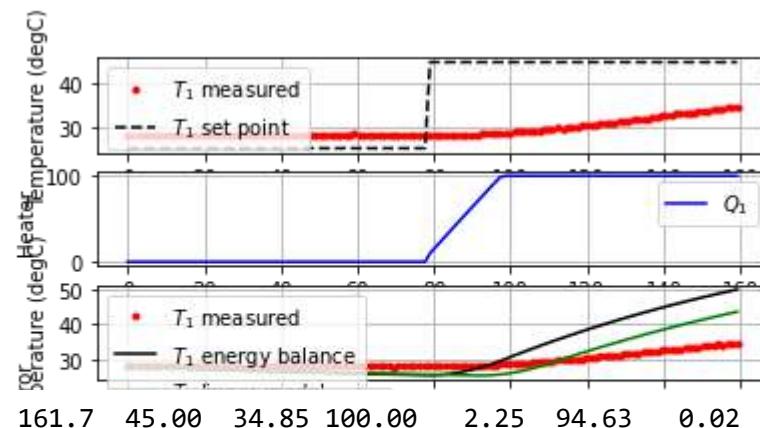




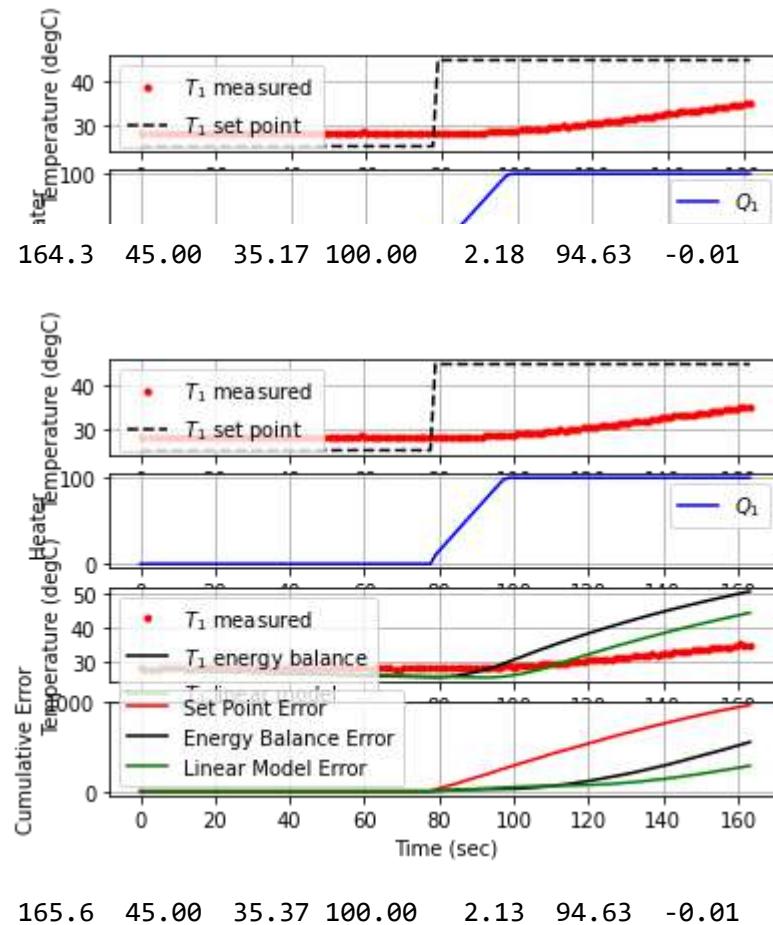


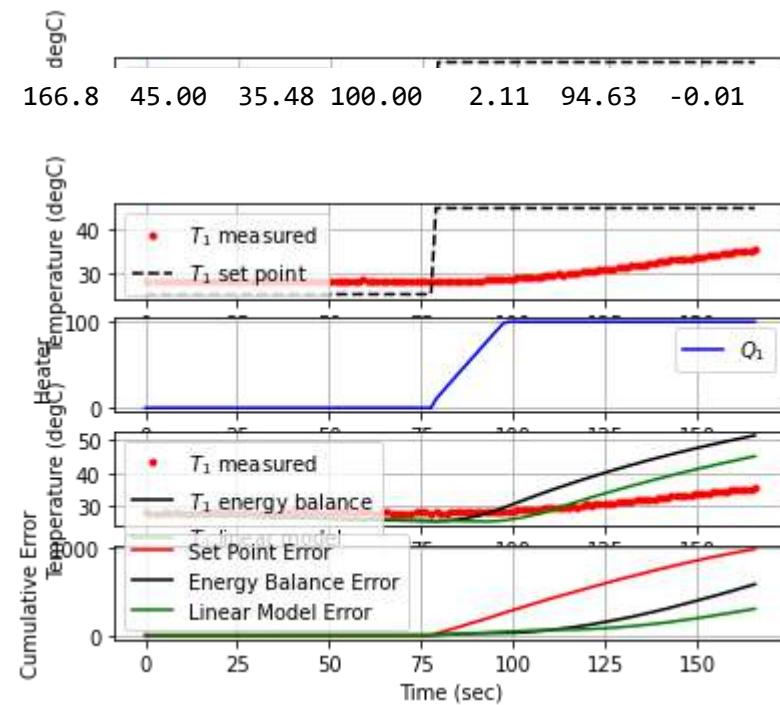


160.5 45.00 35.09 100.00 2.19 94.63 -0.03

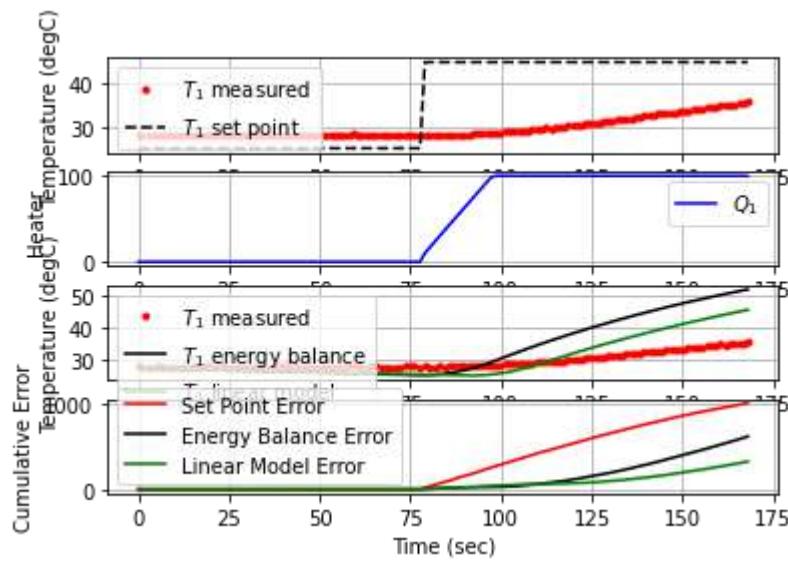
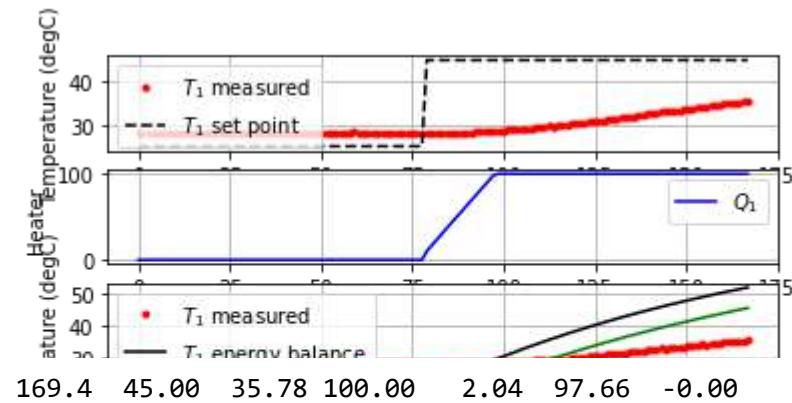


163.1 45.00 35.07 100.00 2.20 94.63 -0.01

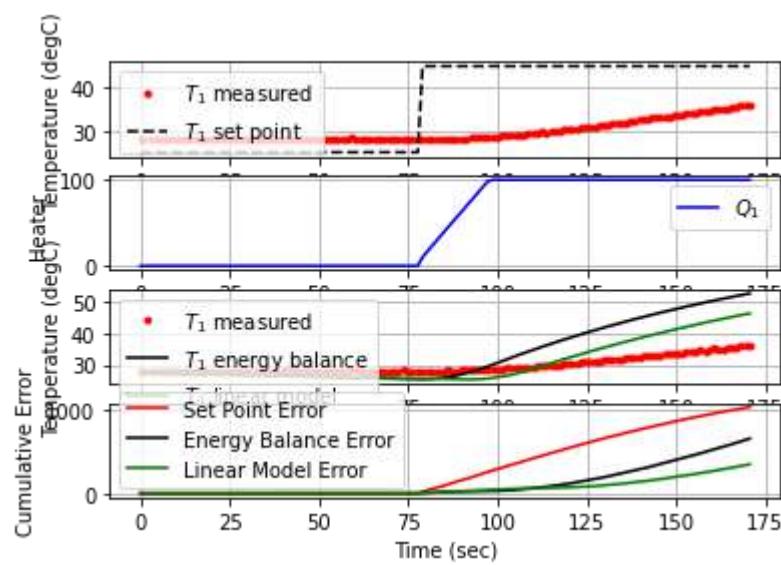
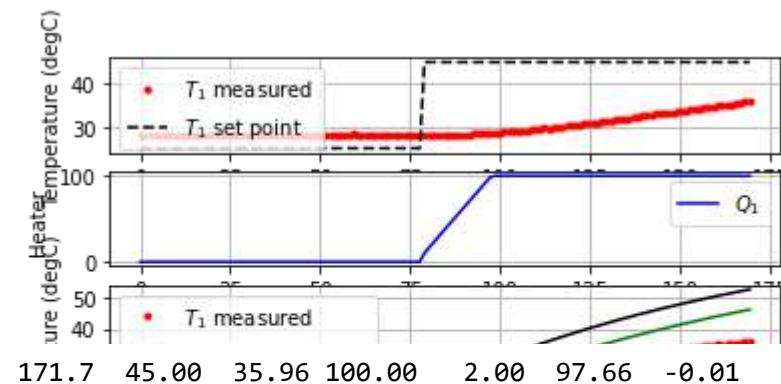


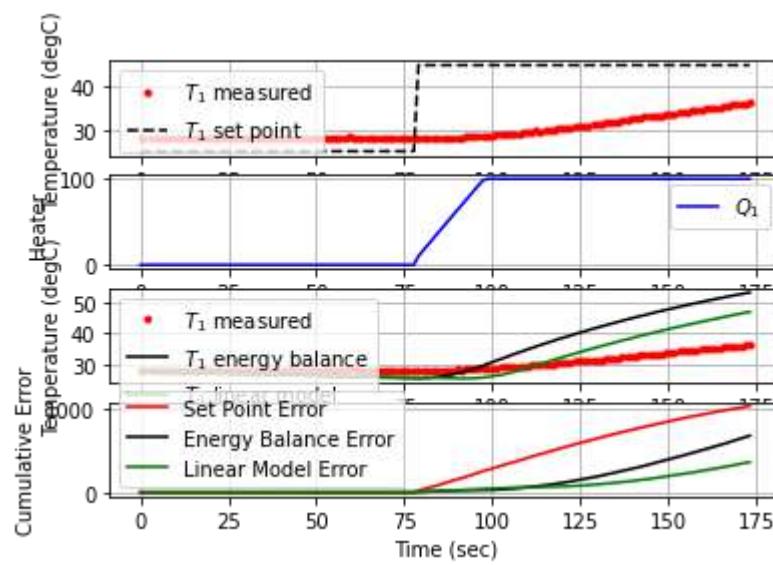
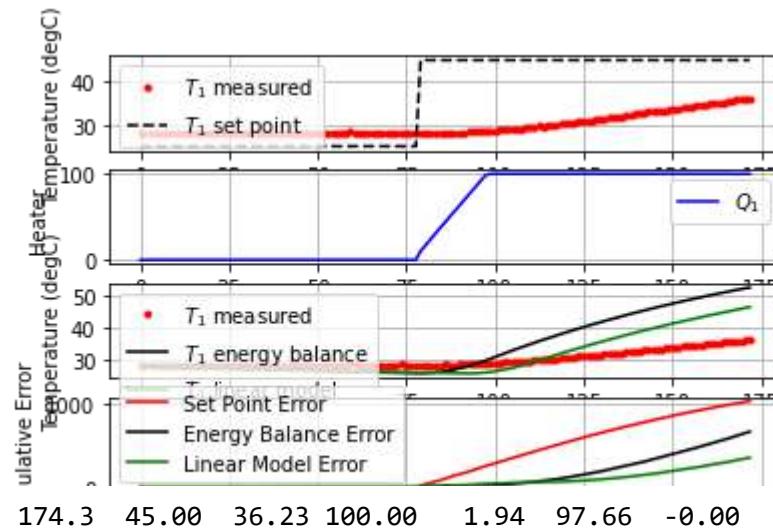


168.0 45.00 35.75 99.69 2.05 97.66 -0.02

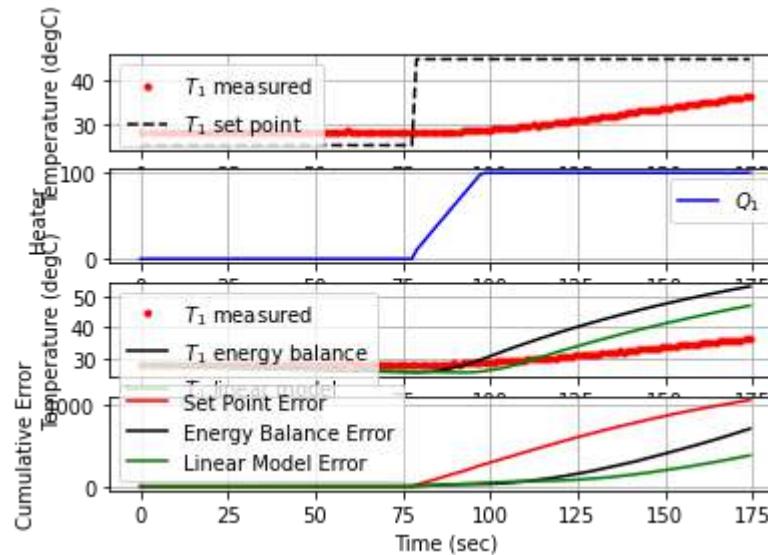


170.5 45.00 35.85 100.00 2.03 97.66 -0.01

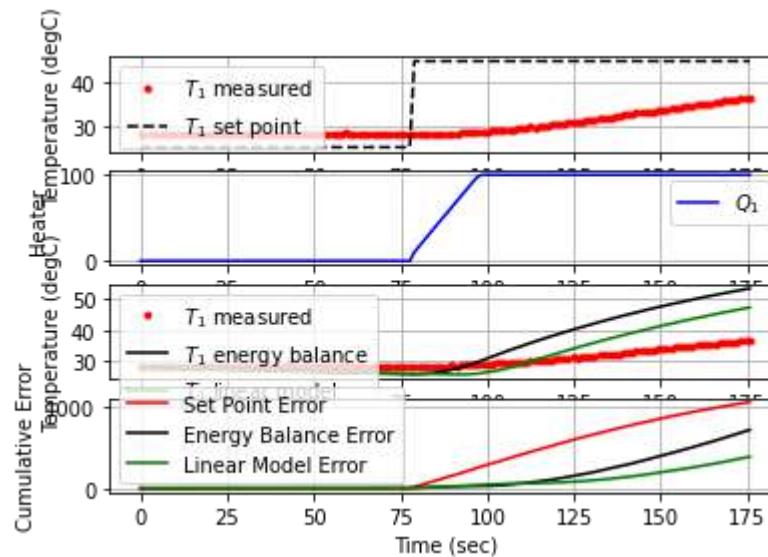




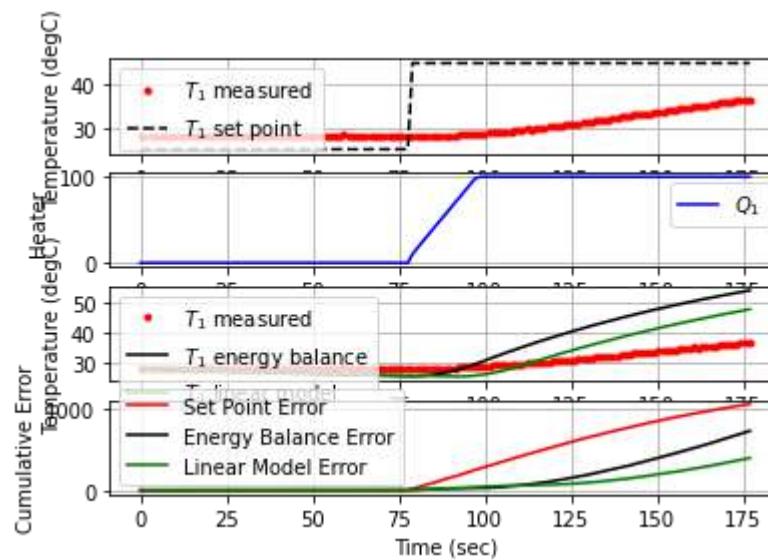
175.6 45.00 36.51 100.00 1.88 97.66 -0.02



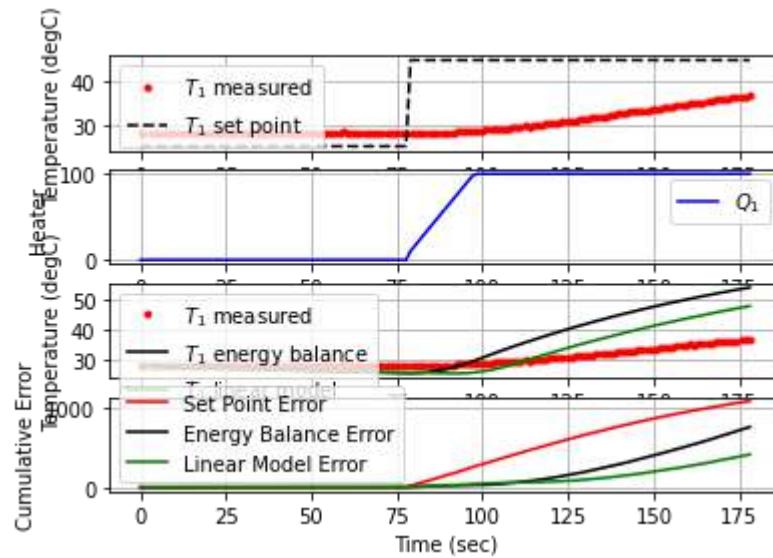
176.9 45.00 36.57 100.00 1.87 97.66 -0.00



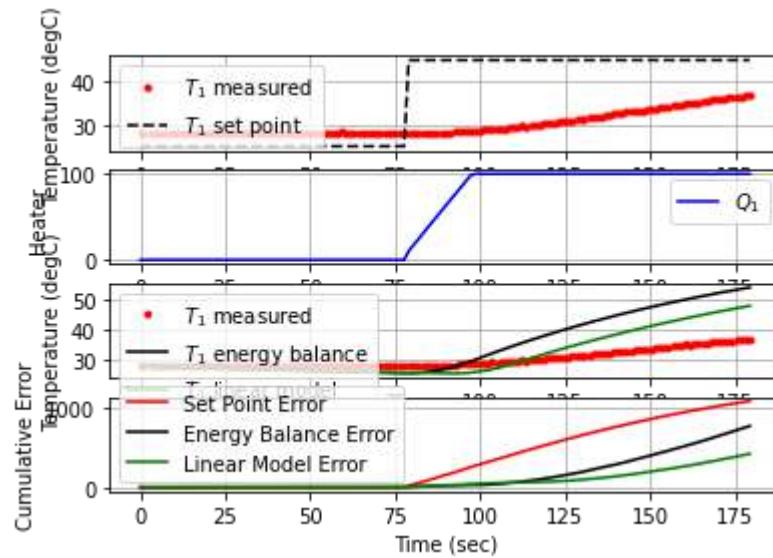
178.1 45.00 36.78 100.00 1.82 97.66 -0.01



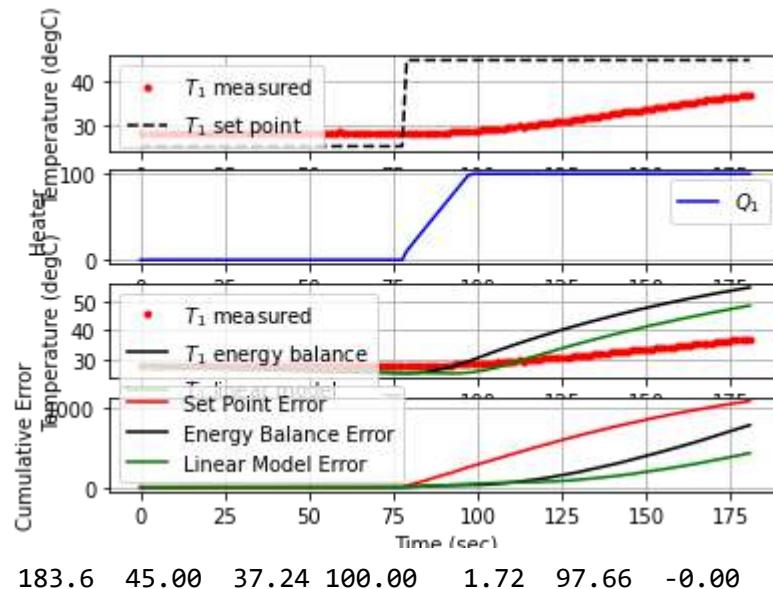
179.3 45.00 36.77 100.00 1.82 97.66 0.00



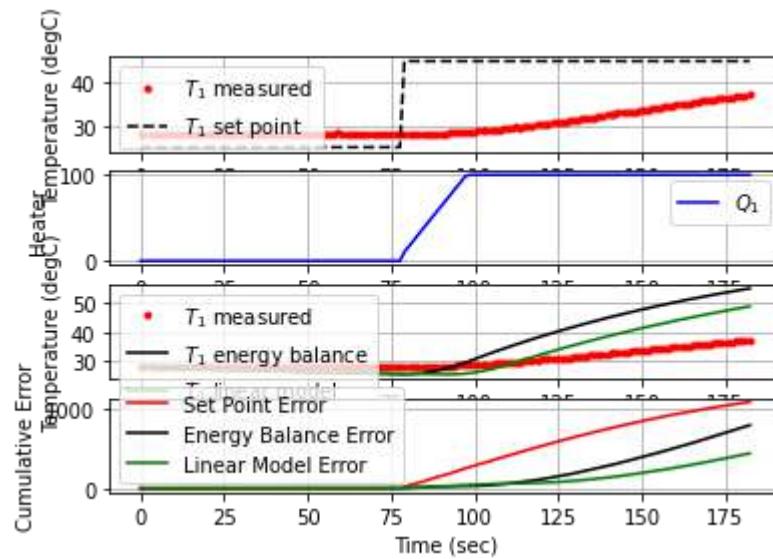
180.7 45.00 36.85 100.00 1.81 97.66 -0.01



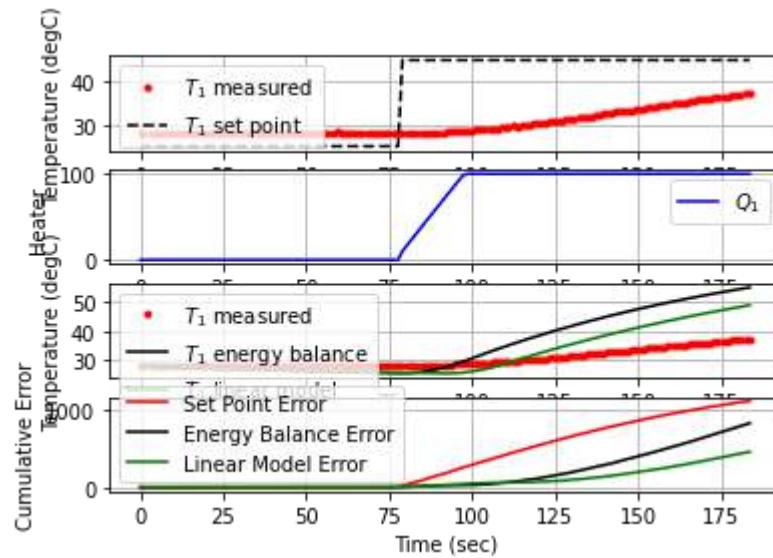
182.3 45.00 37.21 100.00 1.73 97.66 -0.02



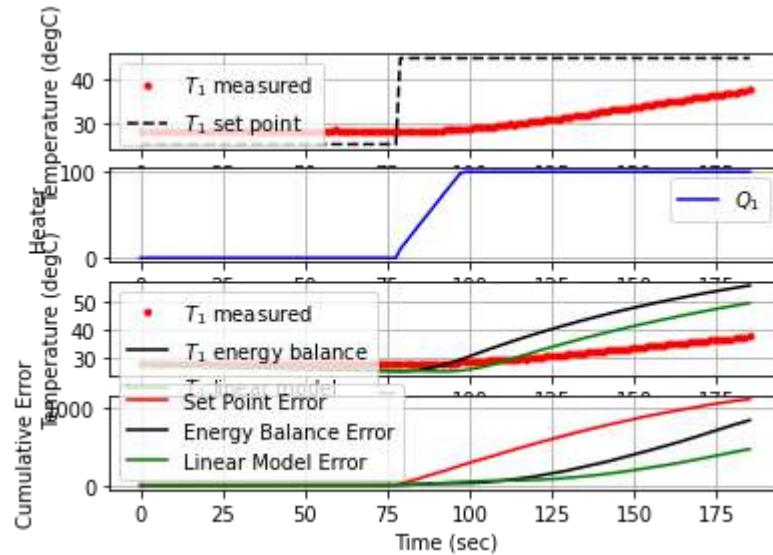
183.6 45.00 37.24 100.00 1.72 97.66 -0.00



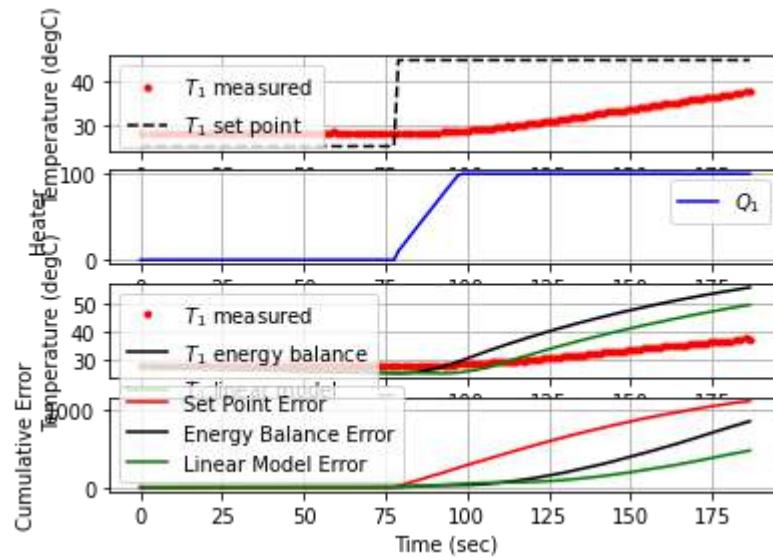
185.2 45.00 37.72 100.00 1.61 97.66 -0.03



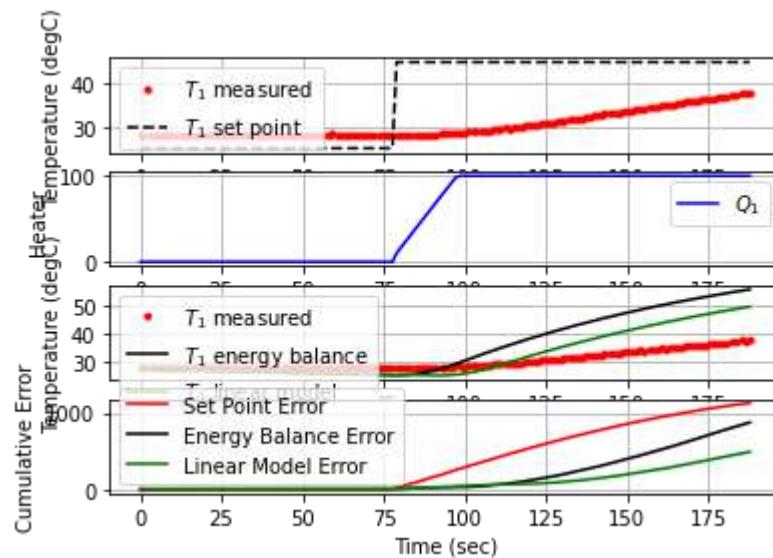
186.5 45.00 37.58 100.00 1.64 97.66 0.01



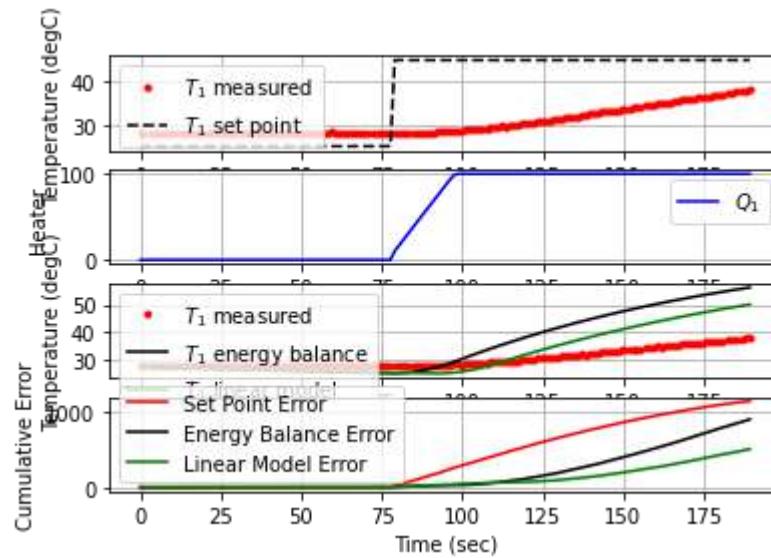
187.8 45.00 37.89 100.00 1.57 97.66 -0.02



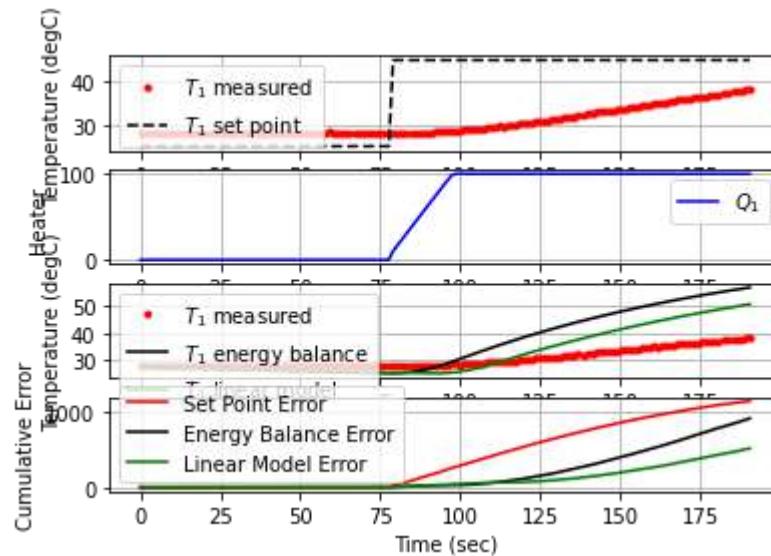
189.2 45.00 38.12 100.00 1.52 97.66 -0.01



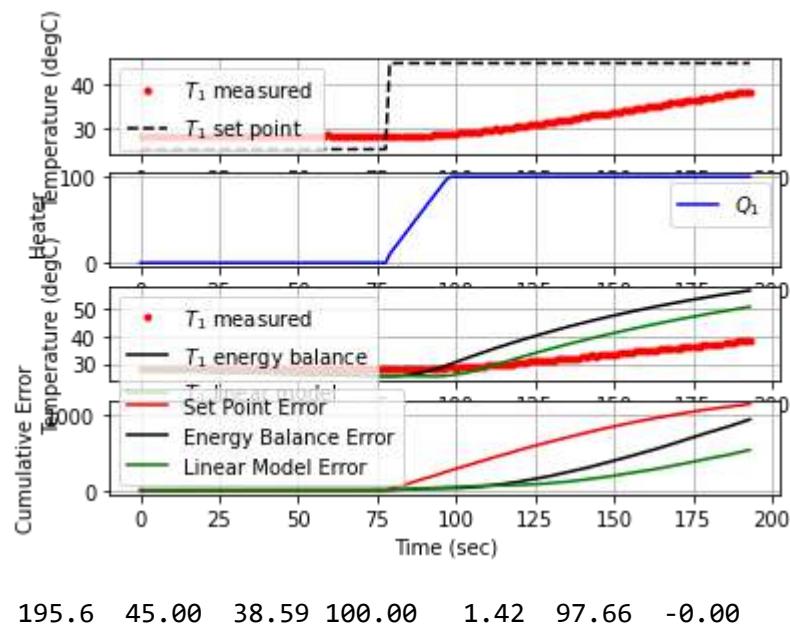
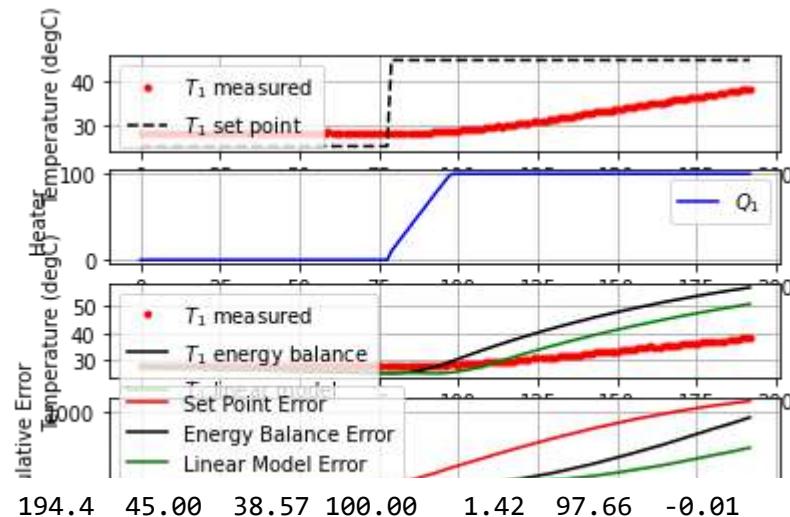
190.4 45.00 38.08 100.00 1.53 97.66 0.00

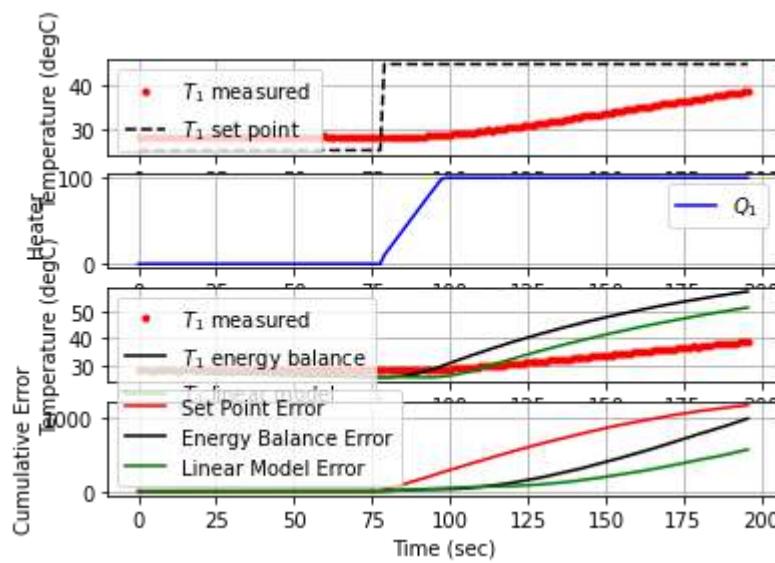
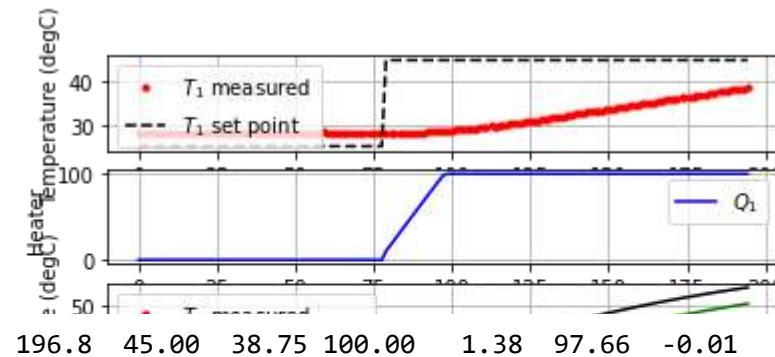


191.7 45.00 38.25 100.00 1.49 97.66 -0.01

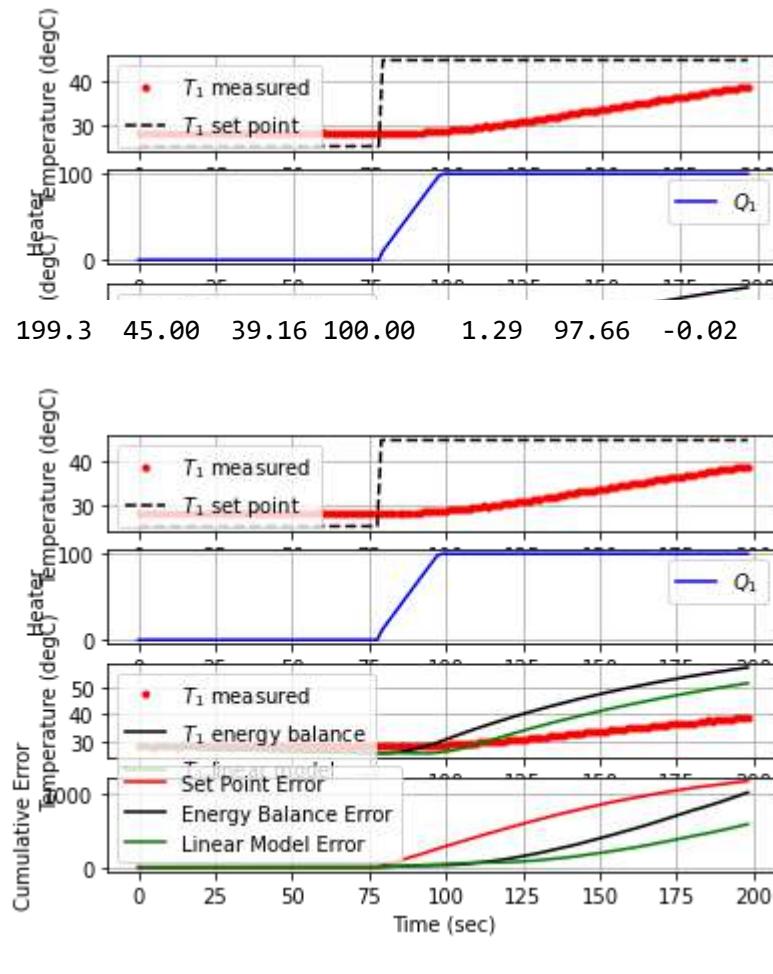


193.0 45.00 38.38 100.00 1.47 97.66 -0.01

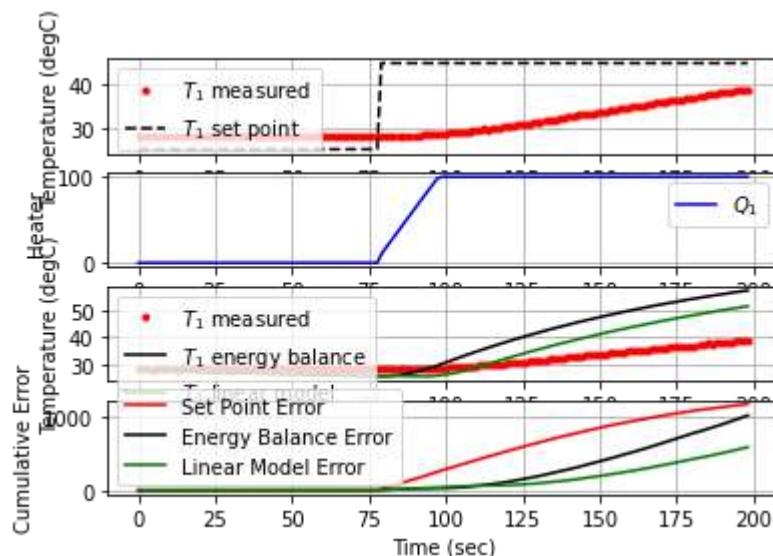


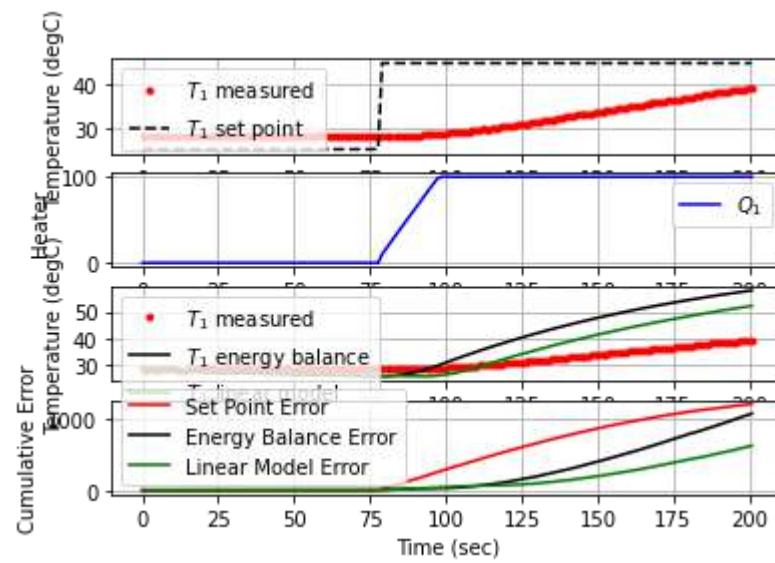
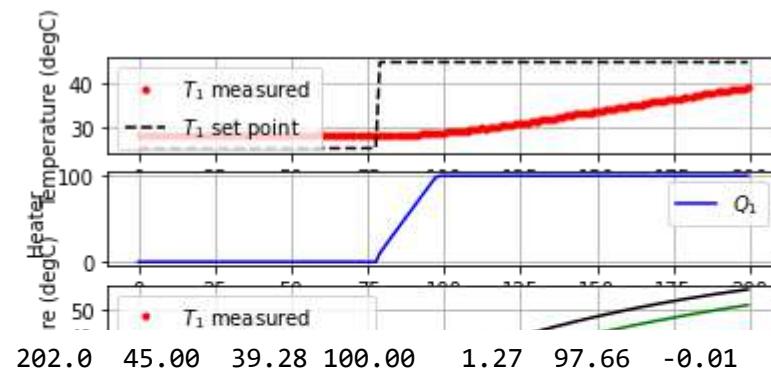


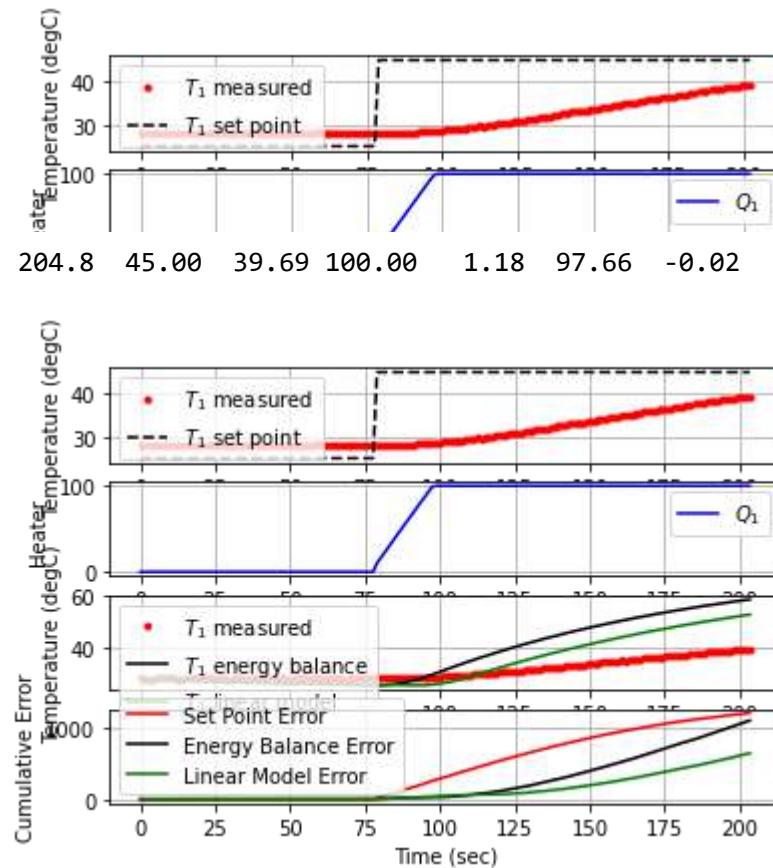
198.1 45.00 38.87 100.00 1.36 97.66 -0.01



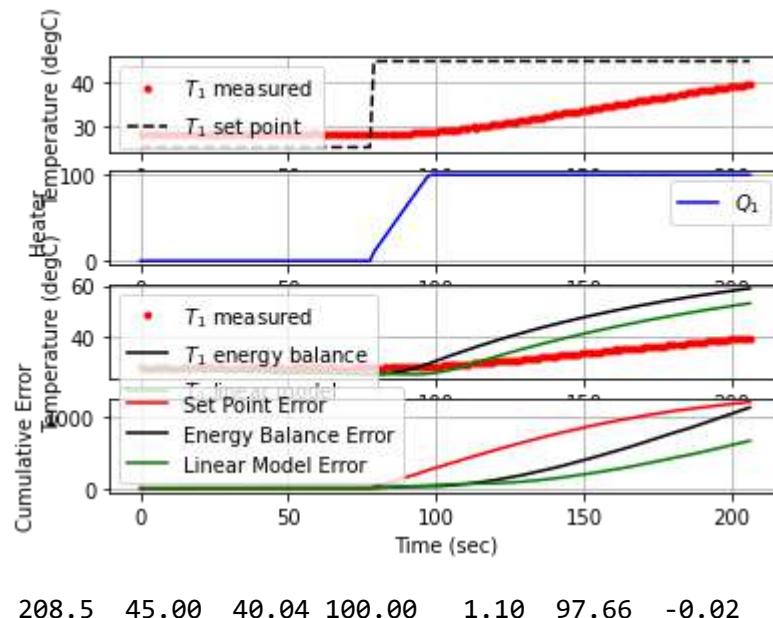
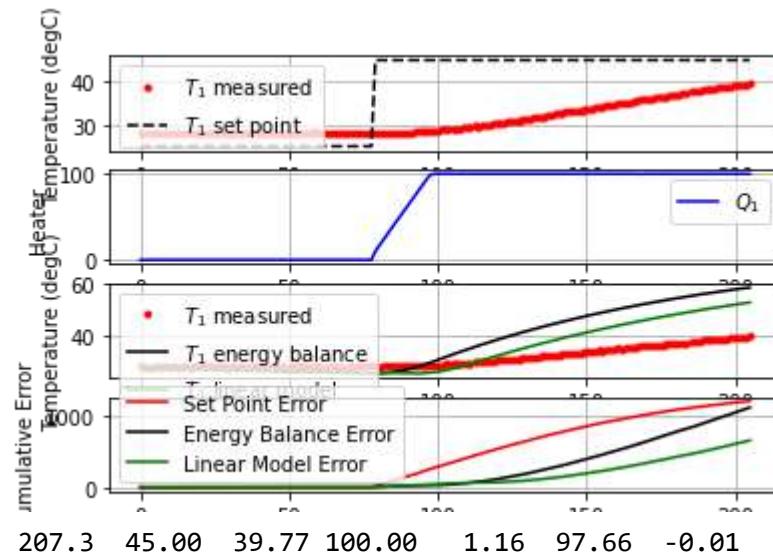
200.7 45.00 39.12 100.00 1.30 97.66 0.00

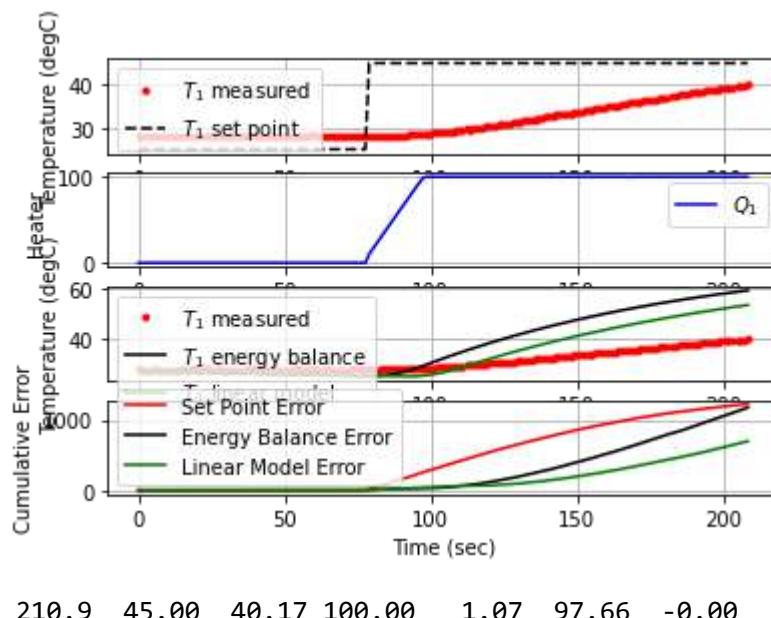
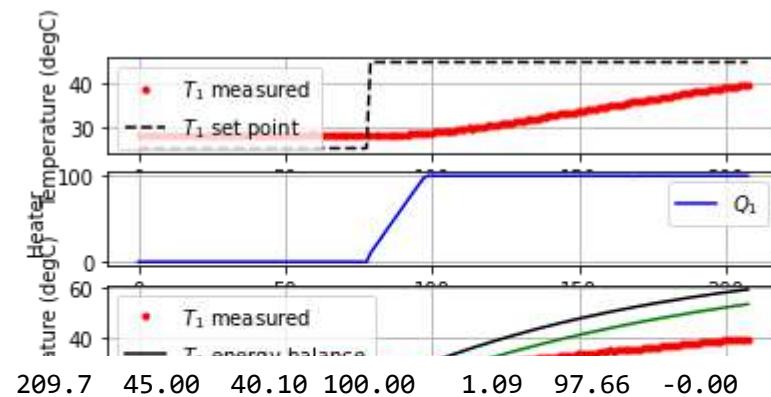


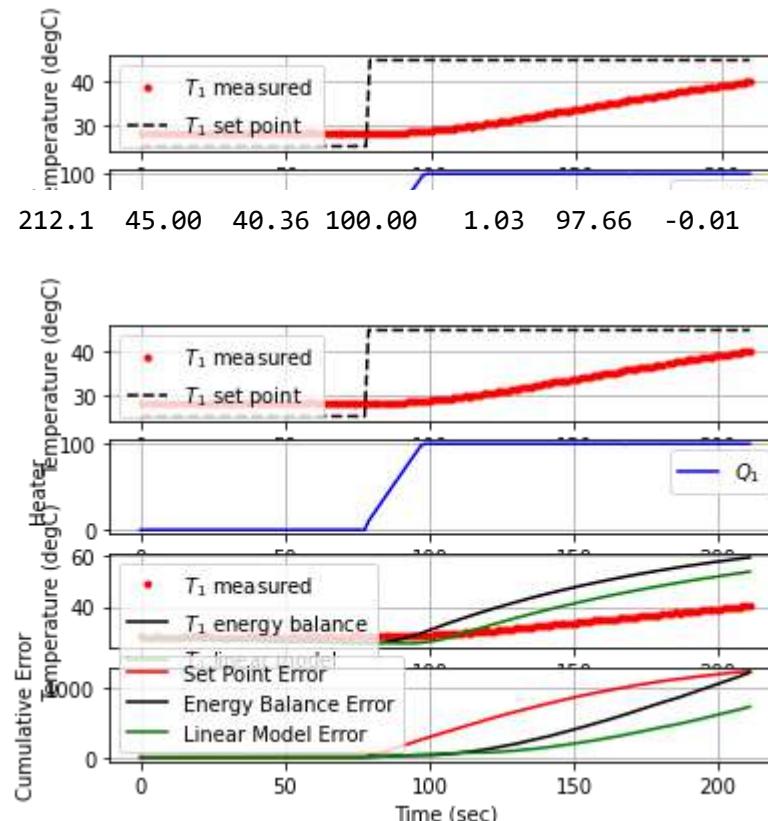




206.1 45.00 39.67 100.00 1.18 97.66 0.00



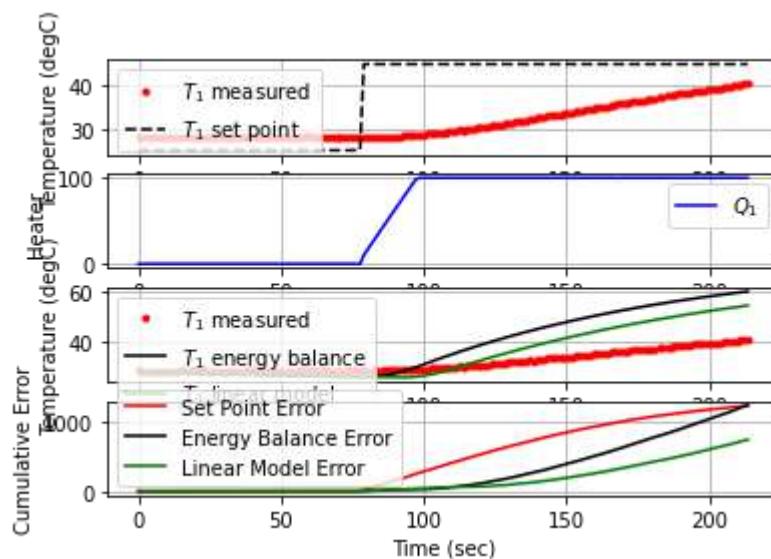




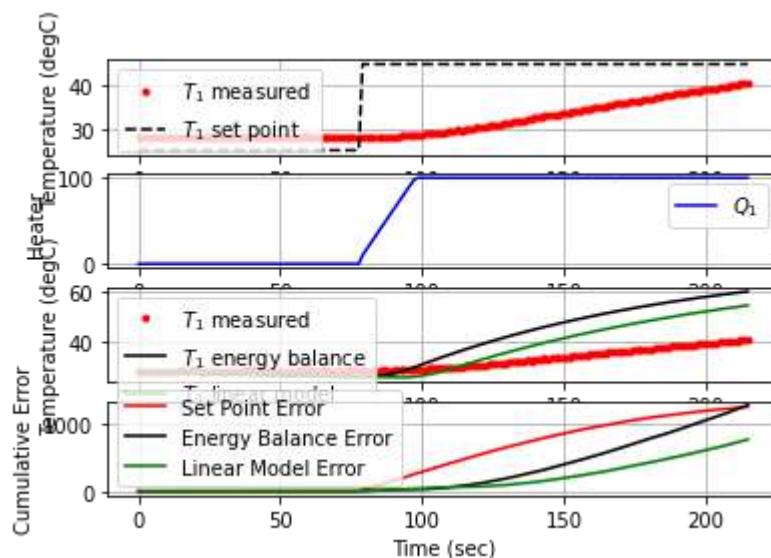
213.4 45.00 40.44 100.00 1.01 97.66 -0.01

C)

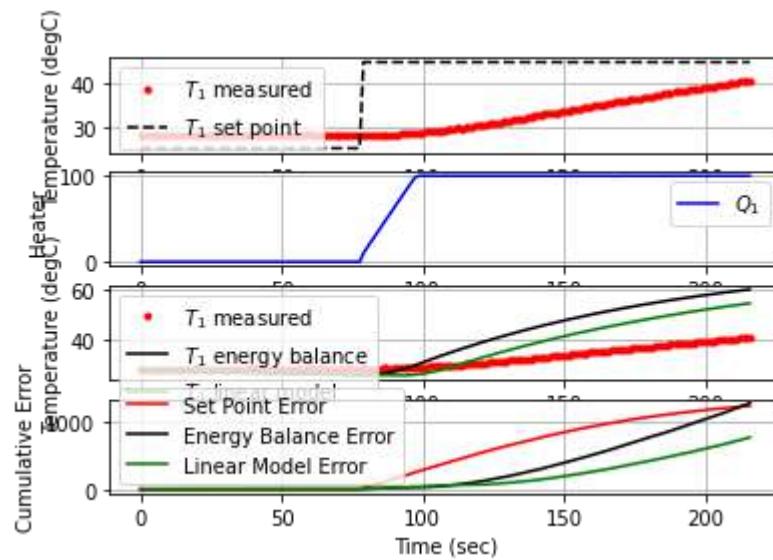
214.6 45.00 40.67 100.00 0.96 97.66 -0.02



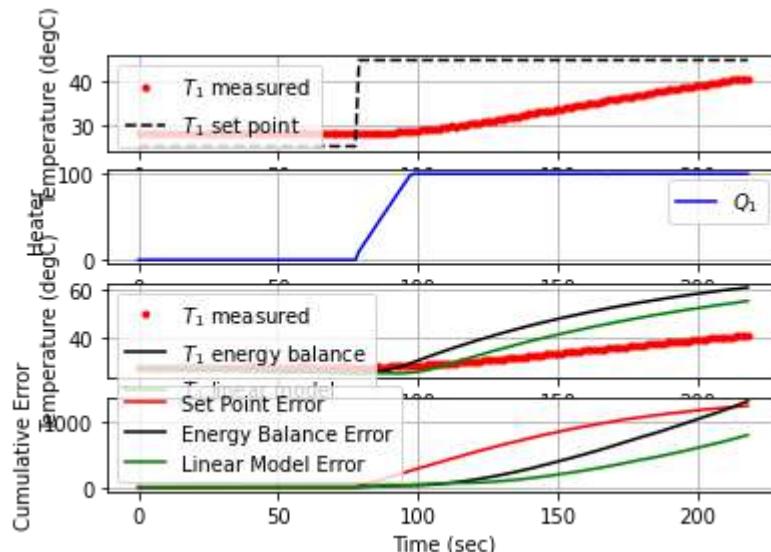
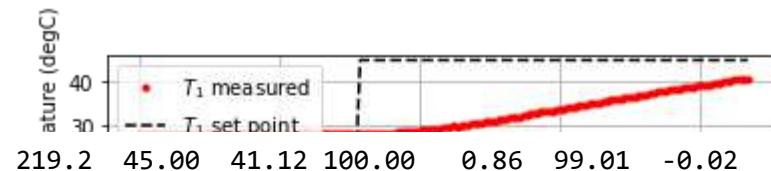
215.7 45.00 40.59 100.00 0.98 97.66 0.01



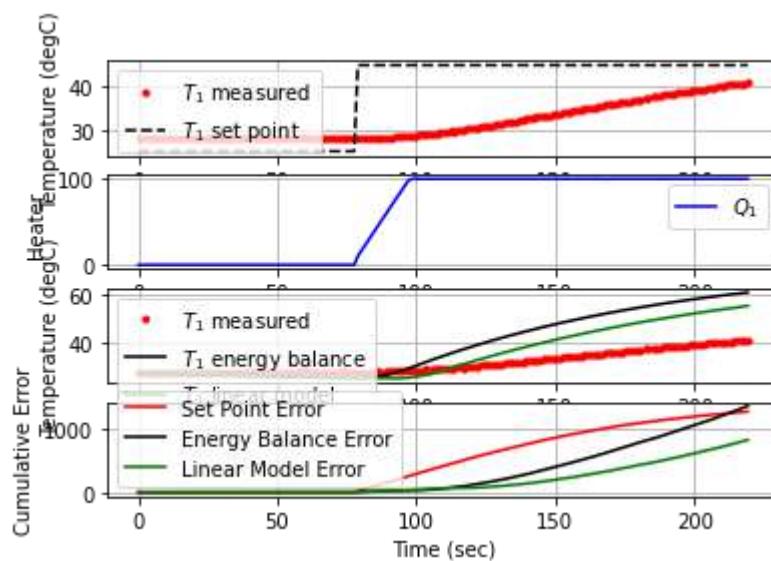
216.9 45.00 40.75 100.00 0.94 97.66 -0.01



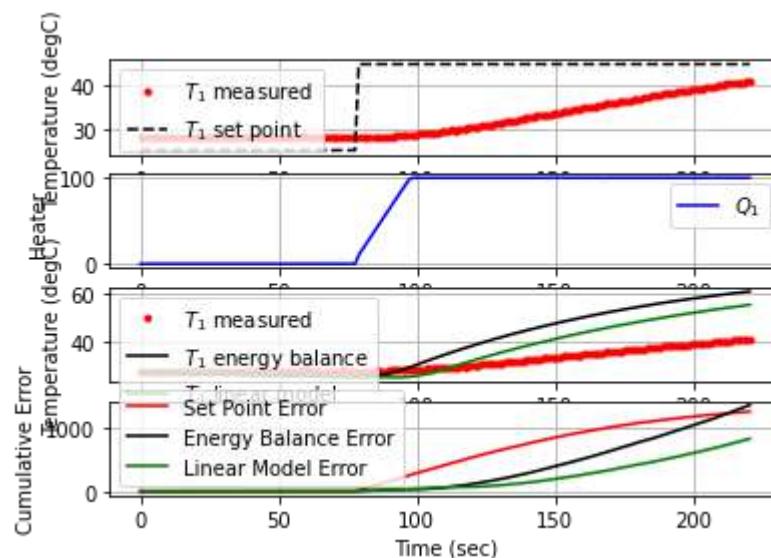
218.0 45.00 40.77 99.94 0.94 99.01 -0.00



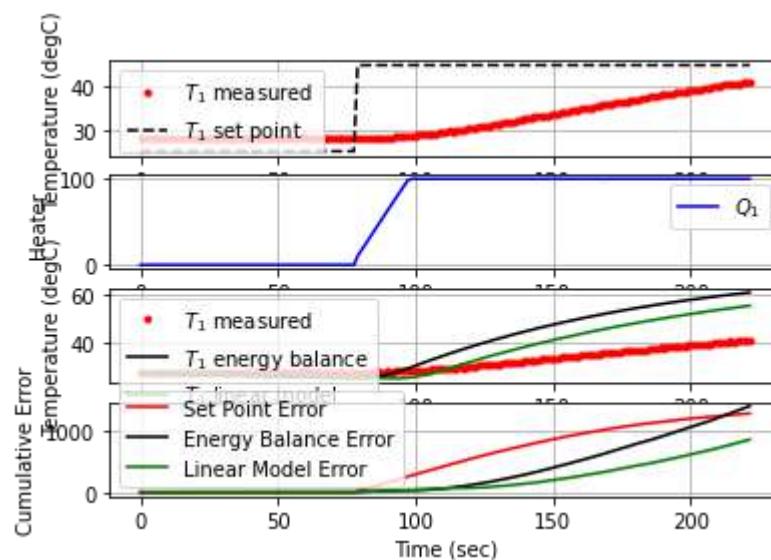
220.3 45.00 41.15 100.00 0.85 99.01 -0.00



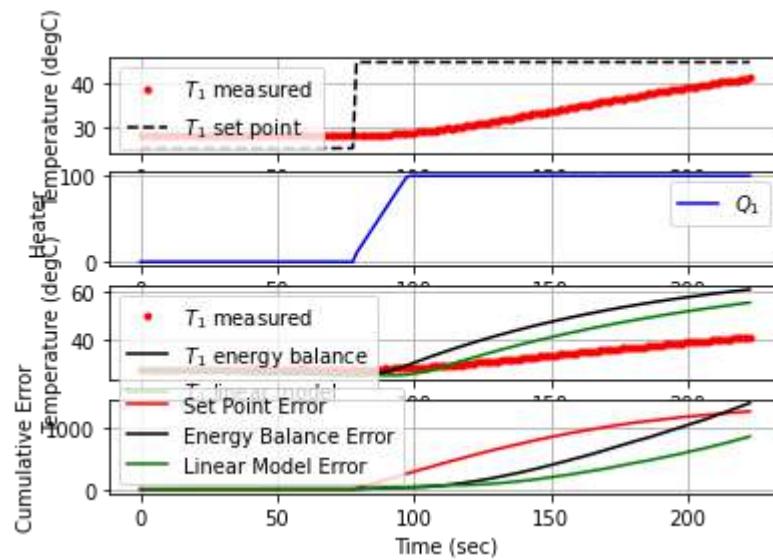
221.5 45.00 41.14 100.00 0.85 99.01 0.00



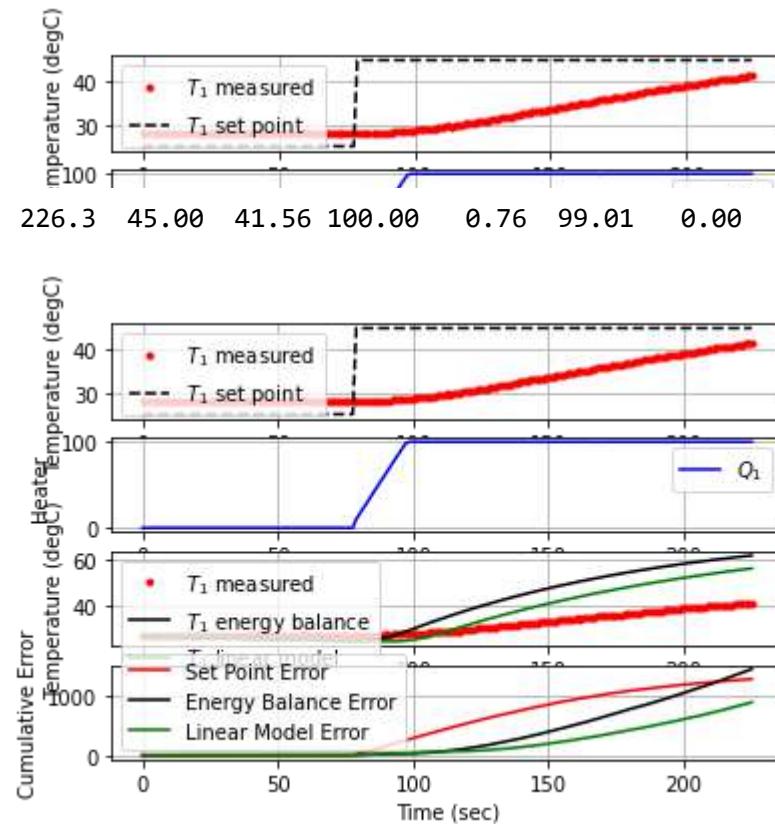
222.7 45.00 41.36 100.00 0.81 99.01 -0.02



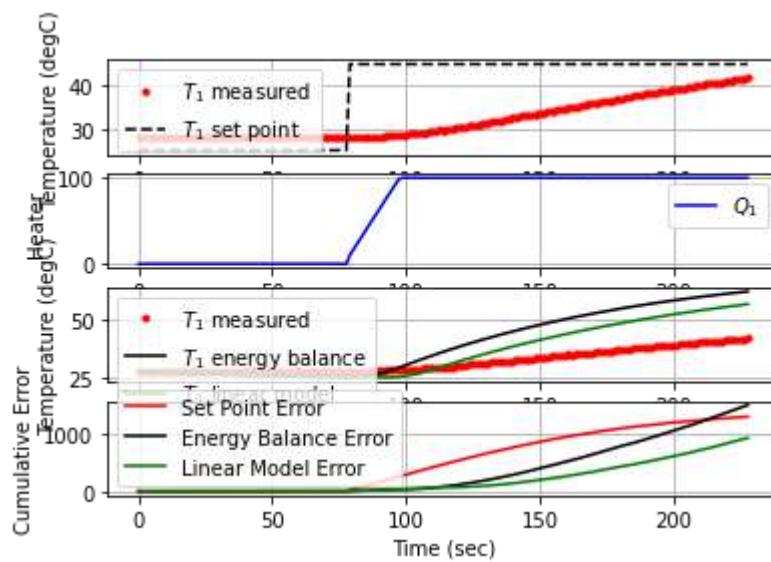
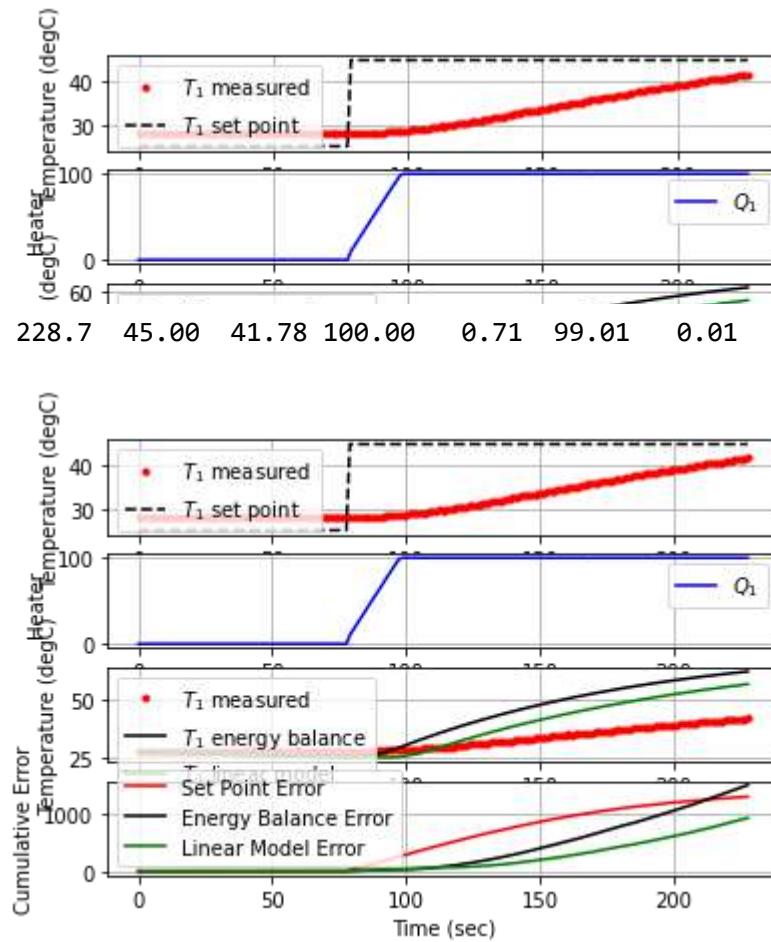
223.8 45.00 41.55 100.00 0.76 99.01 -0.01



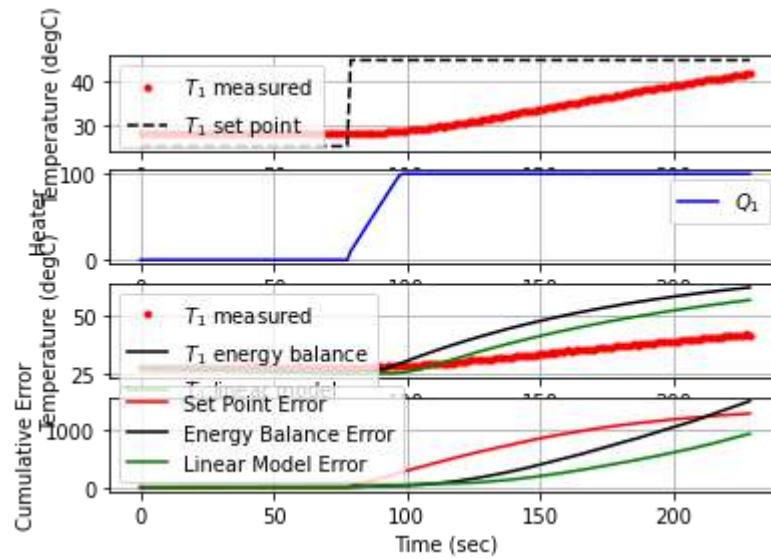
225.0 45.00 41.61 100.00 0.75 99.01 -0.00



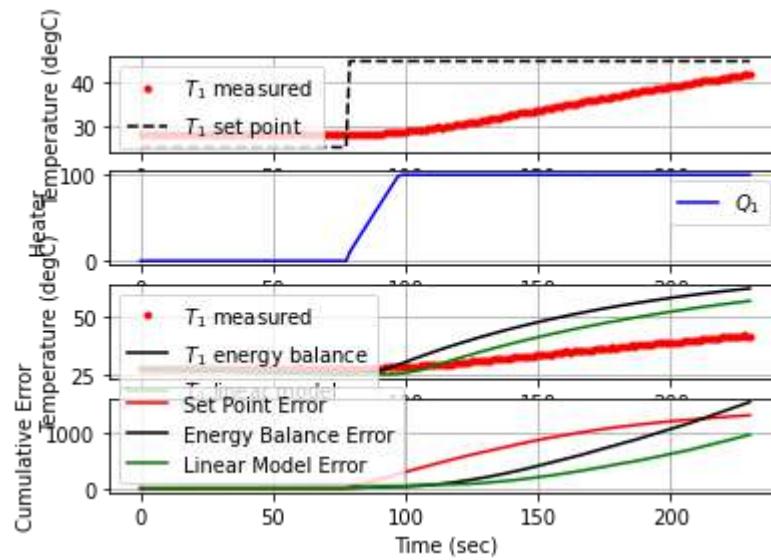
227.5 45.00 41.91 100.00 0.68 99.01 -0.03



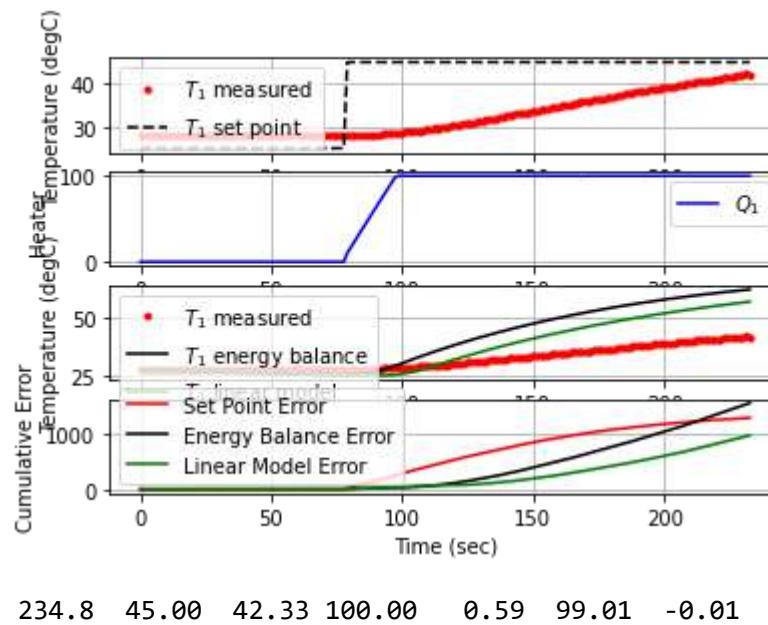
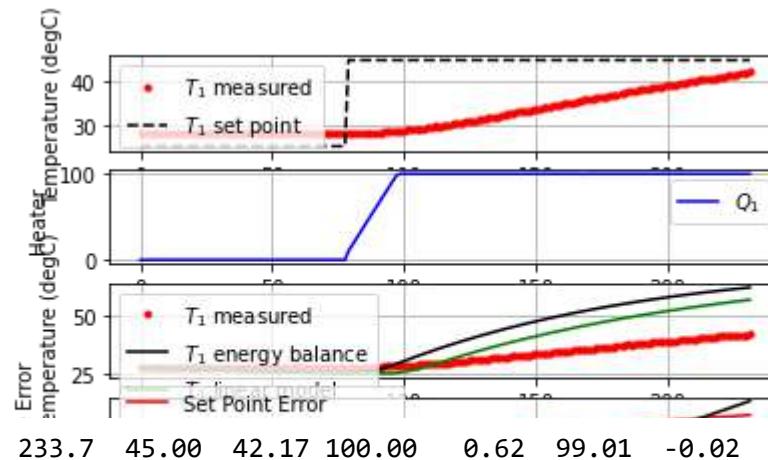
229.9 45.00 41.80 100.00 0.71 99.01 -0.00

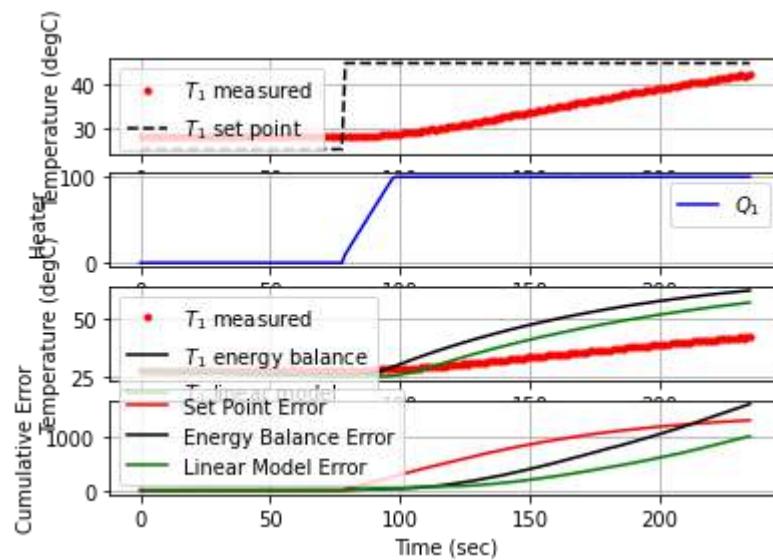
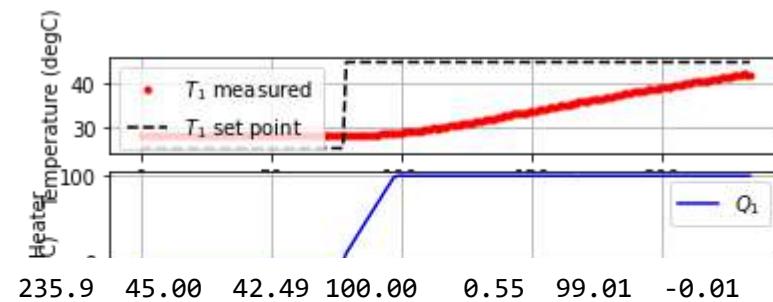


231.2 45.00 42.23 100.00 0.61 99.01 -0.03

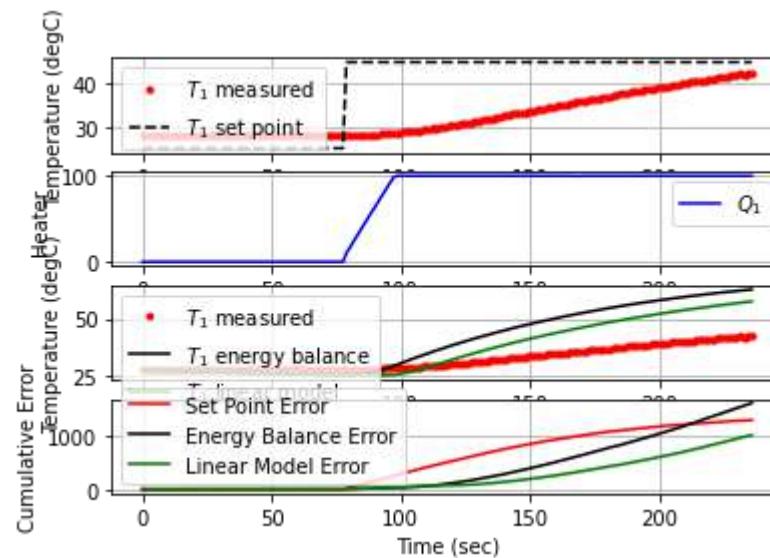


232.6 45.00 41.92 100.00 0.68 99.01 0.02

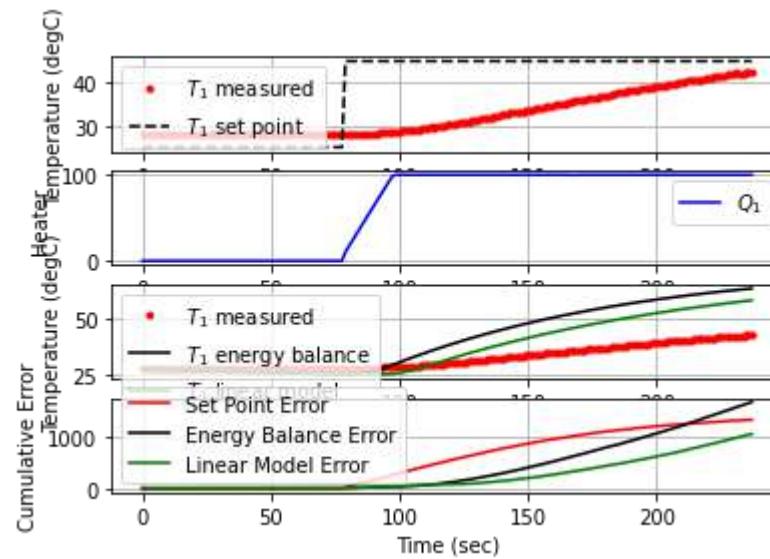




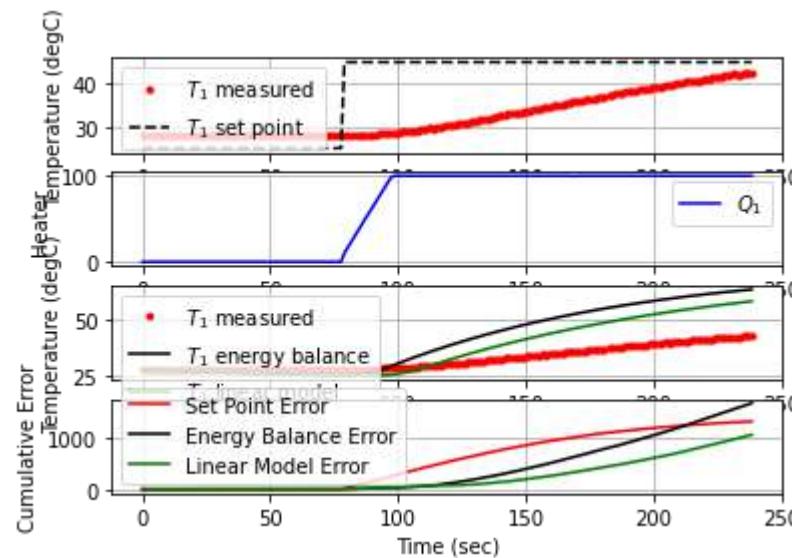
237.1 45.00 42.39 100.00 0.58 99.01 0.01



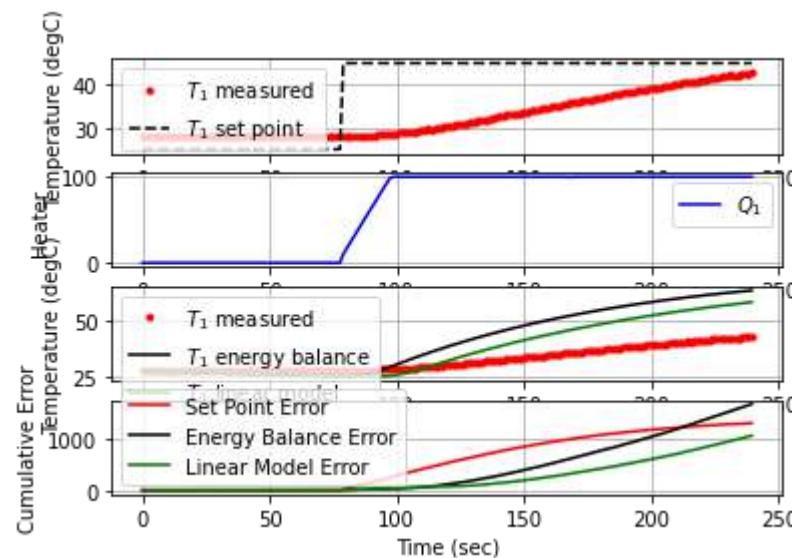
238.2 45.00 42.46 100.00 0.56 99.01 -0.01



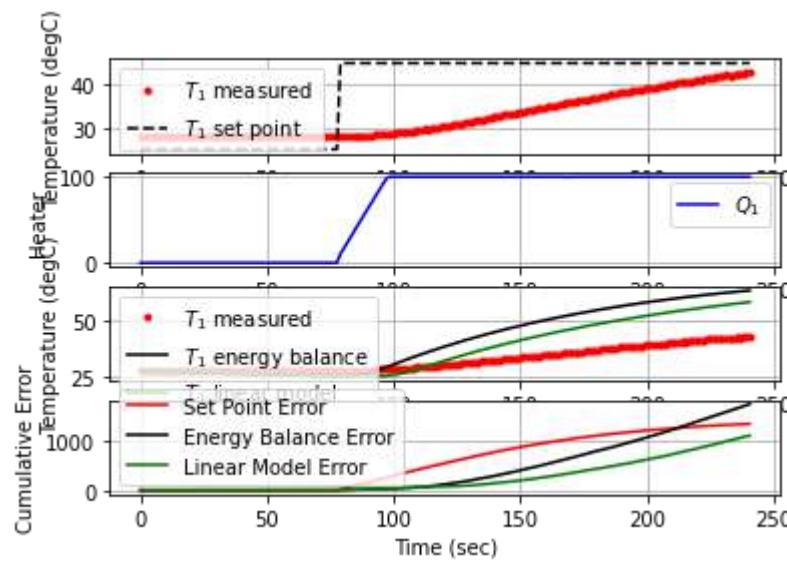
239.5 45.00 42.73 100.00 0.50 99.01 -0.02



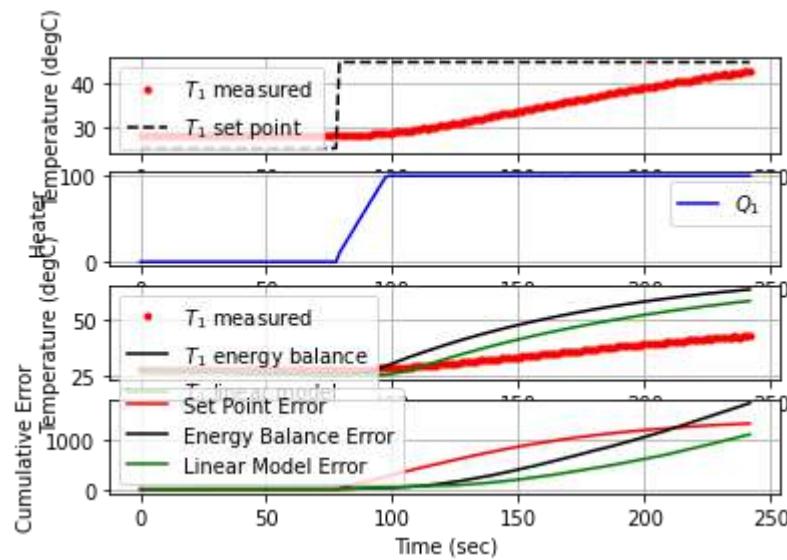
240.6 45.00 42.85 100.00 0.47 99.01 -0.01



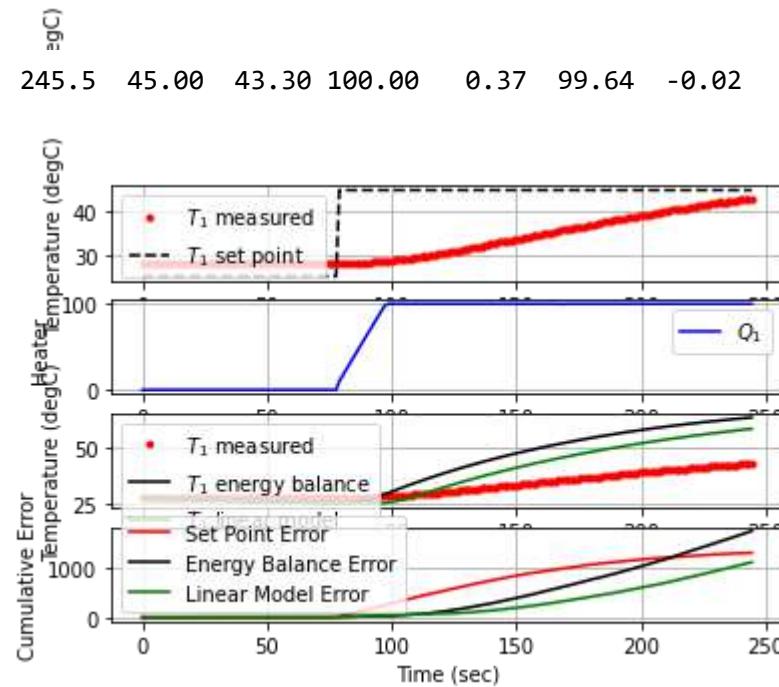
241.8 45.00 42.93 100.00 0.46 99.01 -0.01



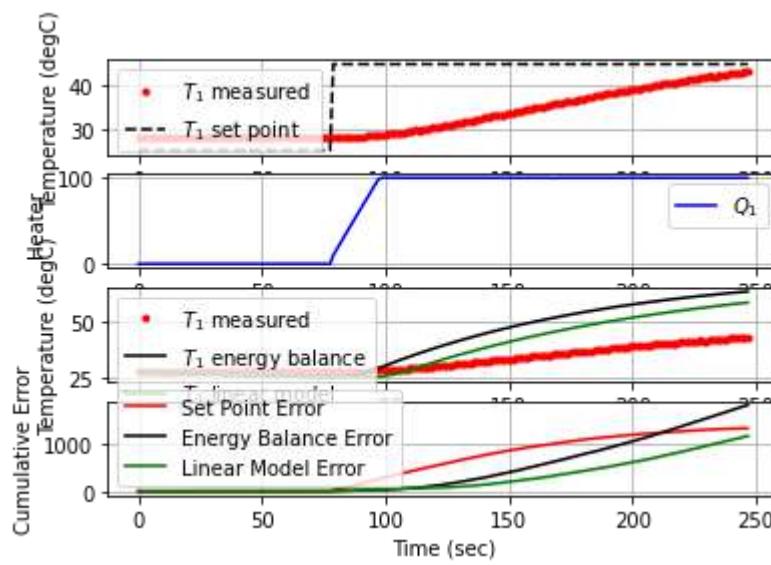
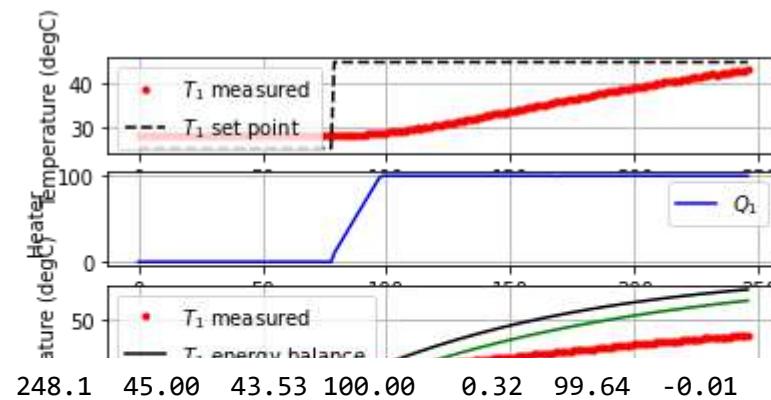
243.0 45.00 42.97 100.00 0.45 99.01 -0.00

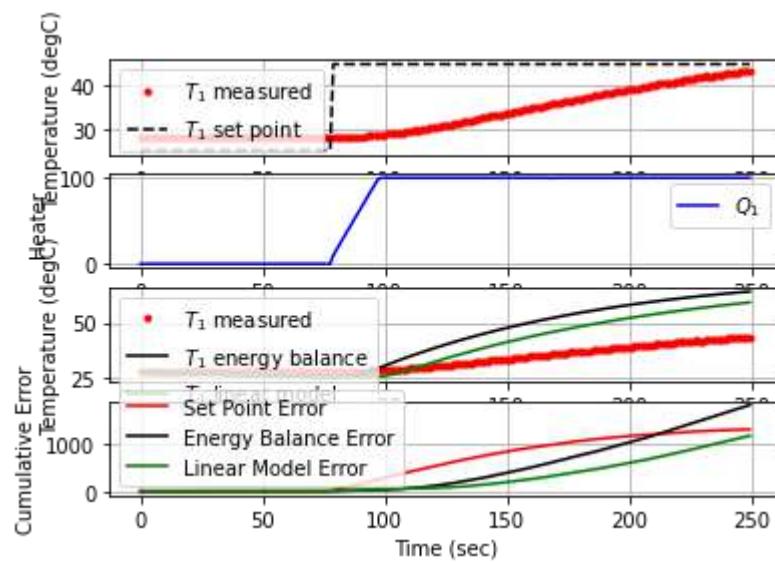
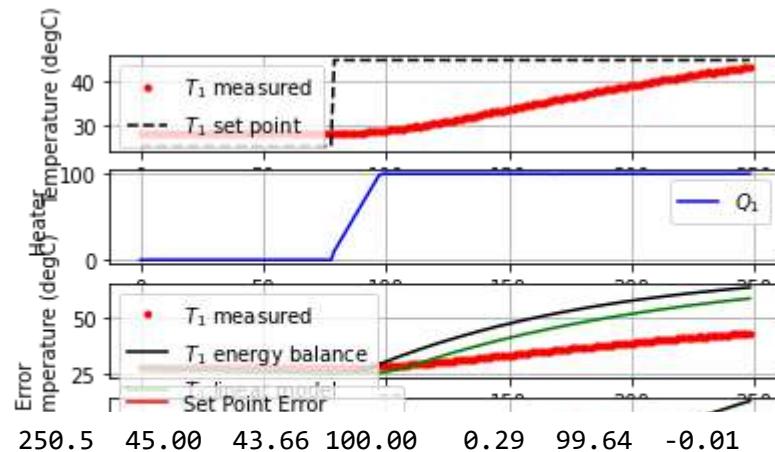


244.2 45.00 43.01 100.00 0.44 99.01 -0.00

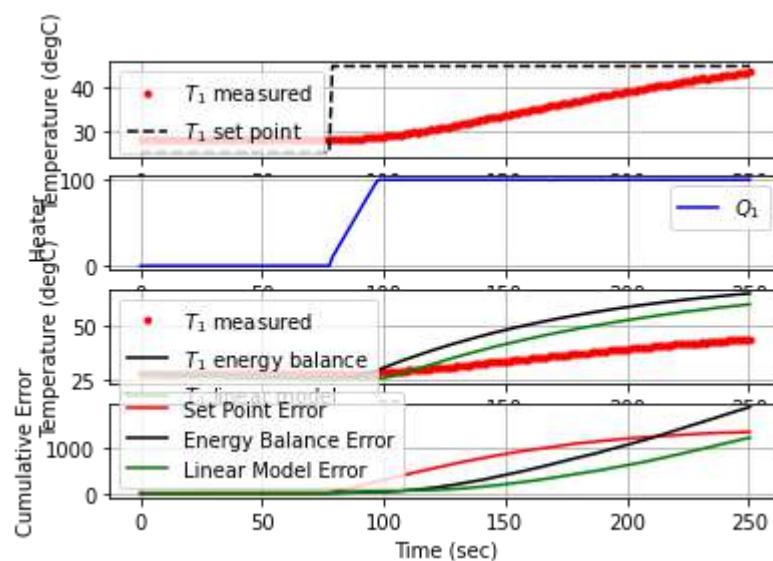


246.8 45.00 43.41 100.00 0.35 99.64 -0.01

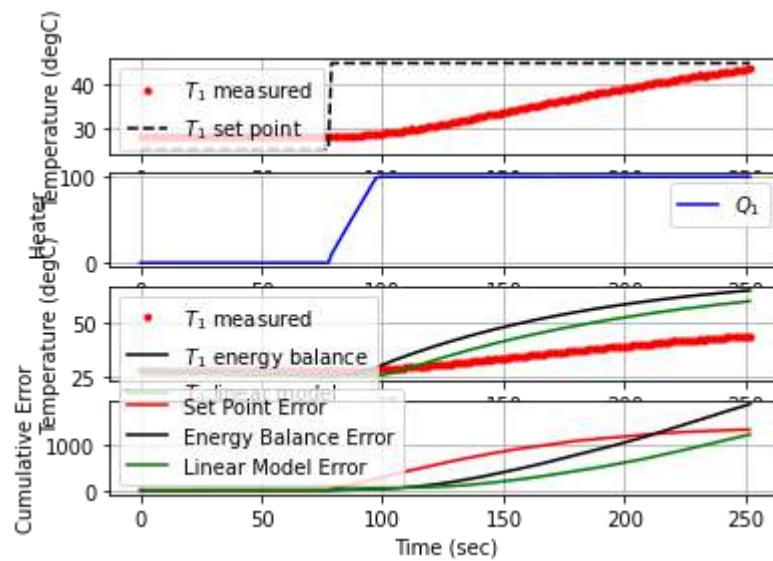


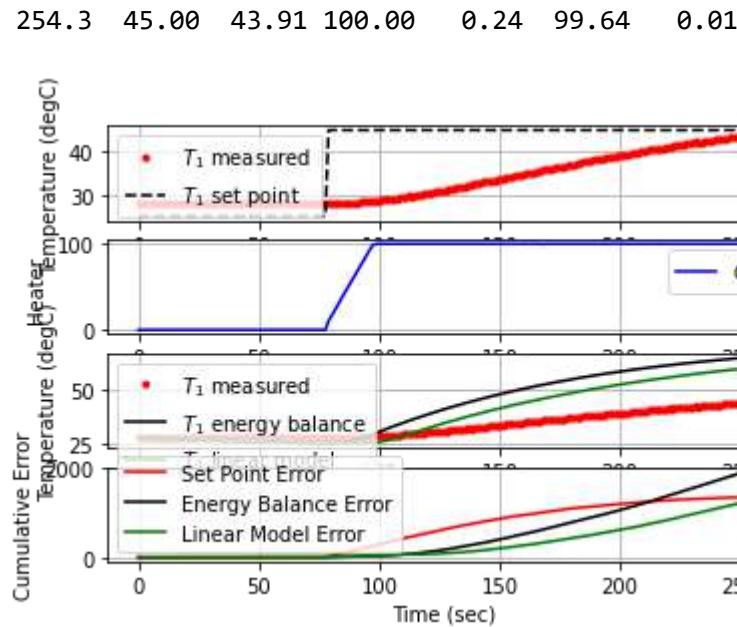


251.7 45.00 43.69 100.00 0.29 99.64 -0.00

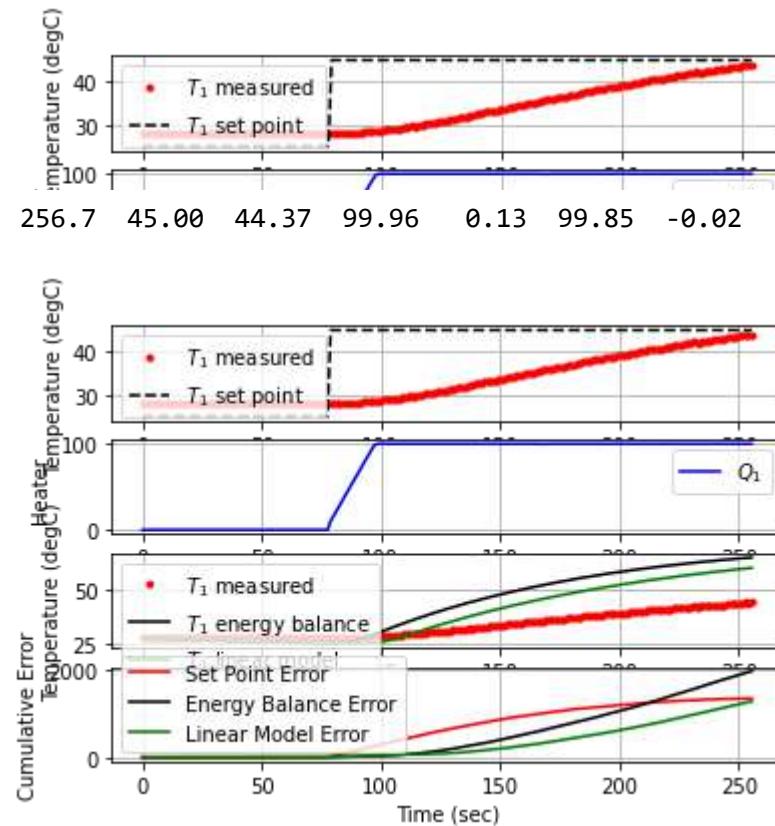


253.1 45.00 44.03 100.00 0.21 99.64 -0.02

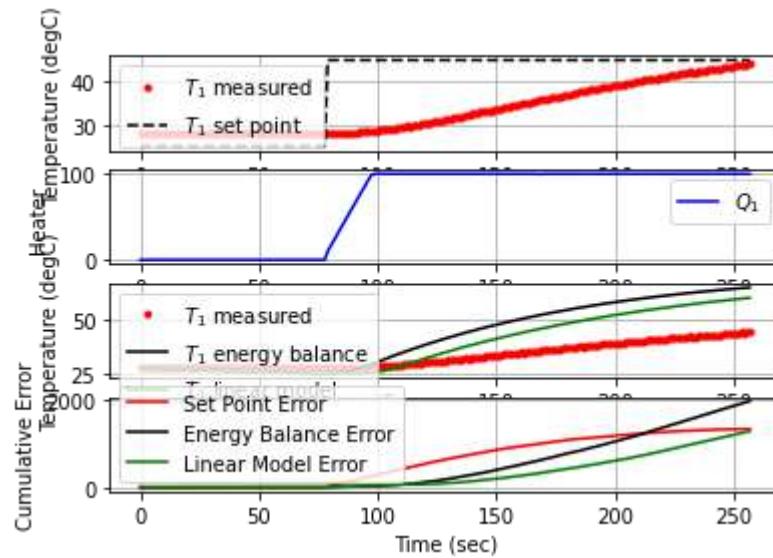




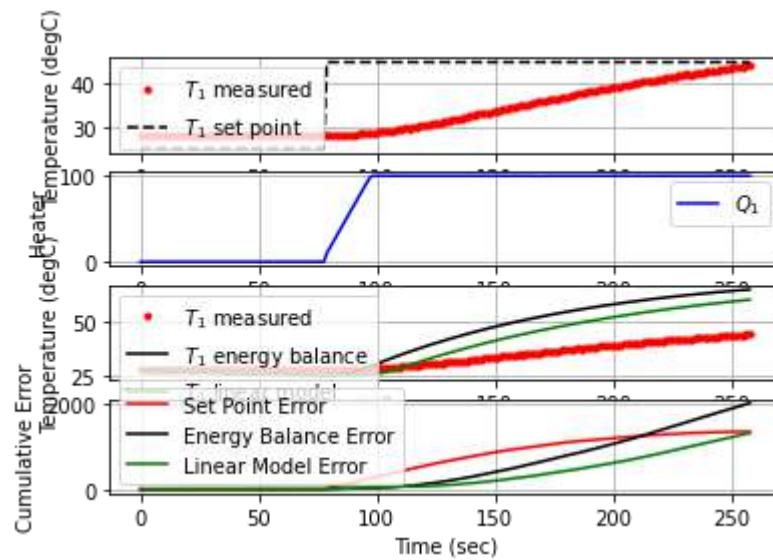
255.5 45.00 44.03 100.00 0.21 99.64 -0.01



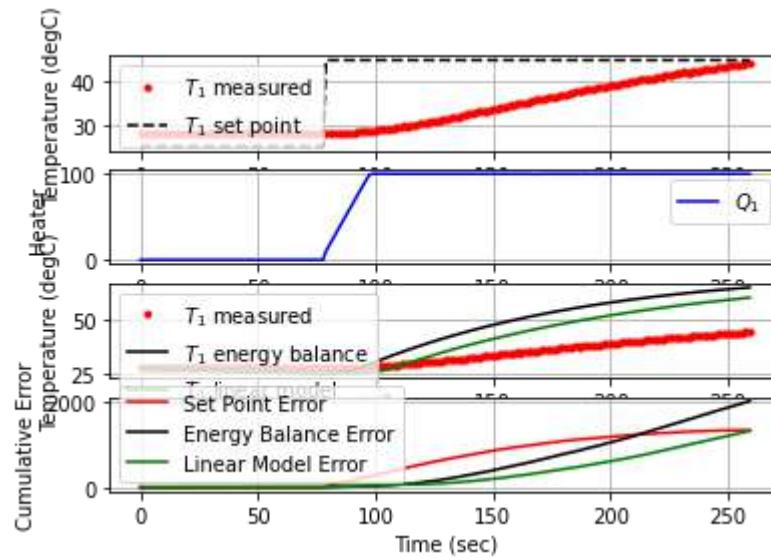
258.0 45.00 44.35 100.00 0.14 99.85 0.00



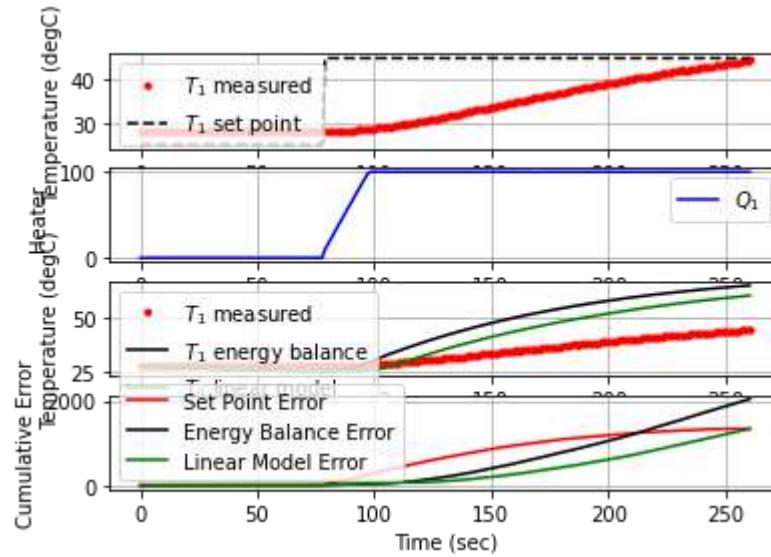
259.2 45.00 44.48 100.00 0.11 99.85 -0.01



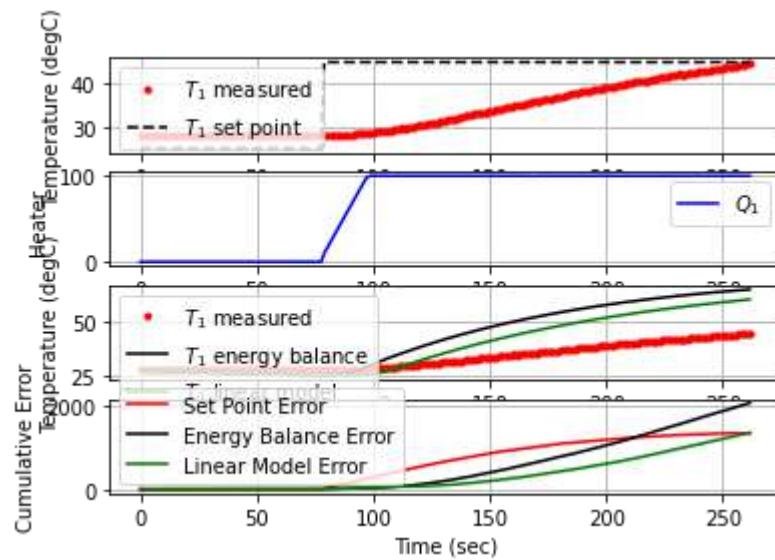
260.4 45.00 44.56 100.00 0.09 99.85 -0.01



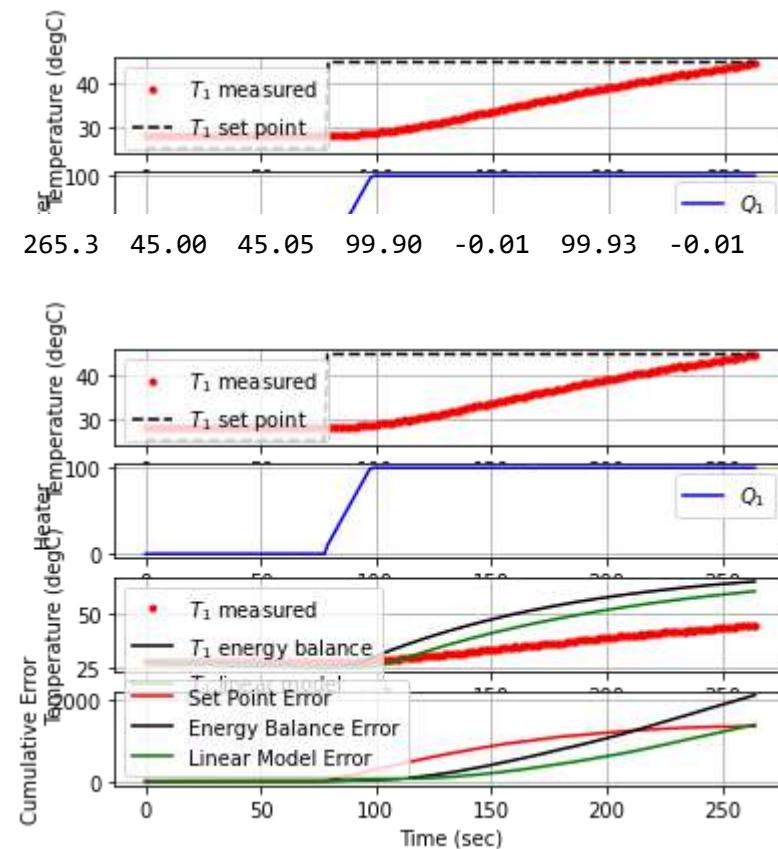
261.6 45.00 44.72 99.99 0.06 99.94 -0.01



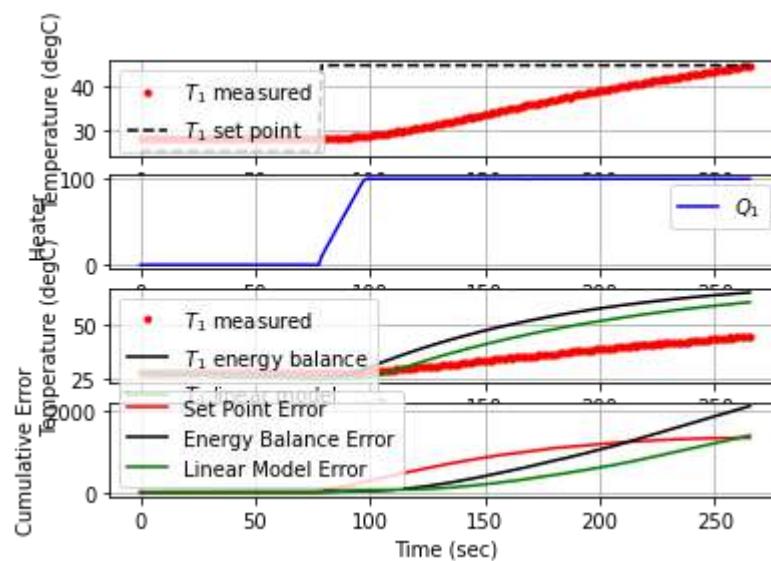
262.9 45.00 44.75 100.00 0.05 99.94 -0.00



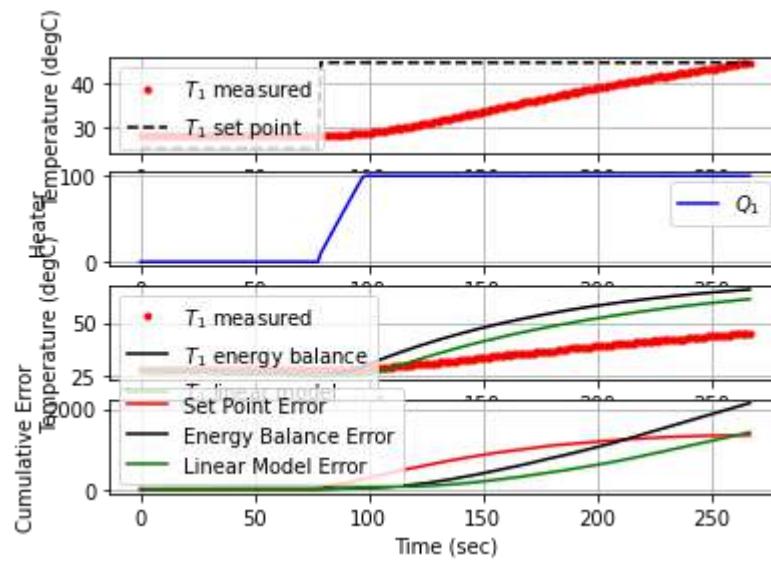
264.1 45.00 44.84 100.00 0.03 99.94 -0.01



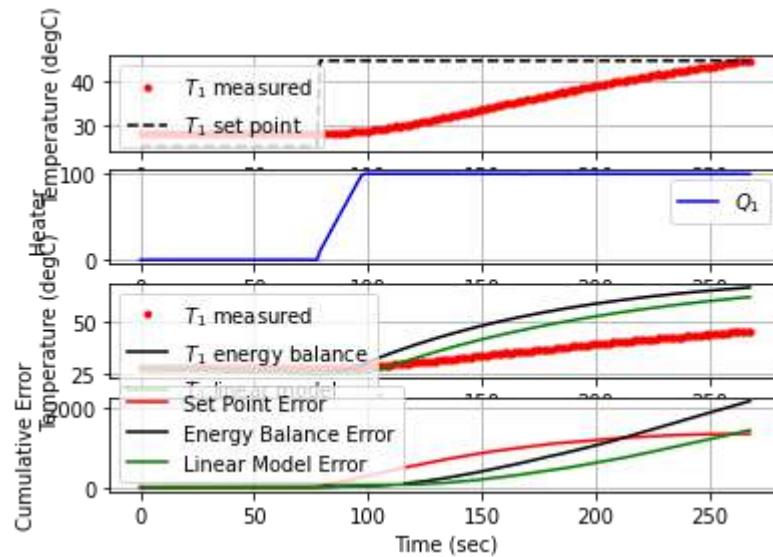
266.6 45.00 45.10 99.87 -0.02 99.89 -0.00



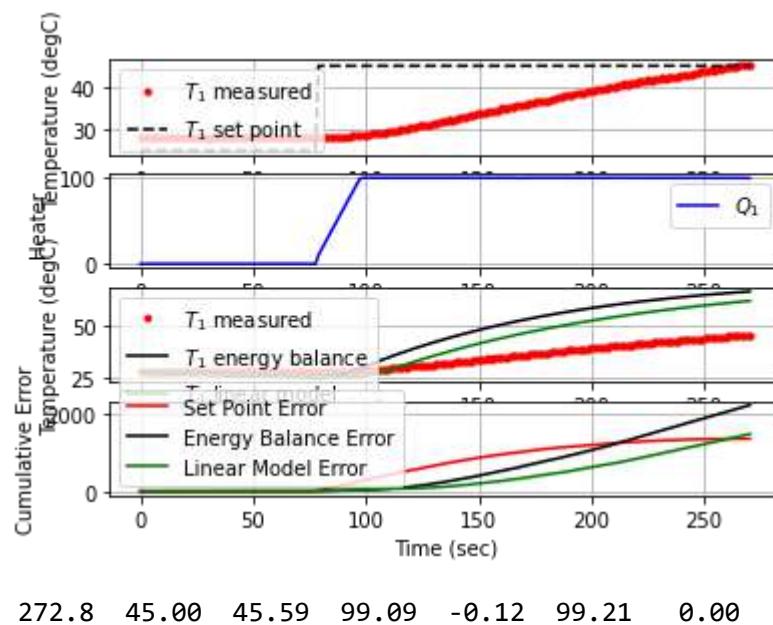
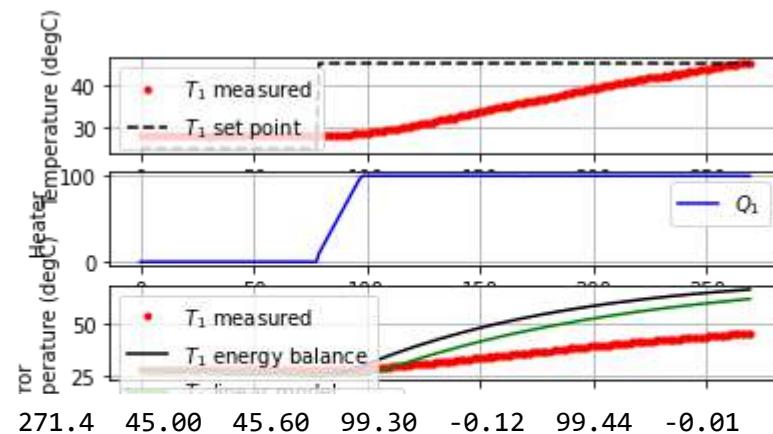
267.8 45.00 45.12 99.83 -0.03 99.85 -0.00

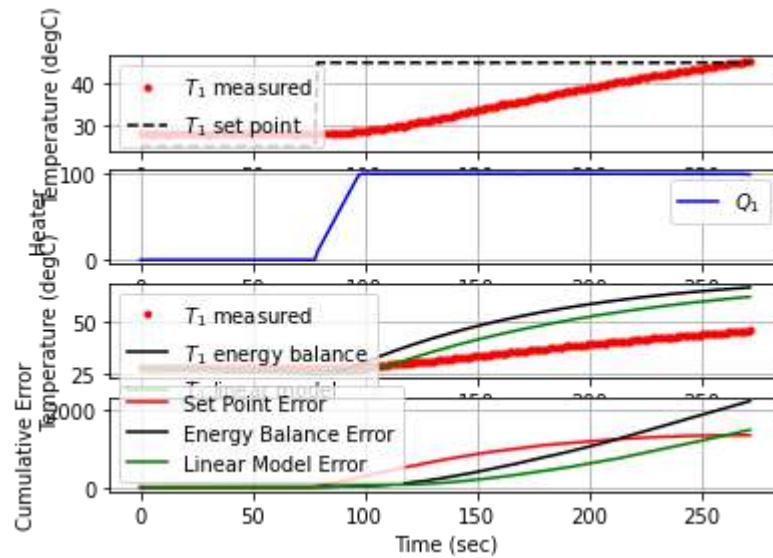


269.0 45.00 45.27 99.70 -0.06 99.76 -0.01

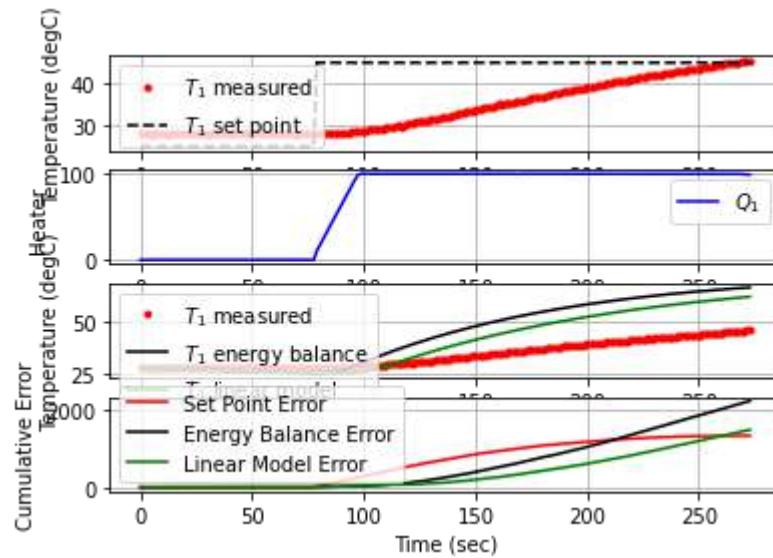


270.2 45.00 45.40 99.55 -0.08 99.64 -0.01

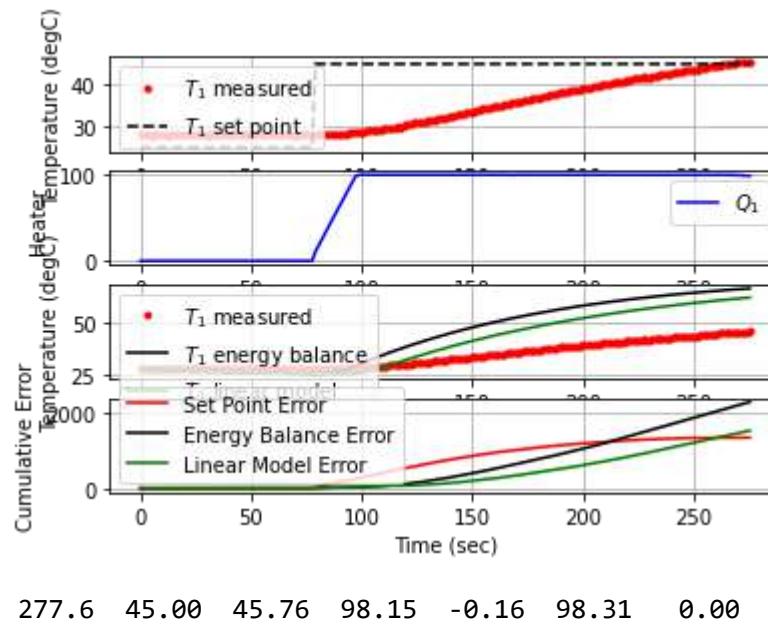
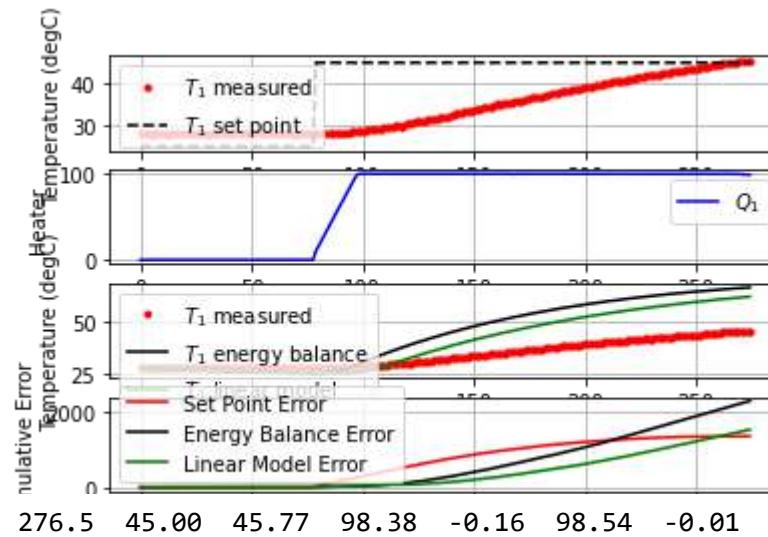


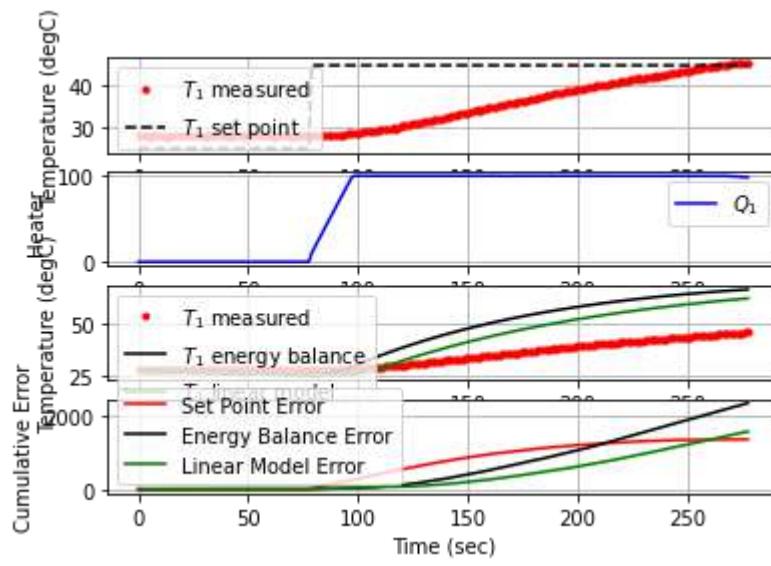
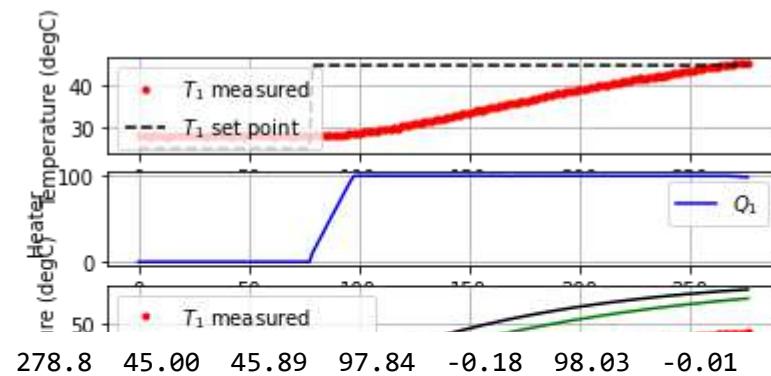


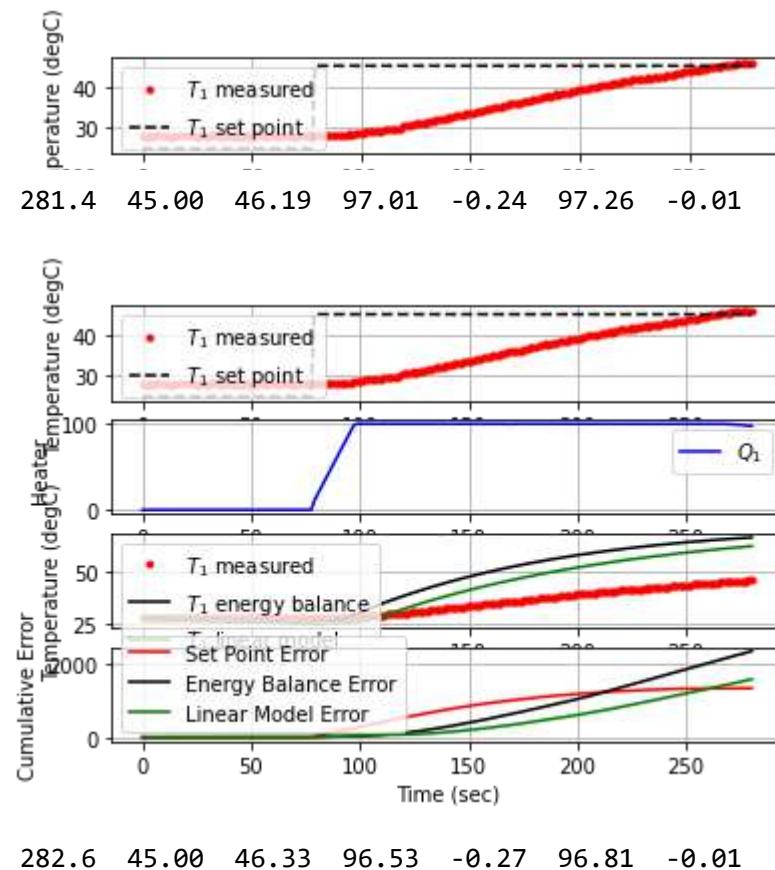
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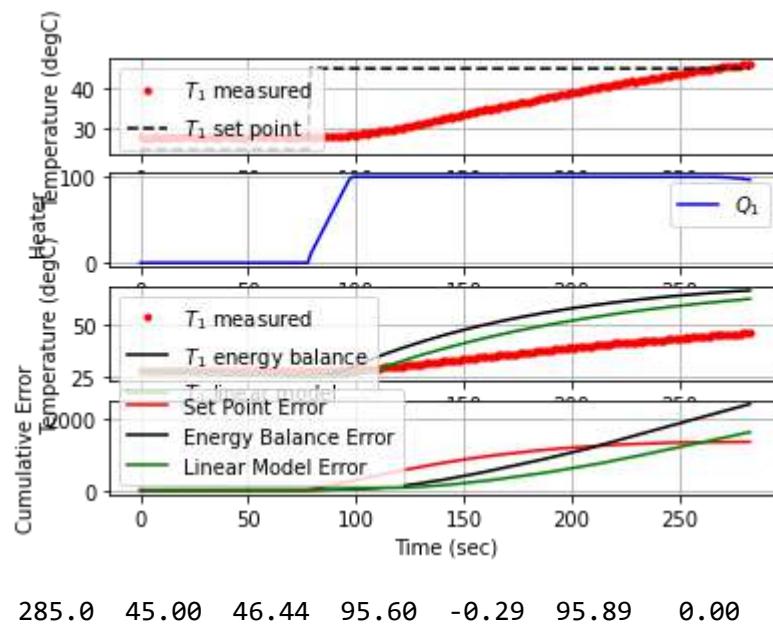
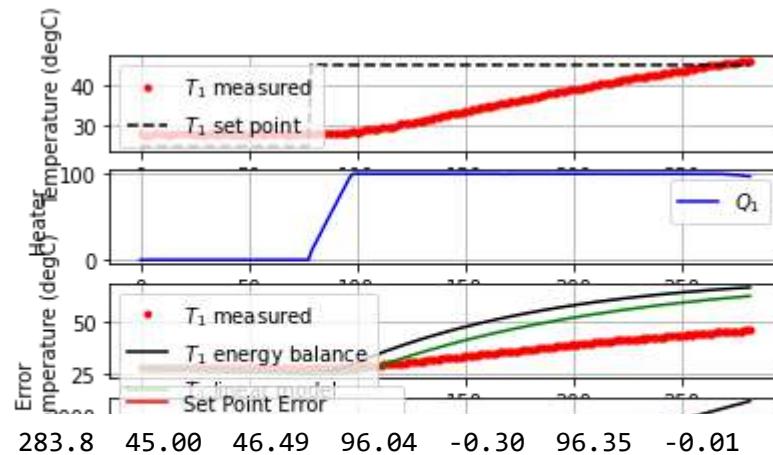


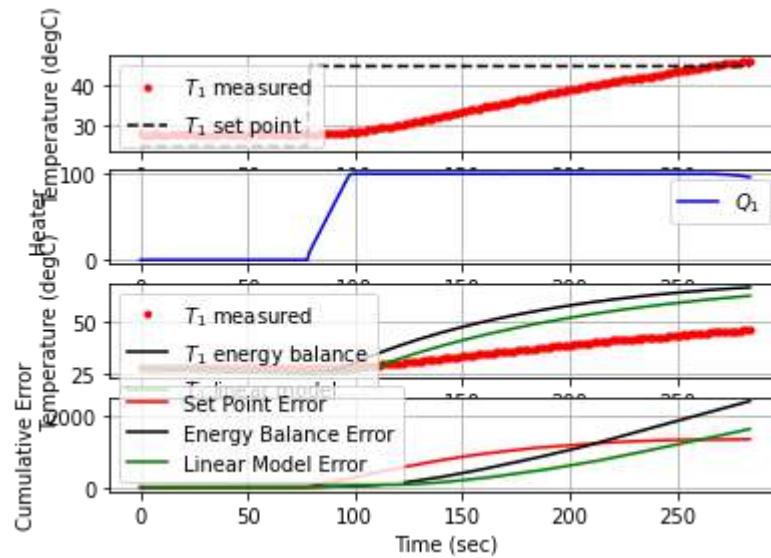
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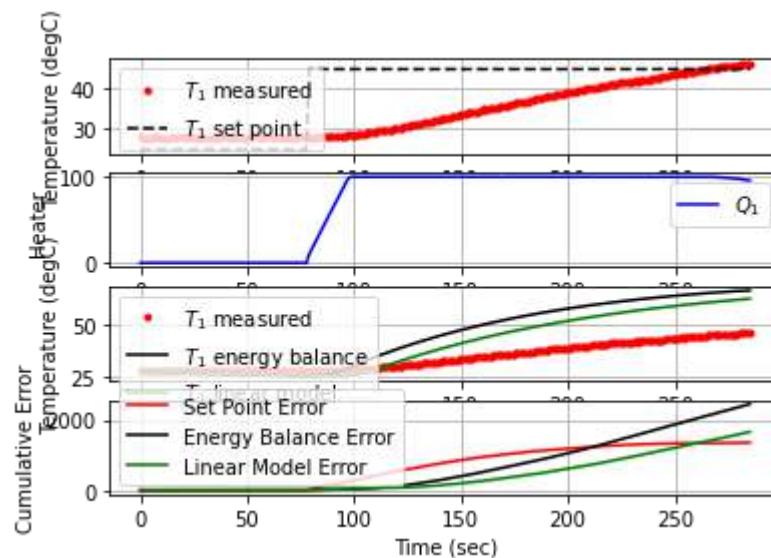




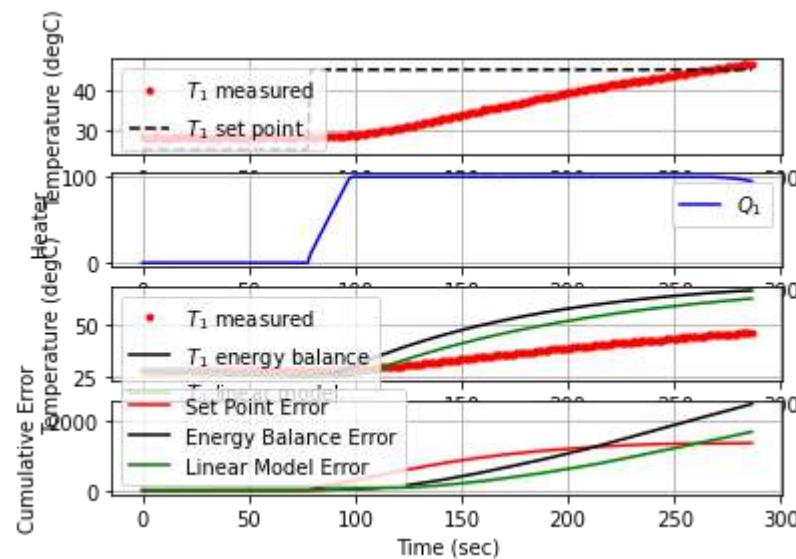




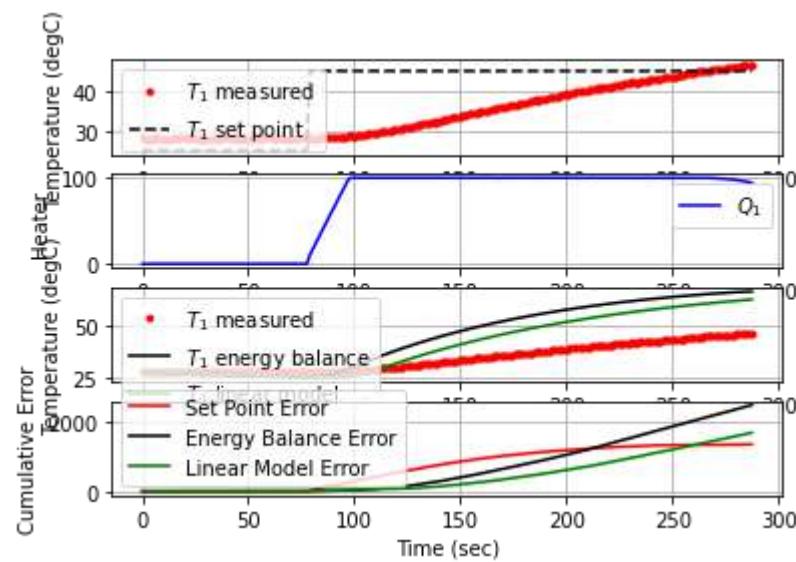
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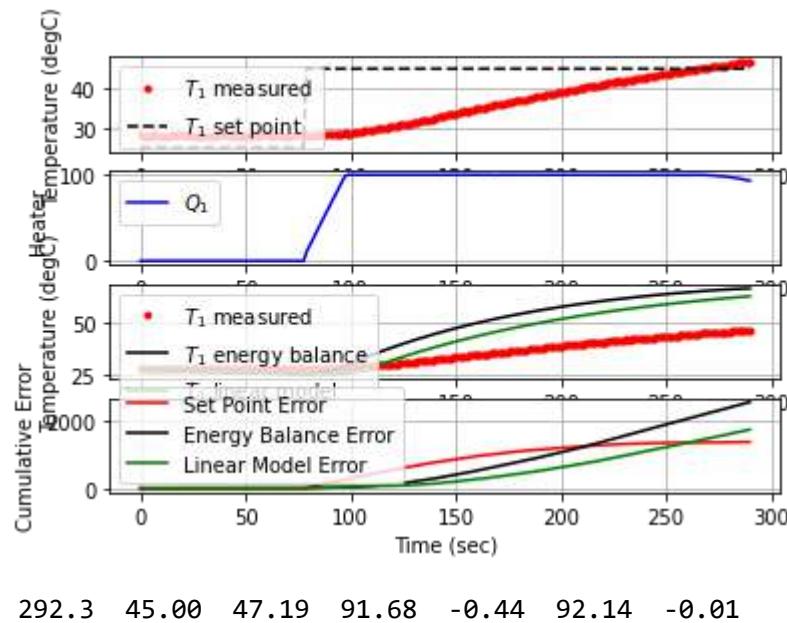
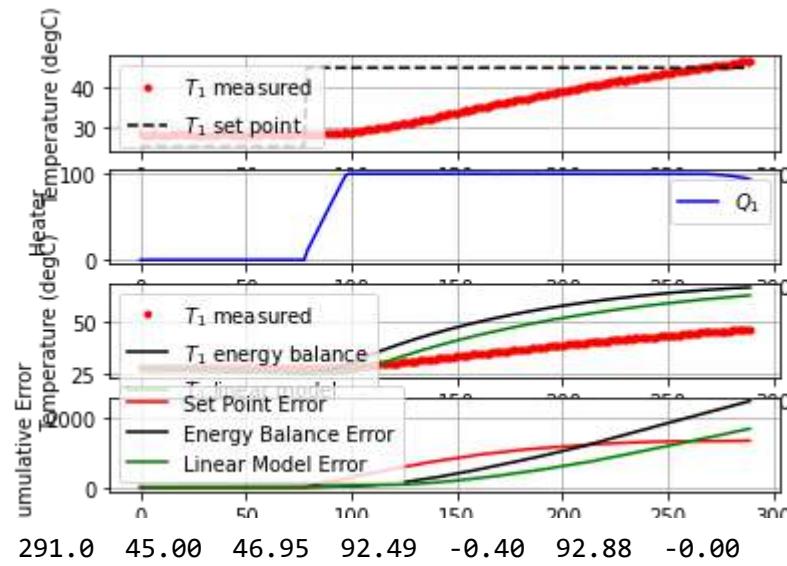
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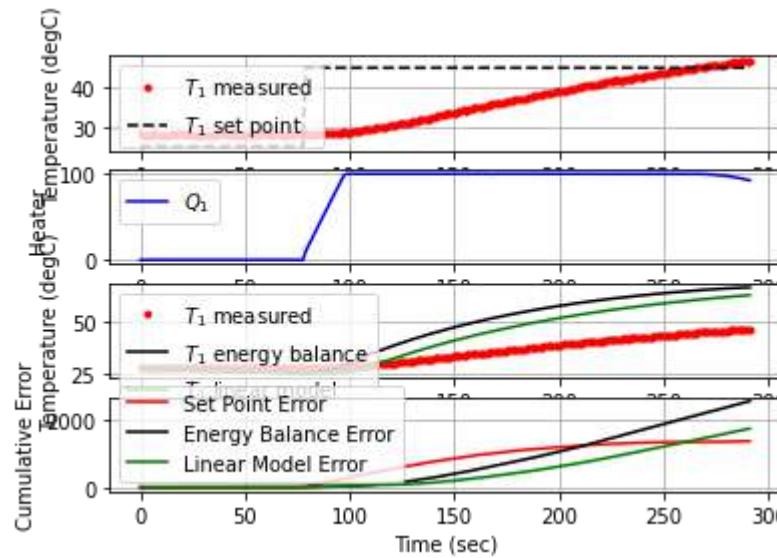


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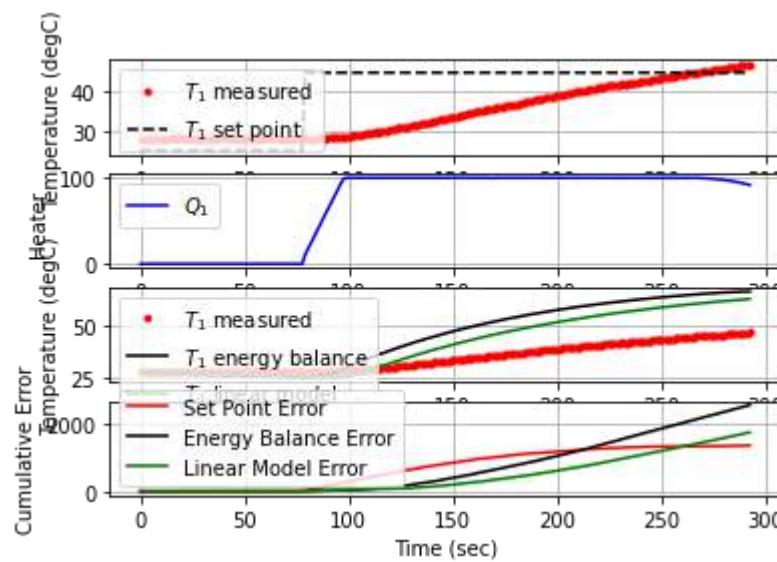


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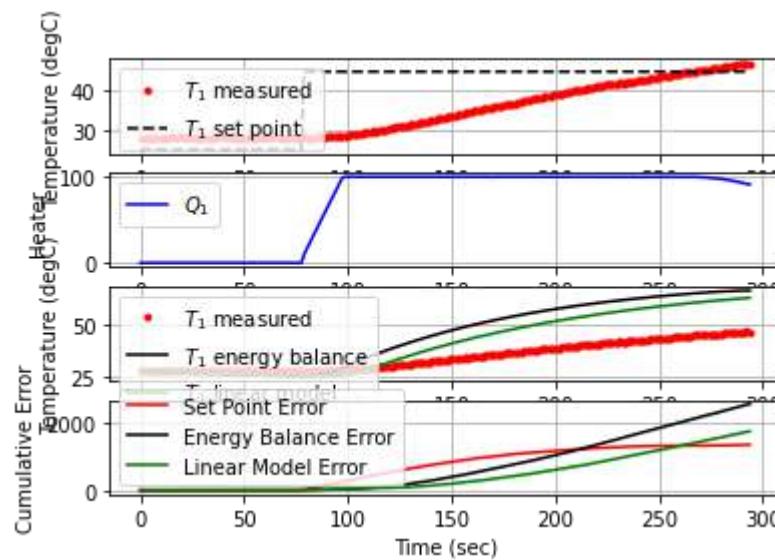




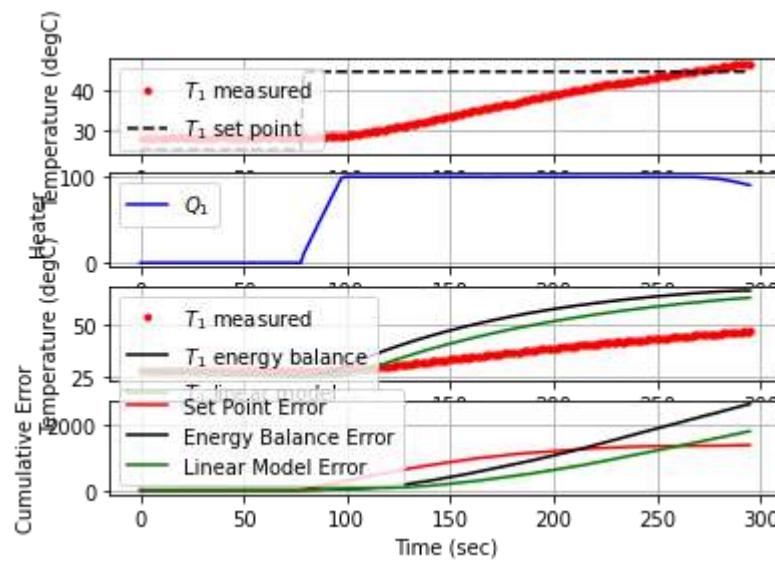
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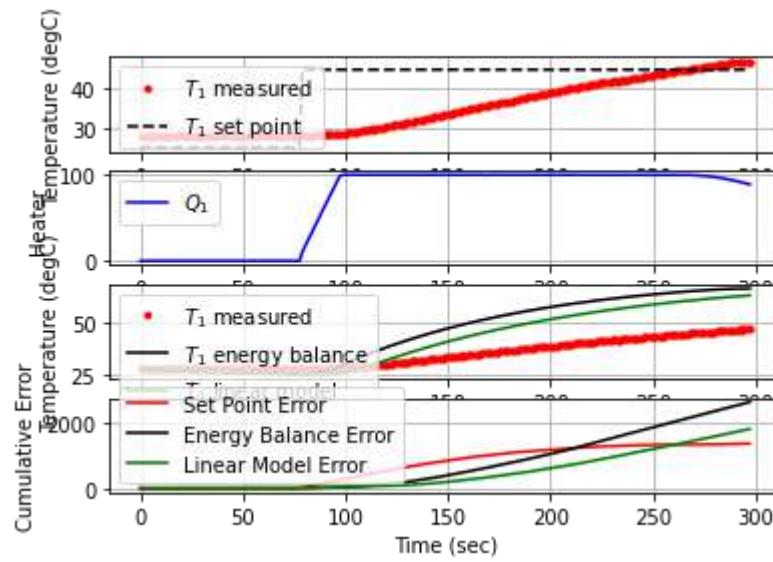
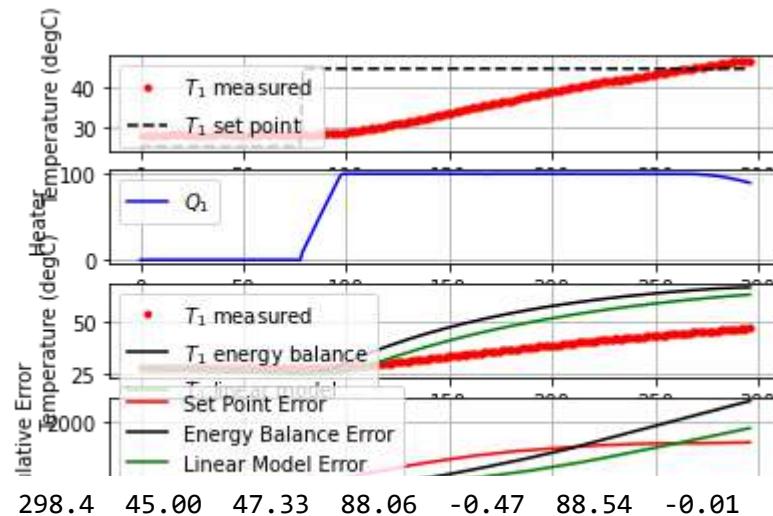
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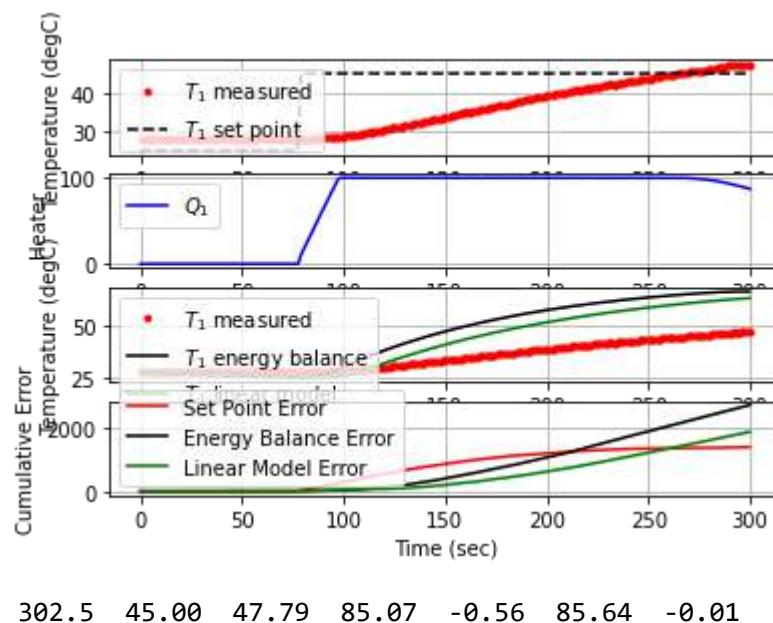
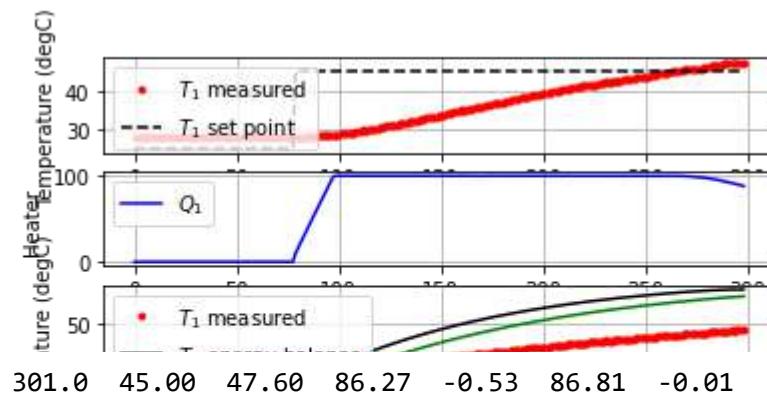


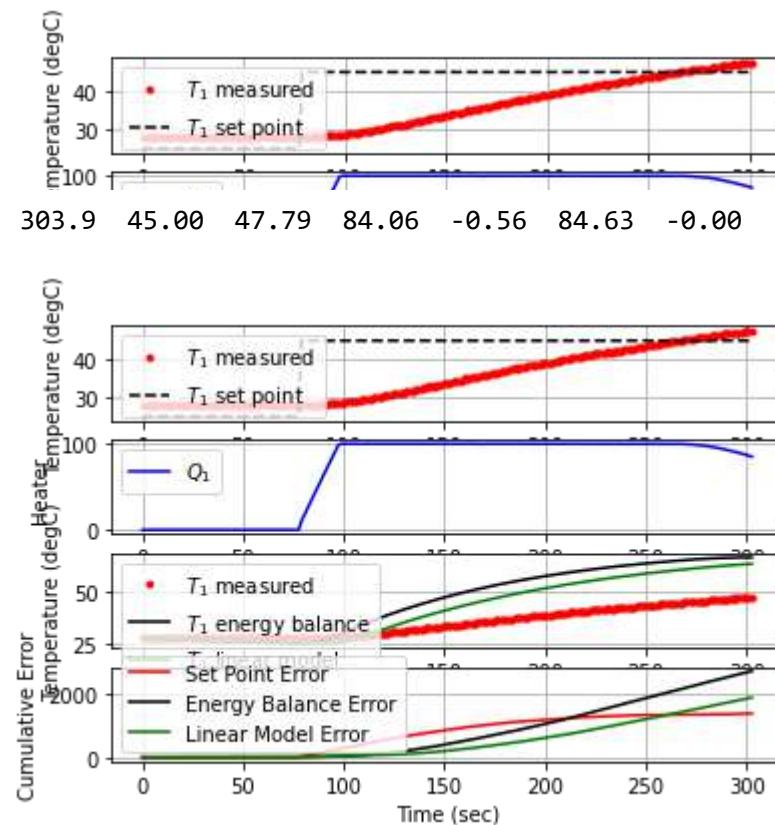
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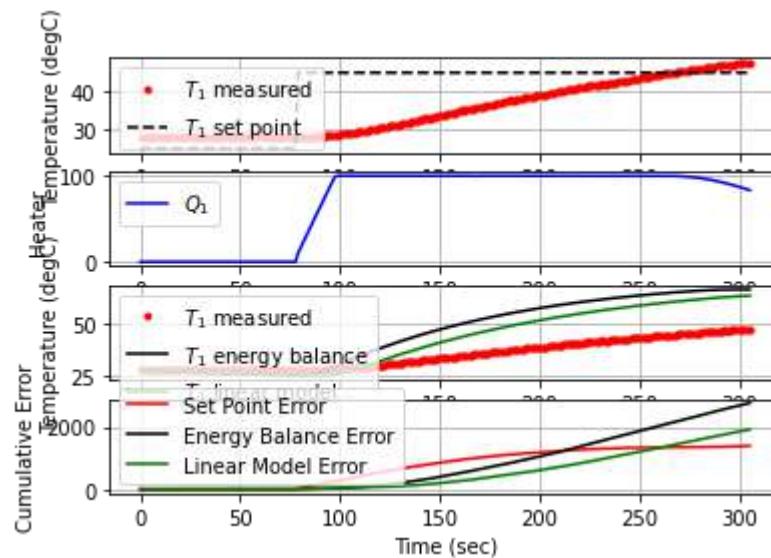




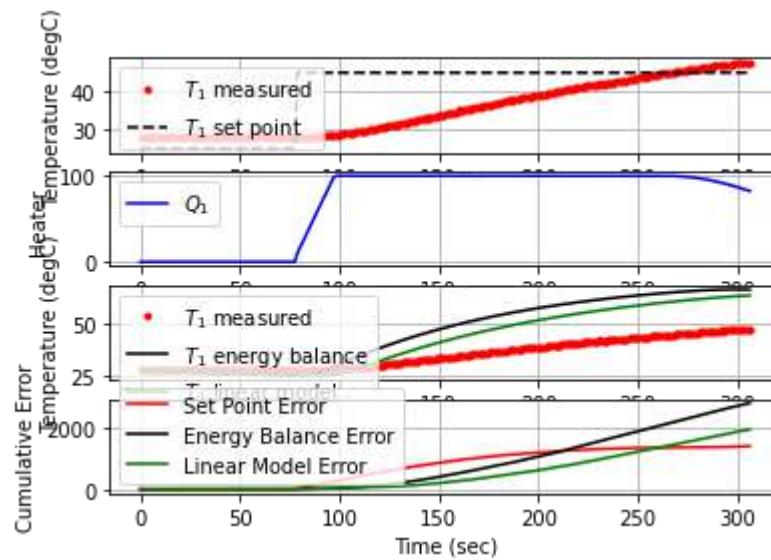


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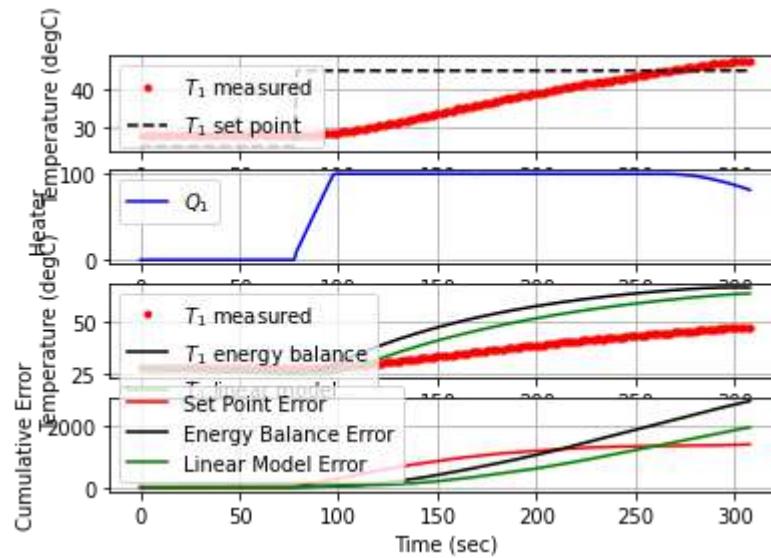
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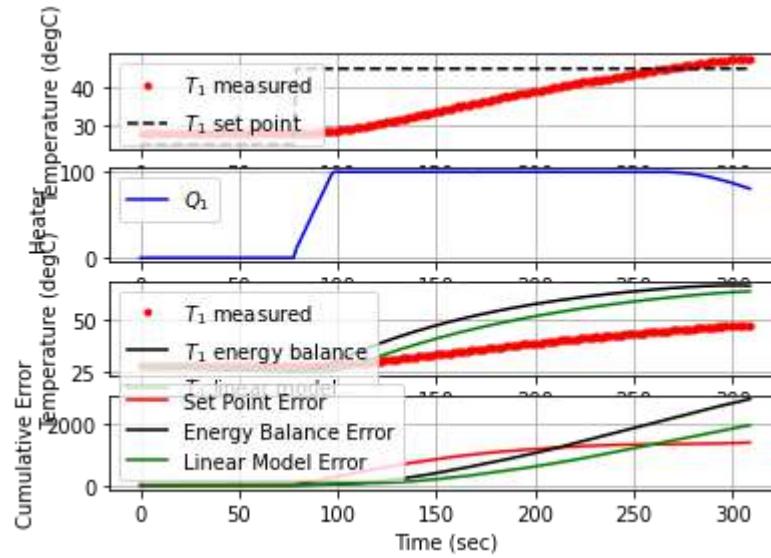
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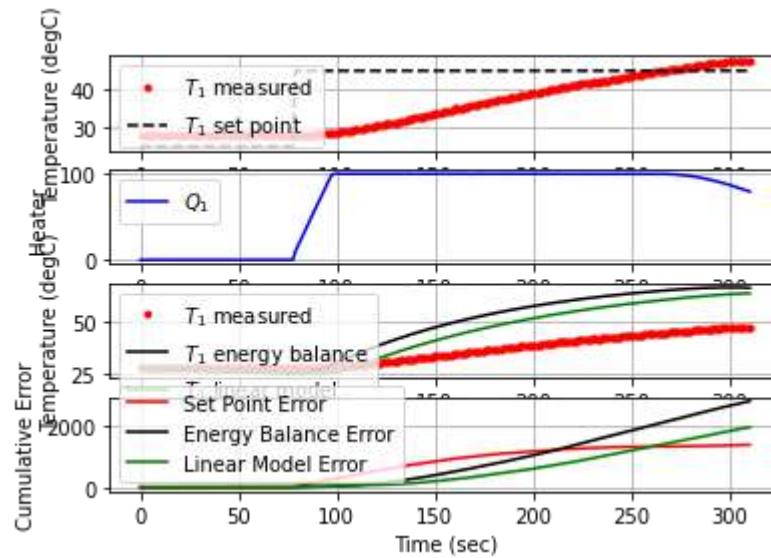
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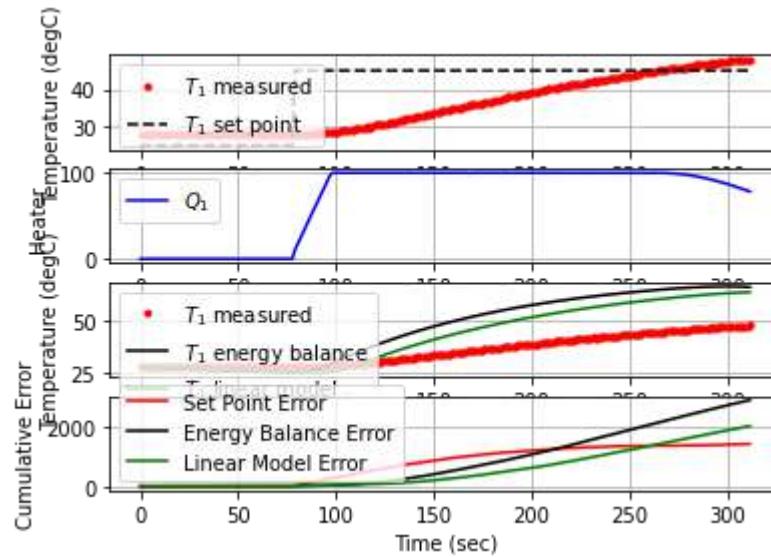
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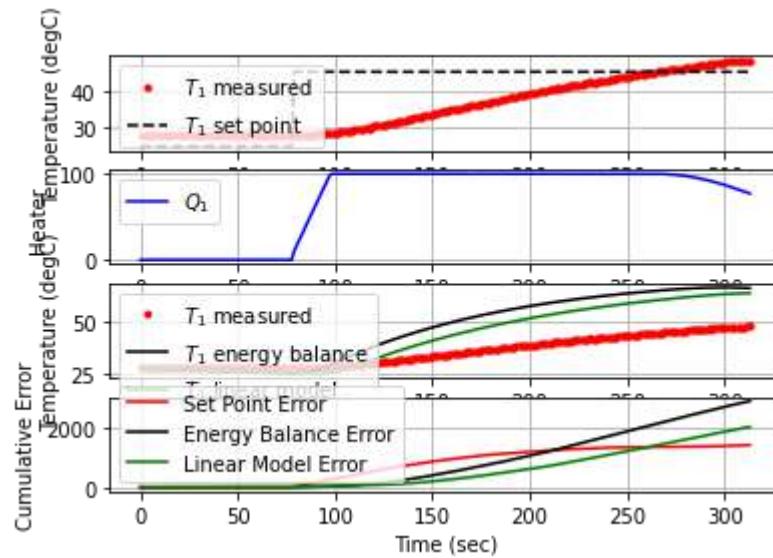
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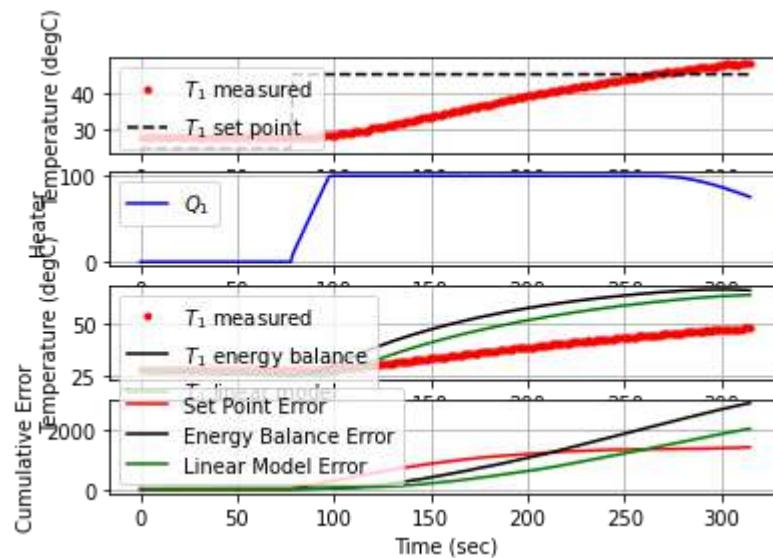
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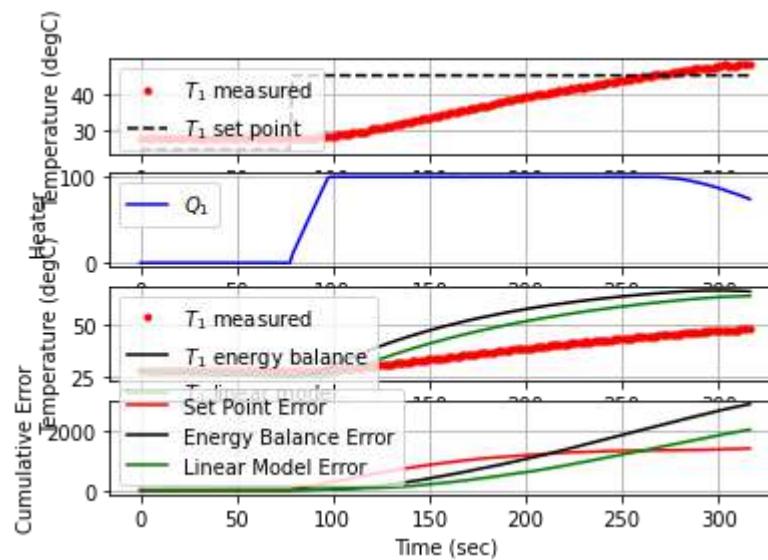
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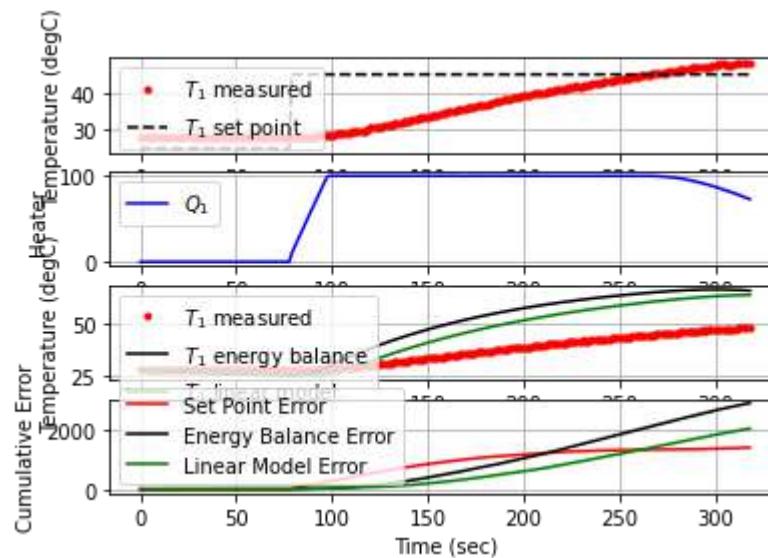
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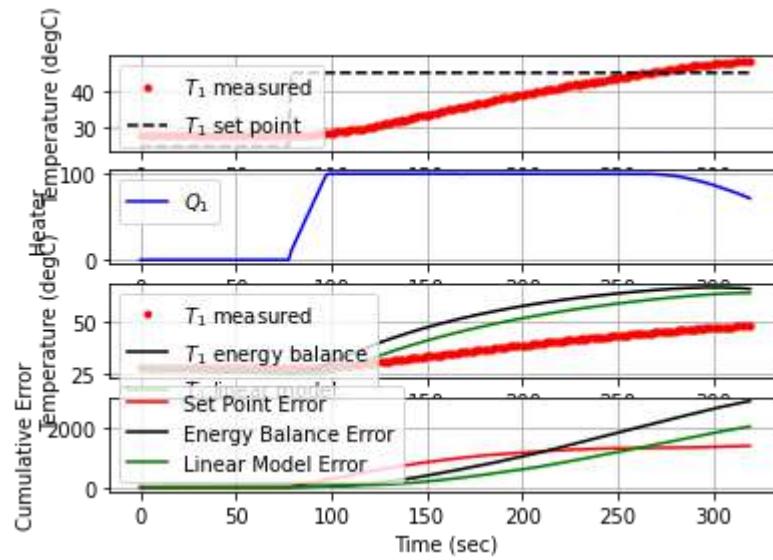
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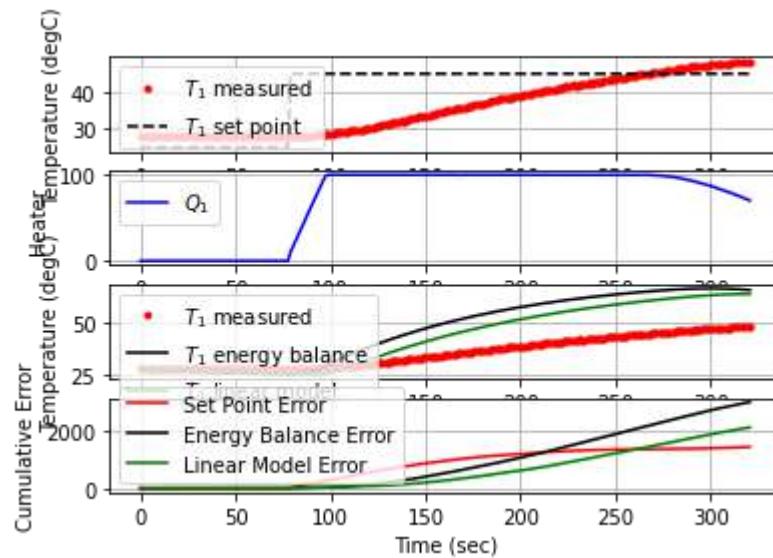
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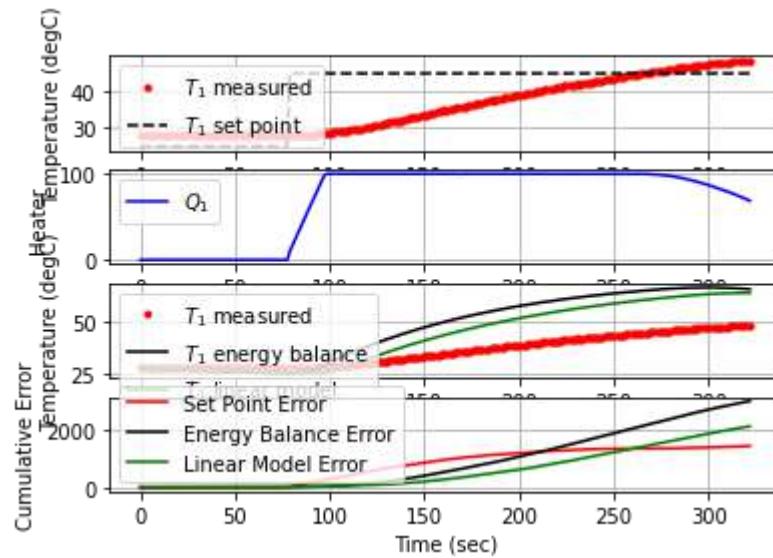
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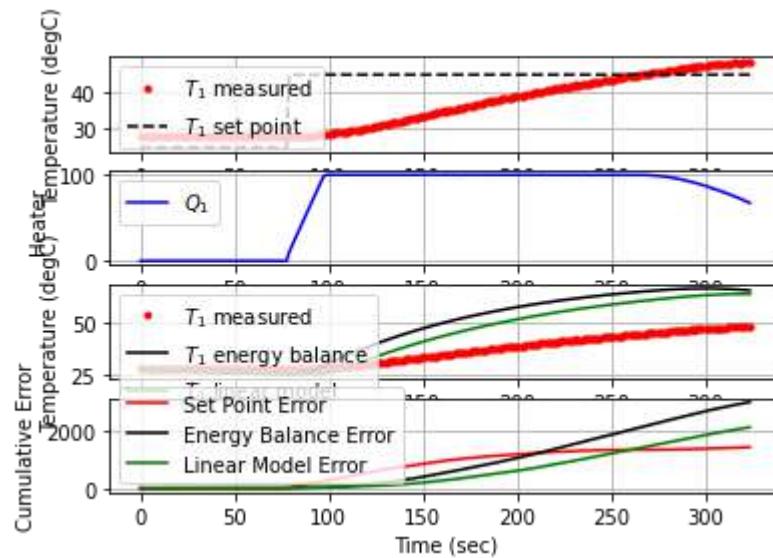
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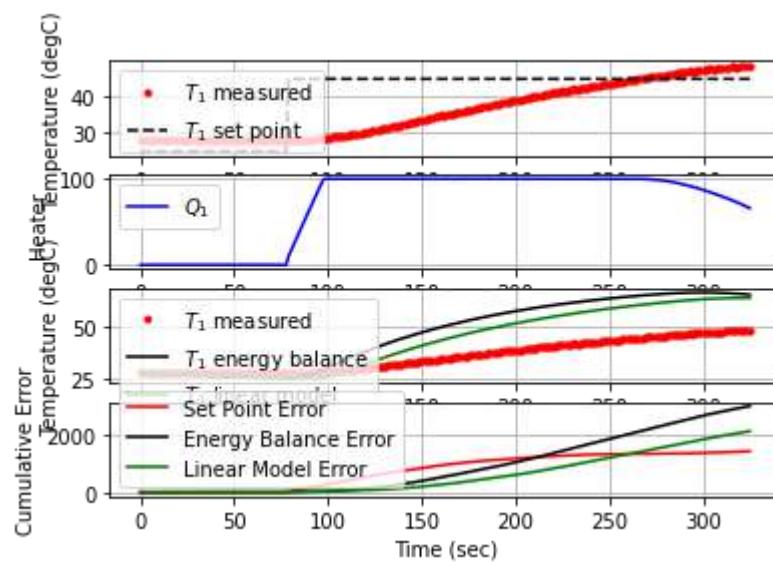
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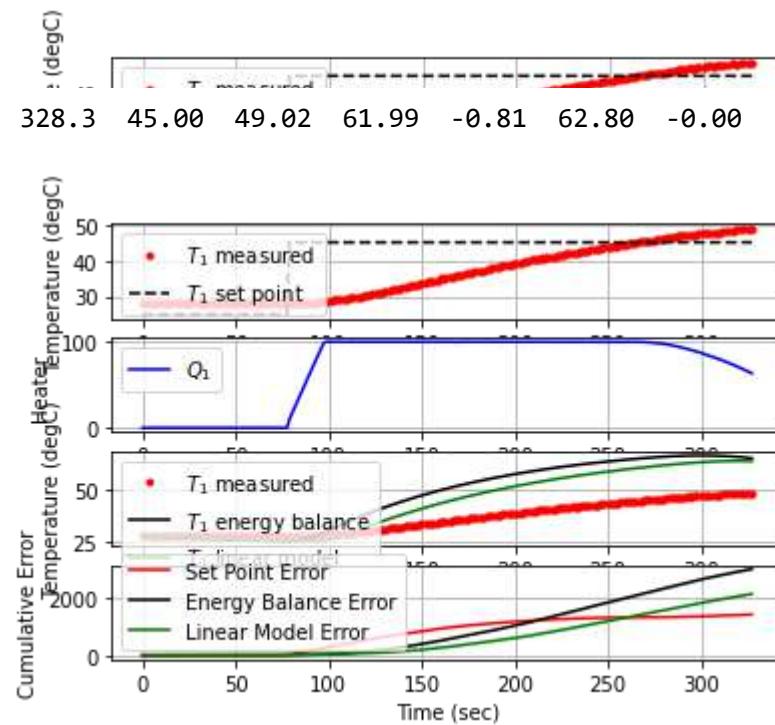
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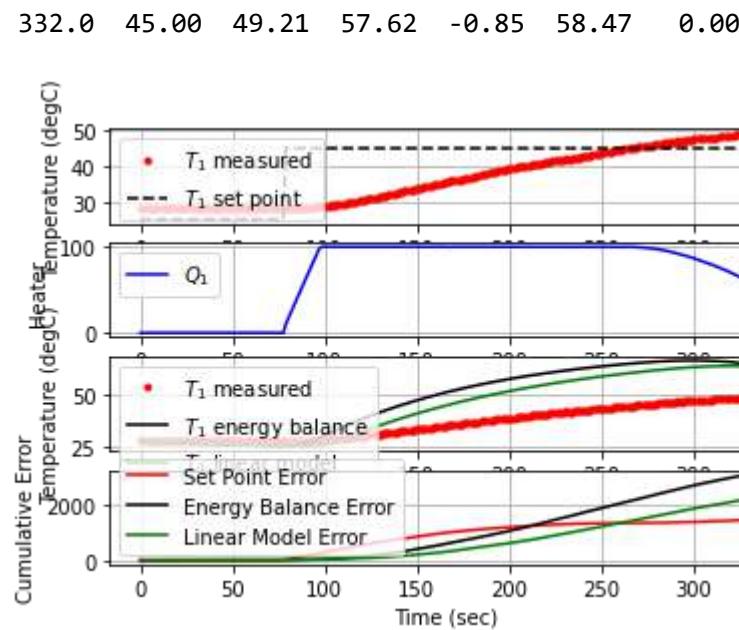
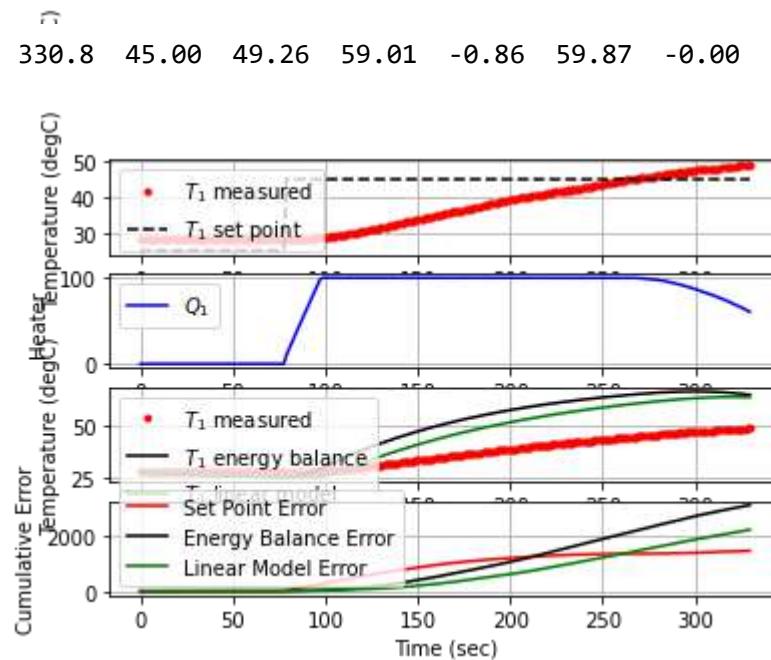
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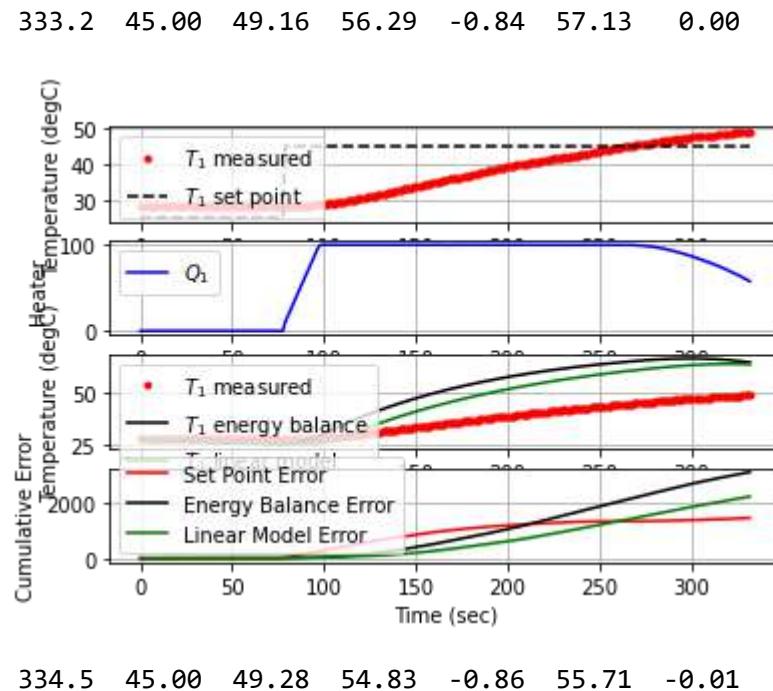


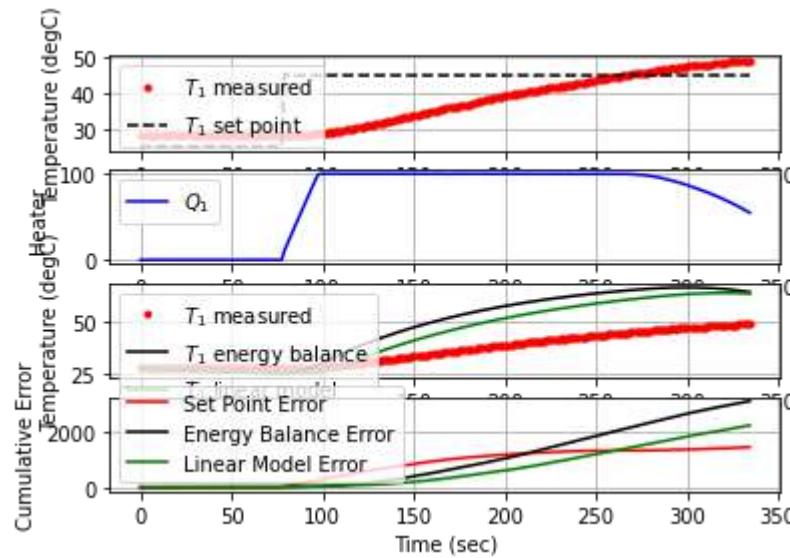
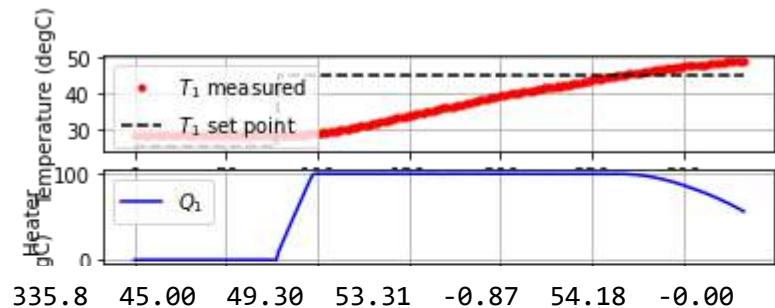
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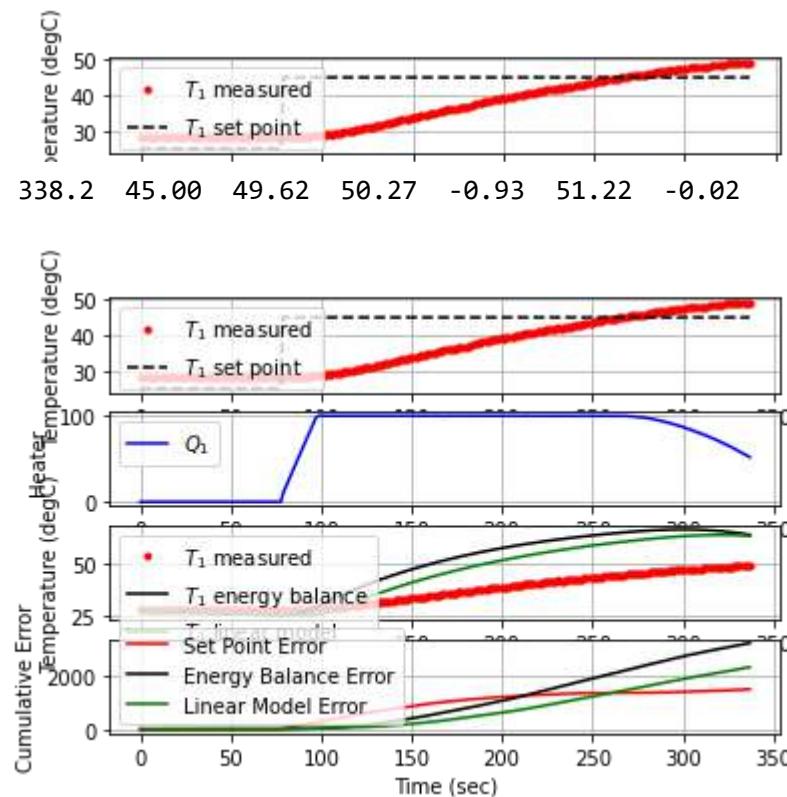
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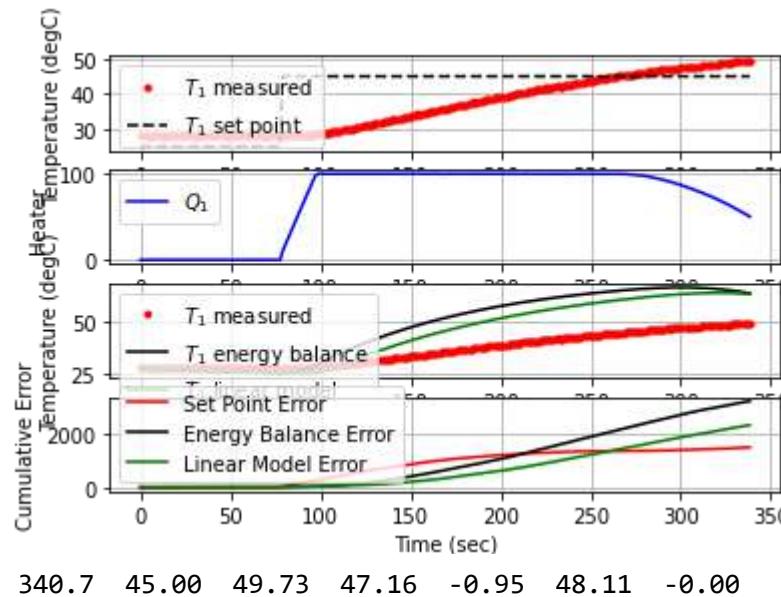




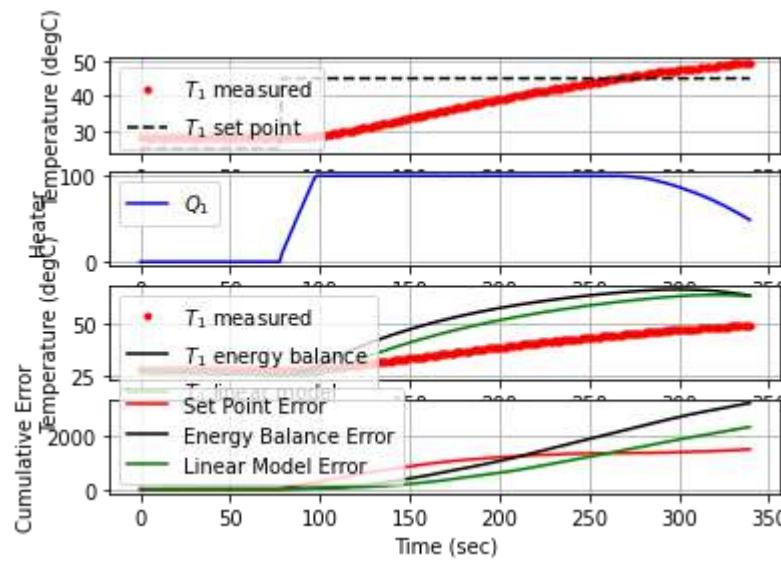
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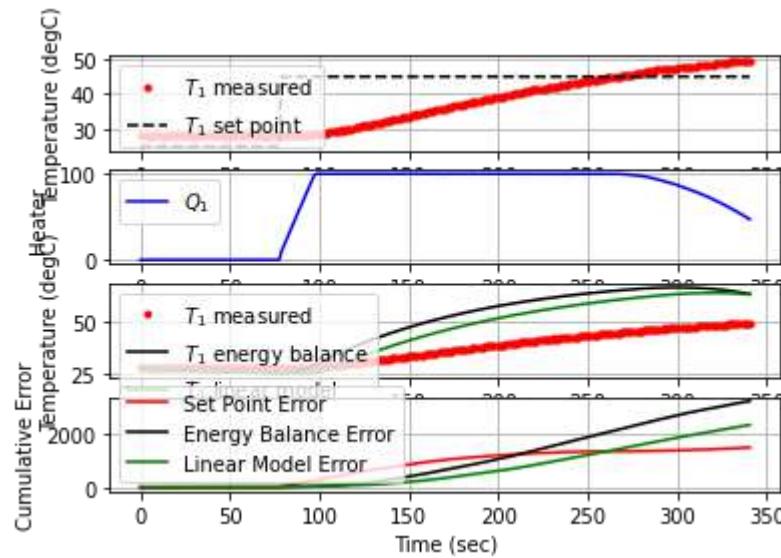
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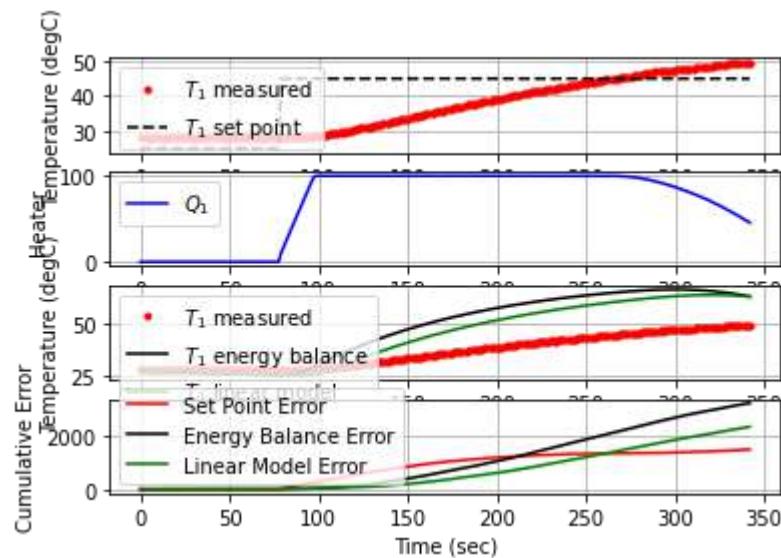
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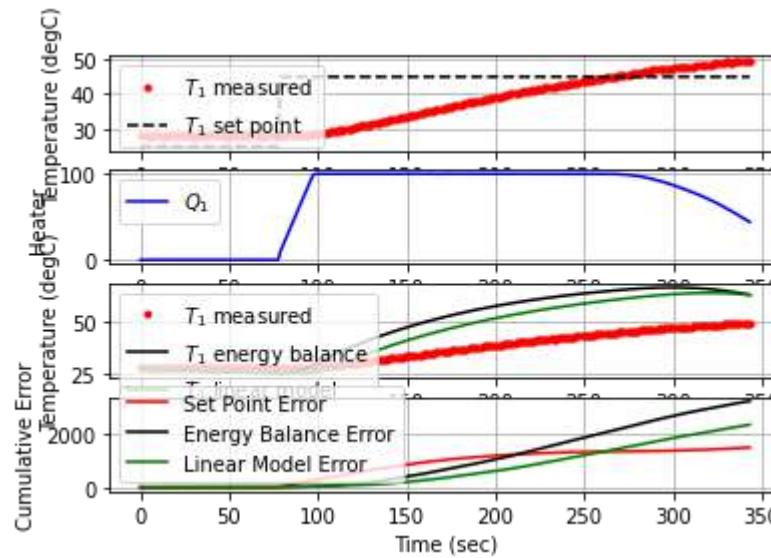
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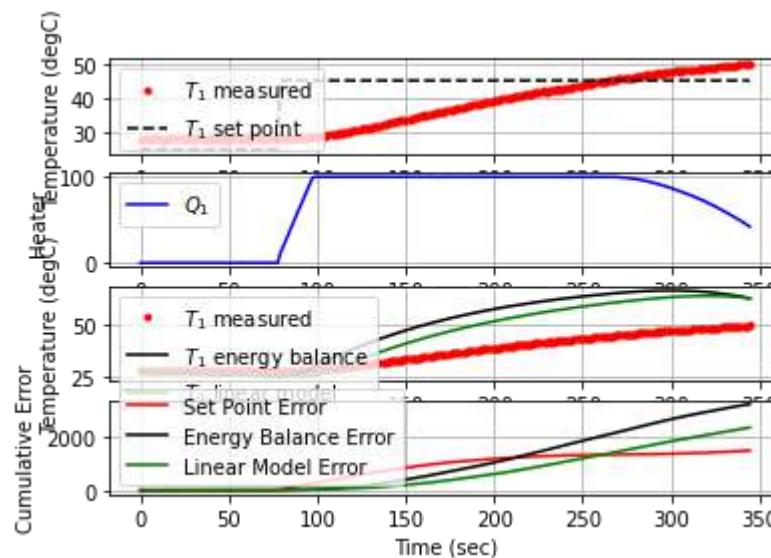
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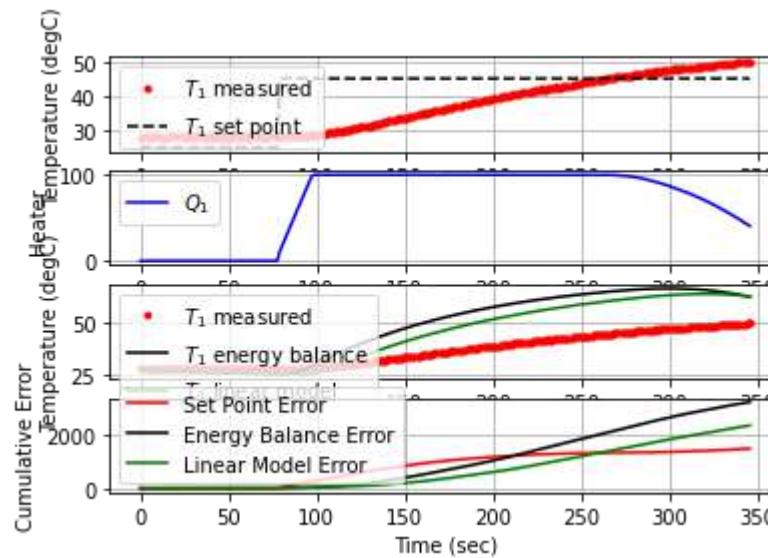
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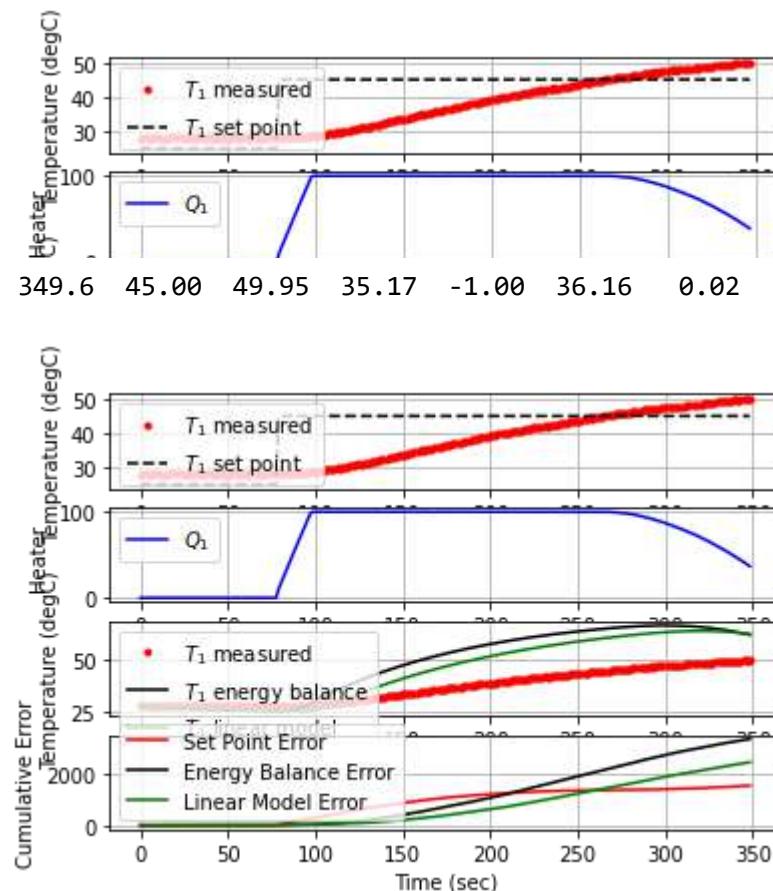
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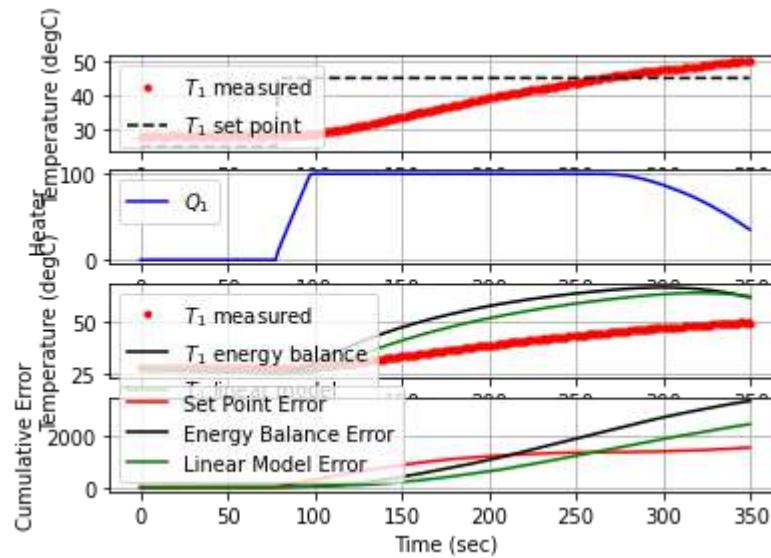
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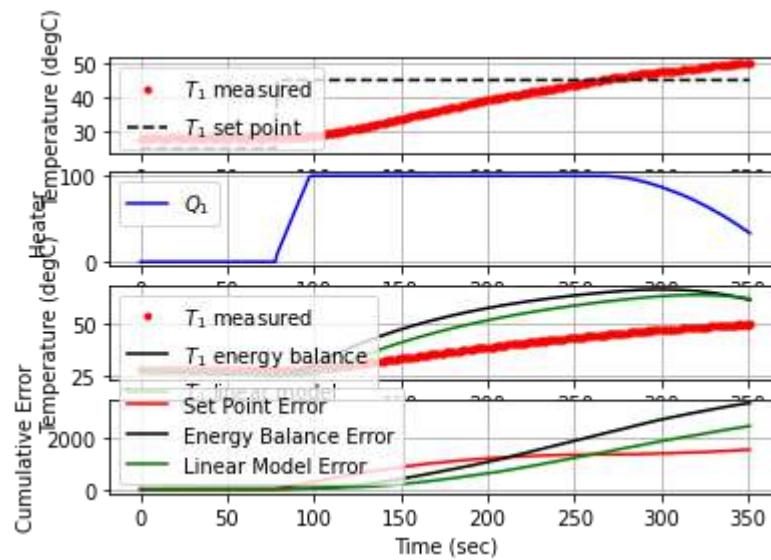
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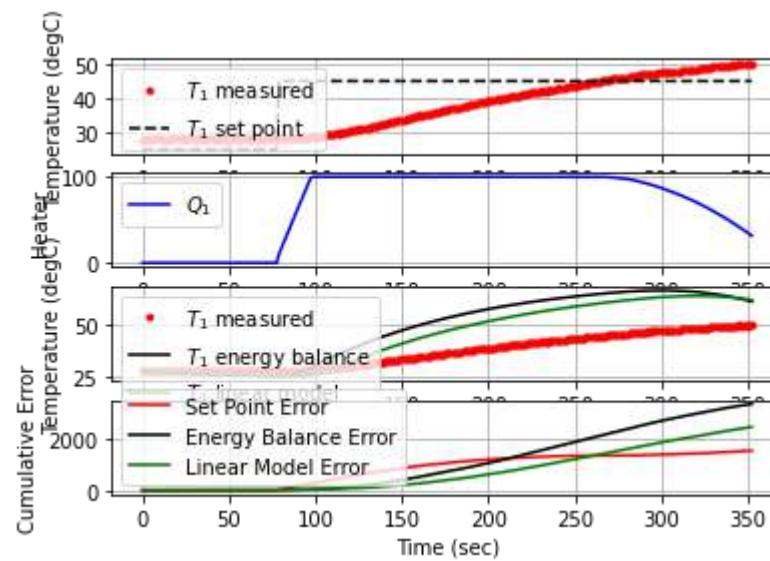
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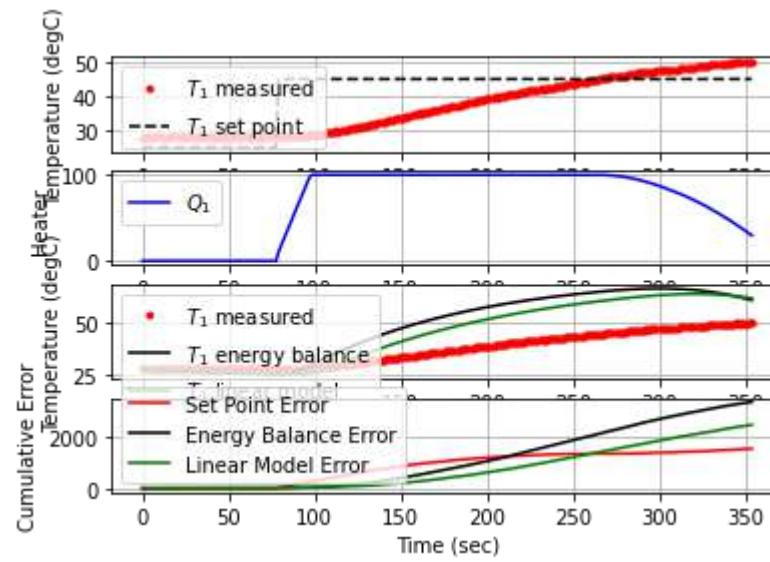
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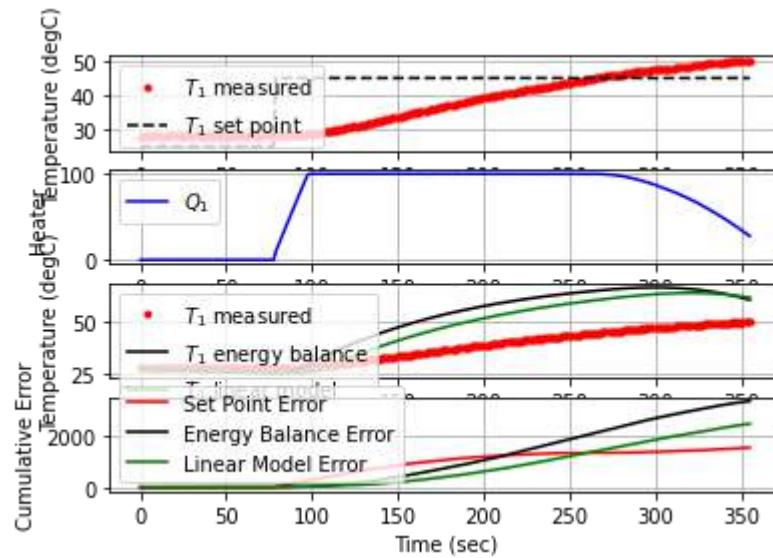
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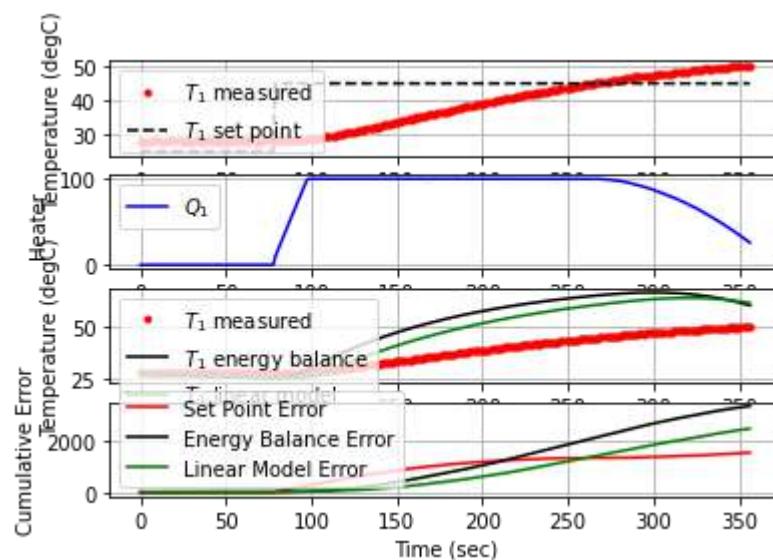
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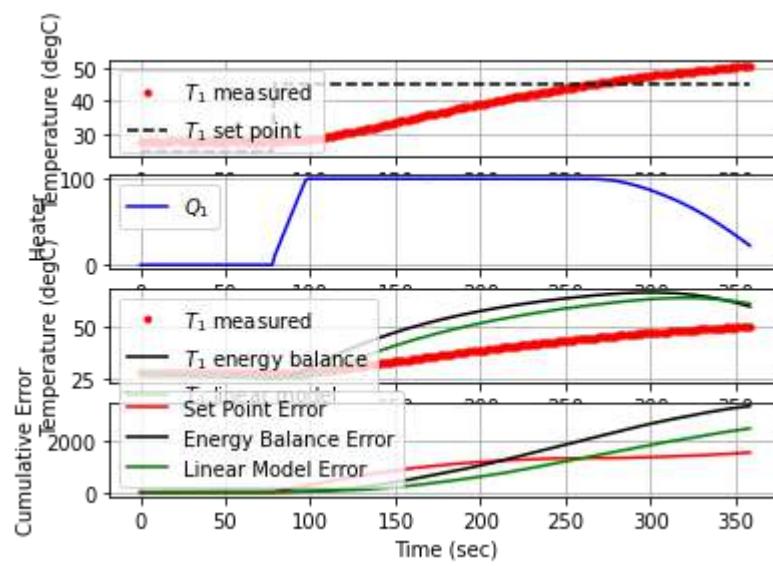
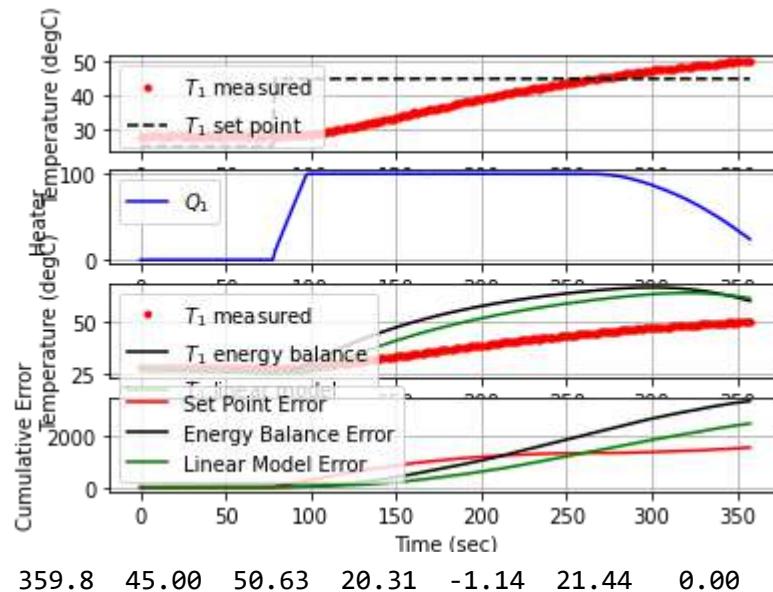
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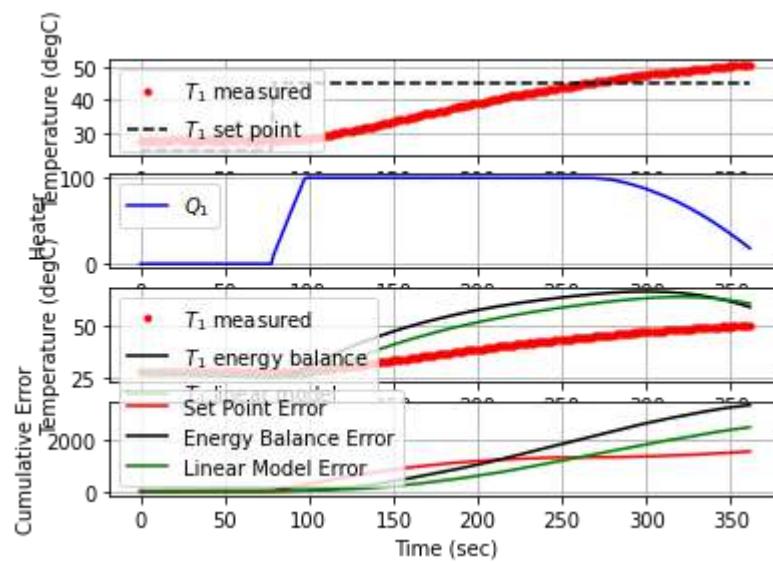
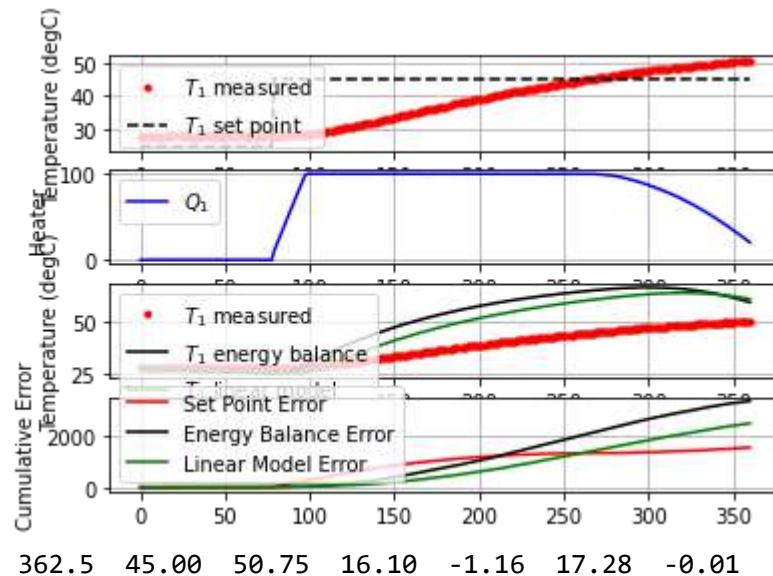
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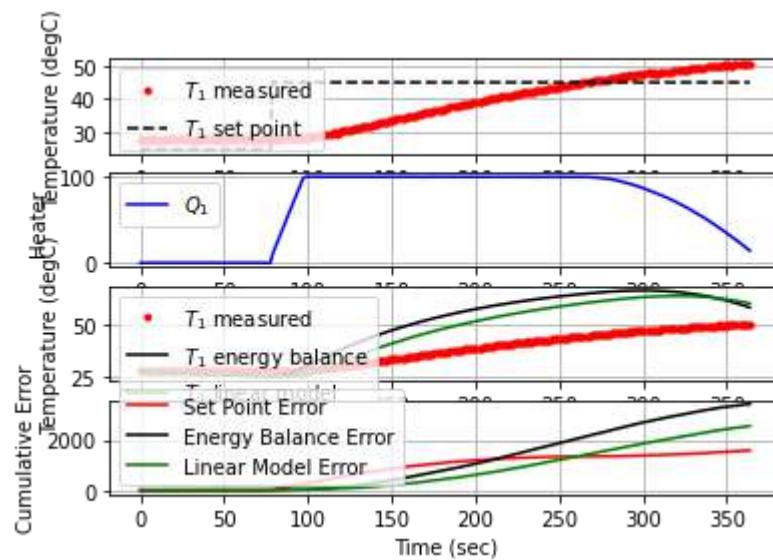
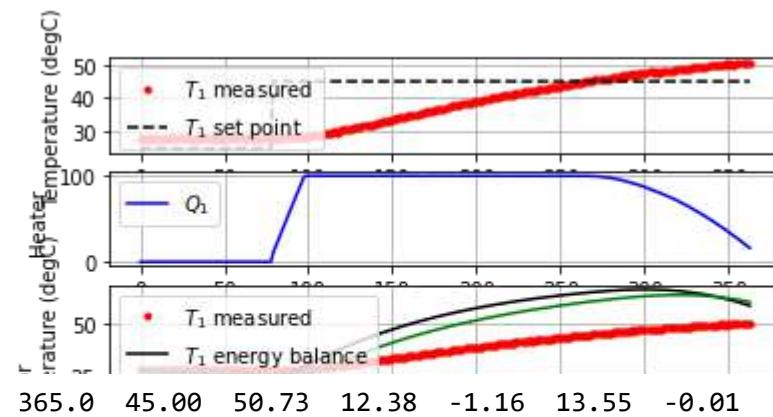
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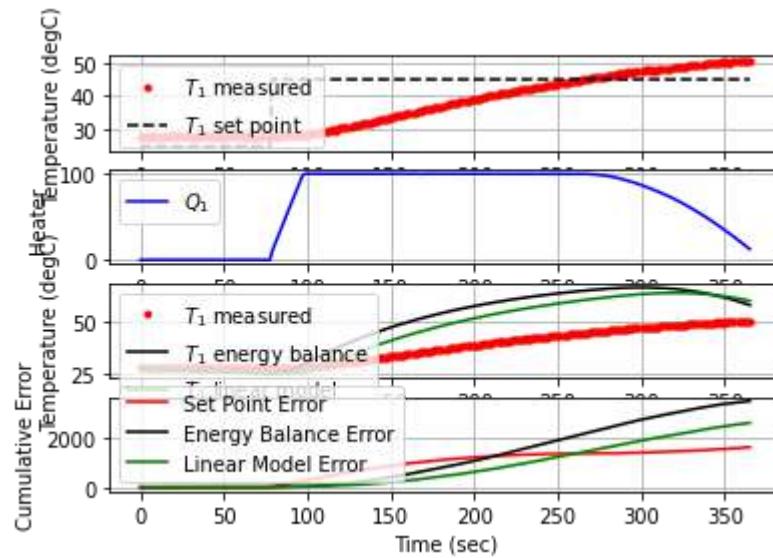
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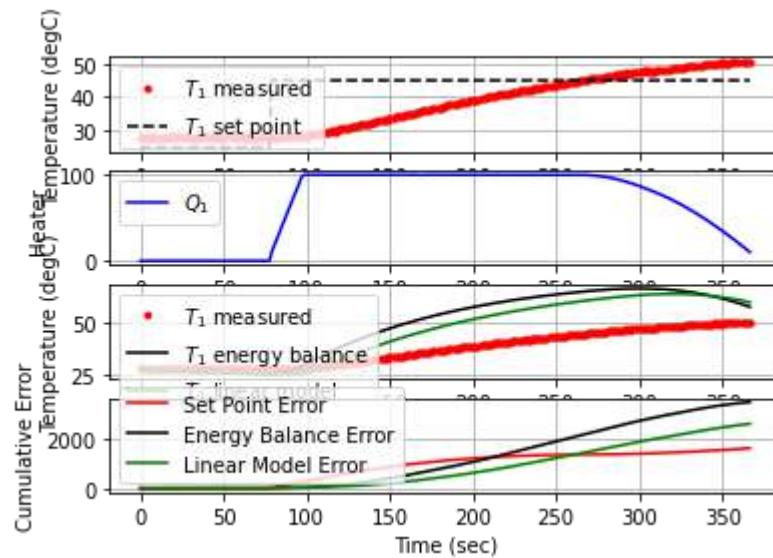
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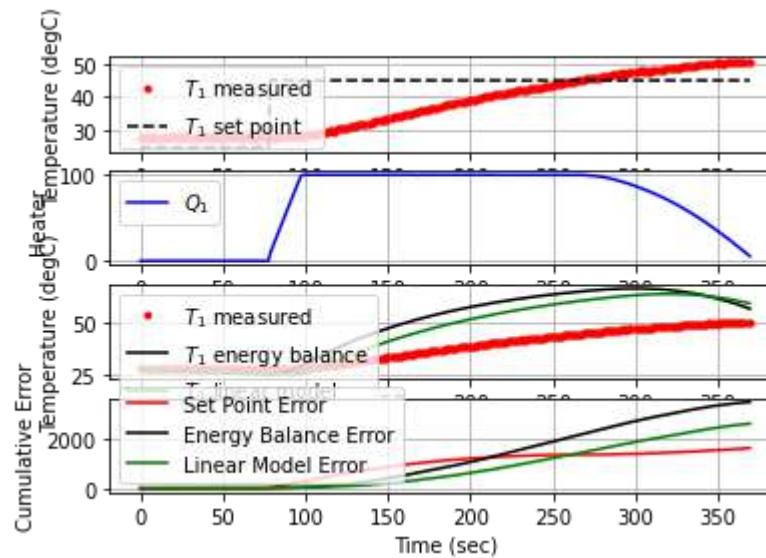
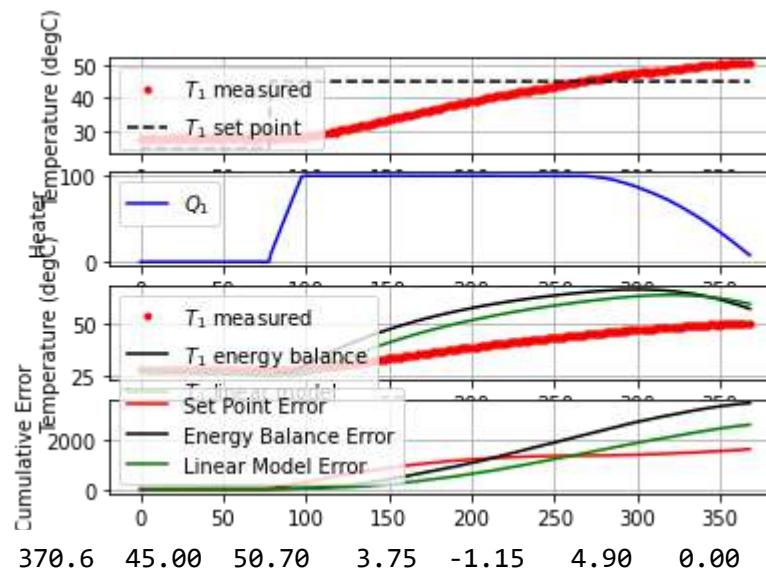
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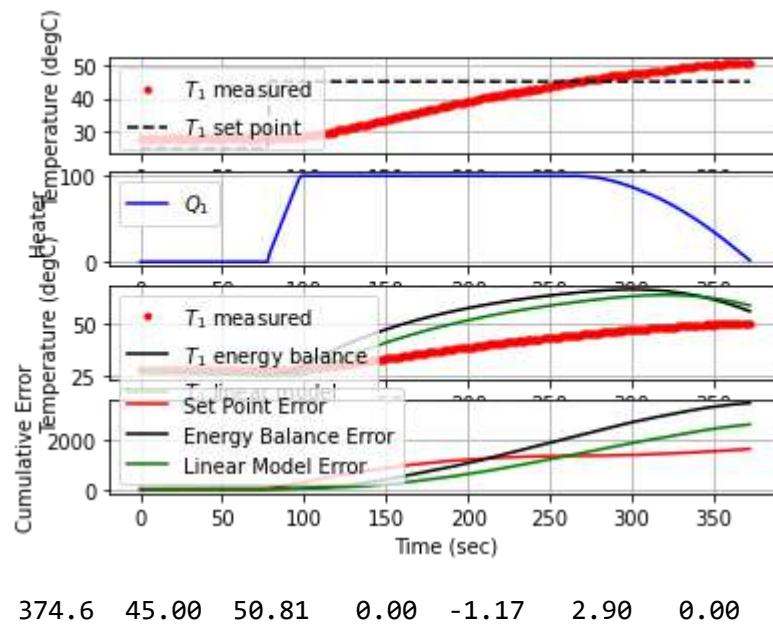
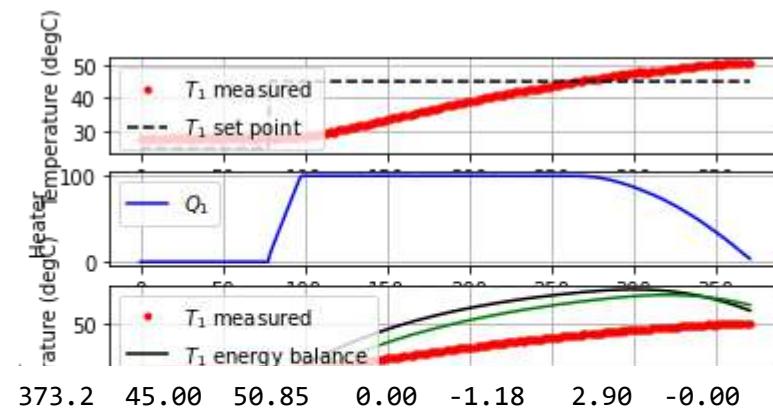


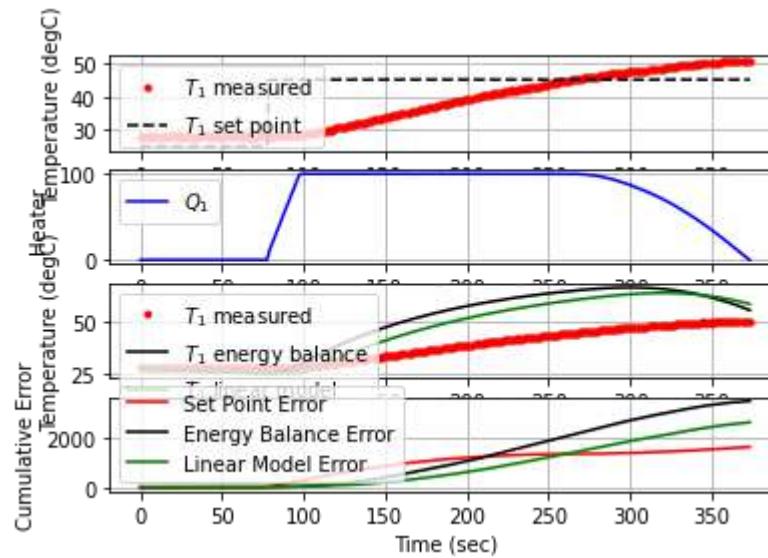
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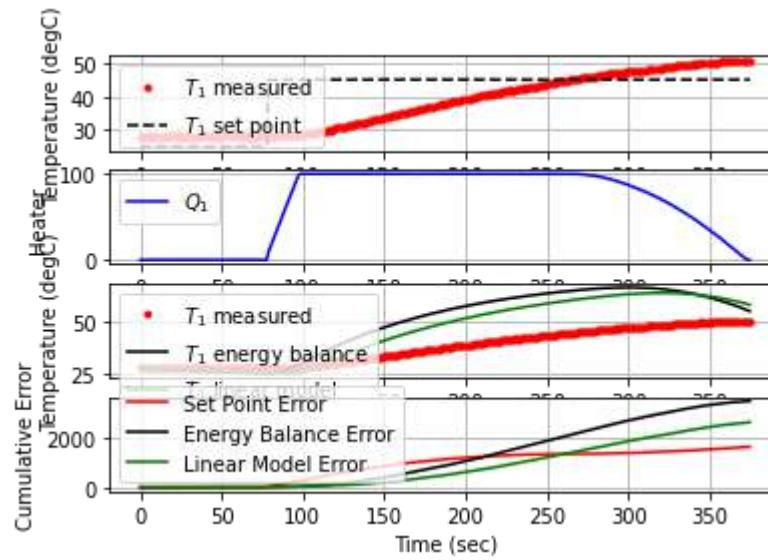
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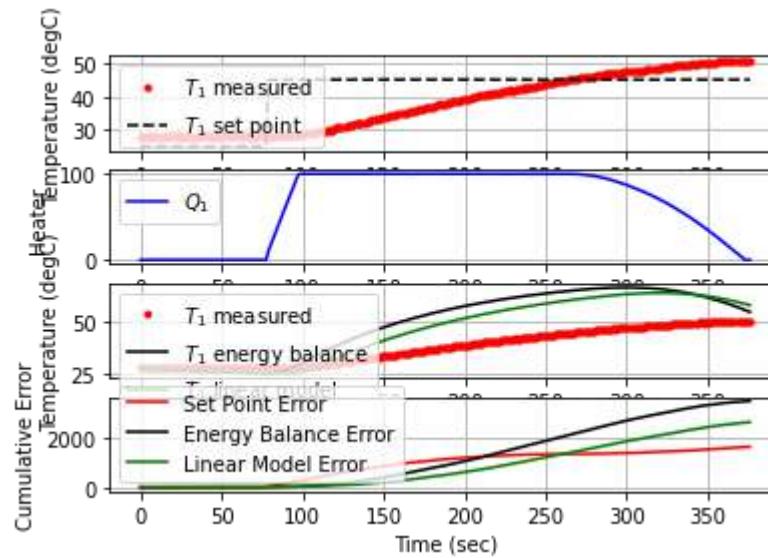




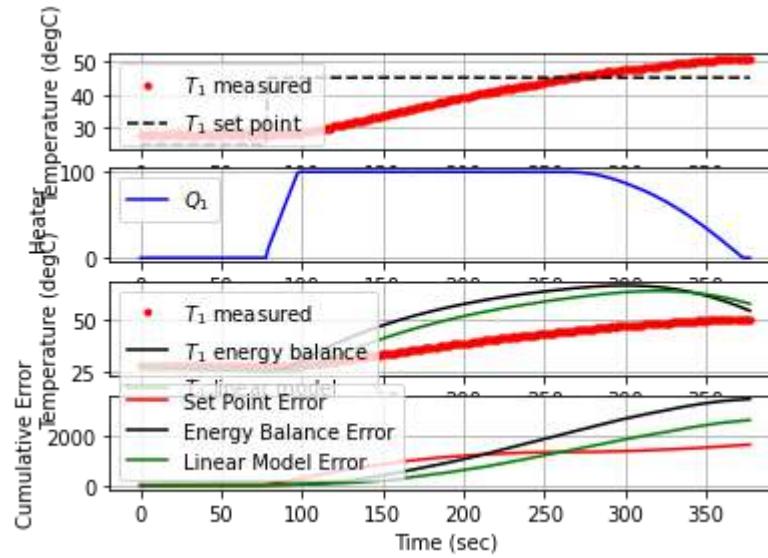
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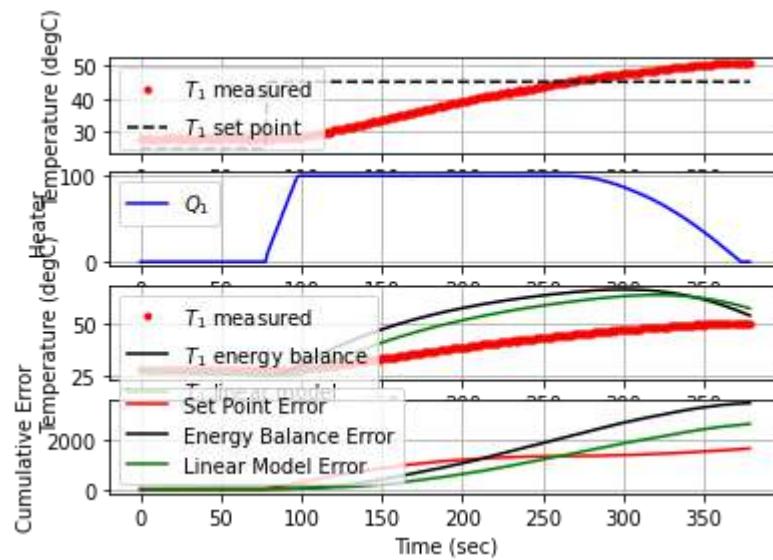
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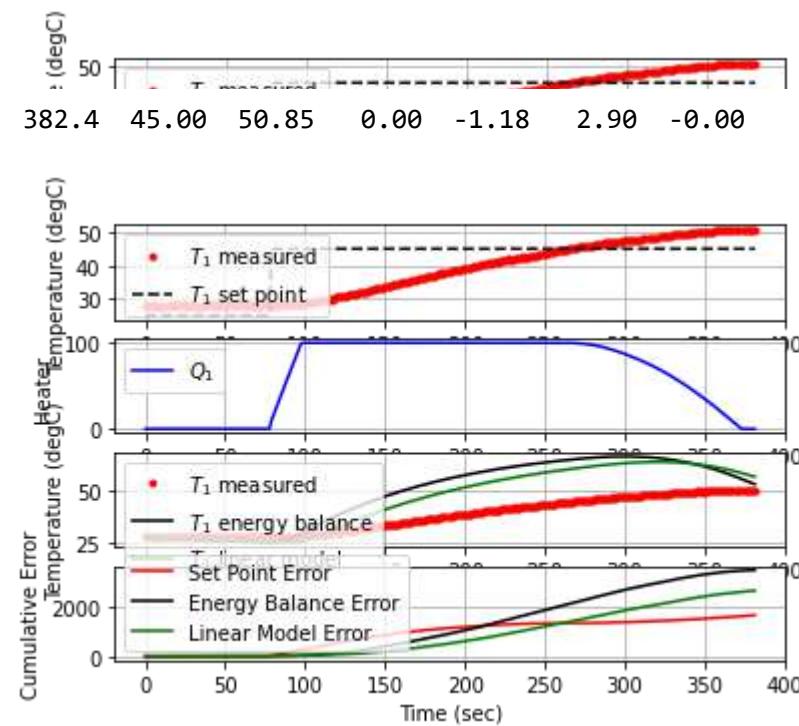
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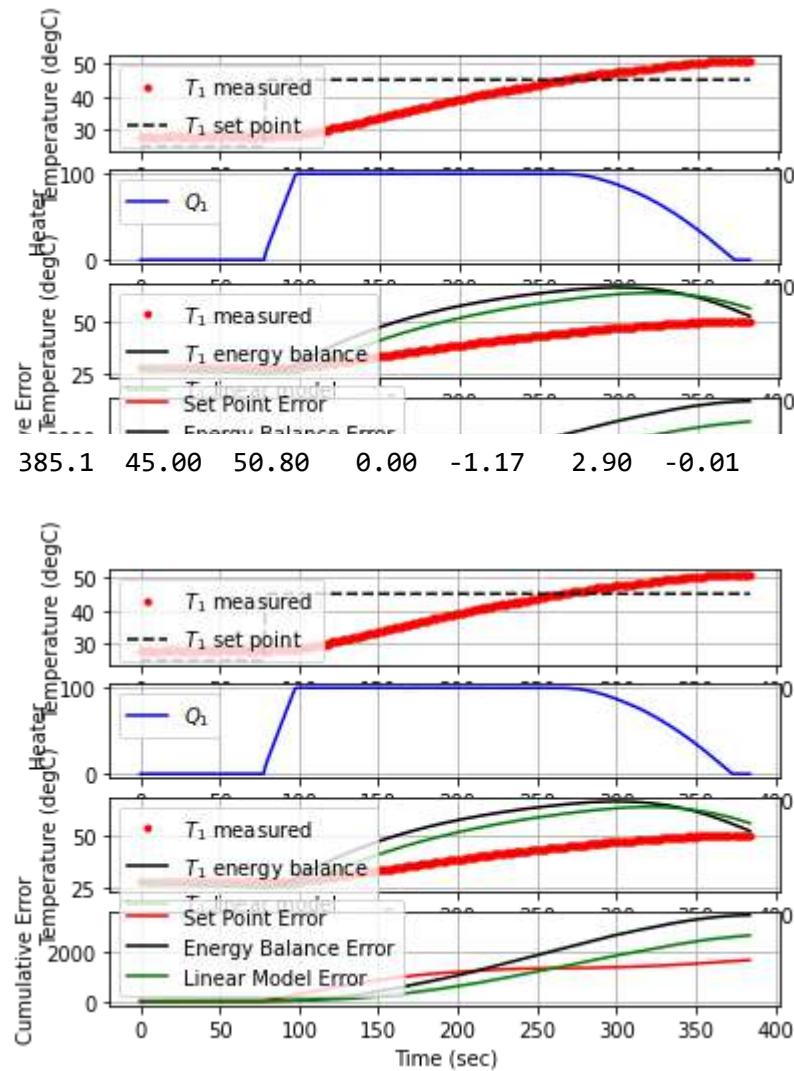
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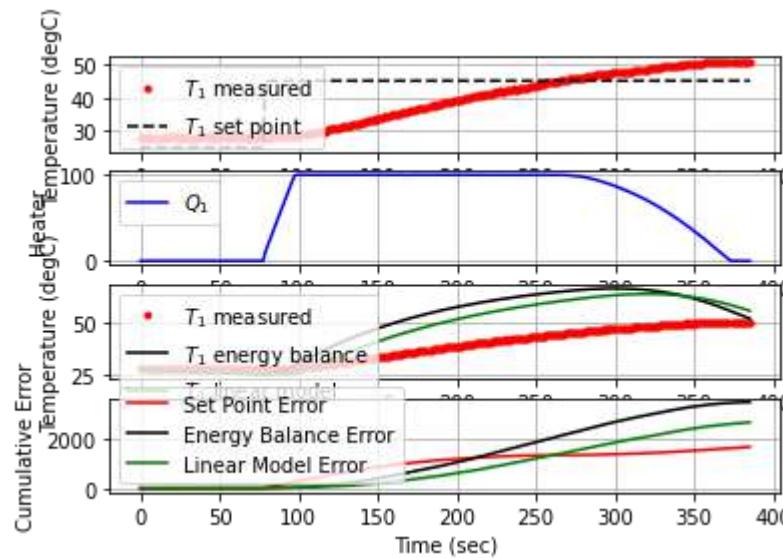
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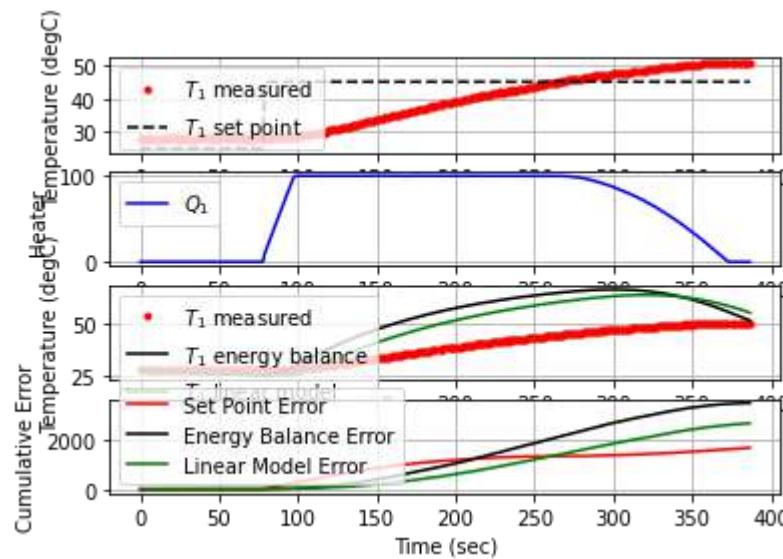
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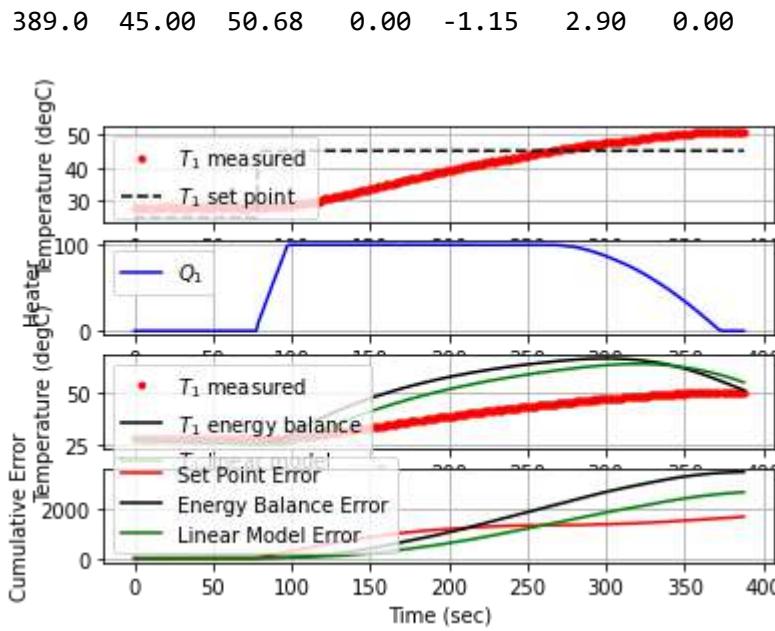


386.5 45.00 50.65 0.00 -1.14 2.90 0.01

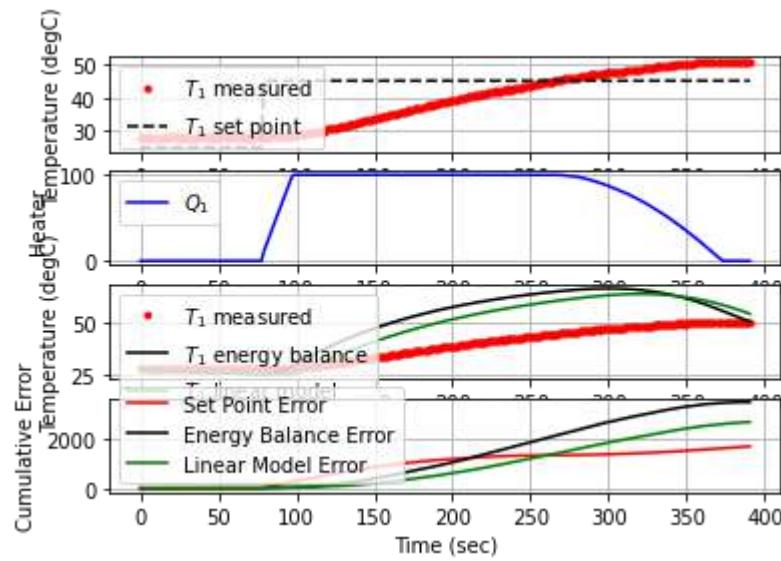
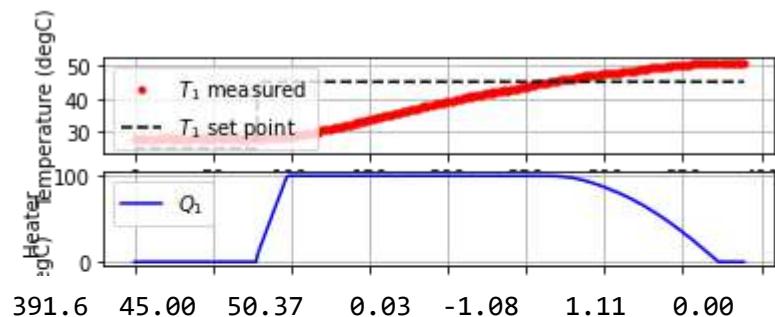


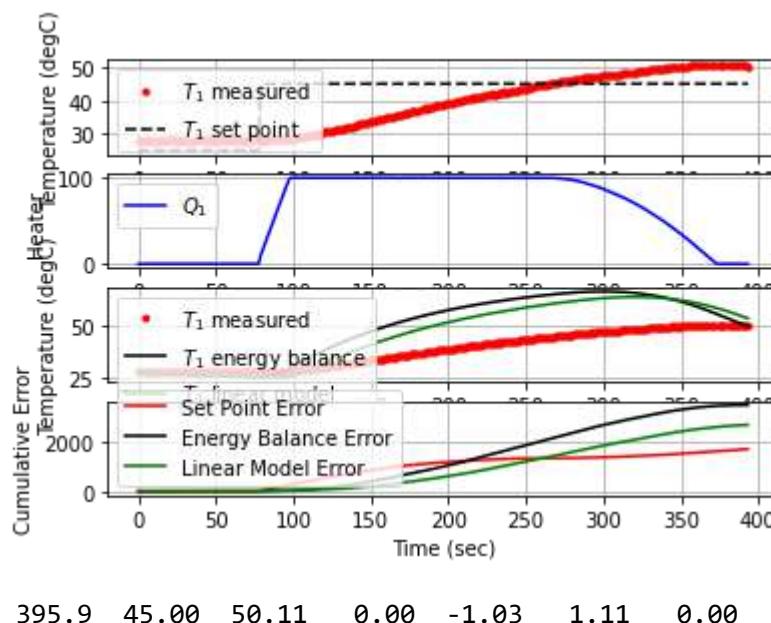
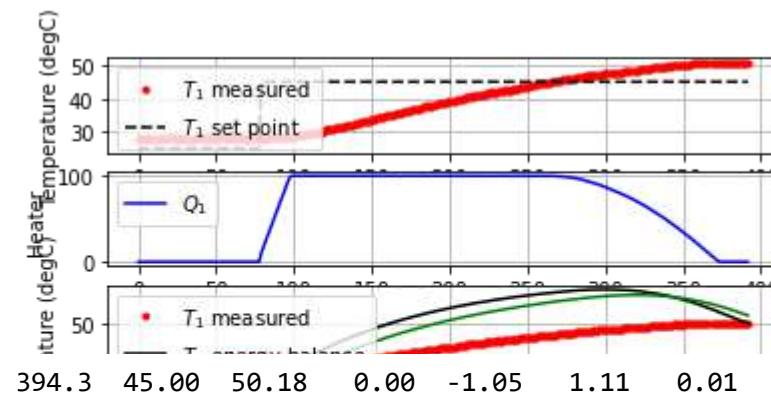
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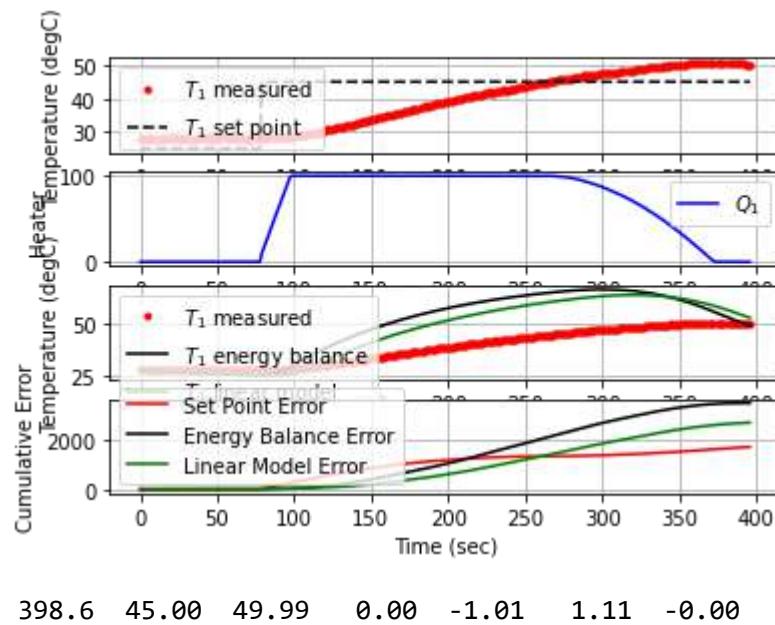
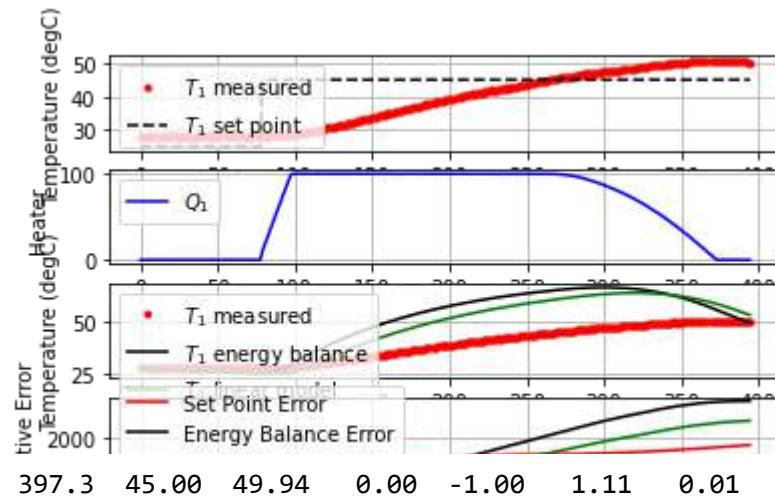


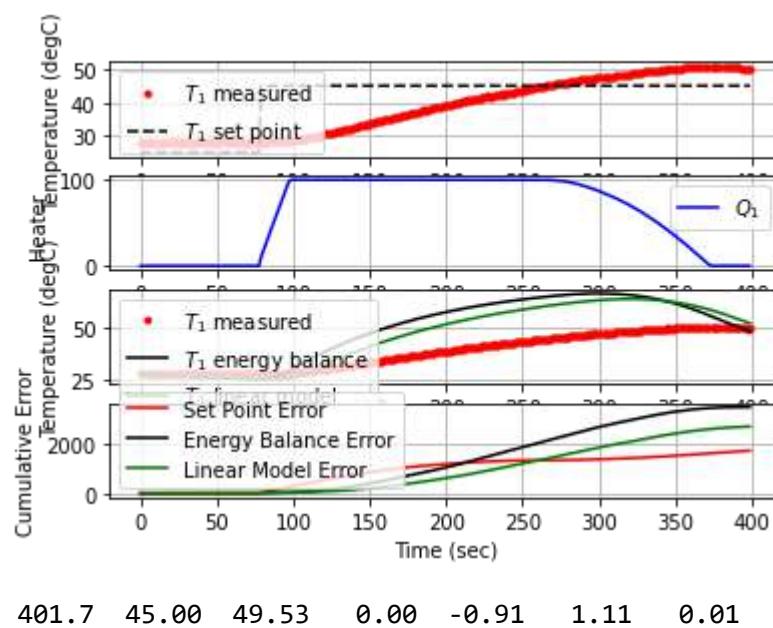
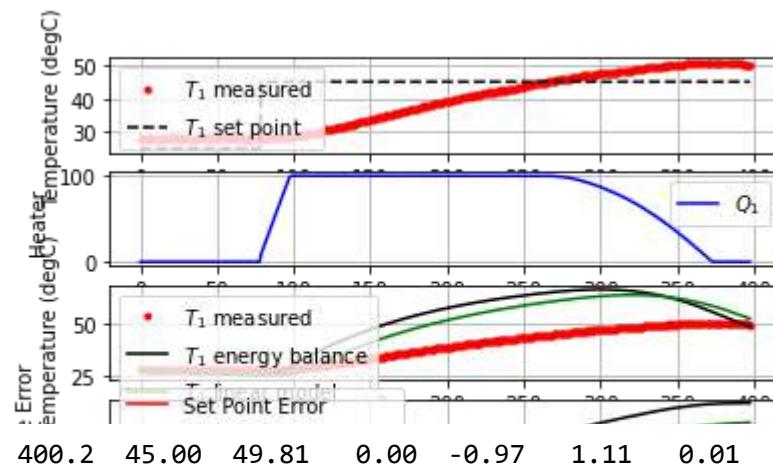


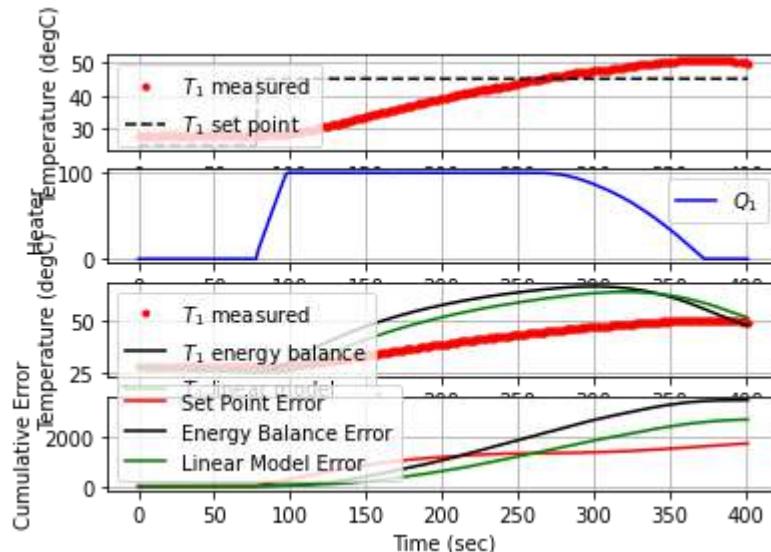
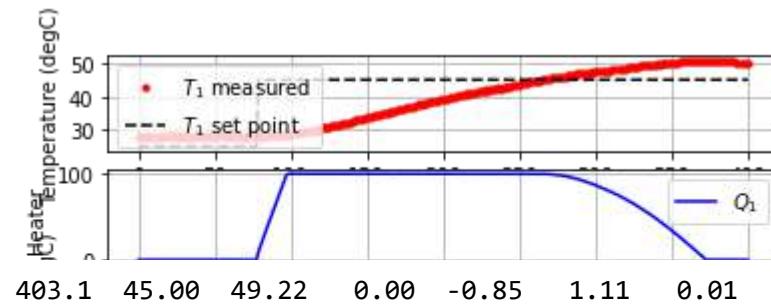
390.3 45.00 50.40 0.00 -1.09 2.90 0.01



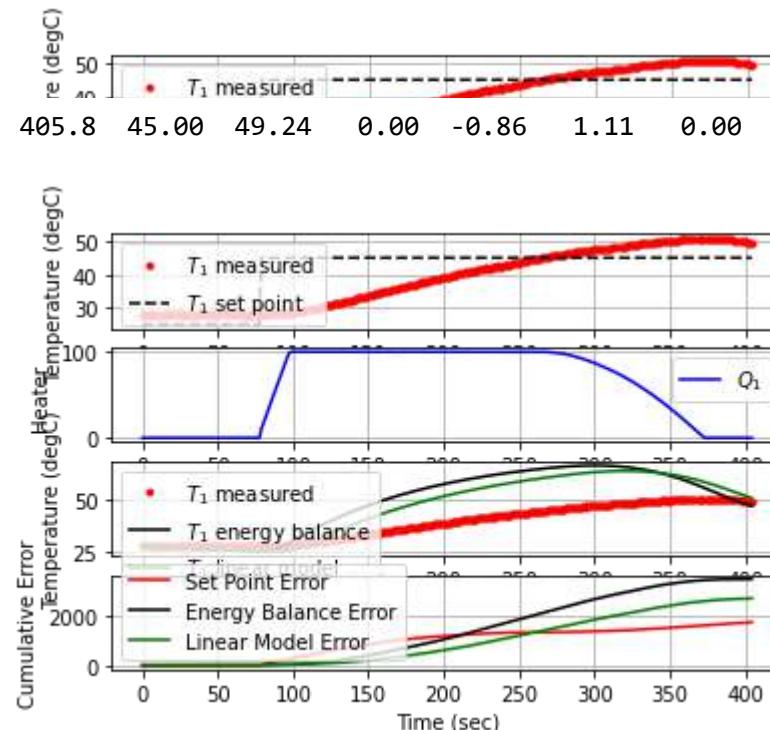




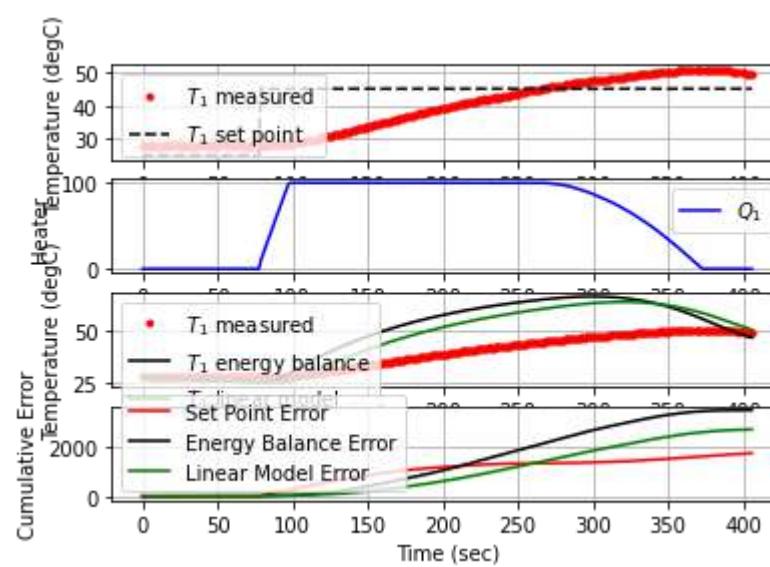




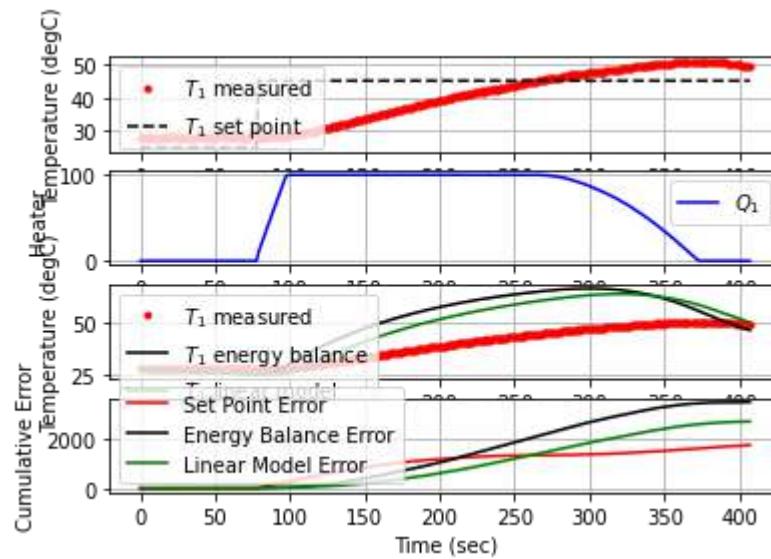
404.3 45.00 49.30 0.00 -0.87 1.11 -0.00



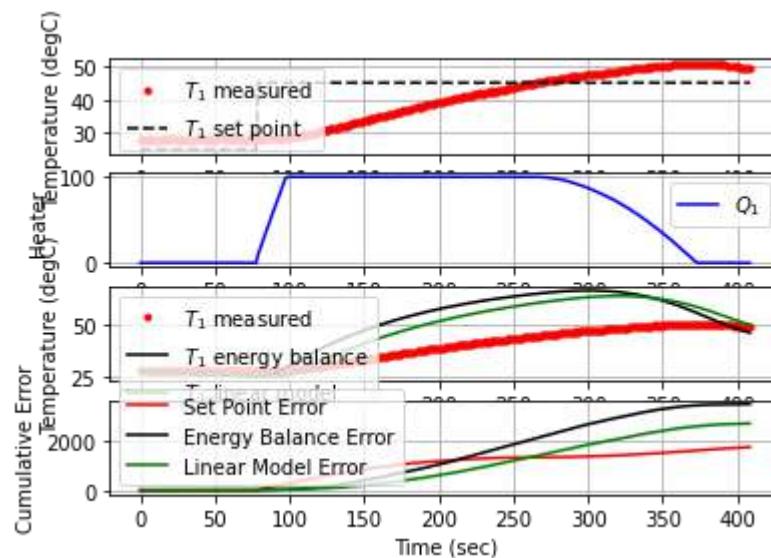
407.1 45.00 49.23 0.00 -0.85 1.11 0.00



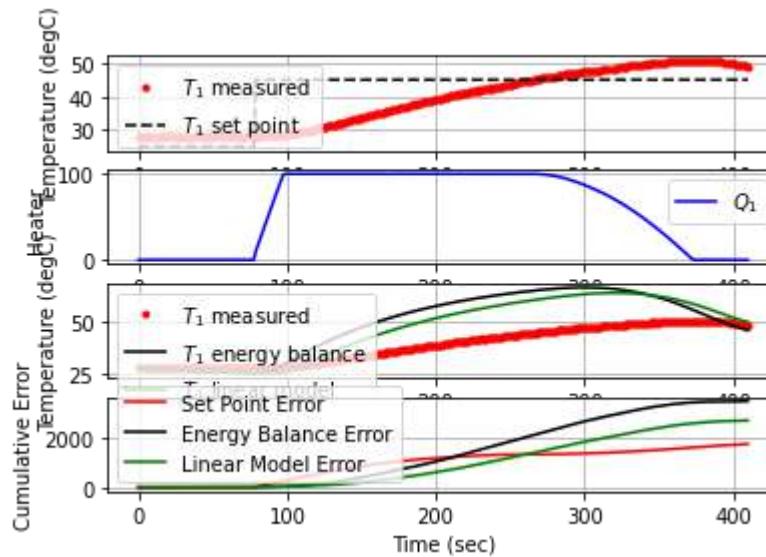
408.4 45.00 49.20 0.00 -0.85 1.11 0.00



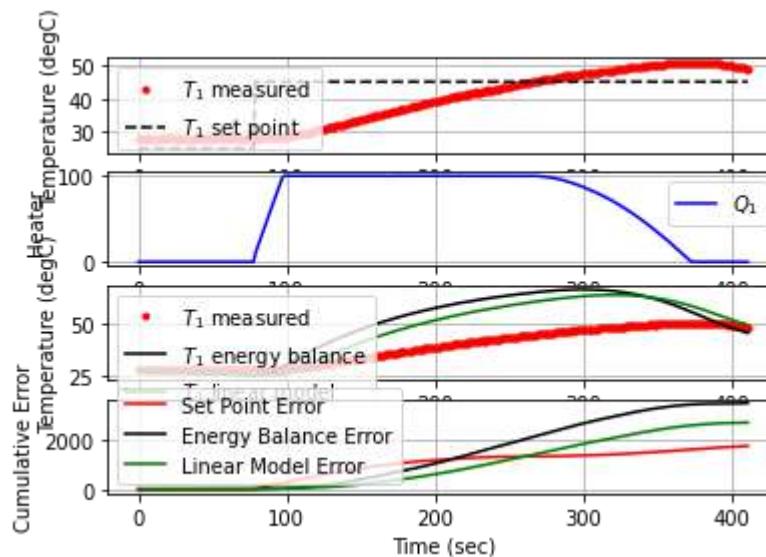
409.7 45.00 48.97 0.00 -0.80 1.11 0.01



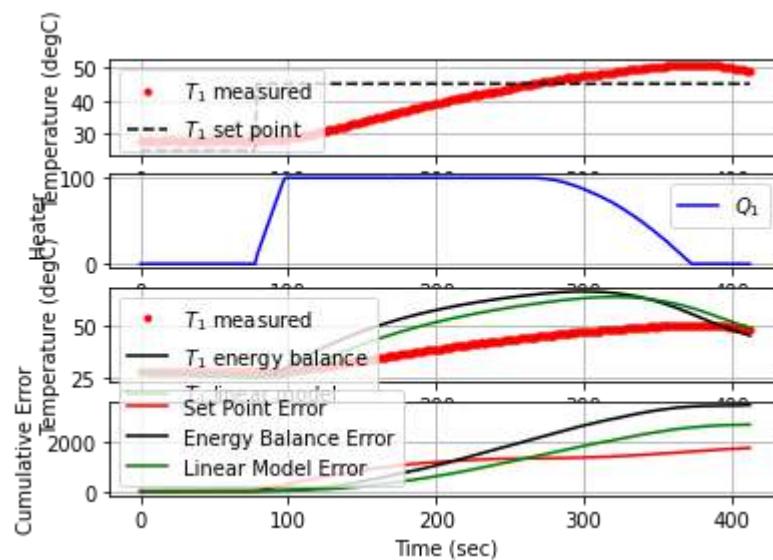
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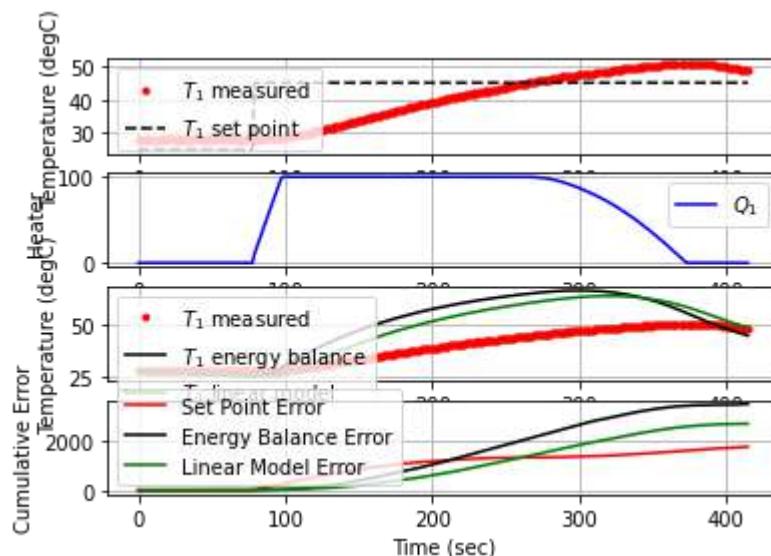
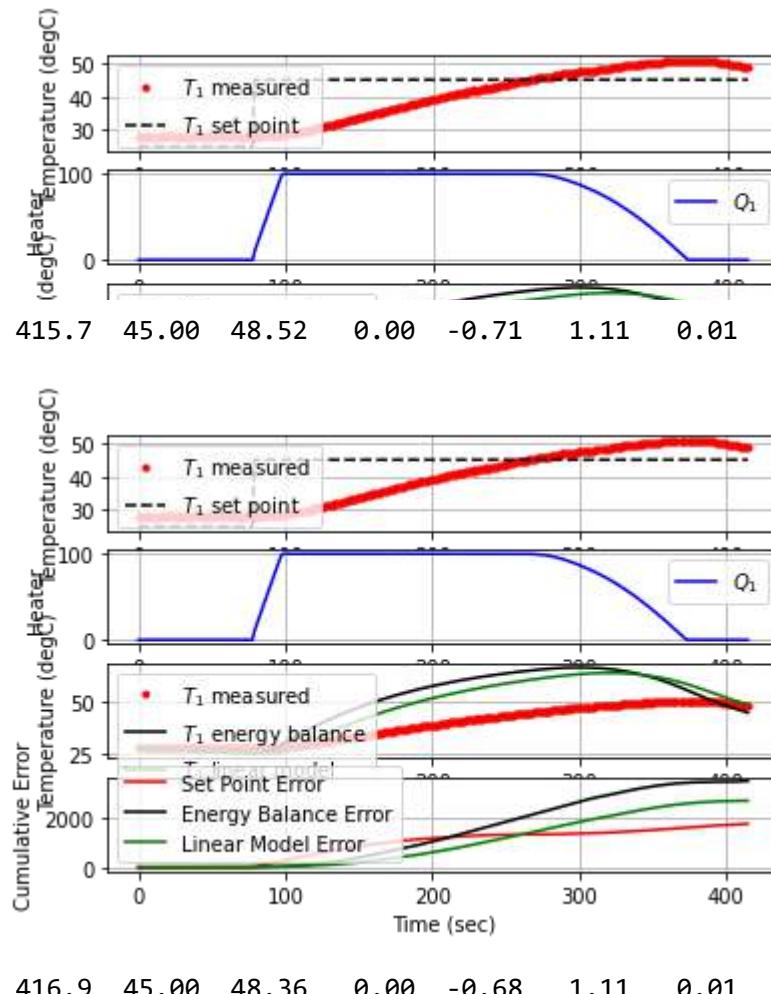
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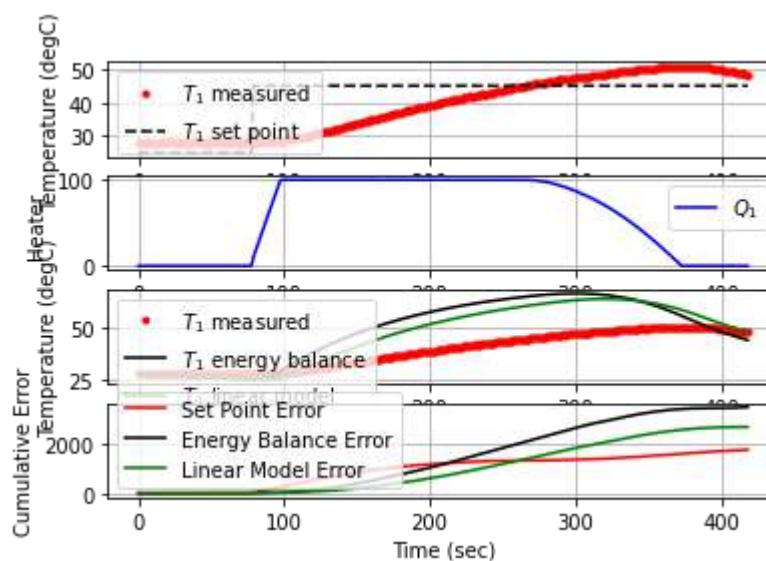
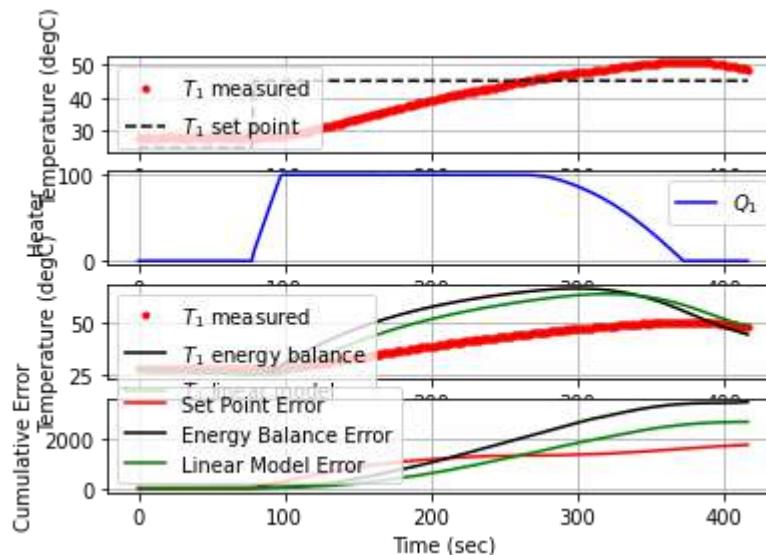
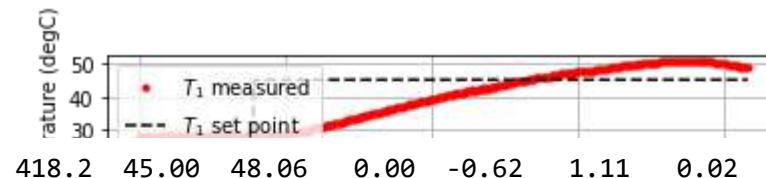


413.5 45.00 48.76 0.00 -0.76 1.11 0.00

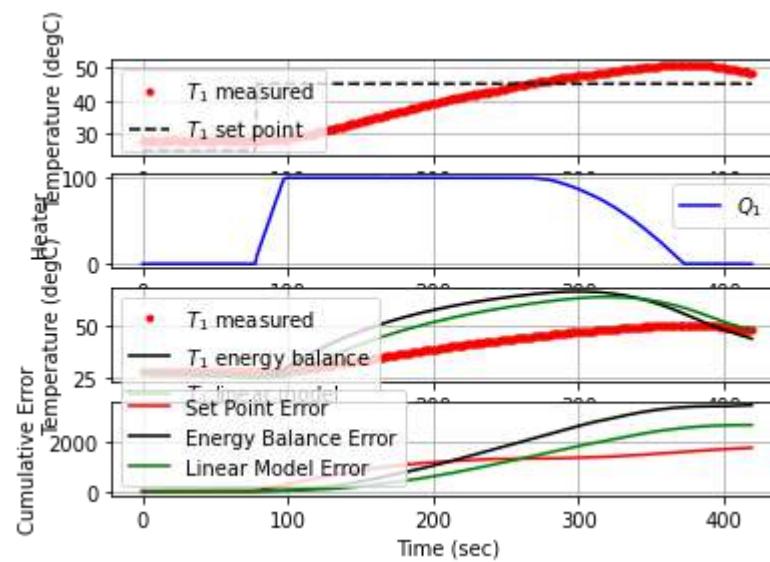


414.6 45.00 48.62 0.00 -0.73 1.11 0.01

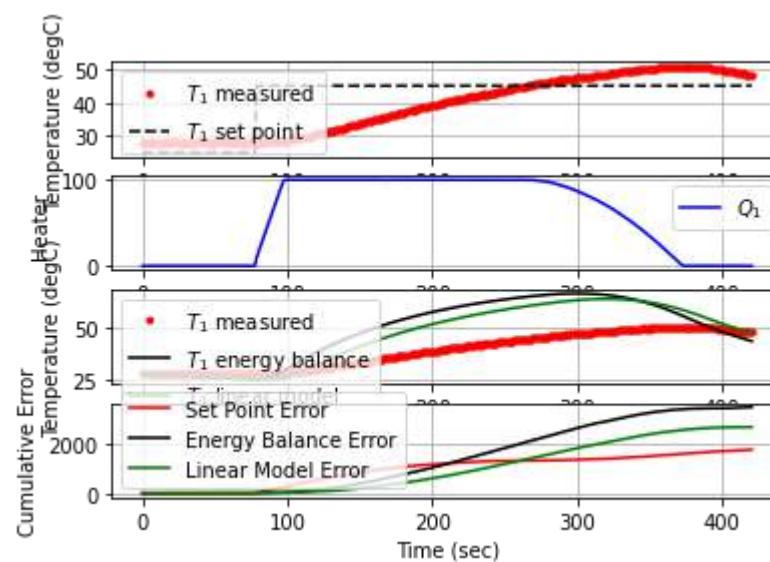




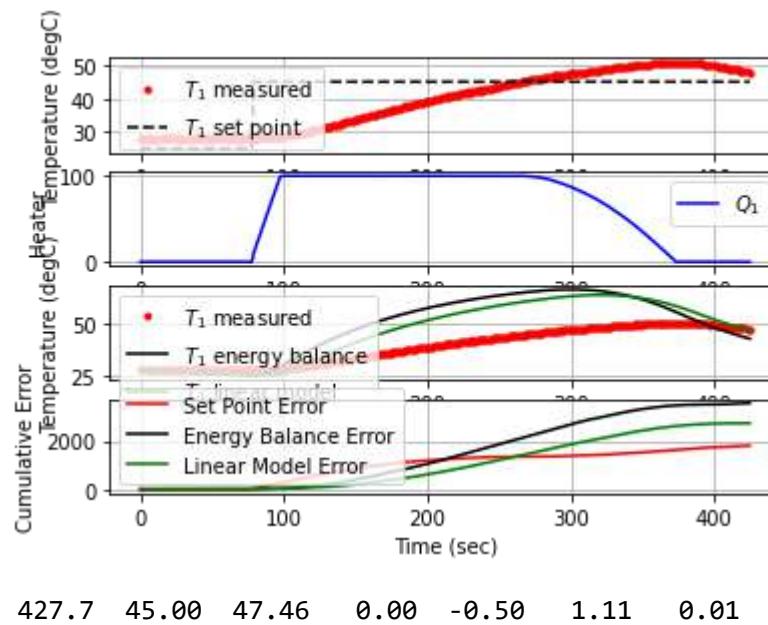
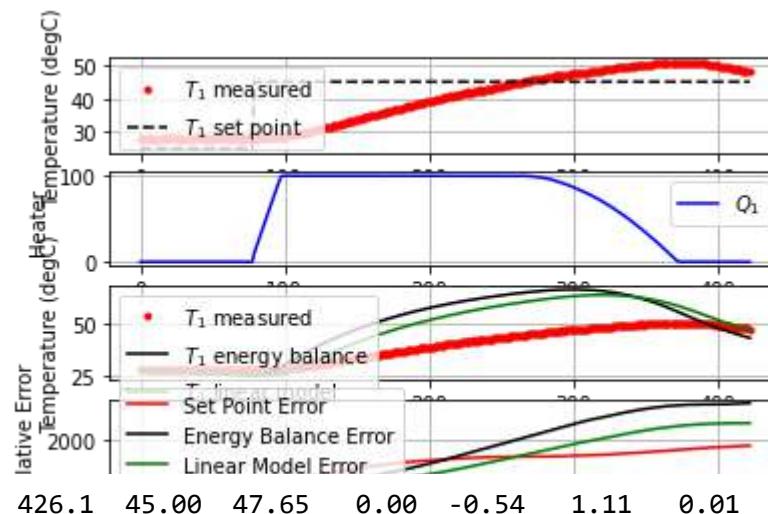
420.5 45.00 48.09 0.00 -0.62 1.11 0.01

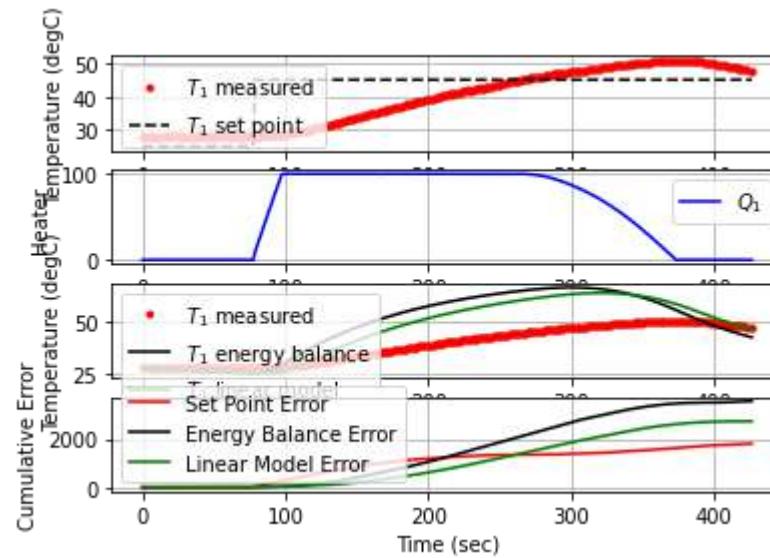


422.5 45.00 47.96 0.00 -0.60 1.11 0.00

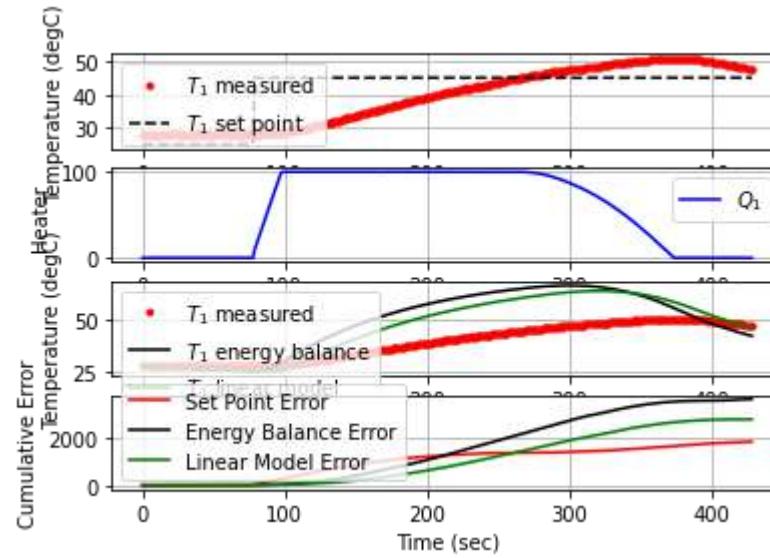


424.4 45.00 47.80 0.00 -0.57 1.11 0.01

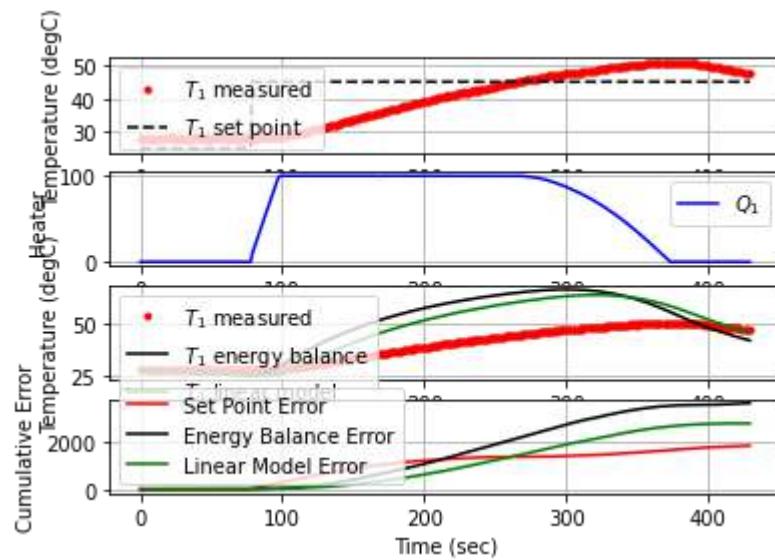




429.1 45.00 47.29 0.00 -0.46 1.11 0.01

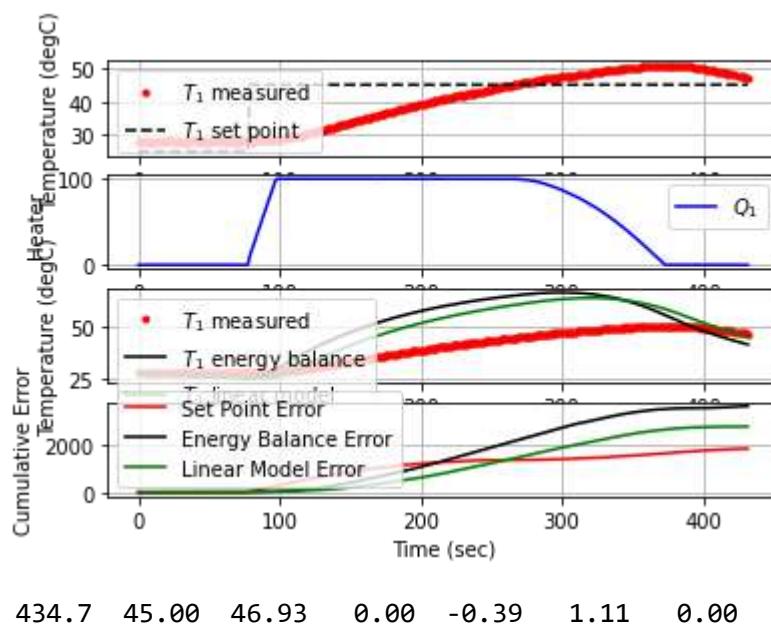
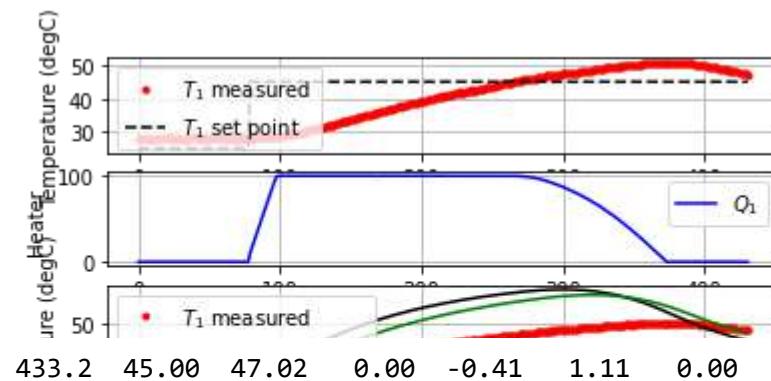


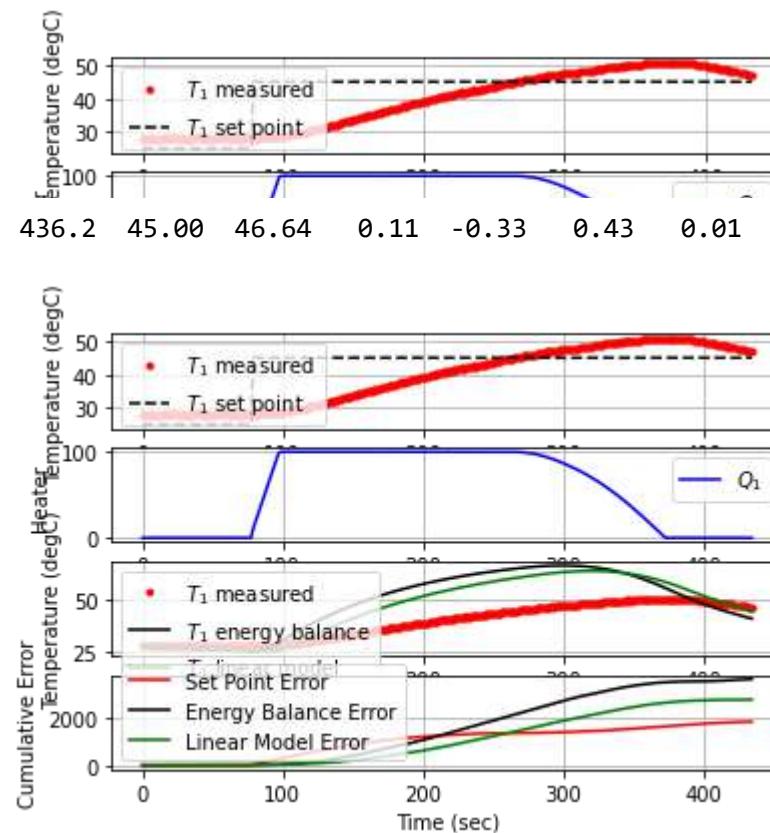
430.4 45.00 47.24 0.00 -0.45 1.11 0.00



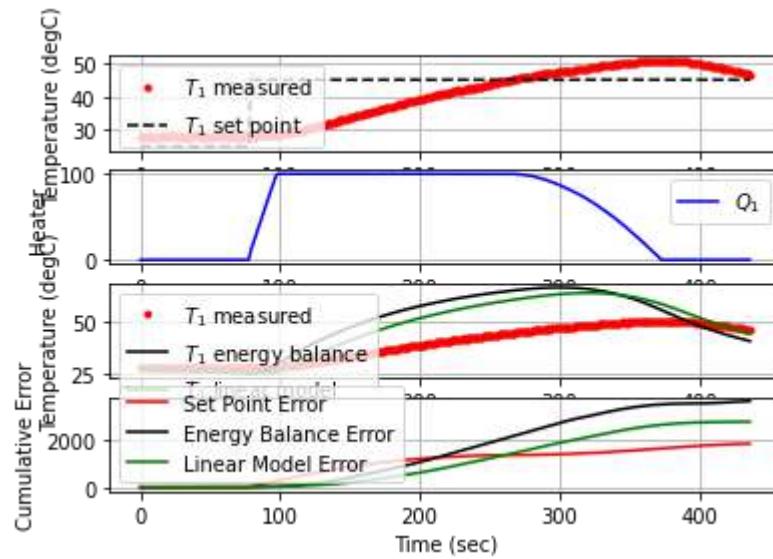
Connected to MQTT Broker!

431.7 45.00 47.04 0.00 -0.41 1.11 0.01

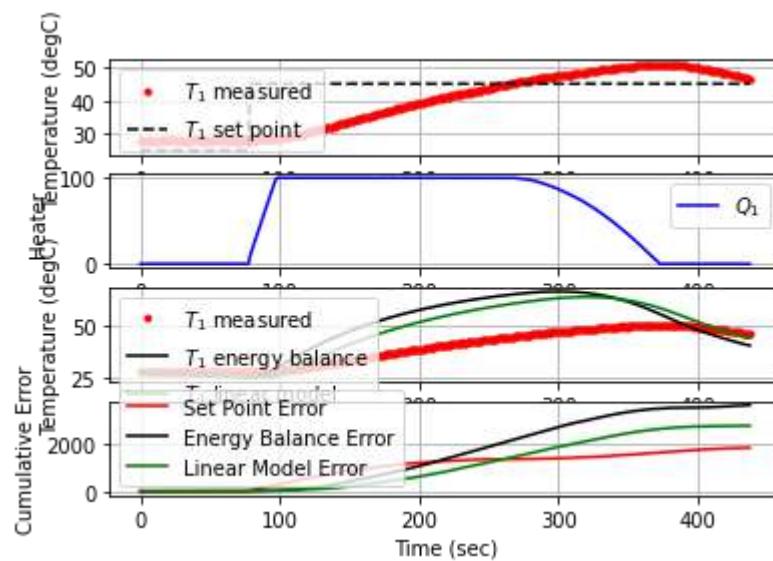




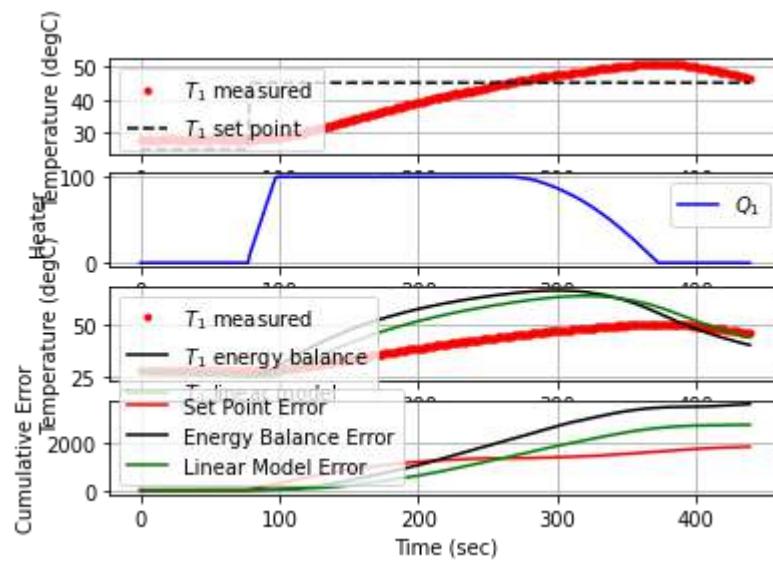
437.6 45.00 46.63 0.00 -0.33 0.43 0.00



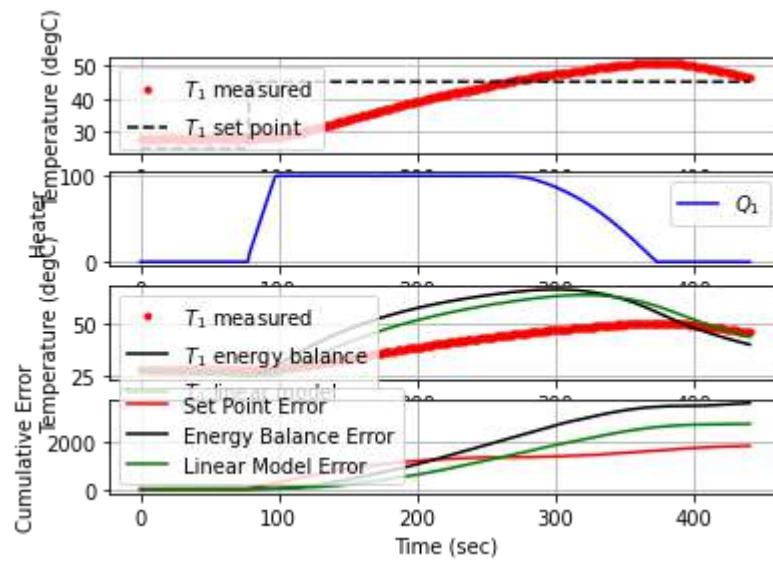
439.0 45.00 46.62 0.00 -0.33 0.43 0.00



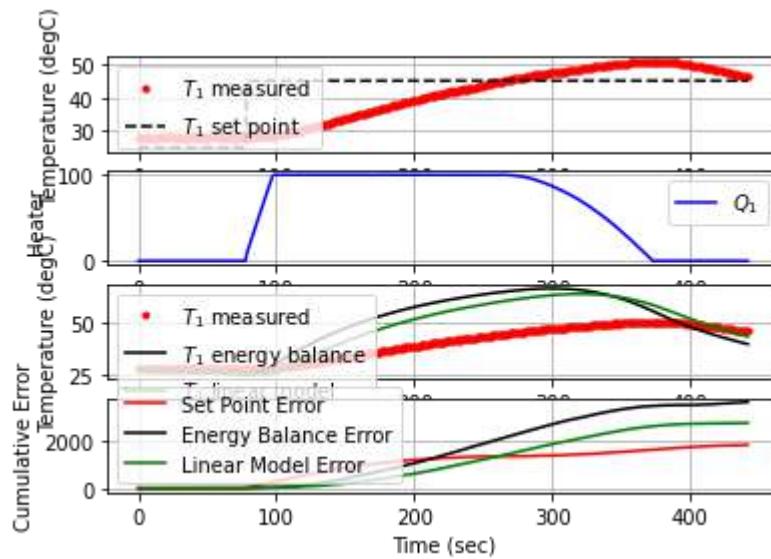
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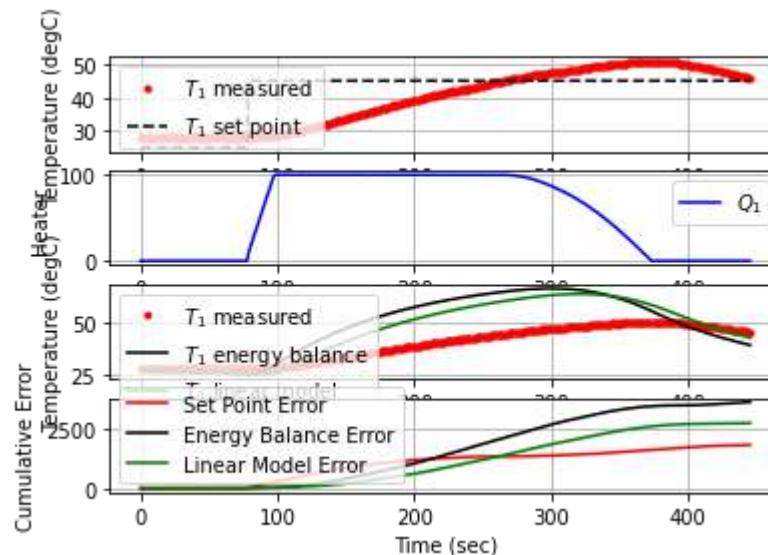
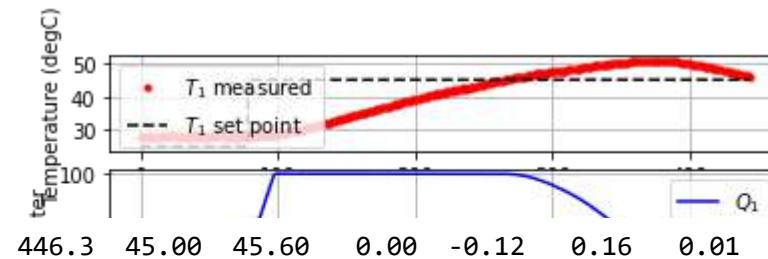
441.9 45.00 46.21 0.00 -0.25 0.43 0.01



443.6 45.00 46.08 0.00 -0.22 0.43 0.01

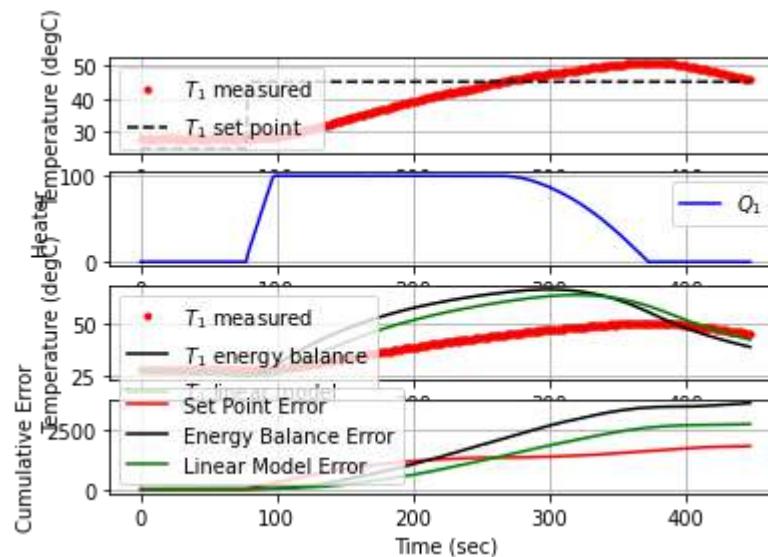


444.9 45.00 45.72 0.03 -0.15 0.16 0.02

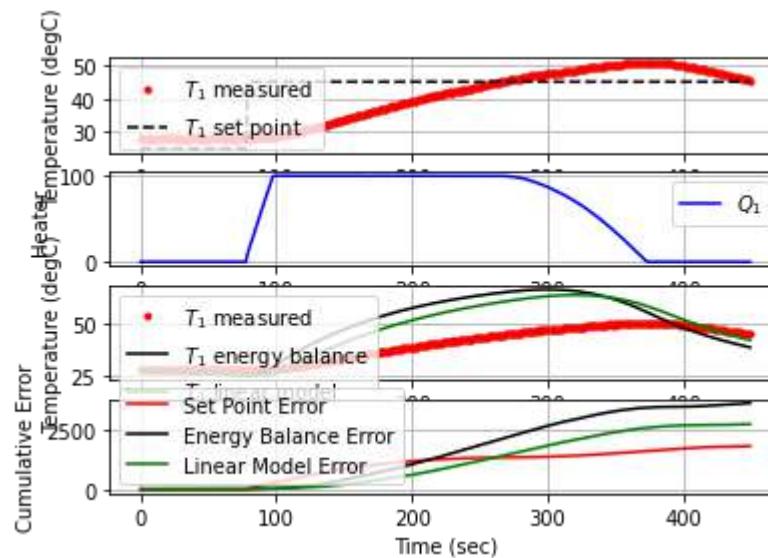


447.7 45.00 45.59 0.00 -0.12 0.16 0.00

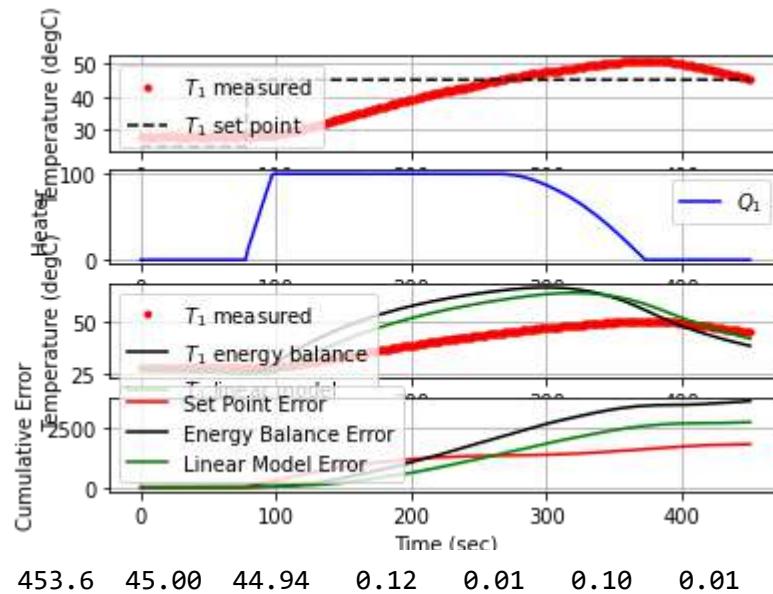
degC
449.1 45.00 45.32 0.00 -0.07 0.16 0.01



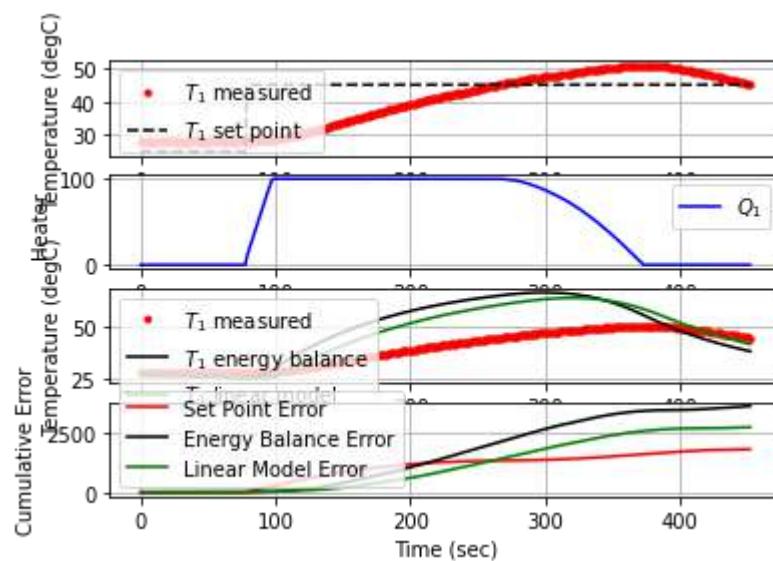
450.7 45.00 45.15 0.08 -0.03 0.10 0.01



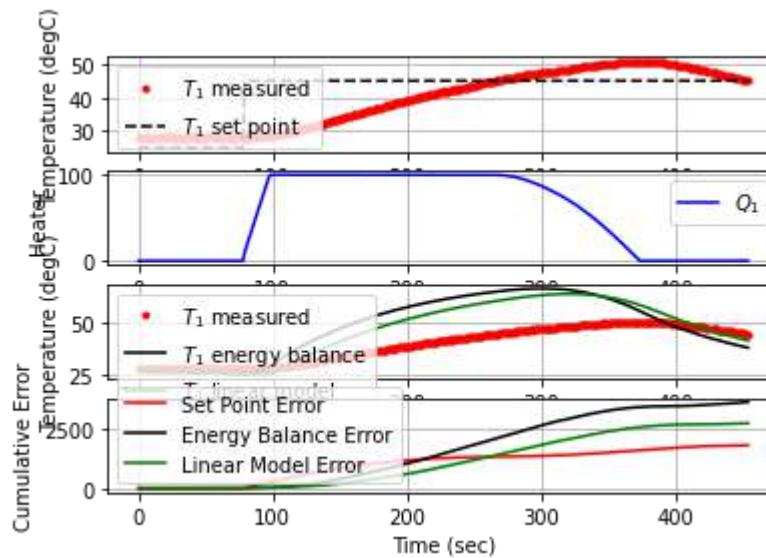
452.1 45.00 45.07 0.06 -0.01 0.07 0.00



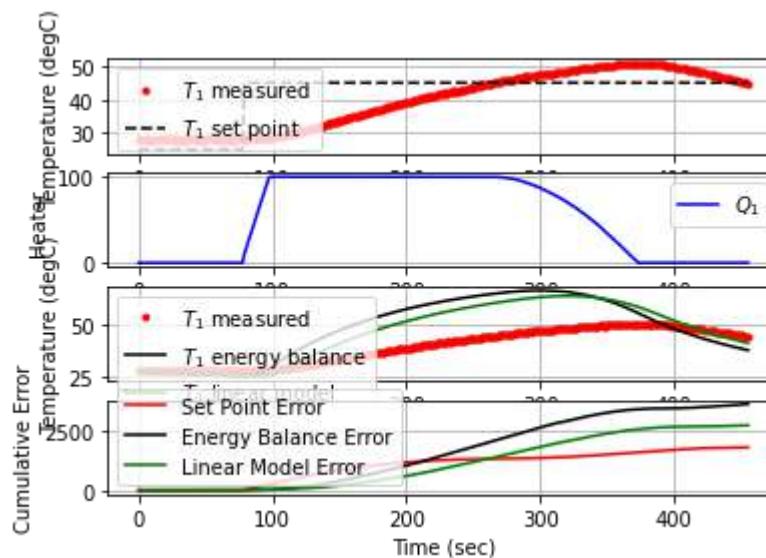
453.6 45.00 44.94 0.12 0.01 0.10 0.01



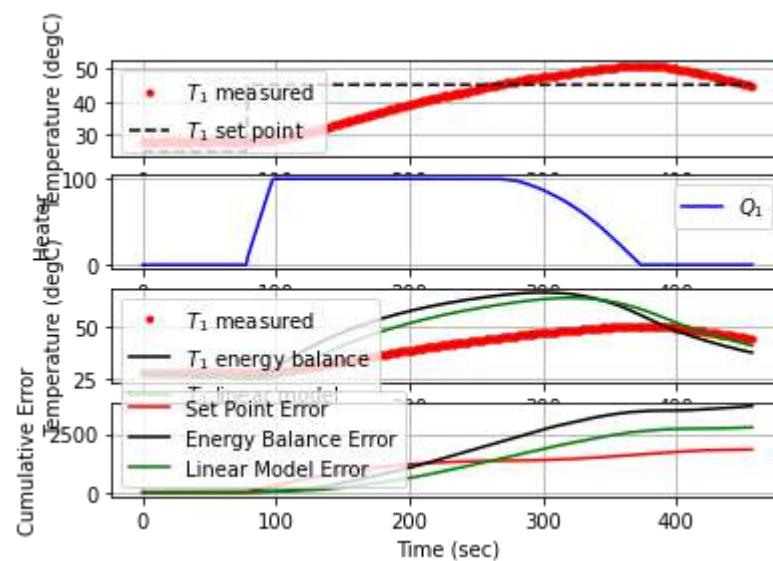
455.1 45.00 44.74 0.28 0.06 0.21 0.01



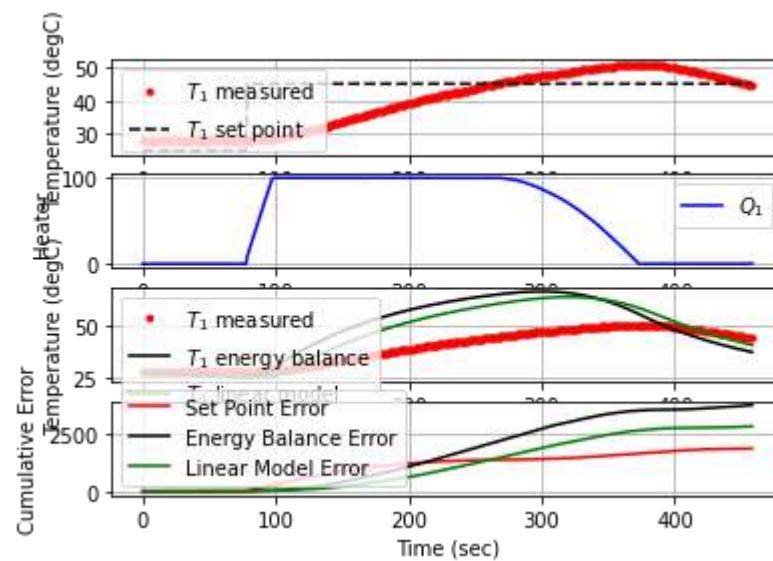
456.6 45.00 44.72 0.38 0.06 0.32 0.00



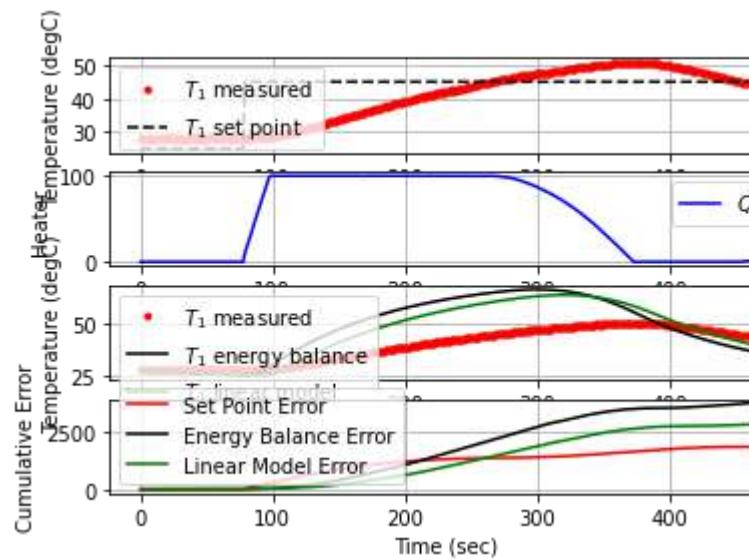
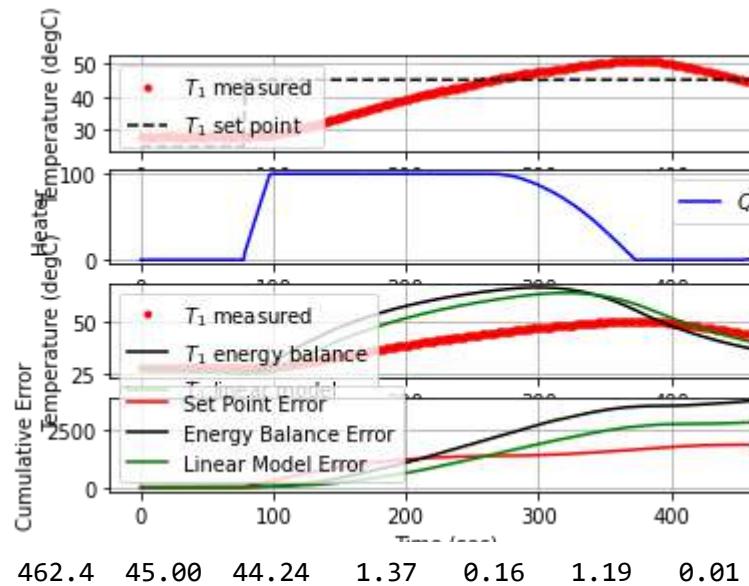
458.1 45.00 44.63 0.56 0.08 0.48 0.00



459.7 45.00 44.51 0.81 0.10 0.70 0.01

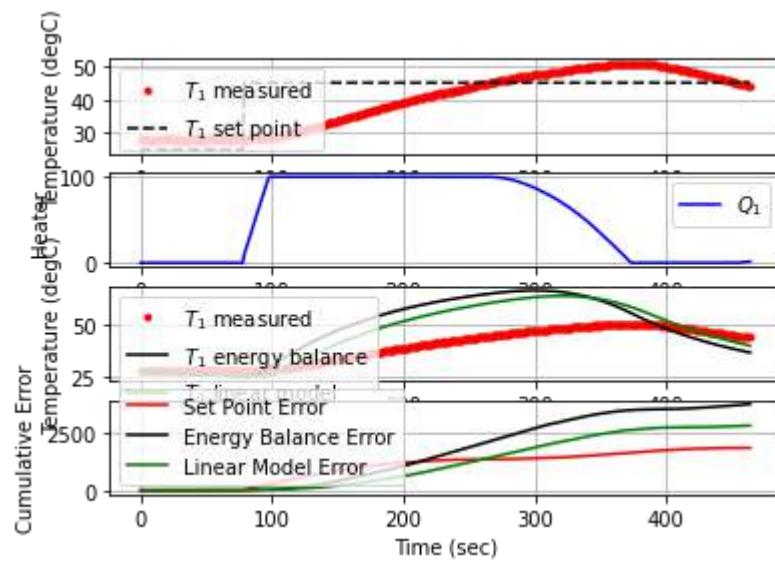
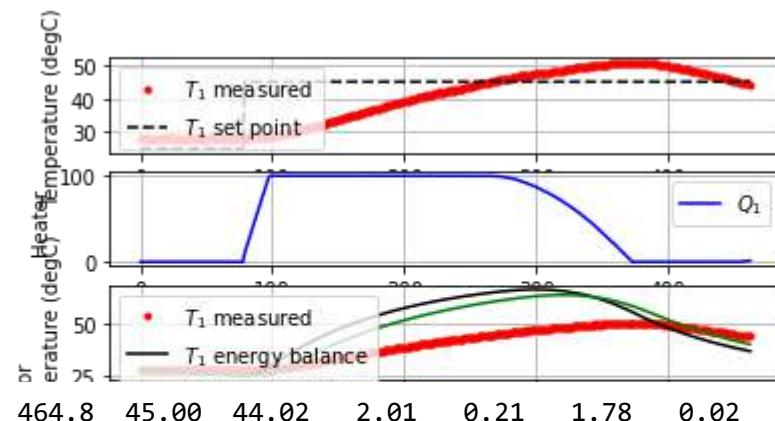


461.1 45.00 44.43 1.05 0.12 0.93 0.00

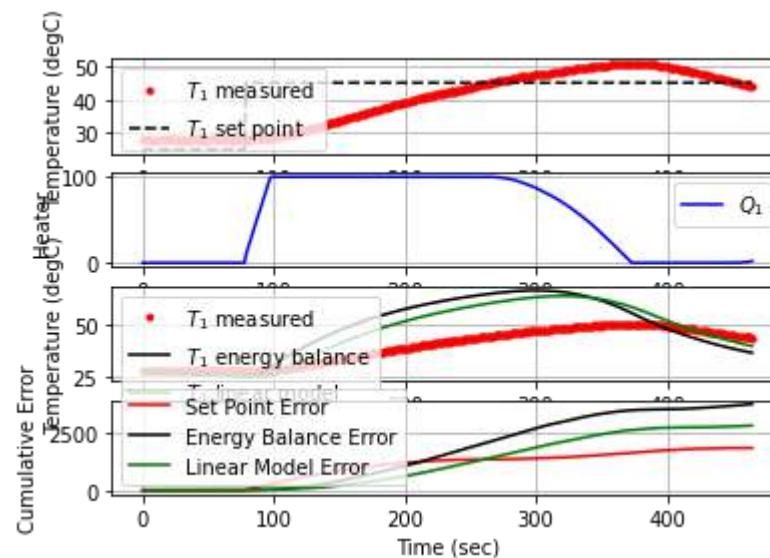


462.4 45.00 44.24 1.37 0.16 1.19 0.01

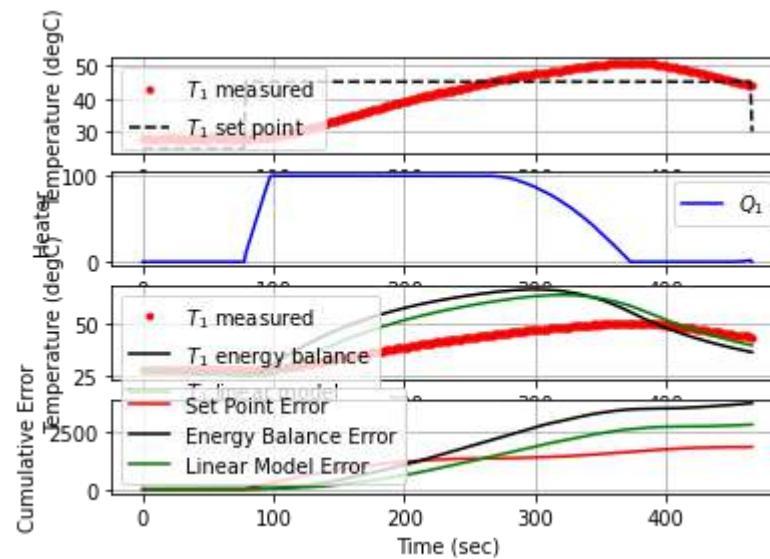
463.6 45.00 44.25 1.61 0.16 1.45 -0.00



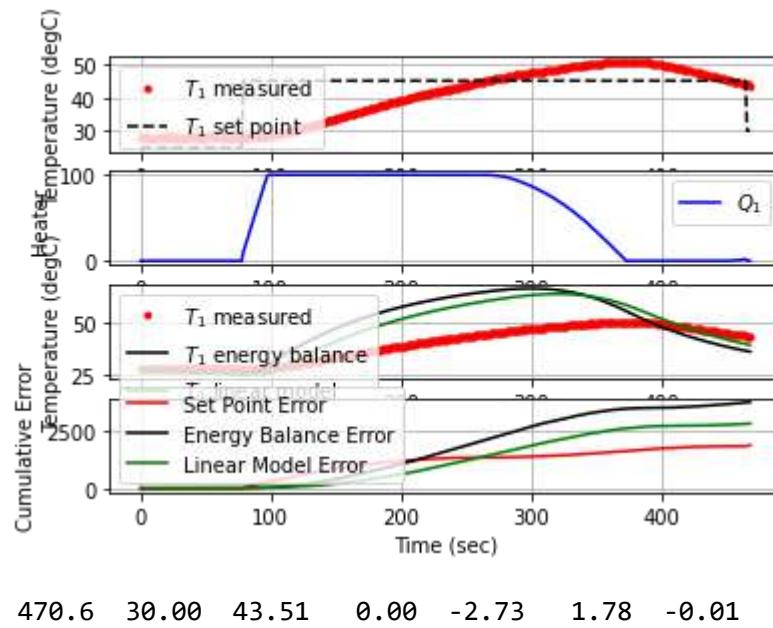
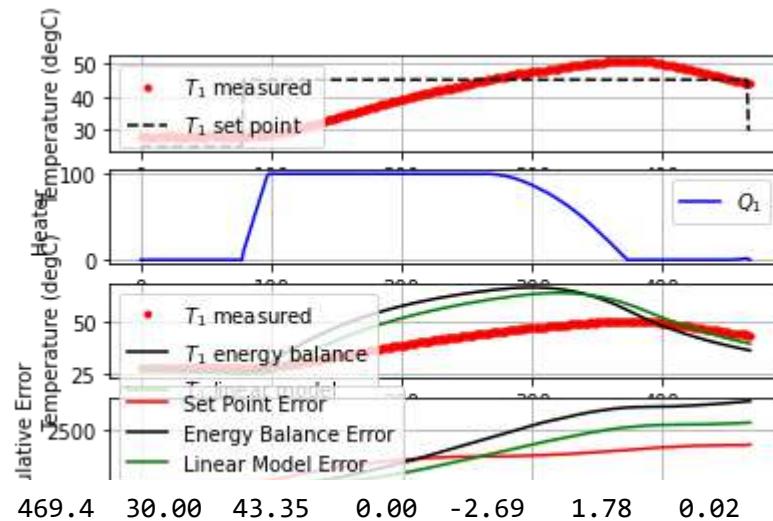
466.0 30.00 43.97 0.00 -2.82 1.78 0.00

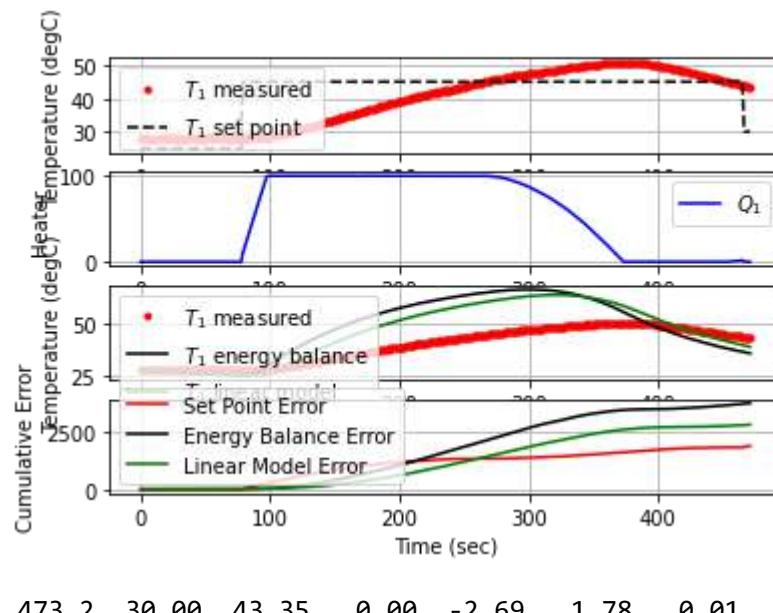
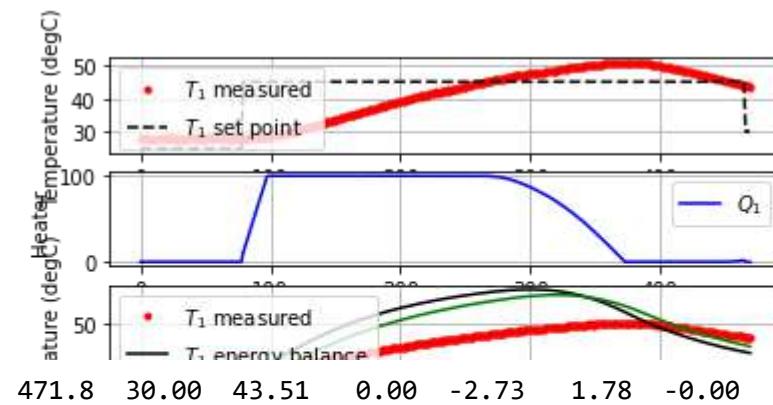


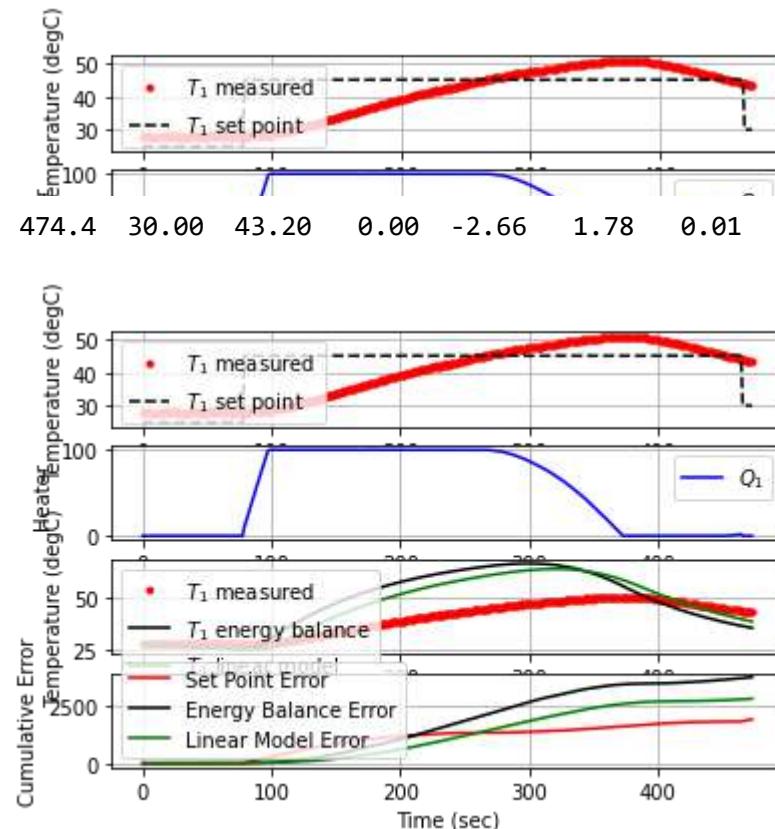
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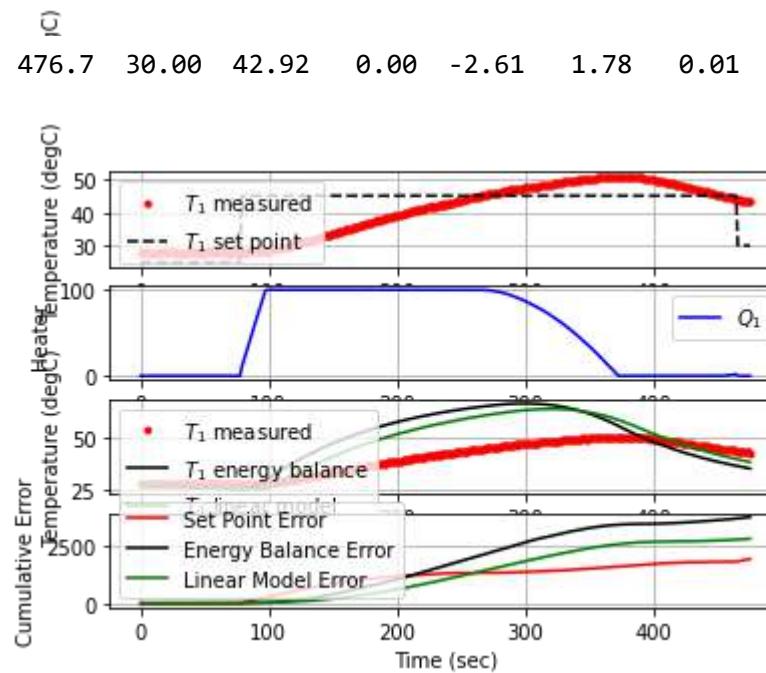
468.2 30.00 43.64 0.00 -2.75 1.78 0.00



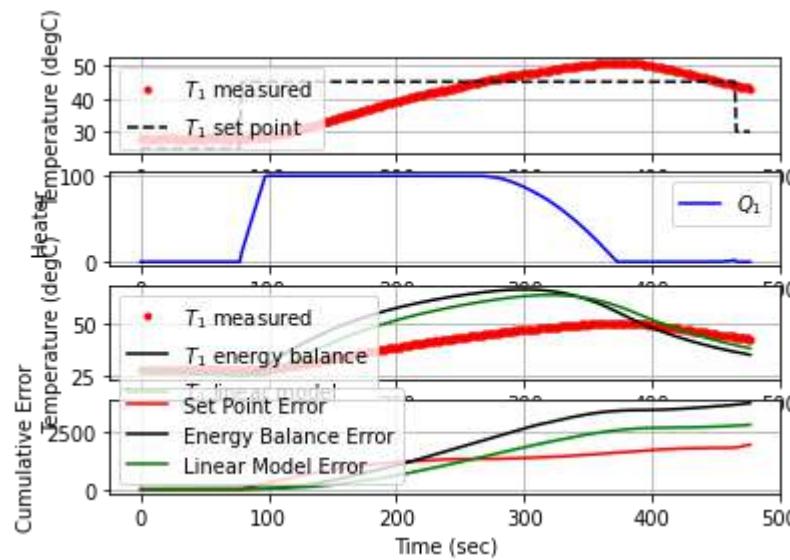




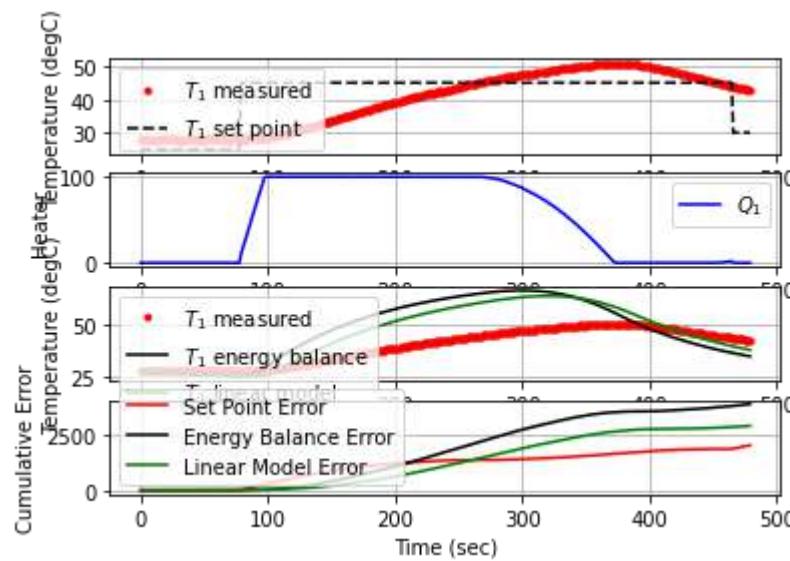
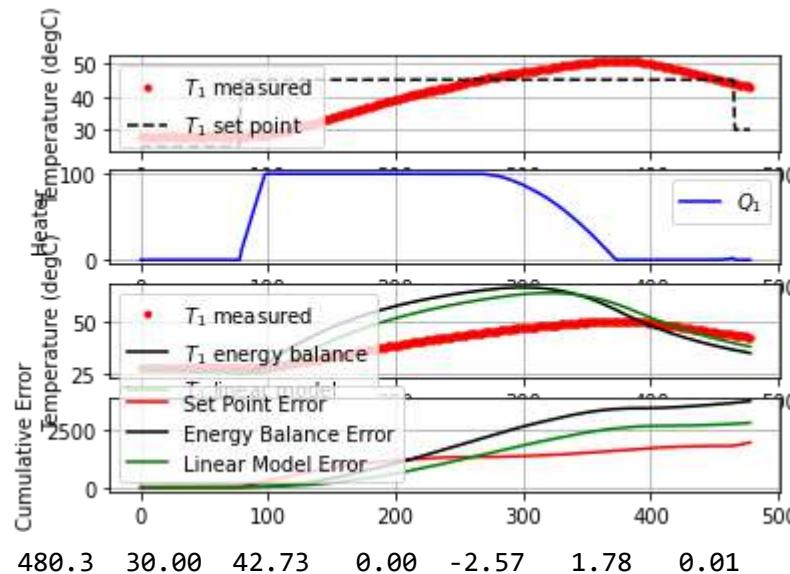
475.6 30.00 43.07 0.00 -2.64 1.78 0.01

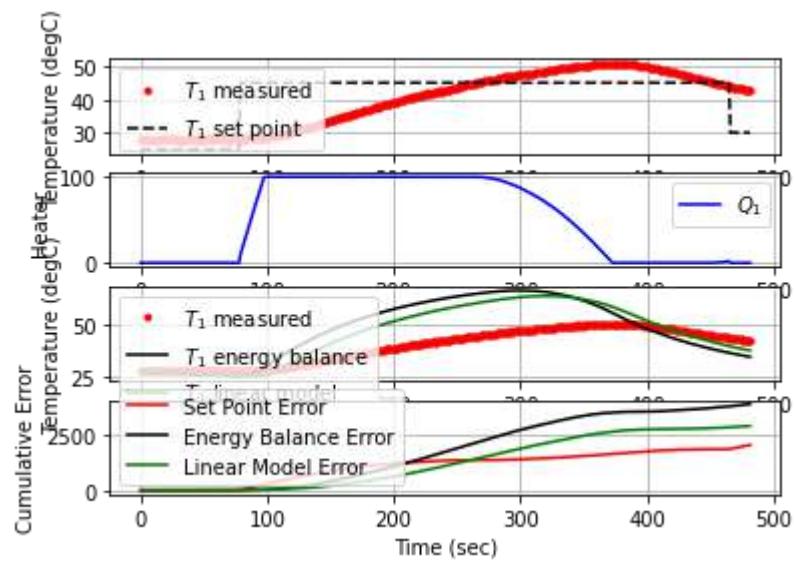
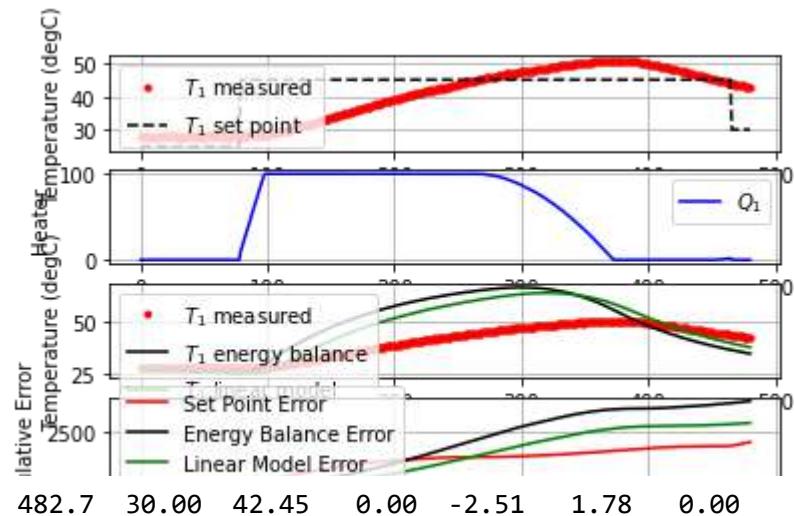


477.8 30.00 42.96 0.00 -2.62 1.78 -0.00

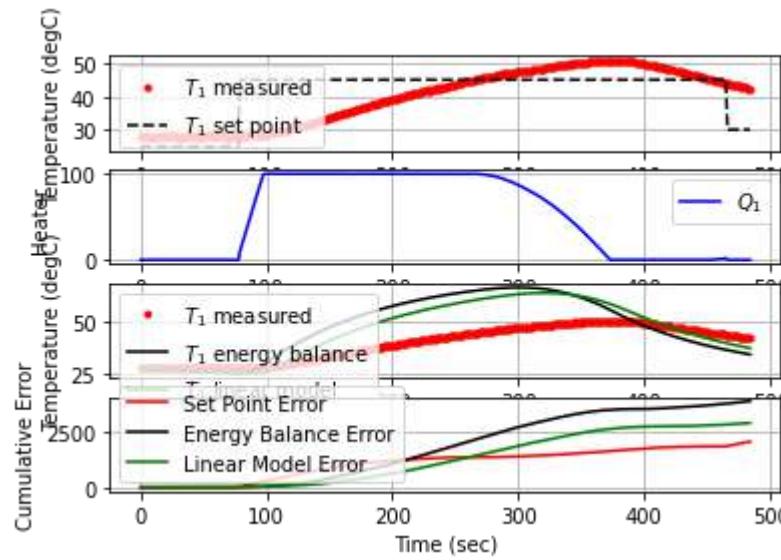
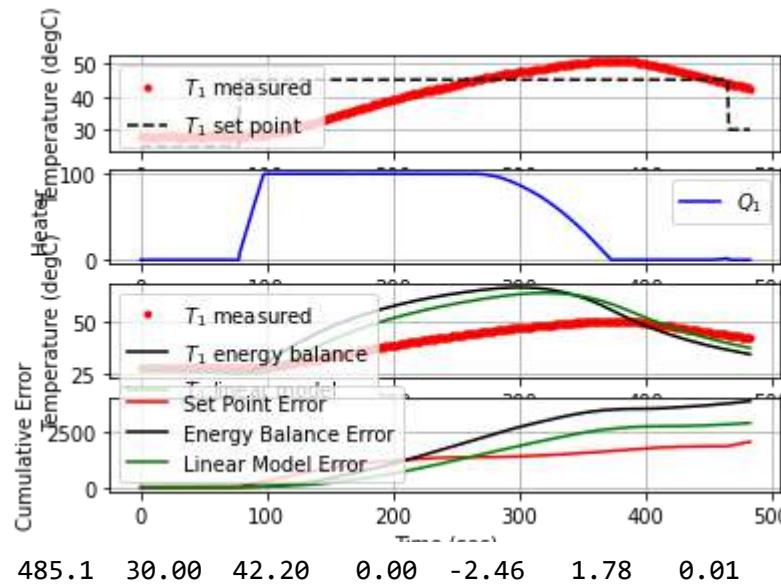


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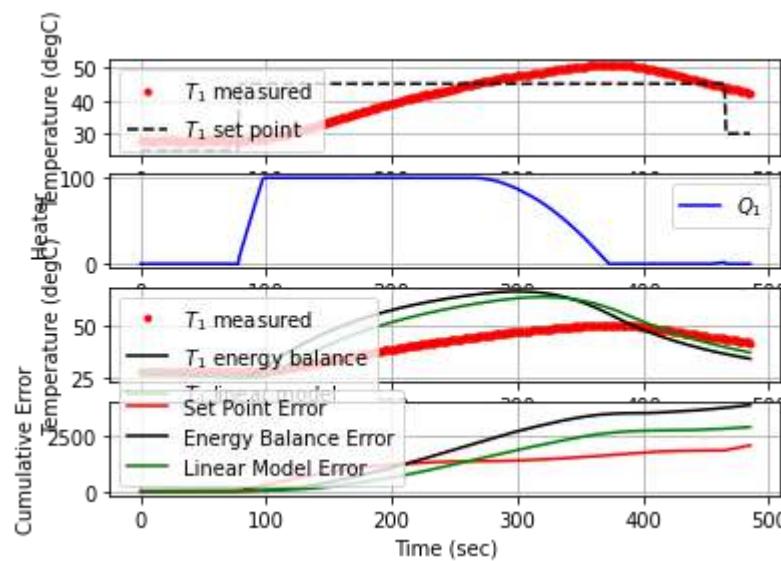




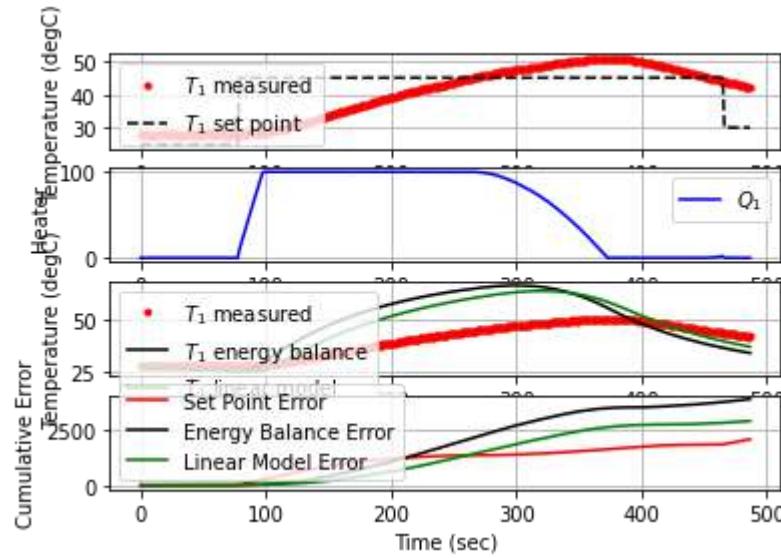
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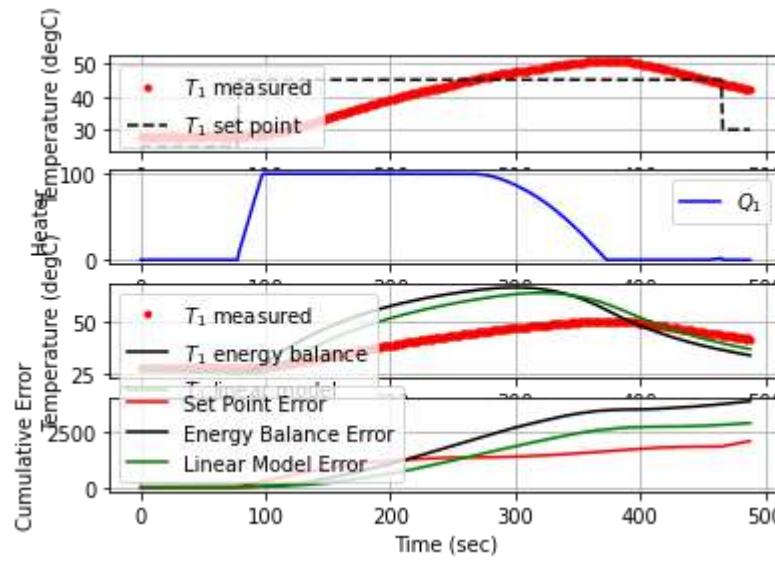
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486.5 30.00 42.44 0.00 -2.51 1.78 -0.01
Connected to MQTT Broker!
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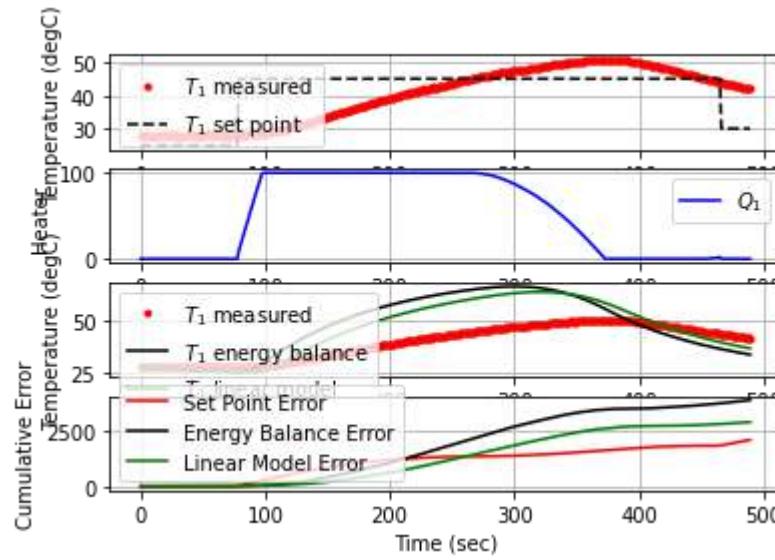
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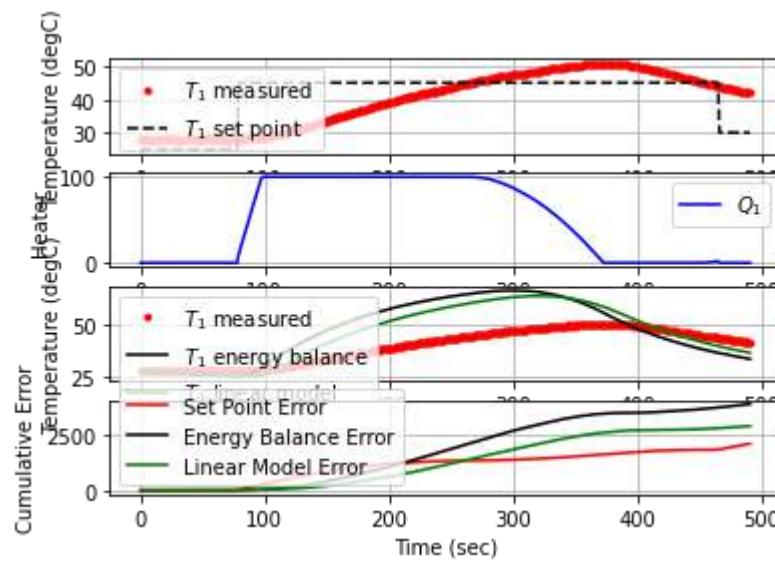
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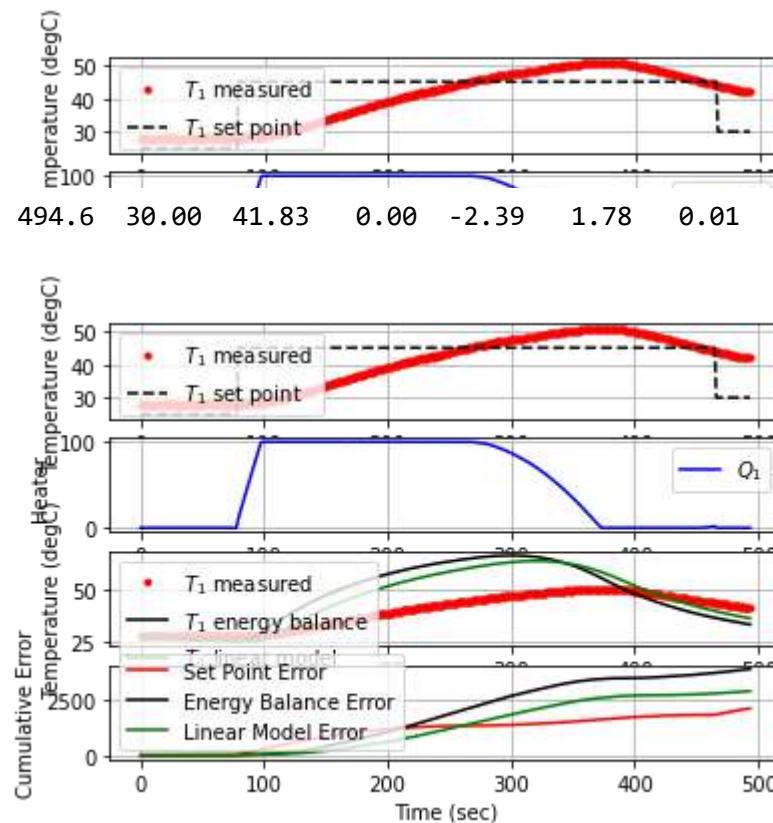
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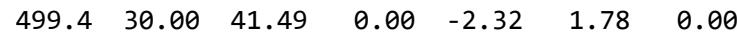
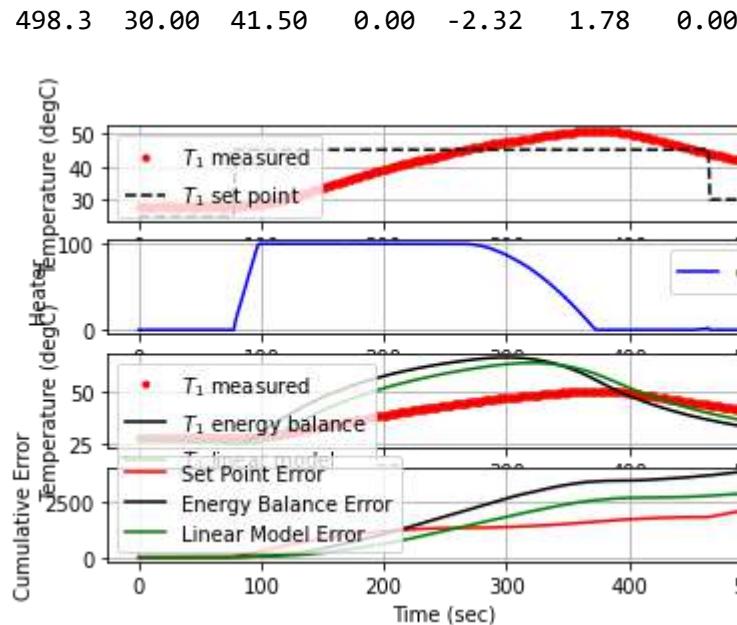
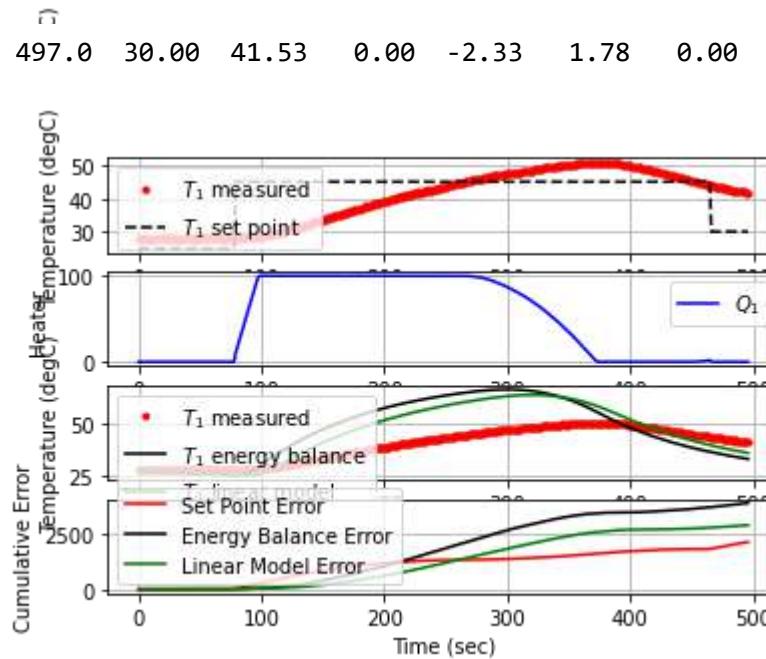
491.9 30.00 41.91 0.00 -2.40 1.78 0.01

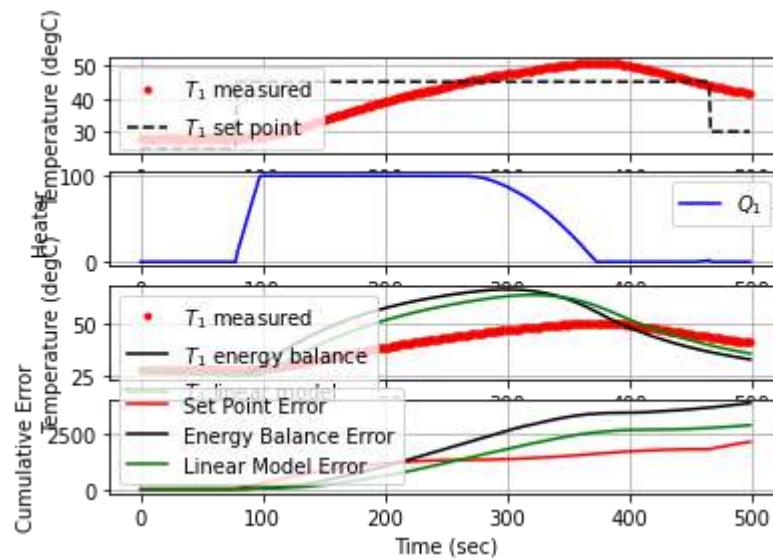


493.3 30.00 42.03 0.00 -2.43 1.78 -0.01

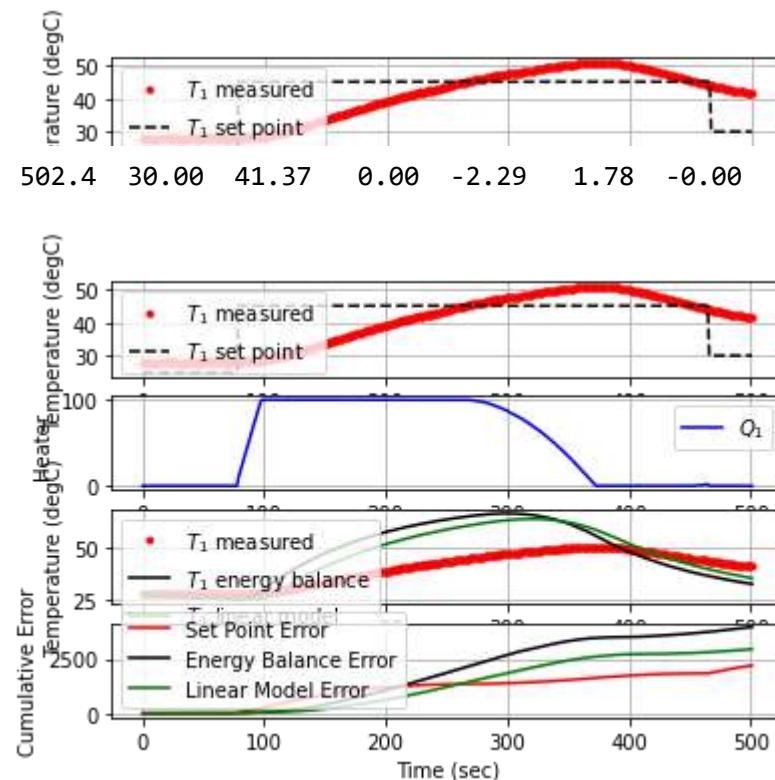


495.8 30.00 41.54 0.00 -2.33 1.78 0.02

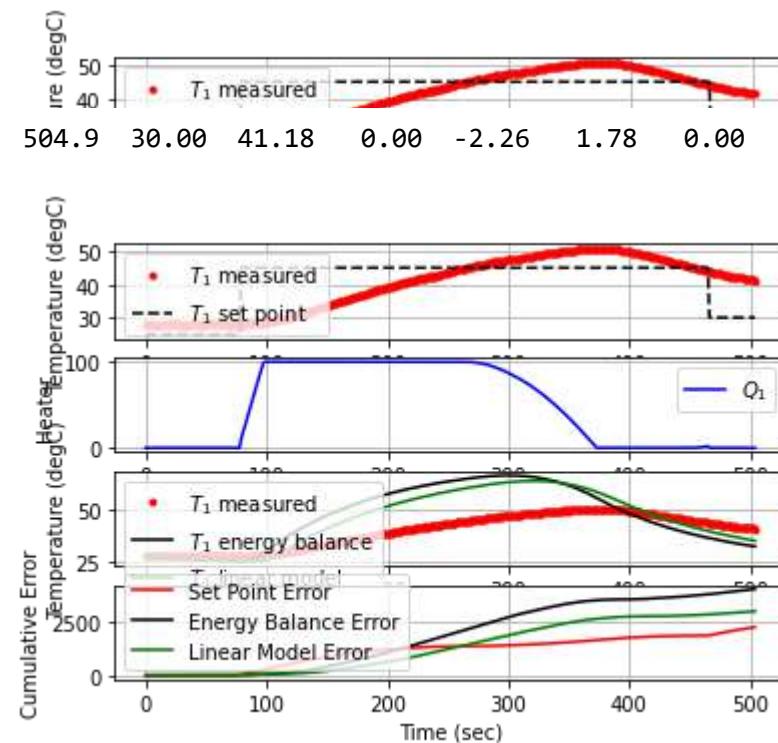




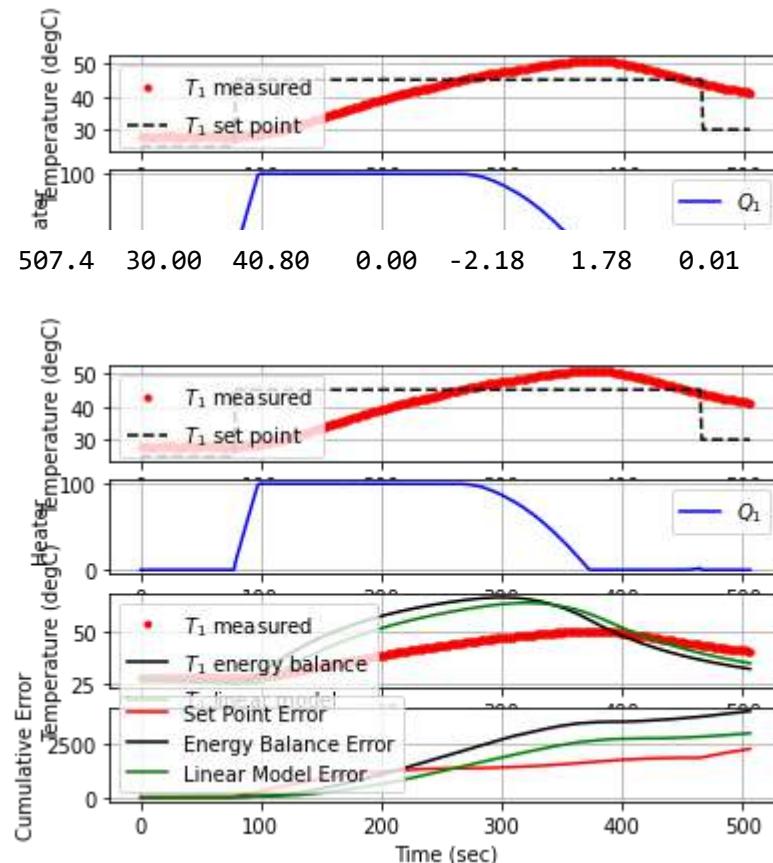
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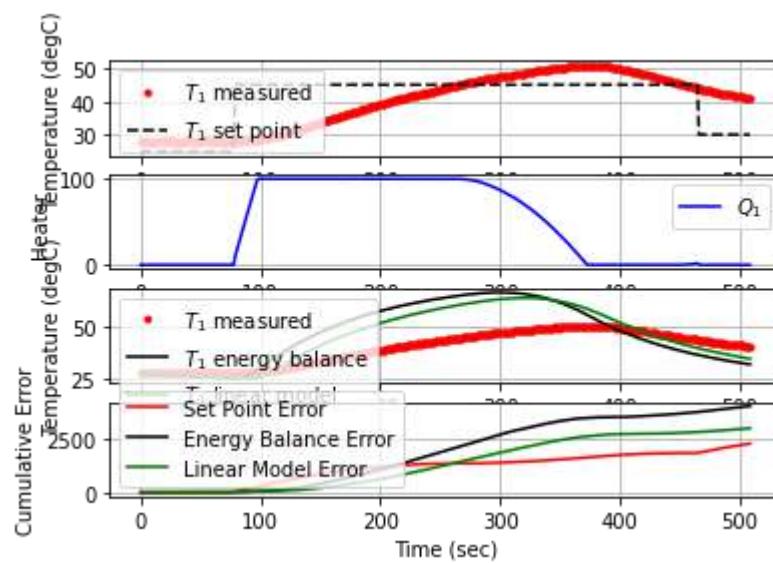
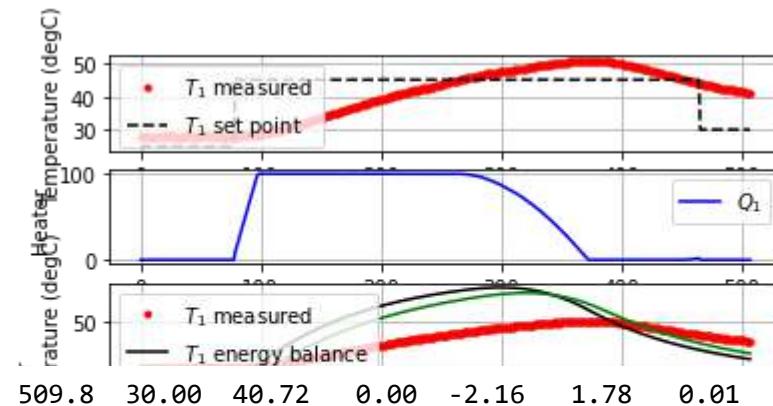
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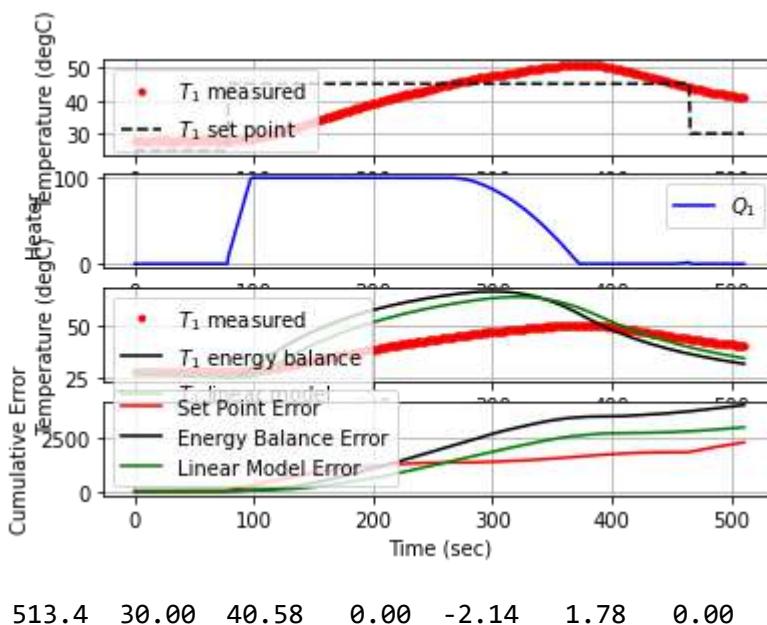
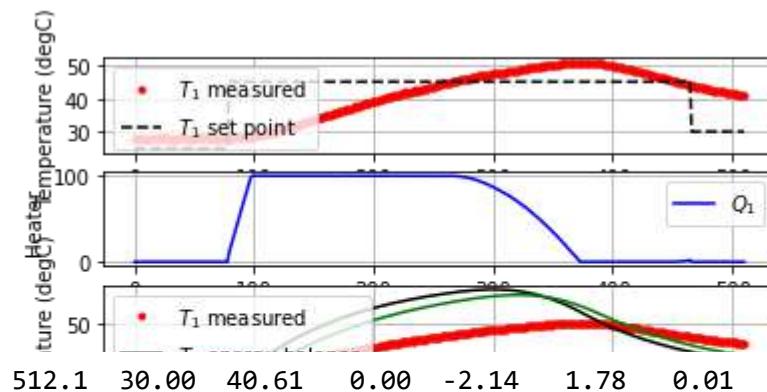
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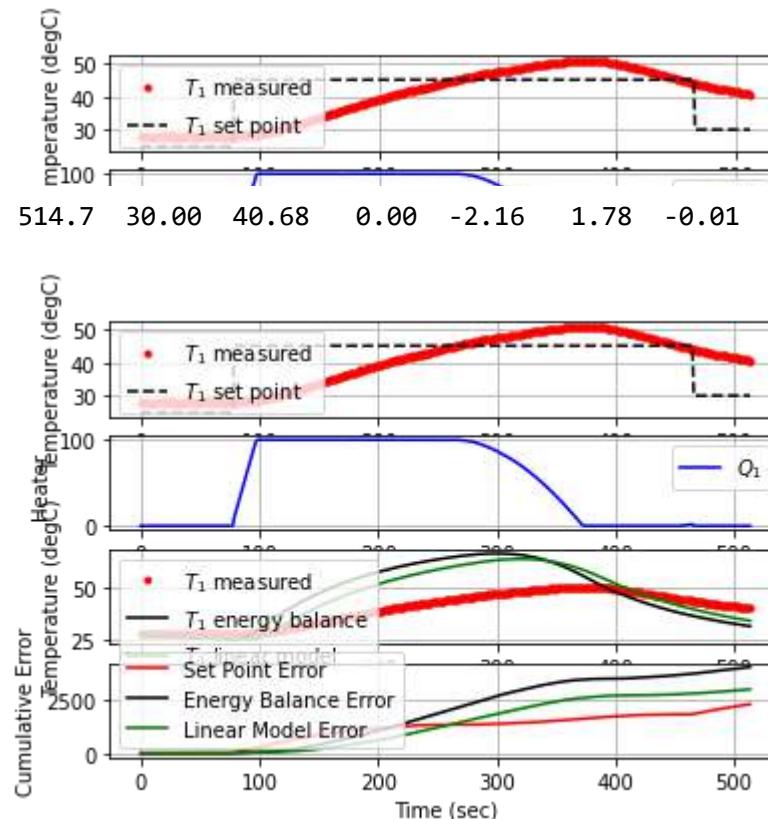


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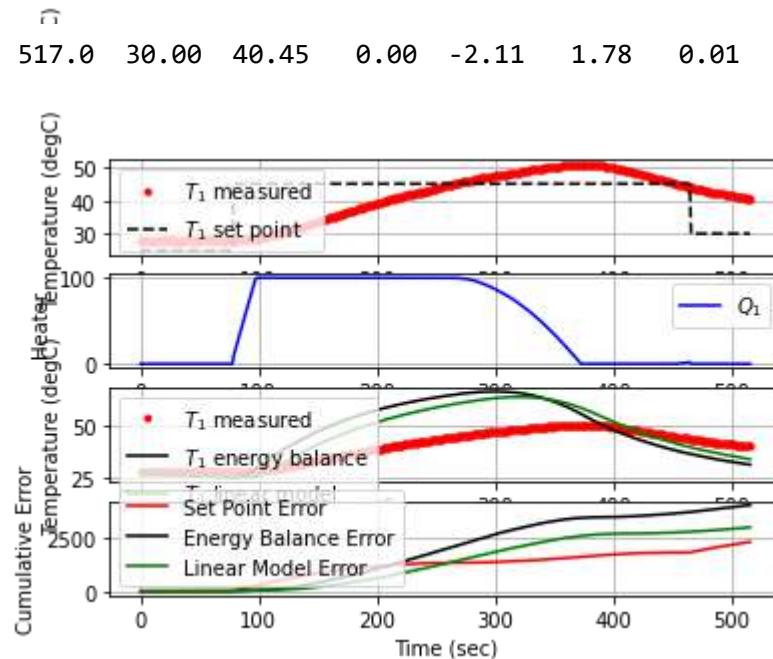


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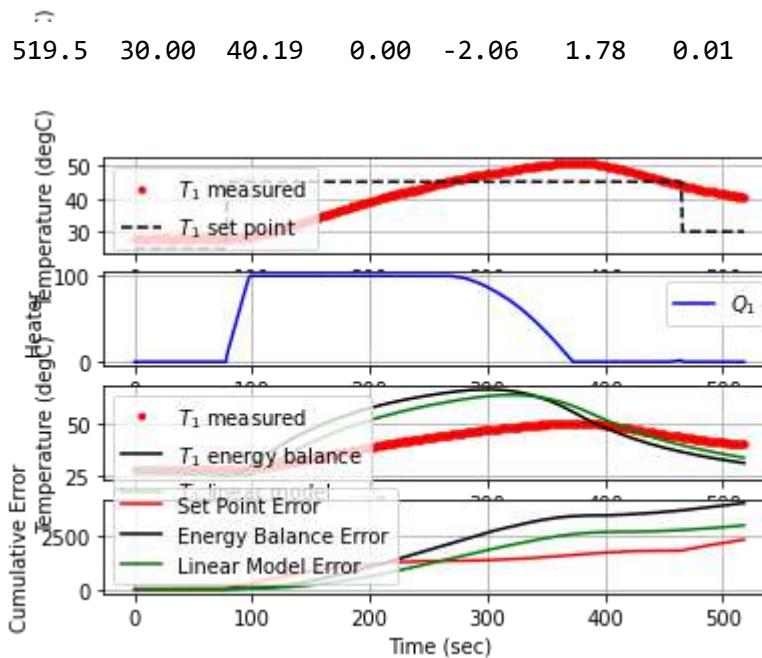




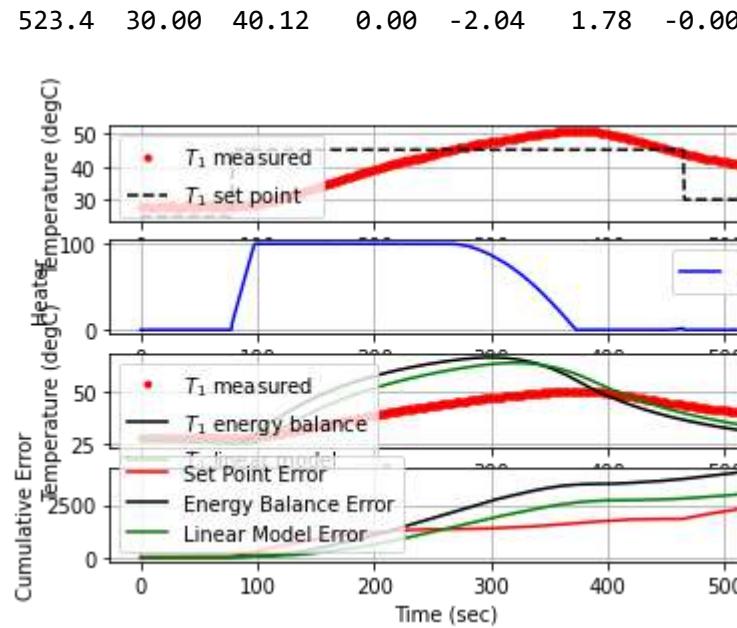
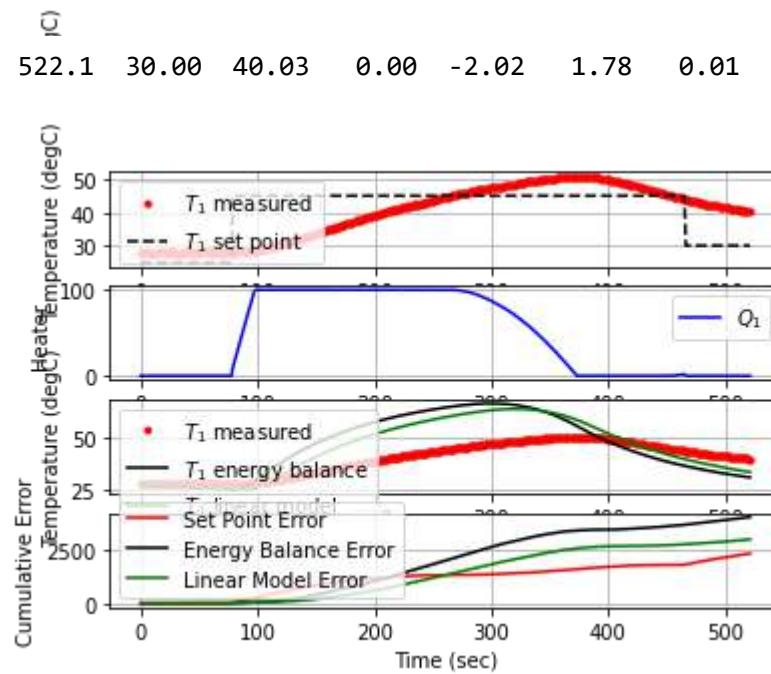
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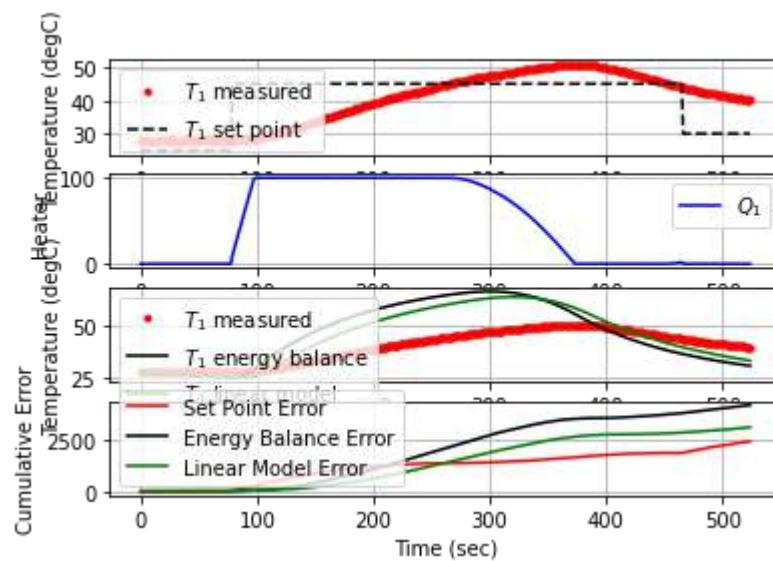
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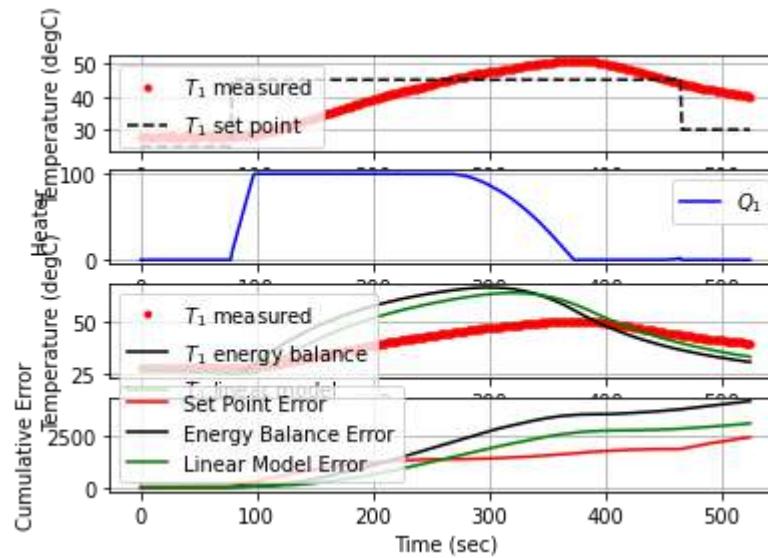
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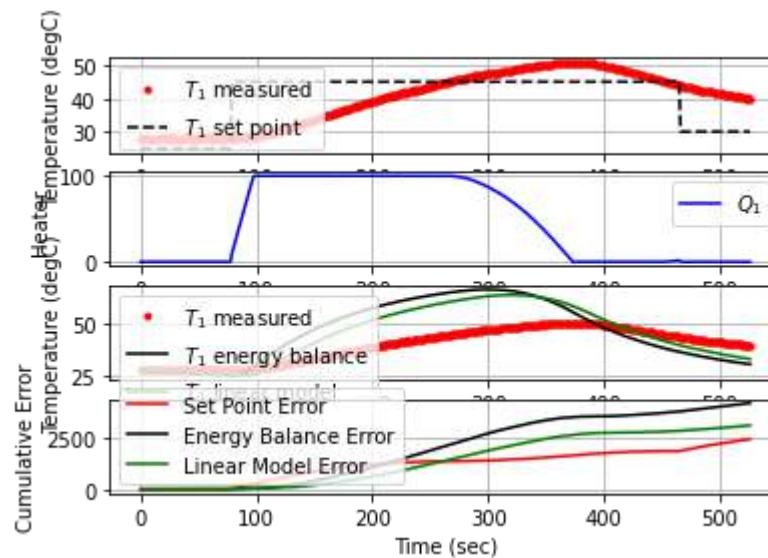
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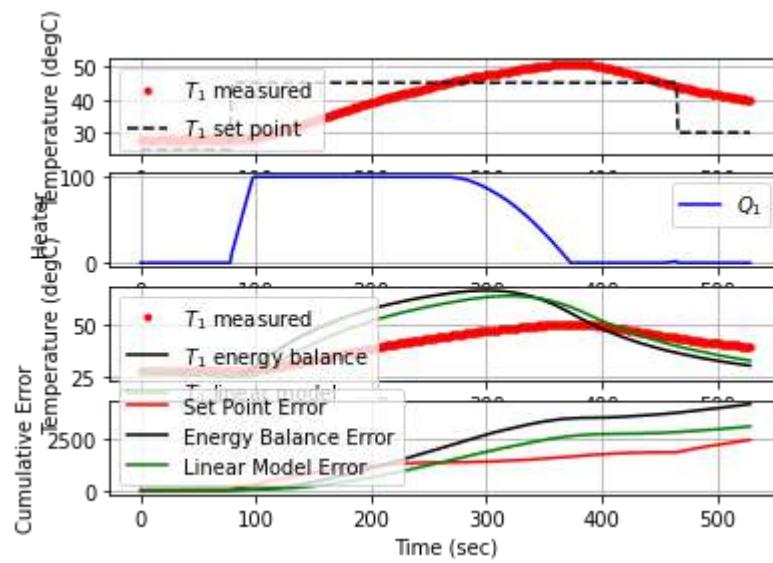
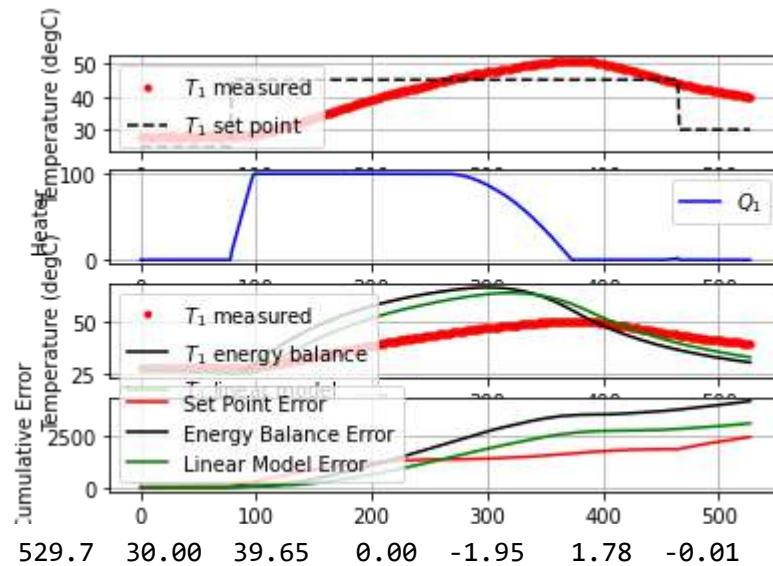
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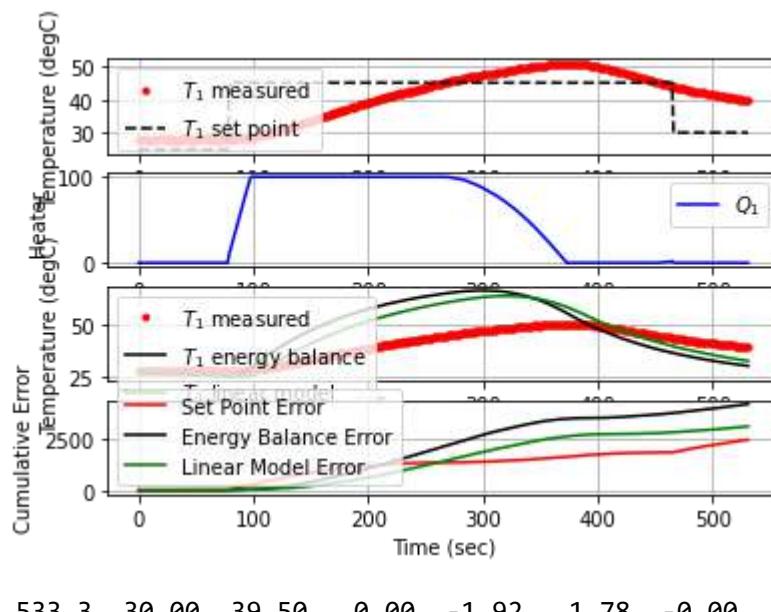
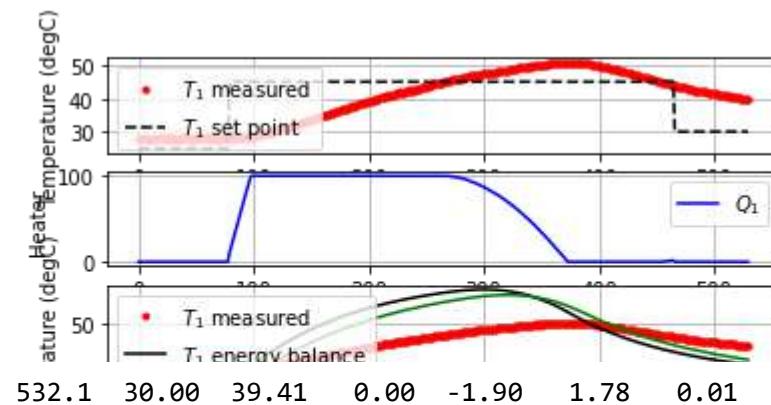


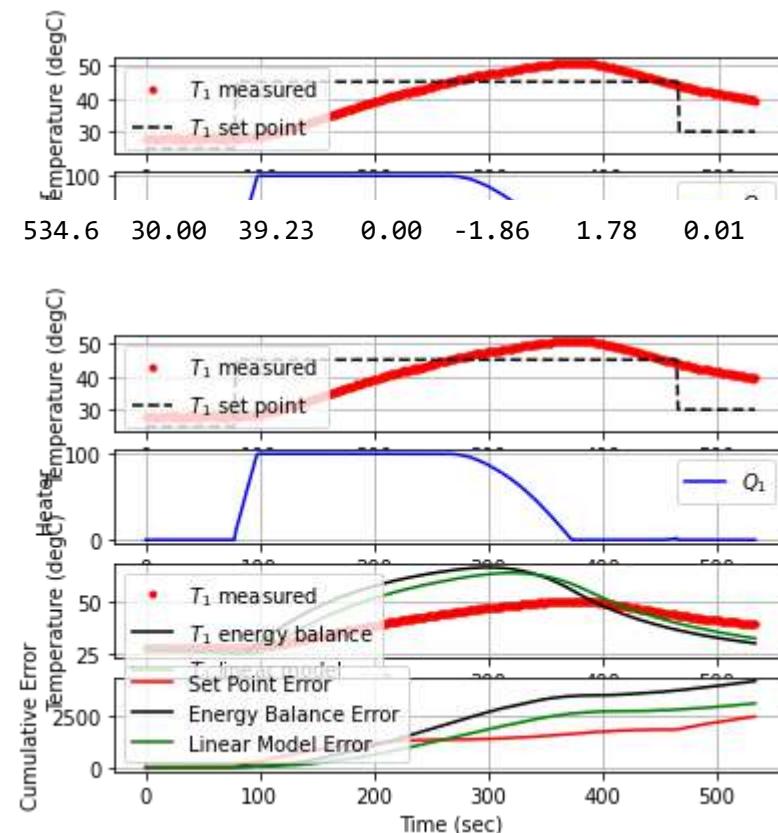
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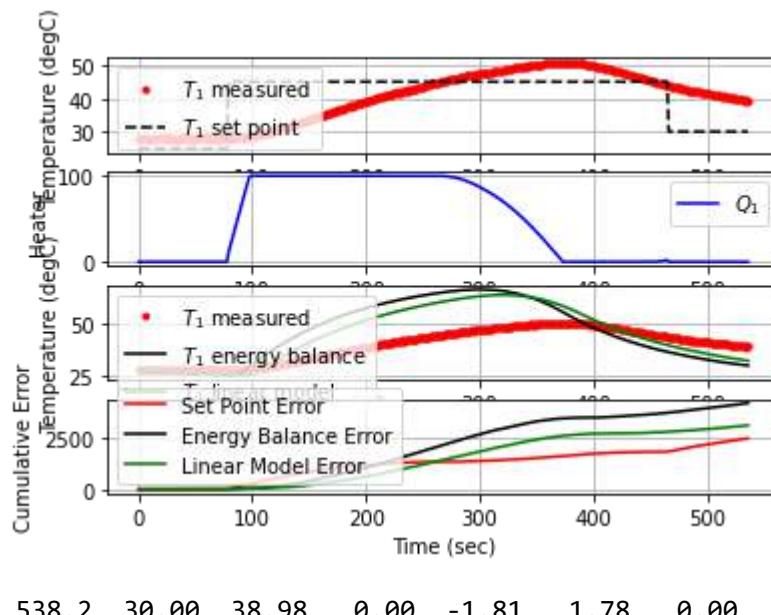
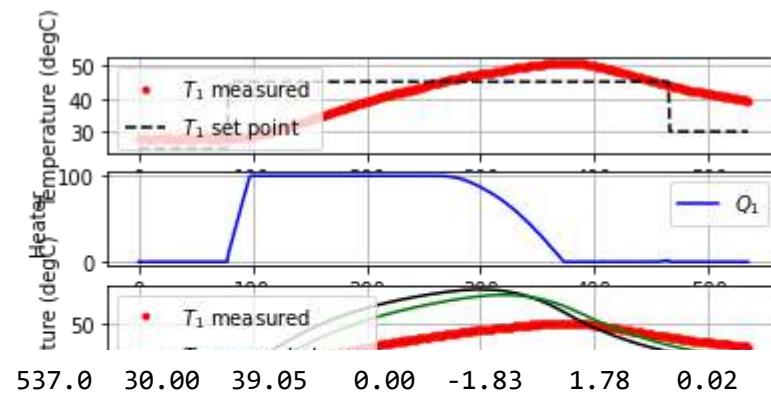
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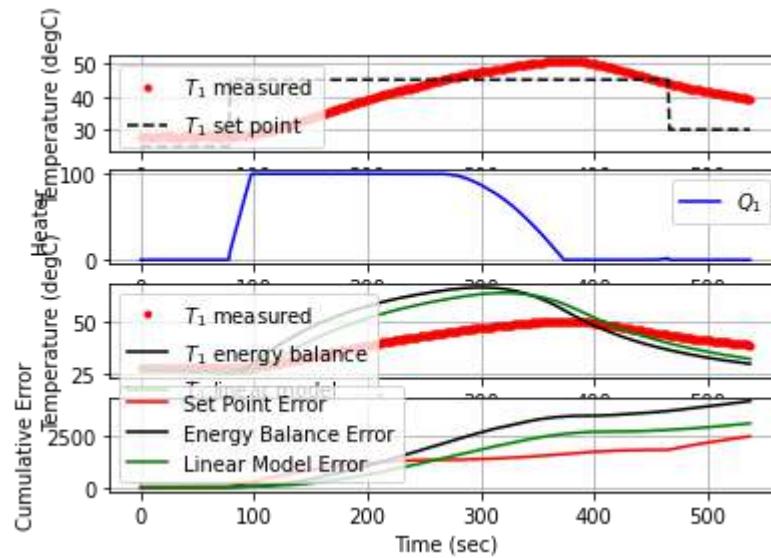
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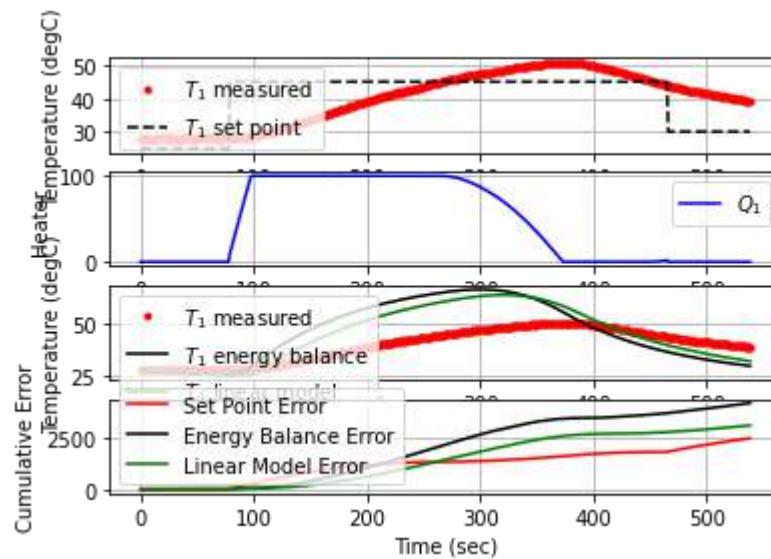


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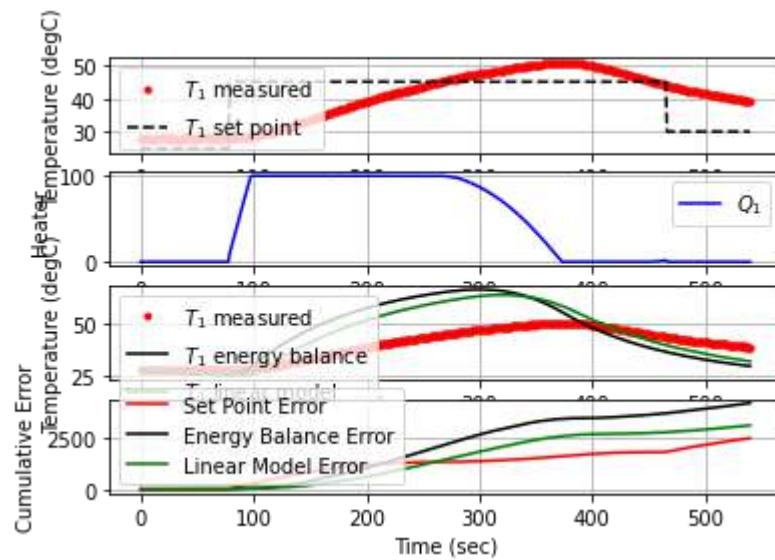




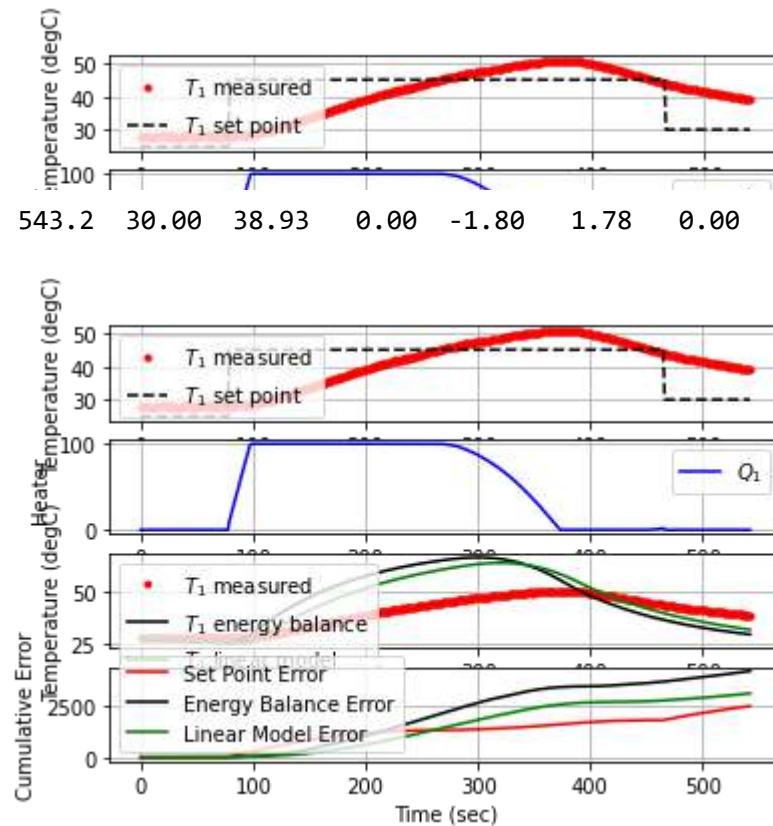
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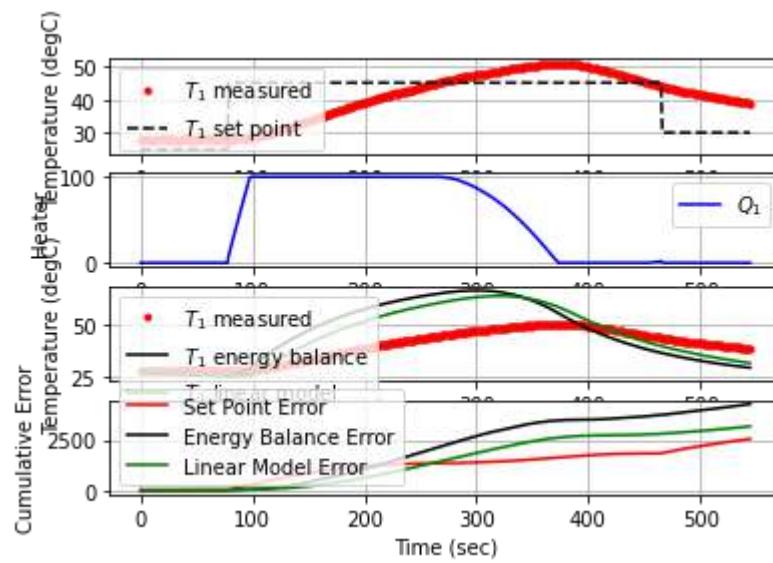
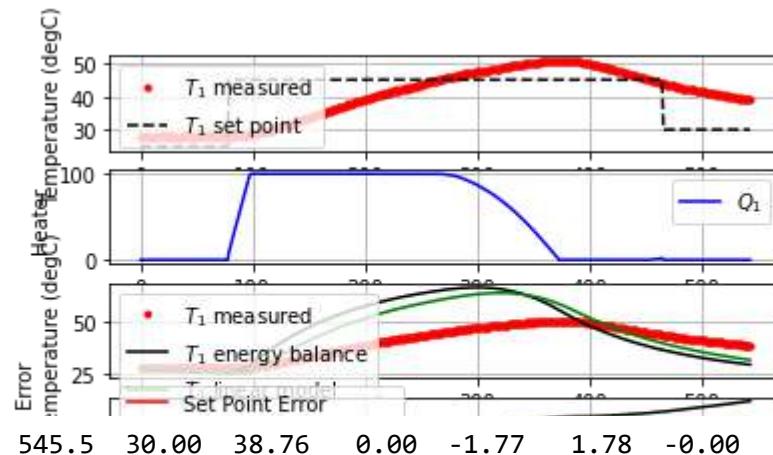
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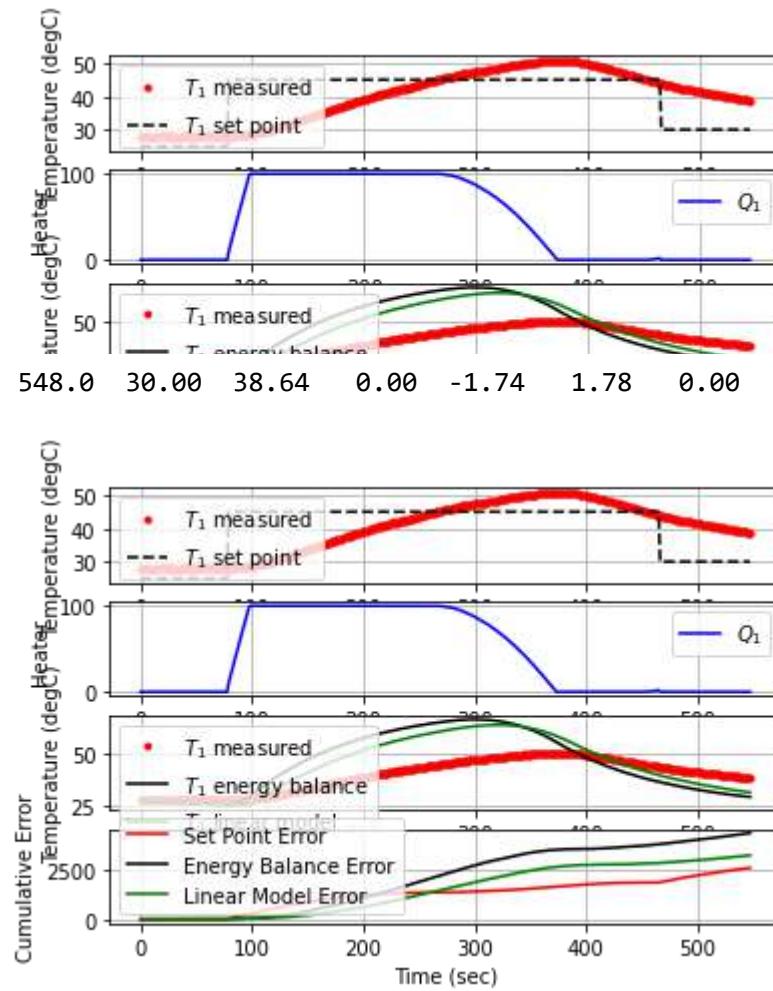
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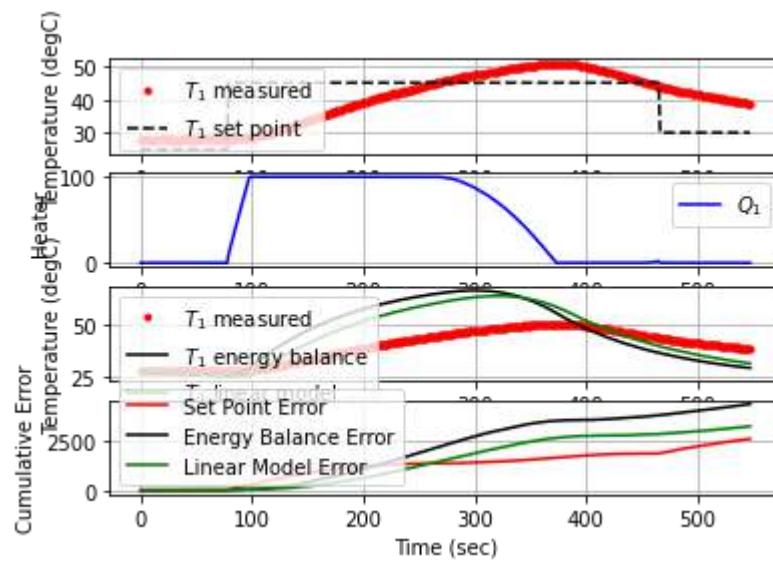
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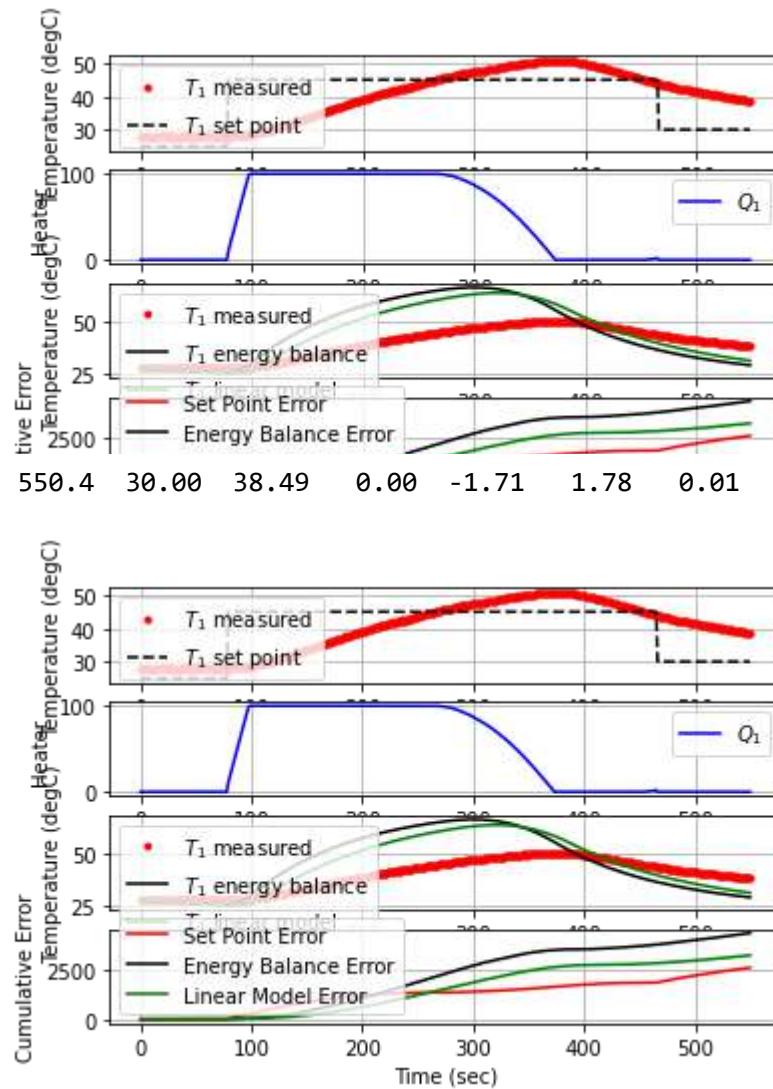
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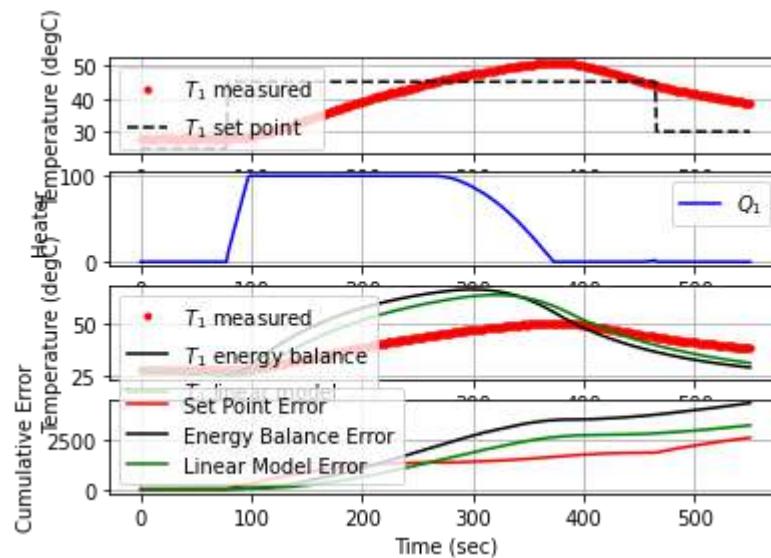
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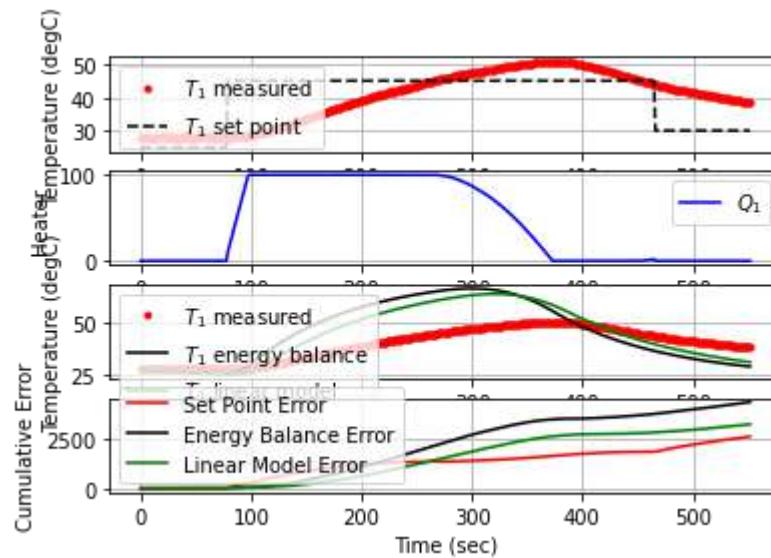
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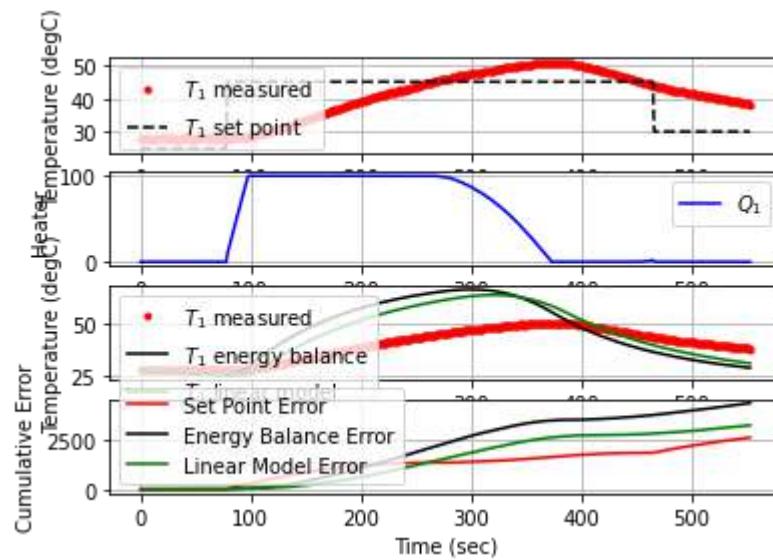
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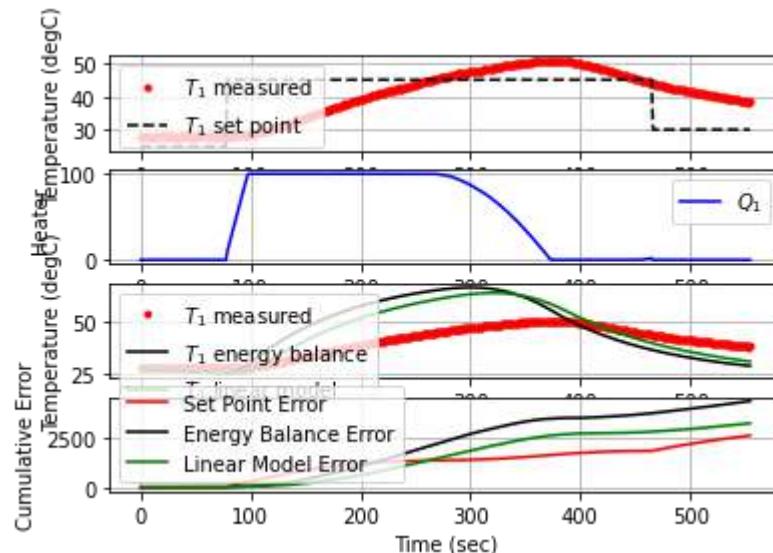
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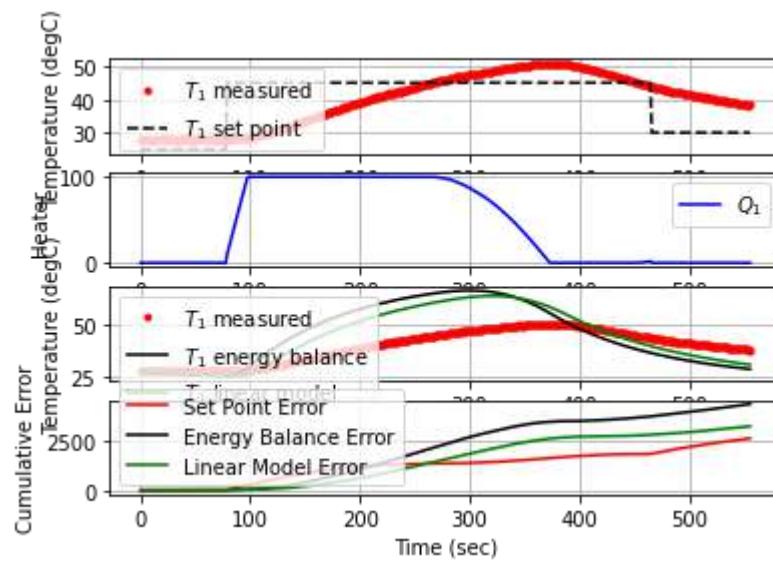
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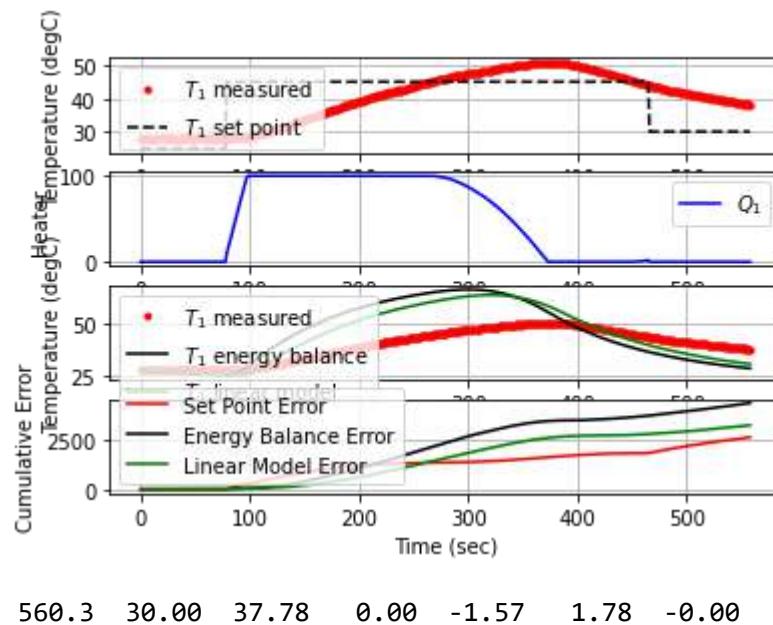
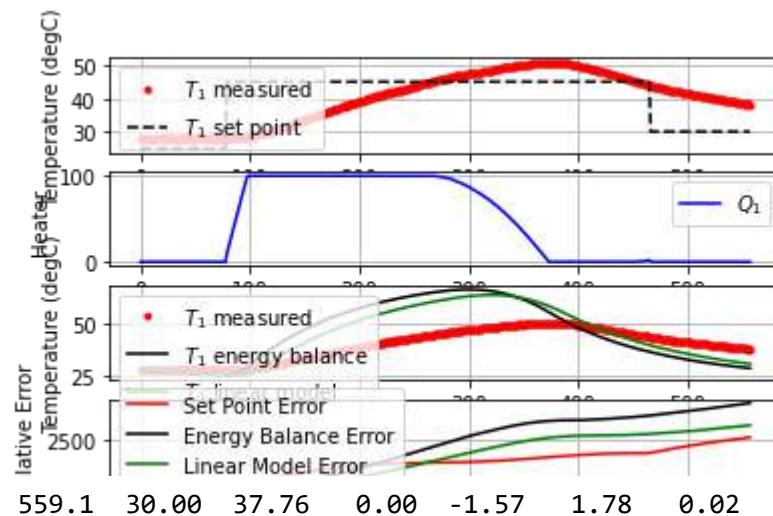
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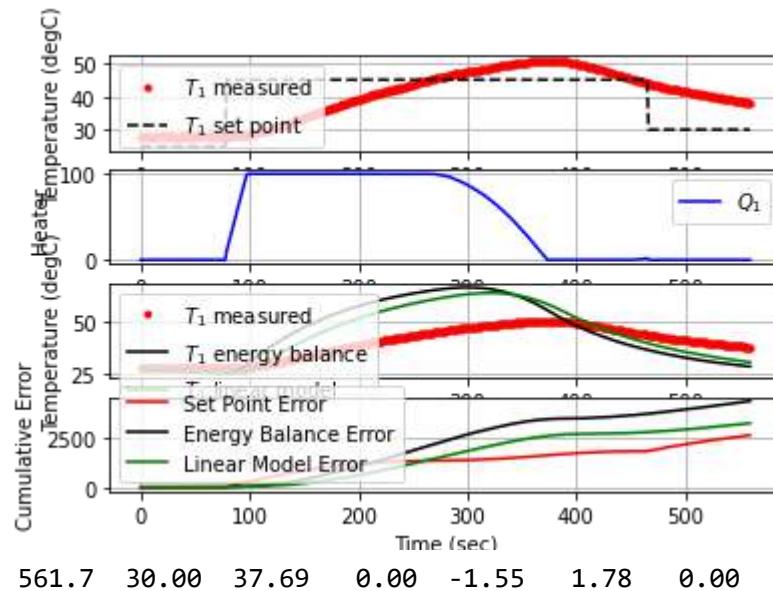


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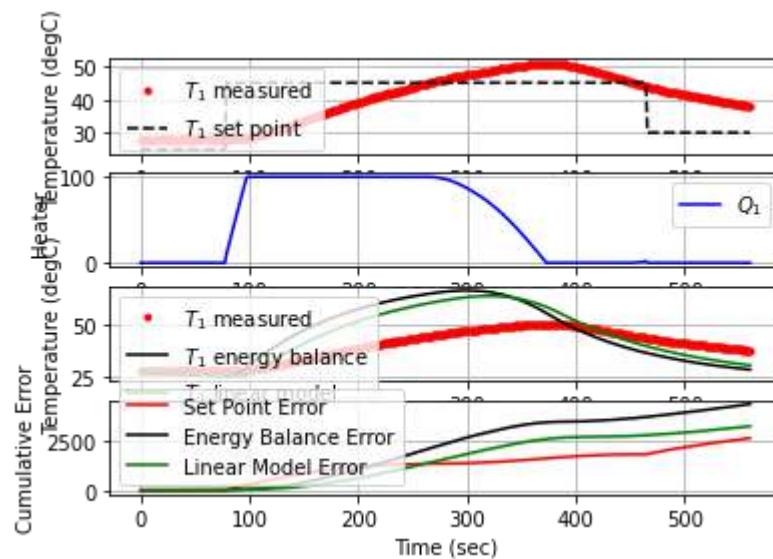


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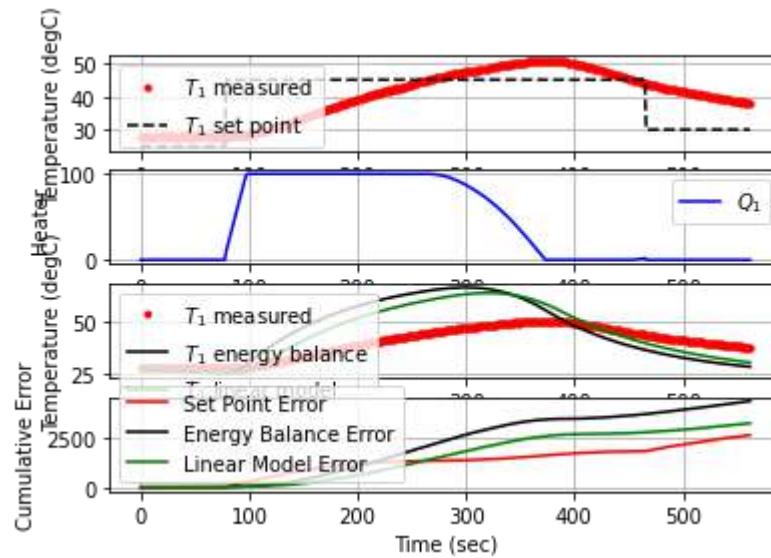




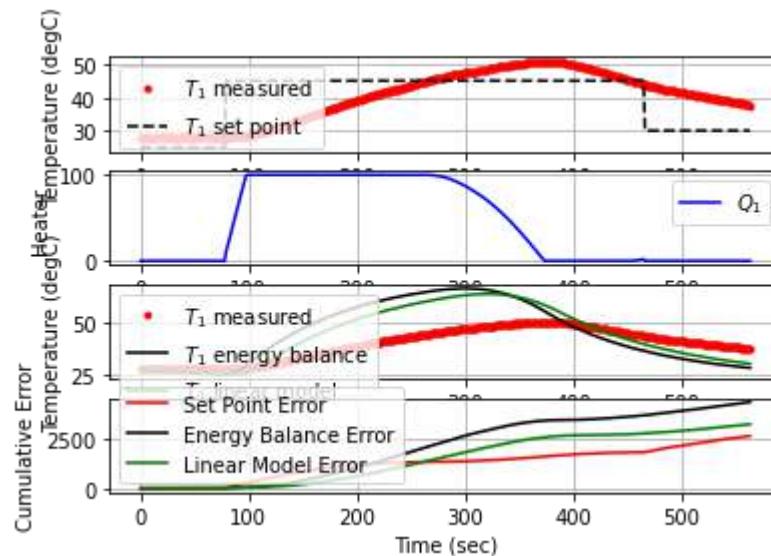
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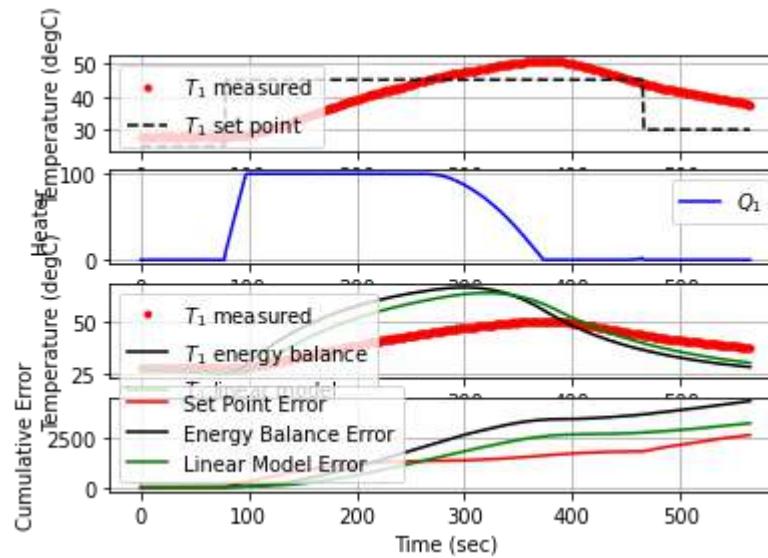
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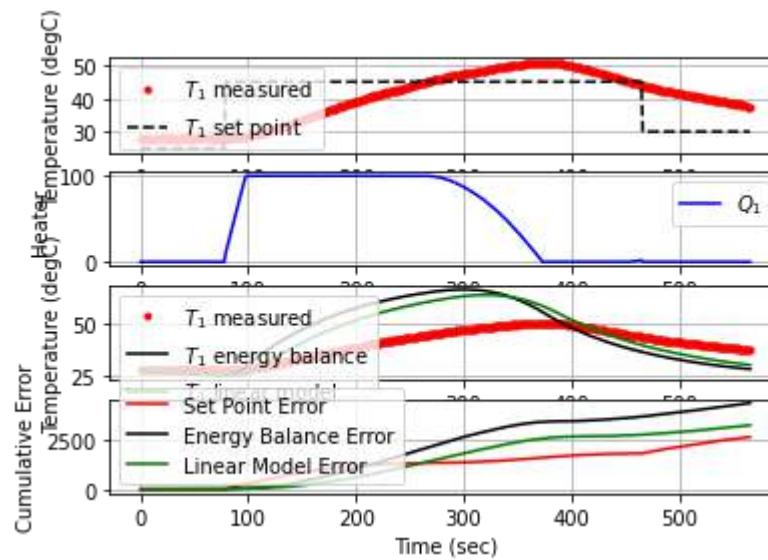
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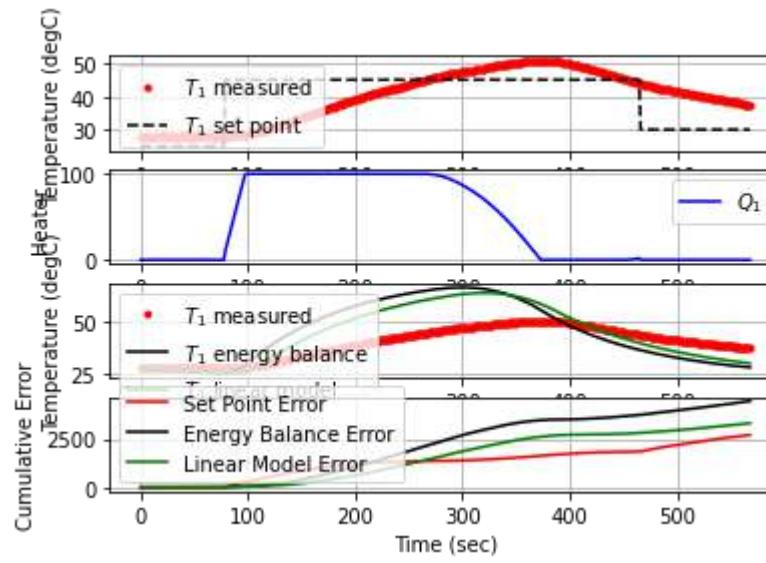
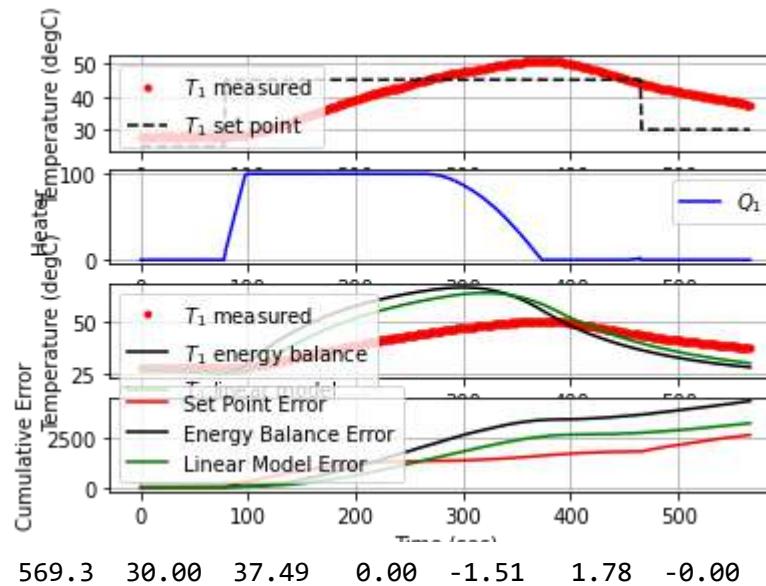
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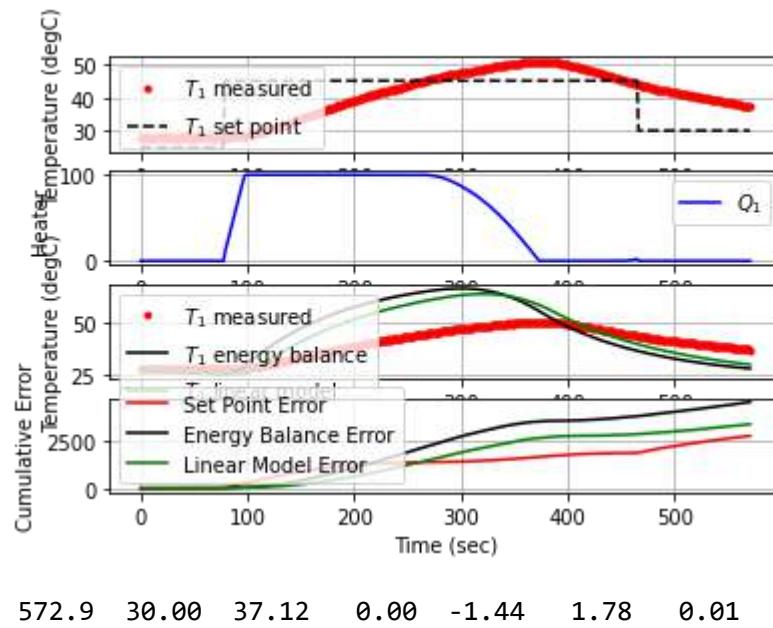
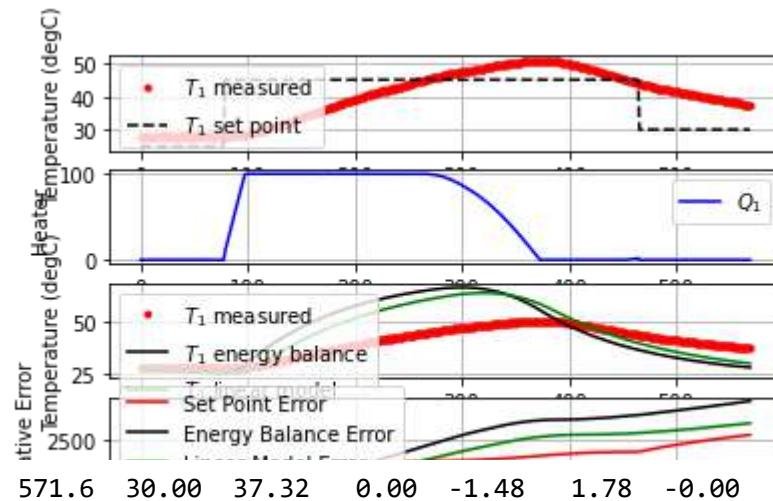


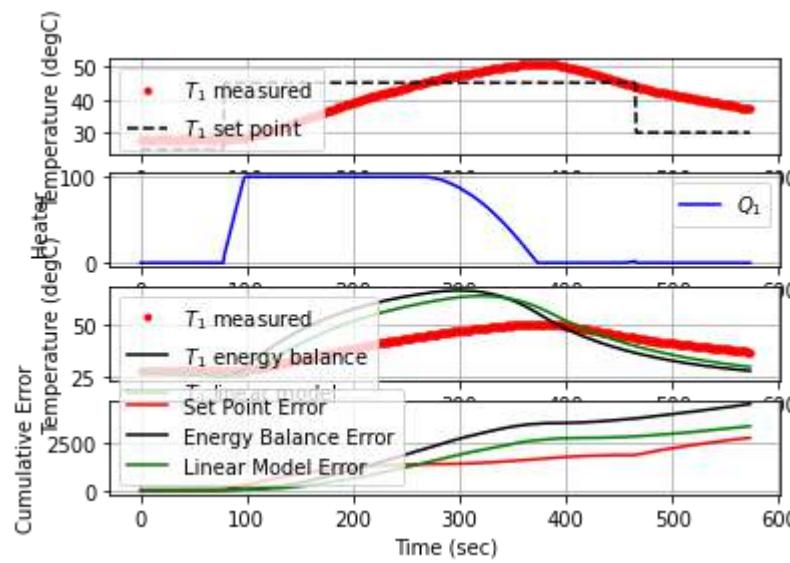
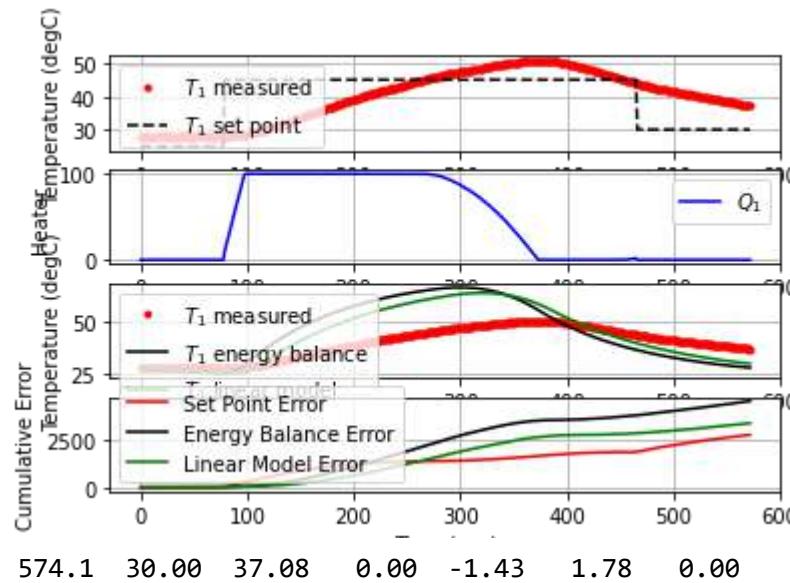
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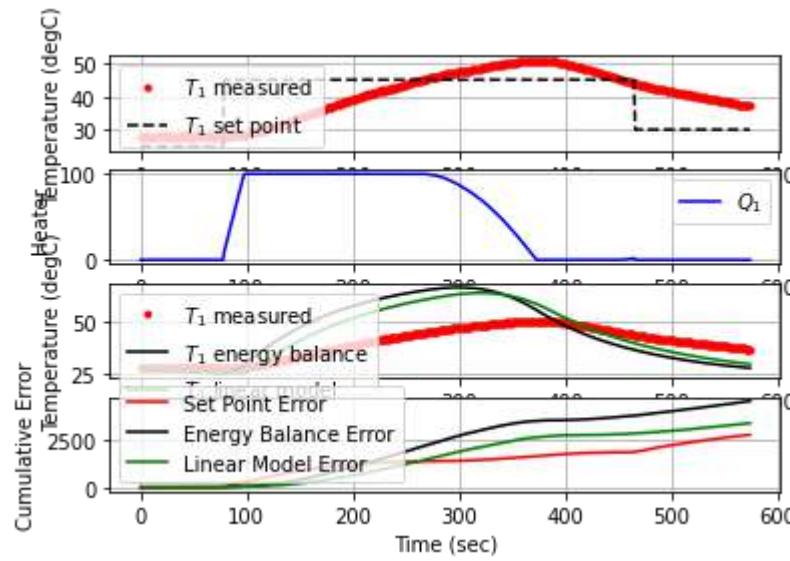


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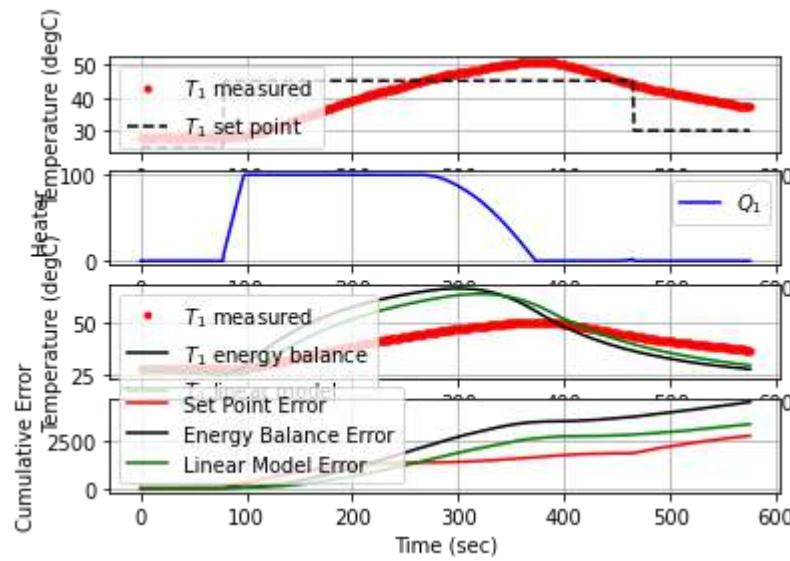




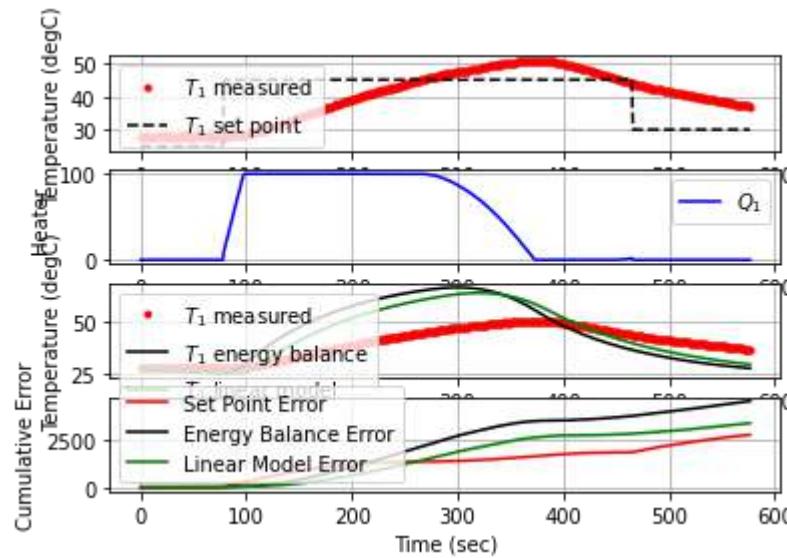




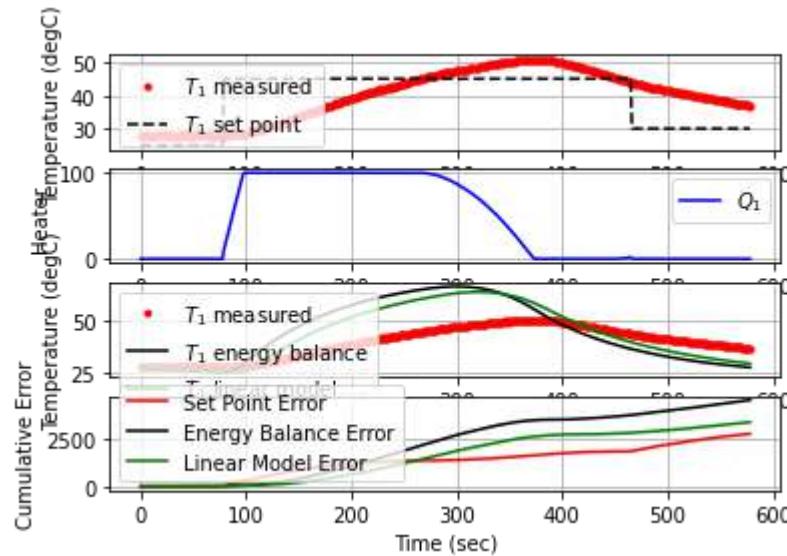
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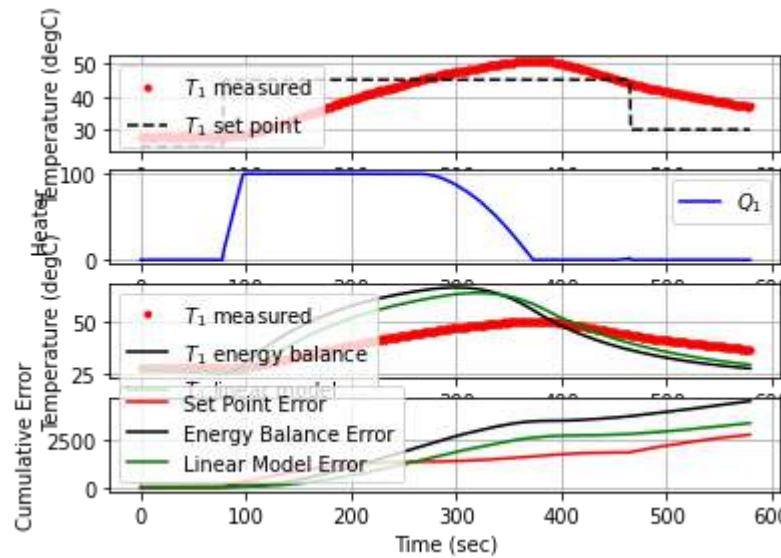
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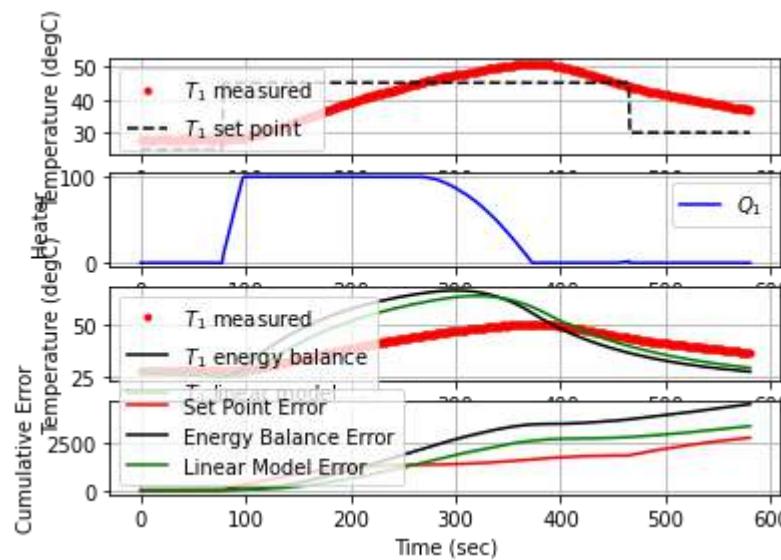
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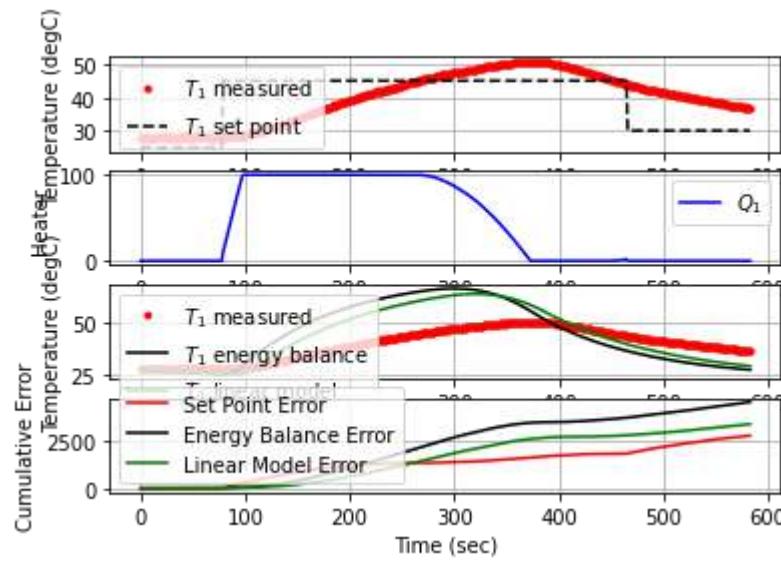
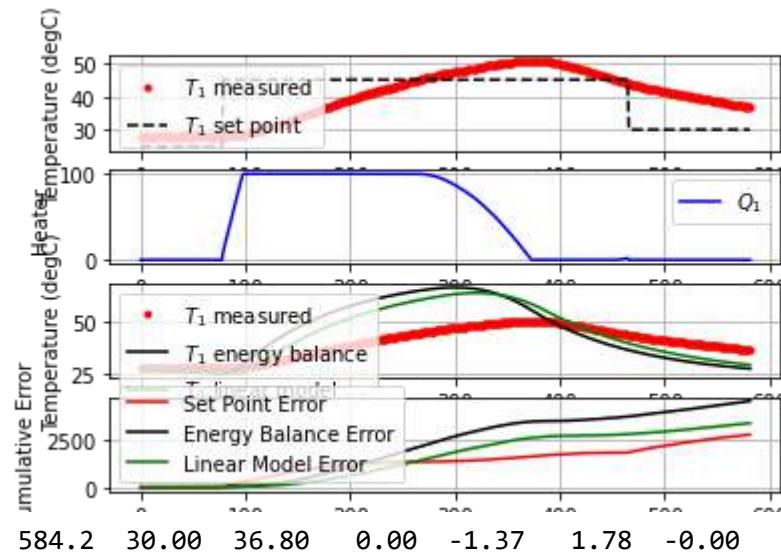
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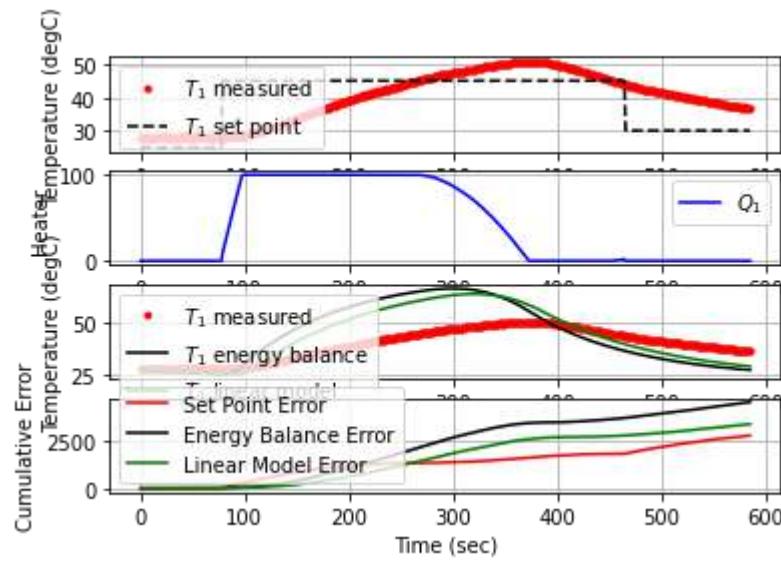
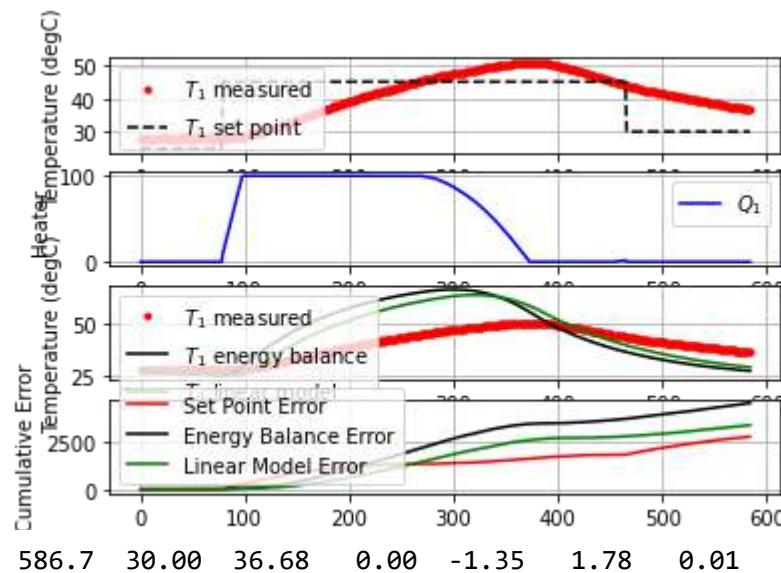


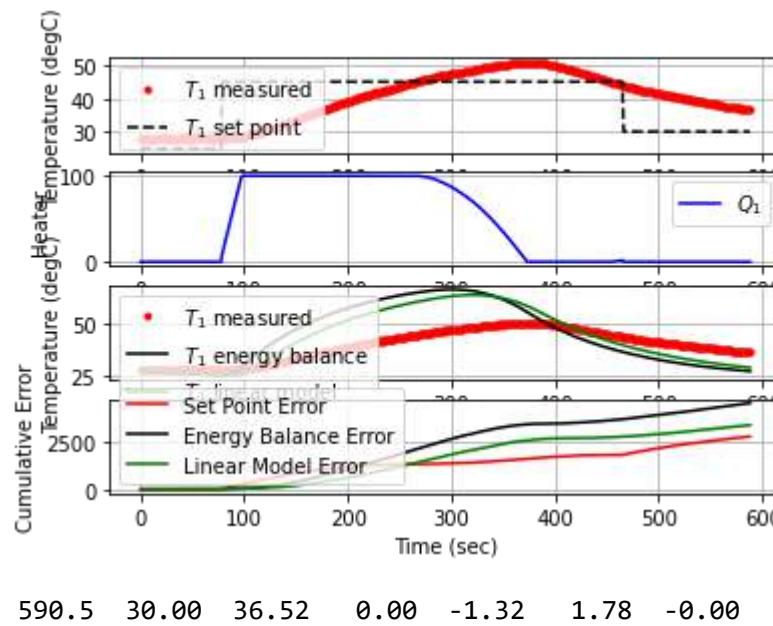
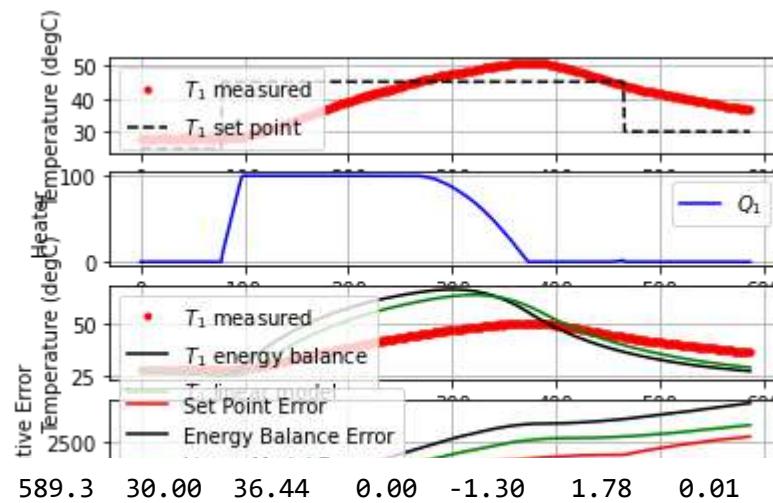
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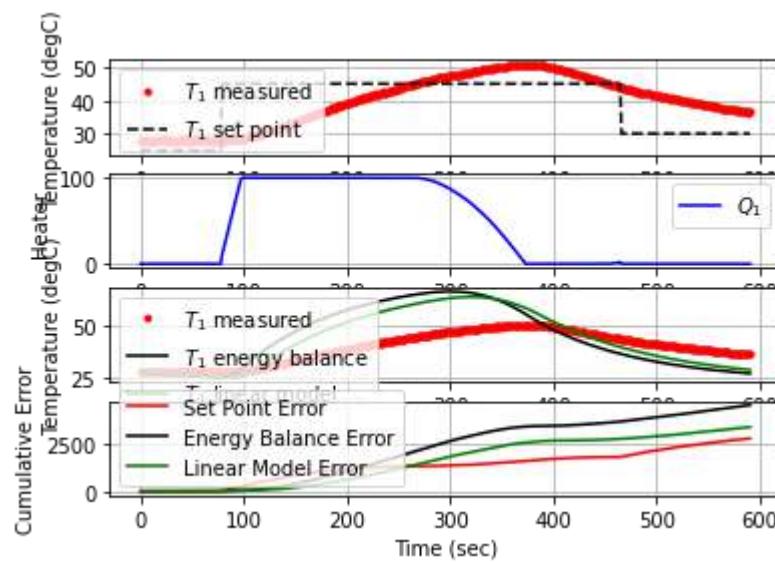
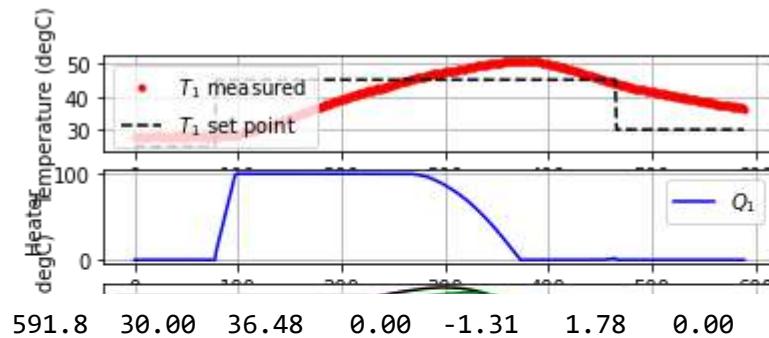


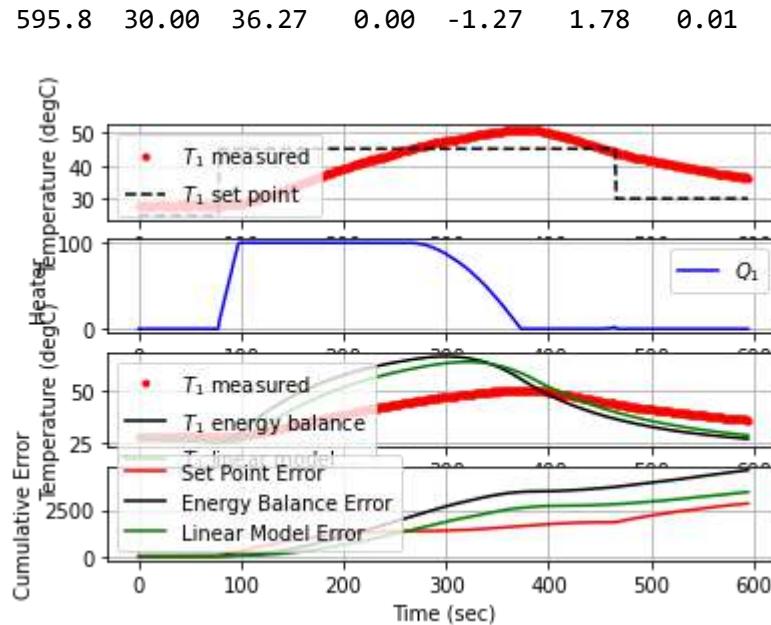
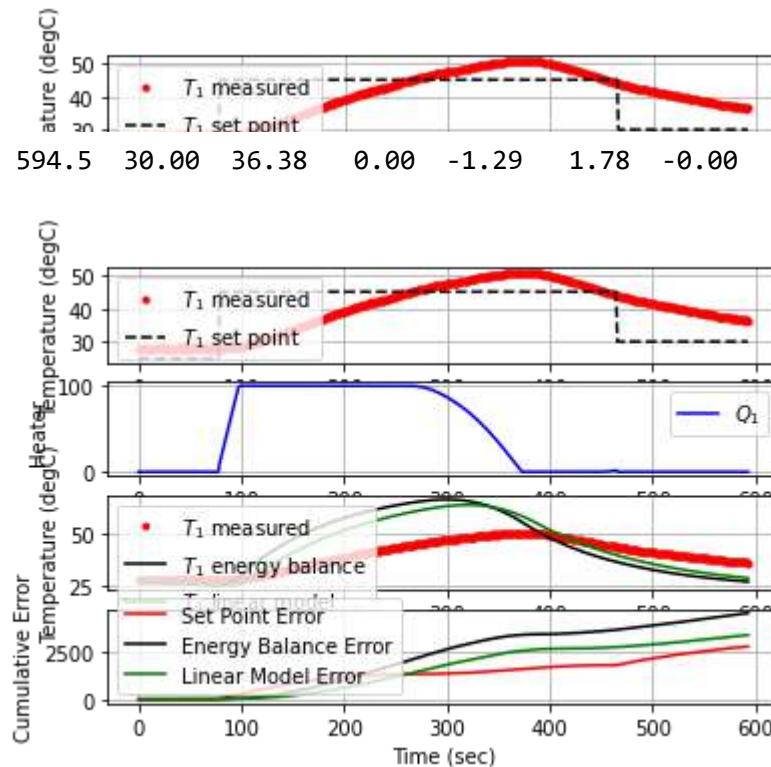
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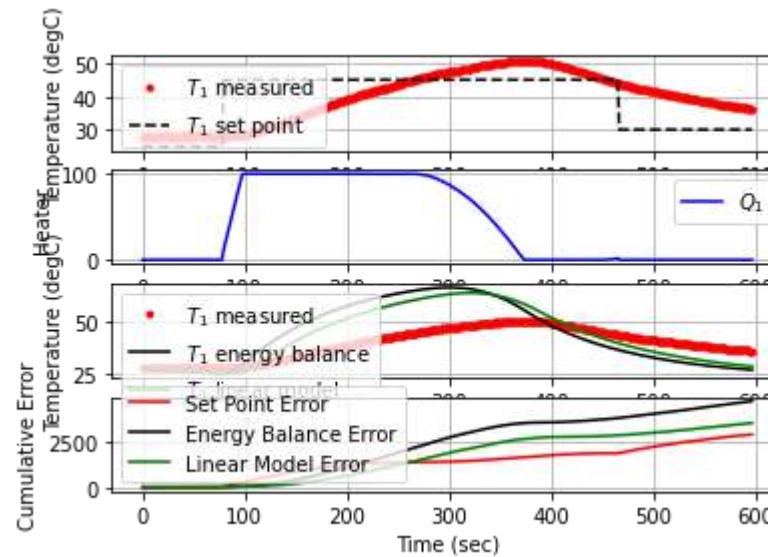




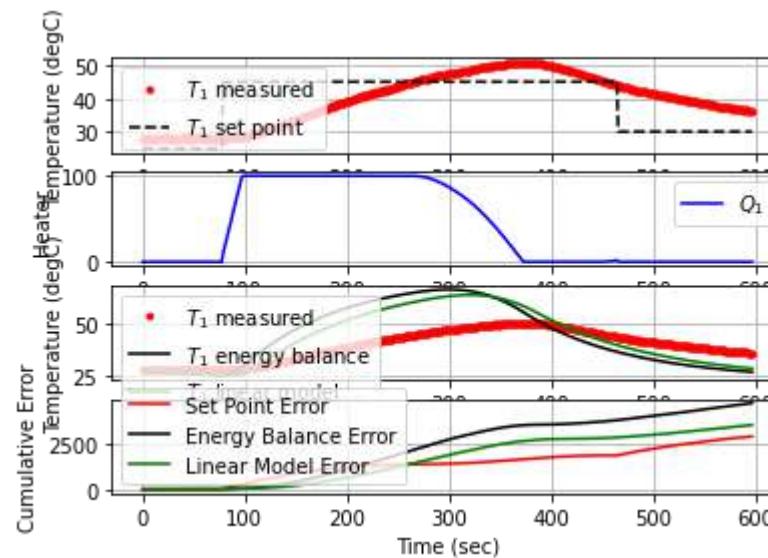




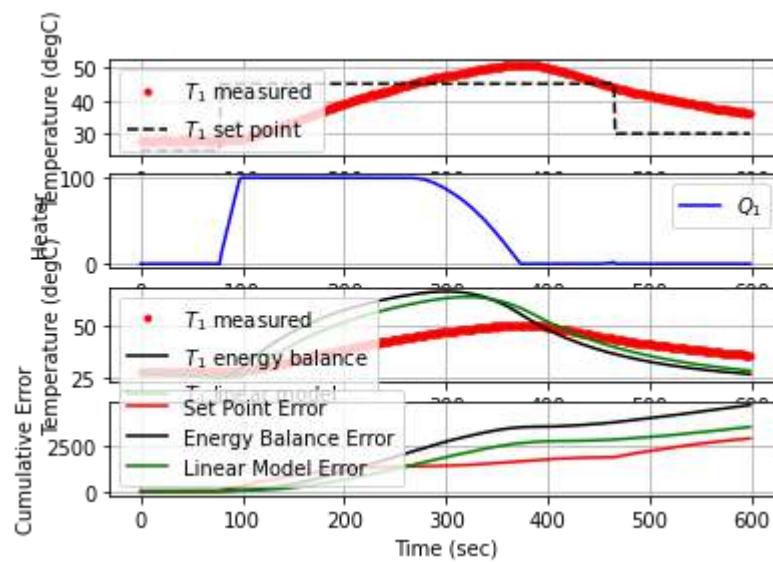
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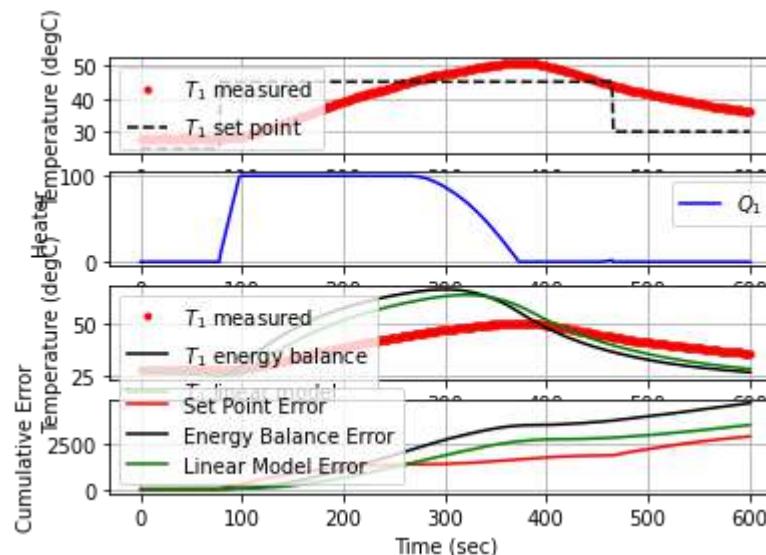
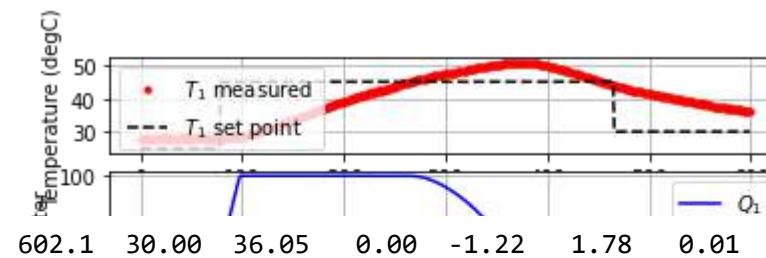
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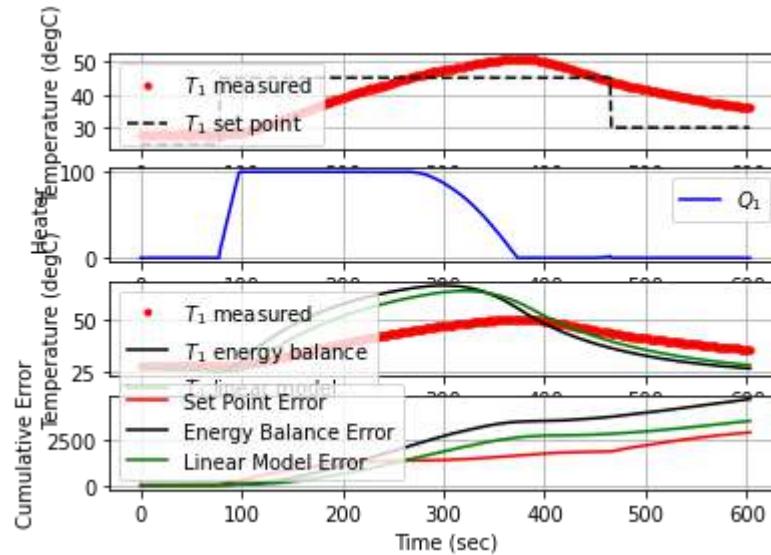


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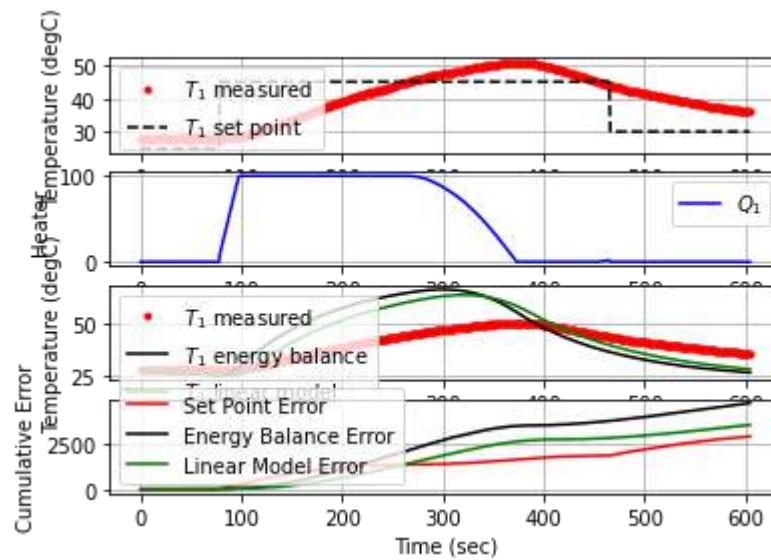


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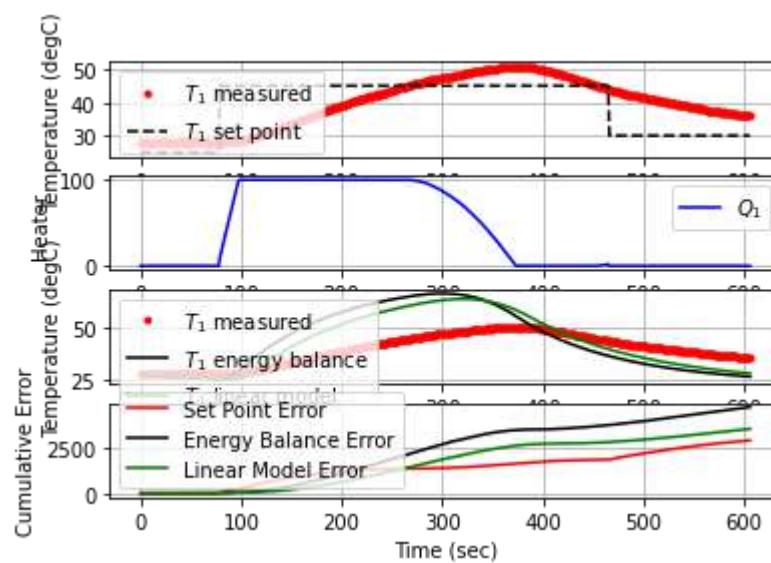
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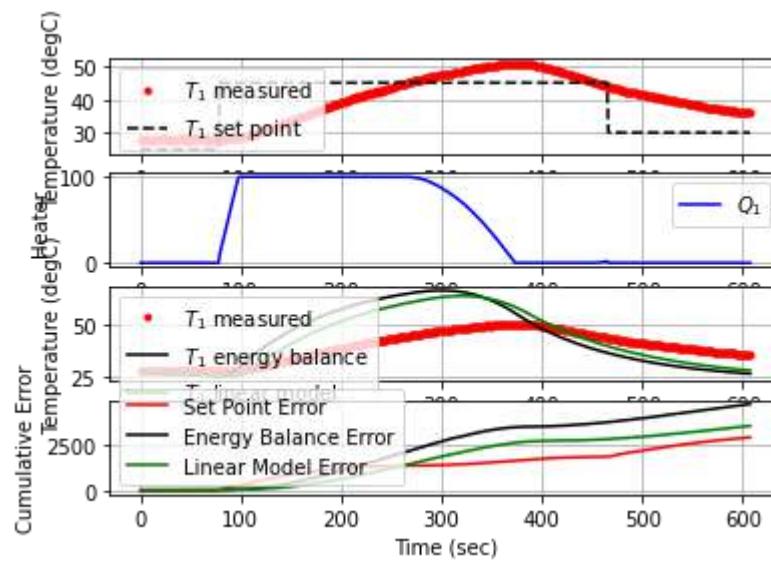
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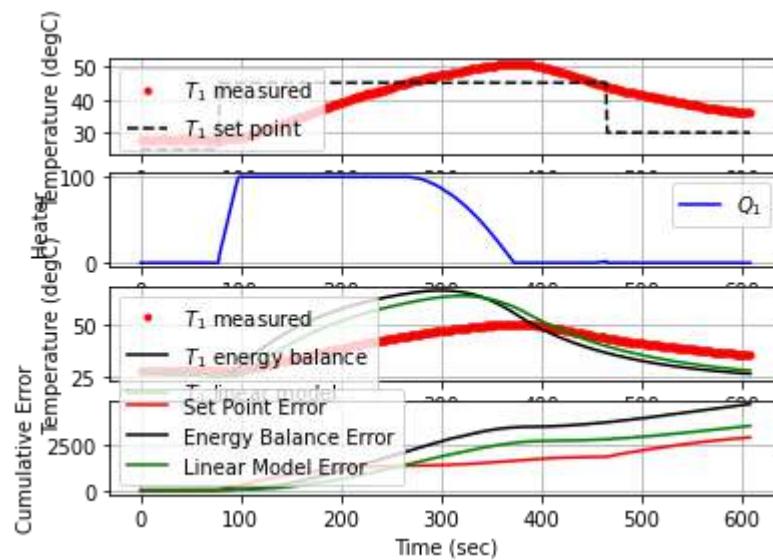
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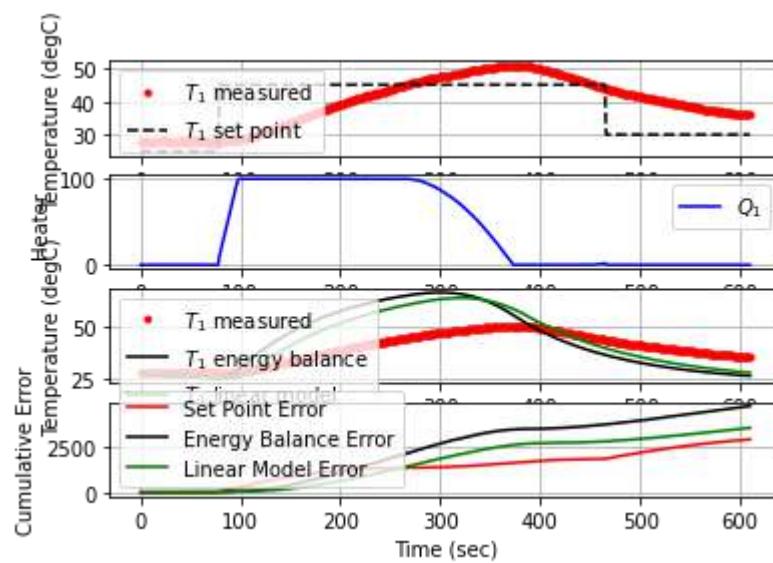
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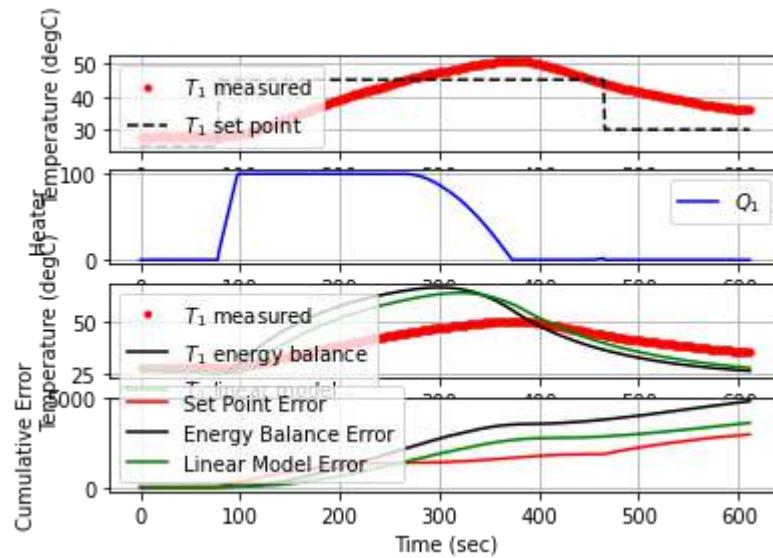
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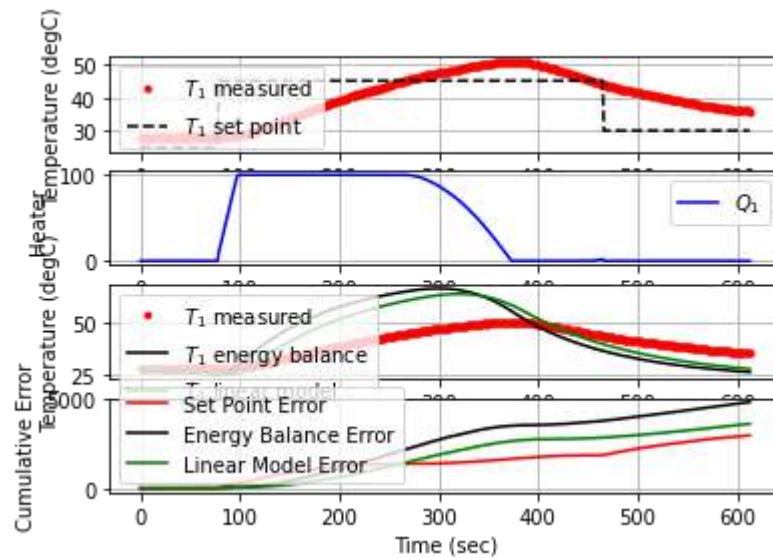
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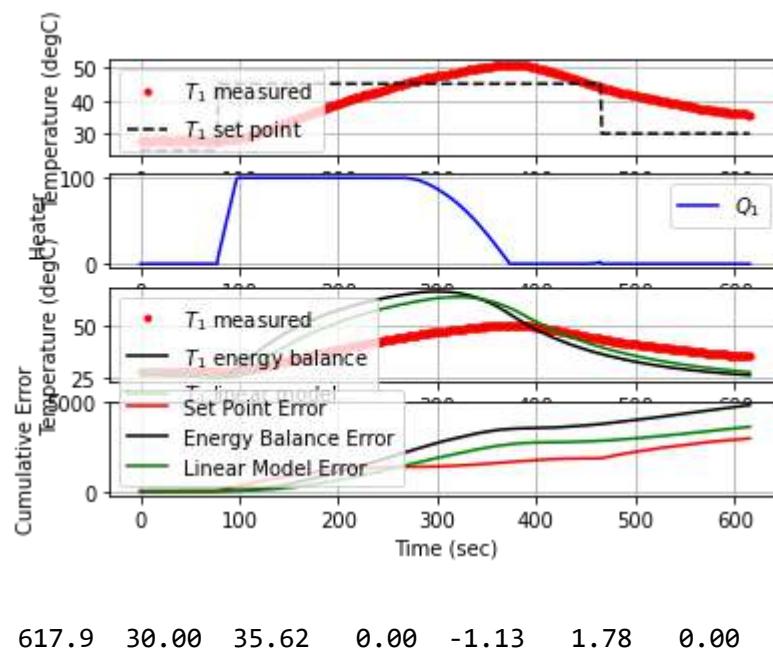
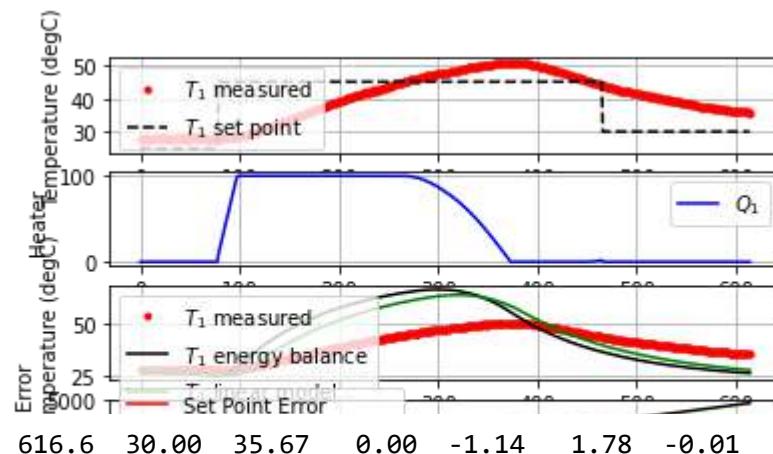
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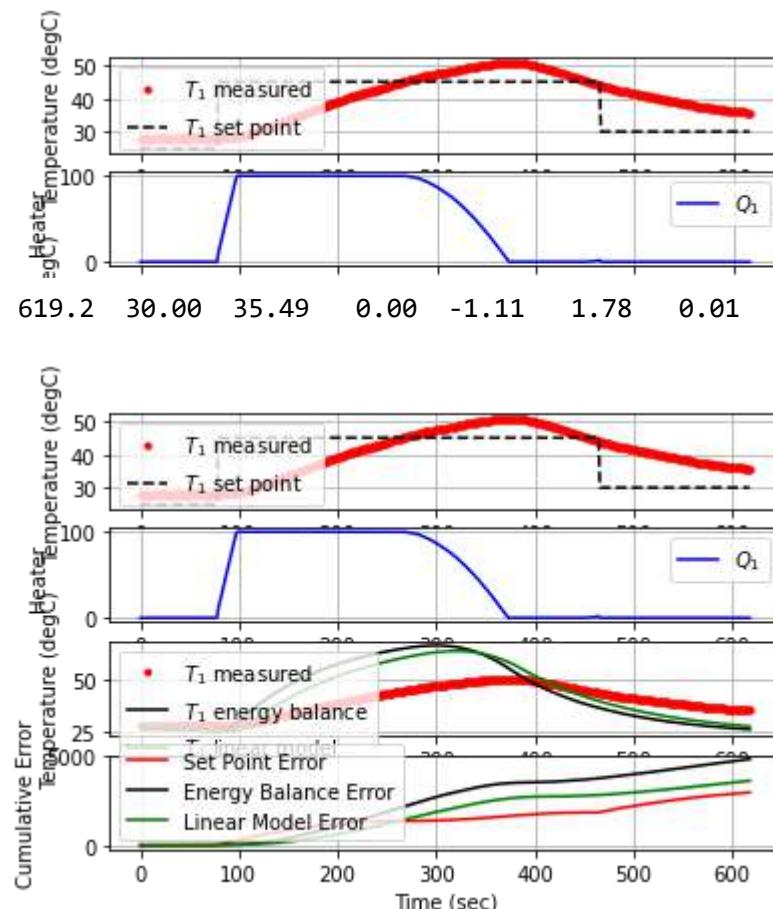


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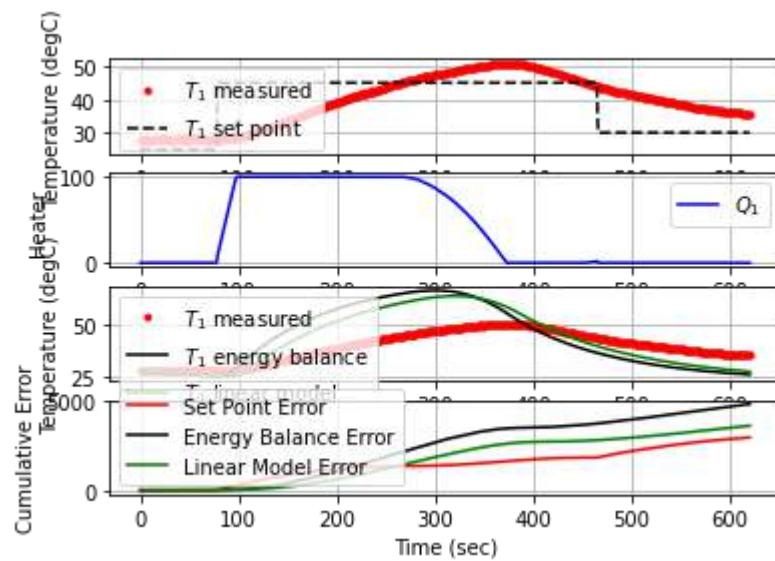
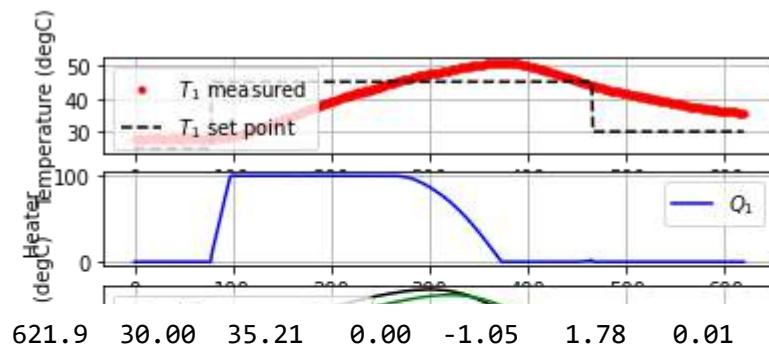


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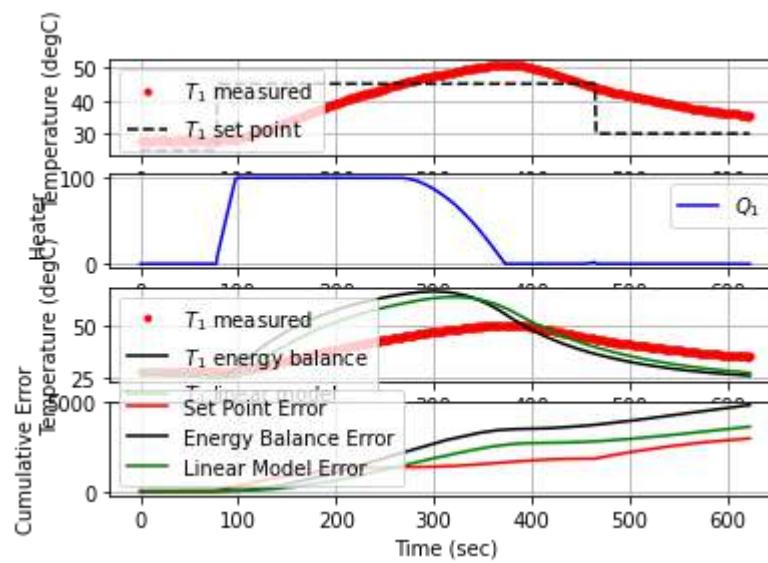
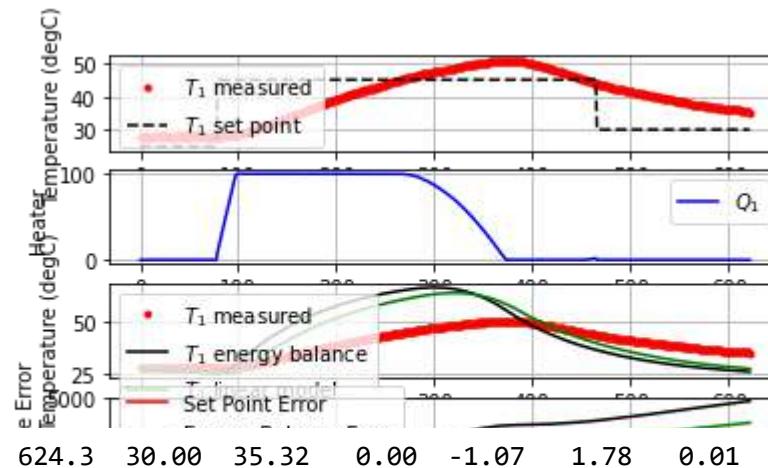


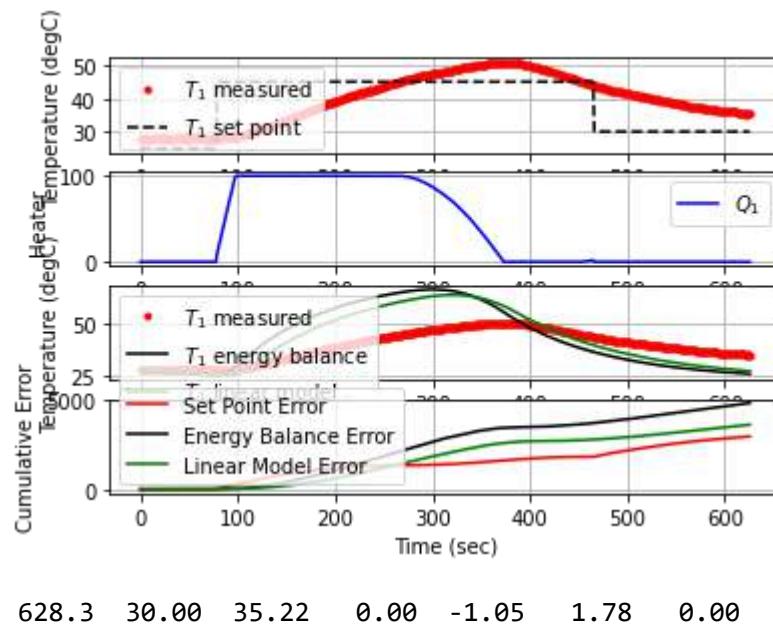
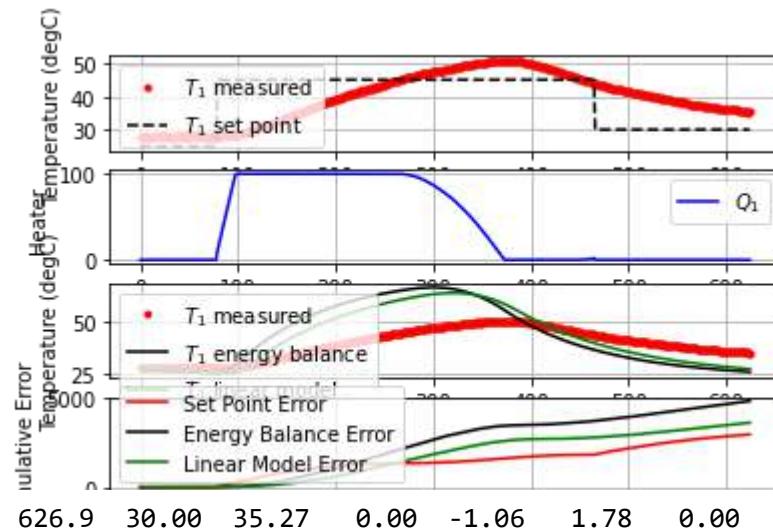


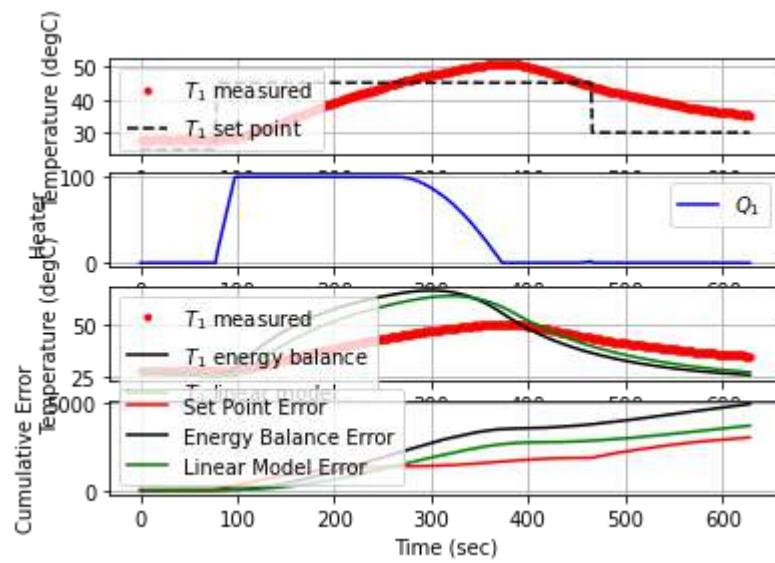
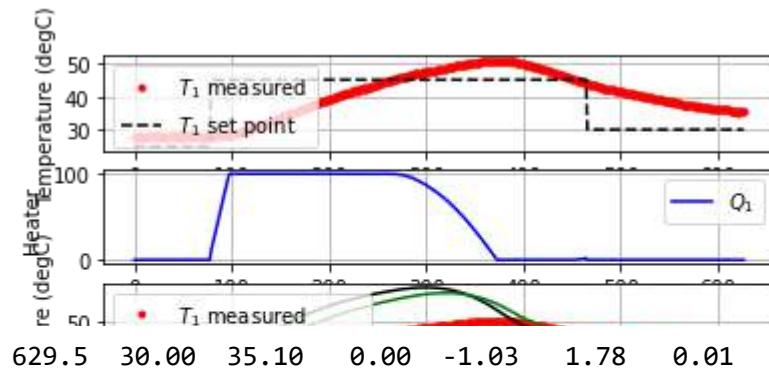
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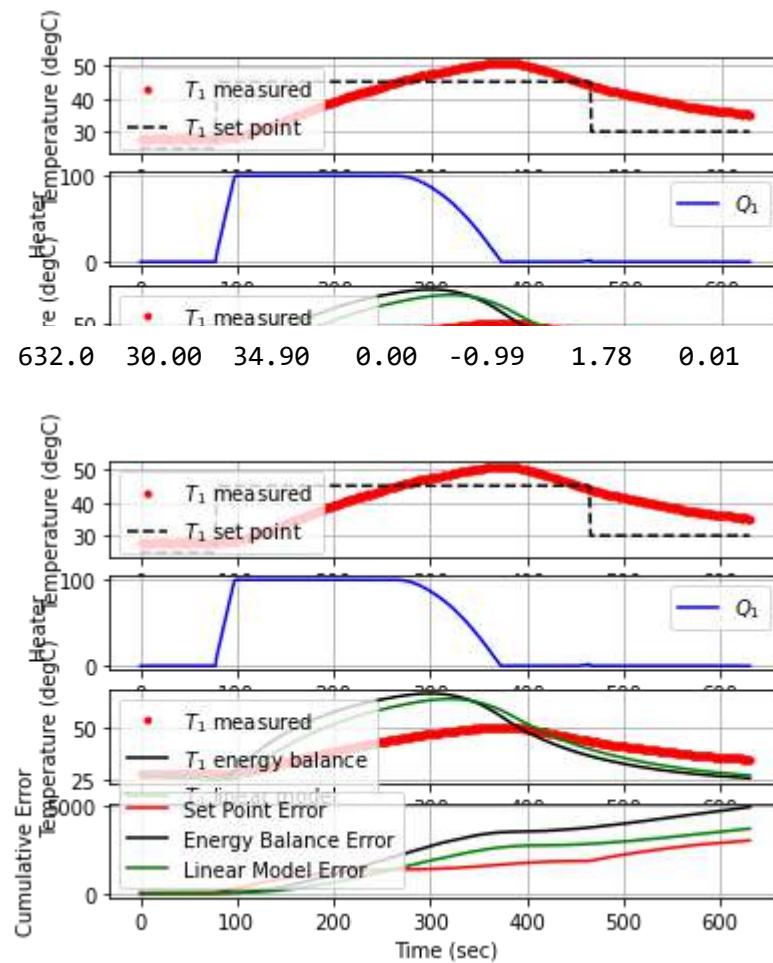


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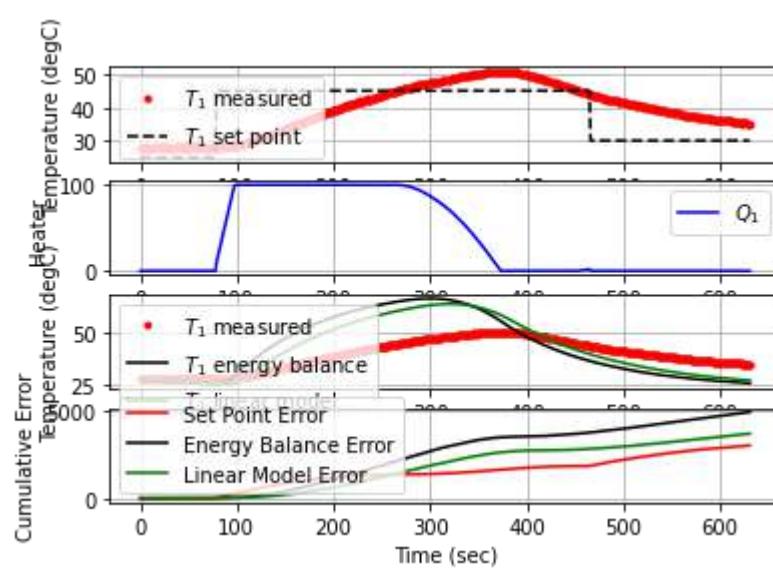




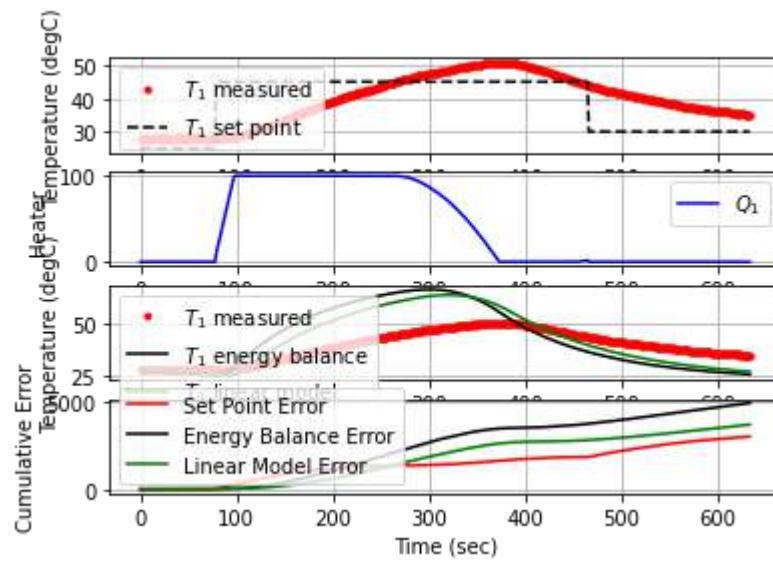
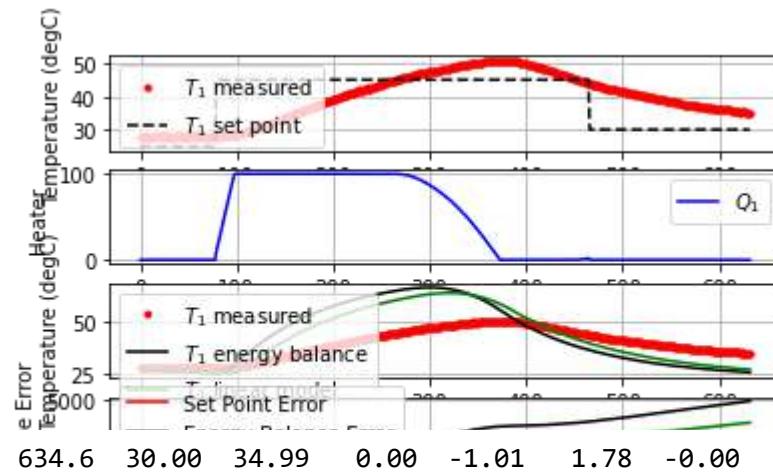




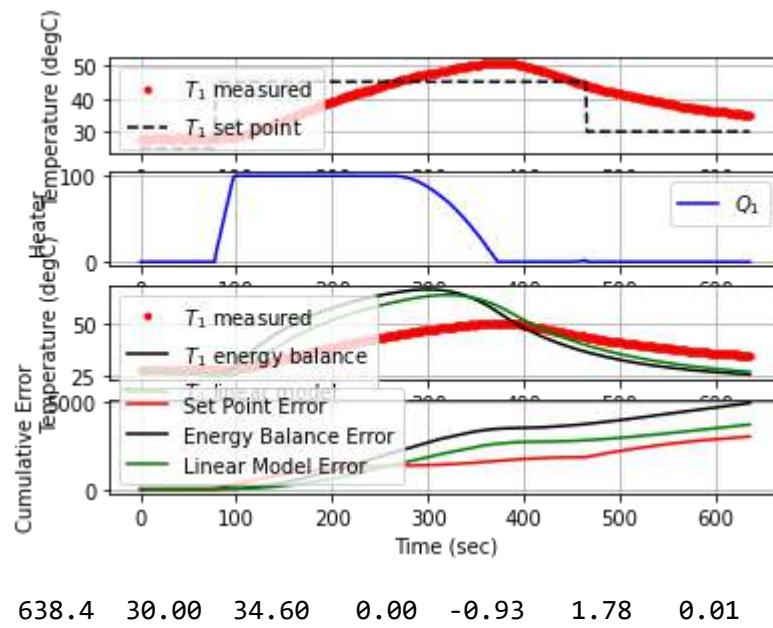
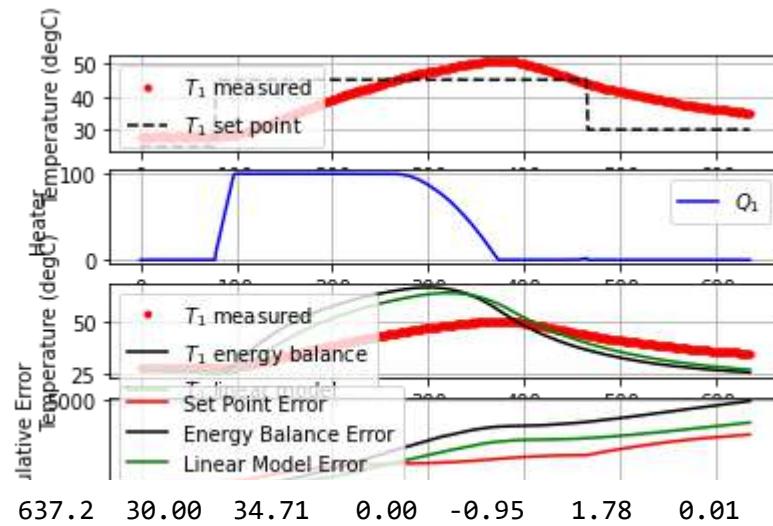
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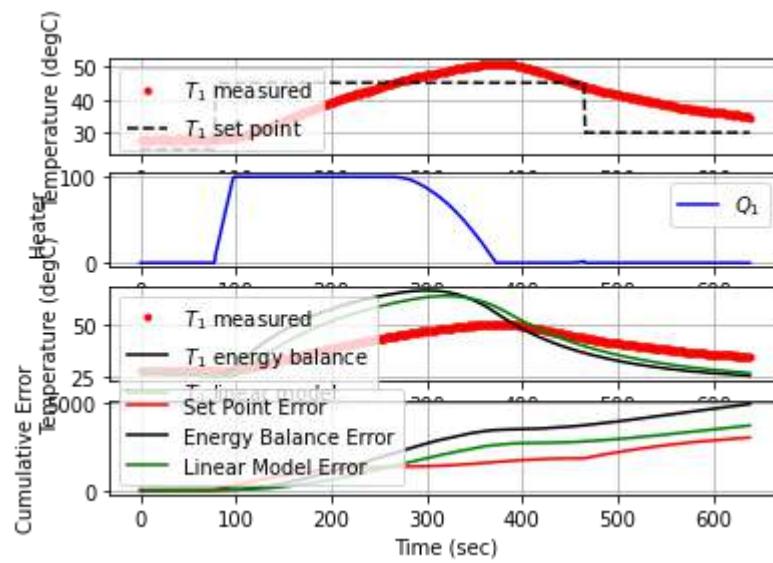
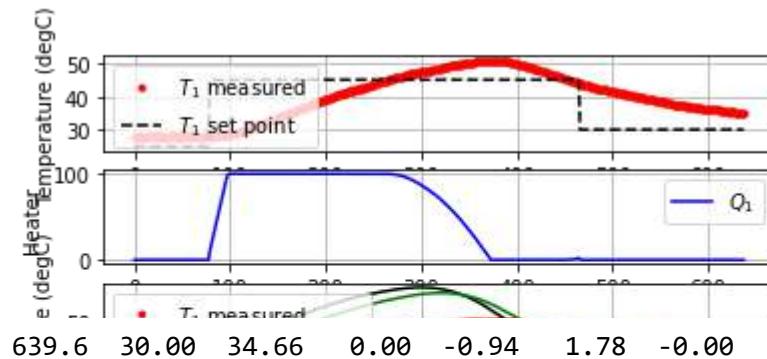


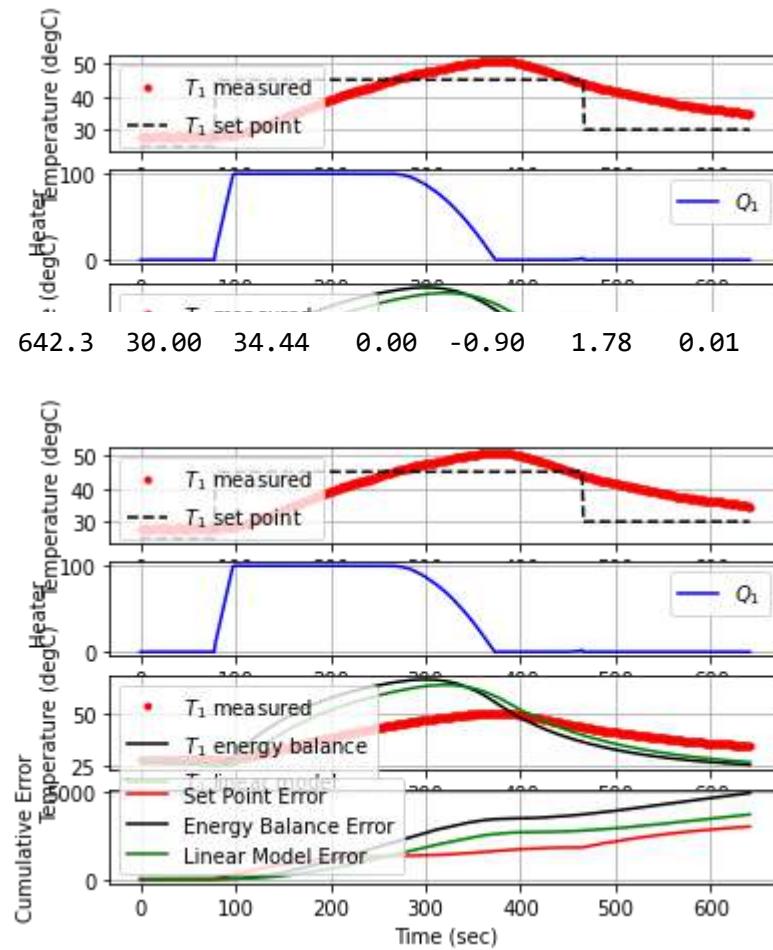
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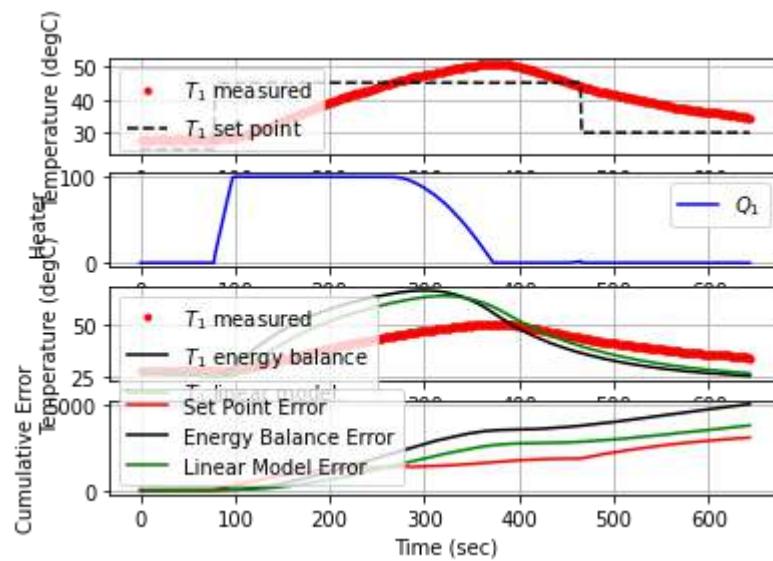
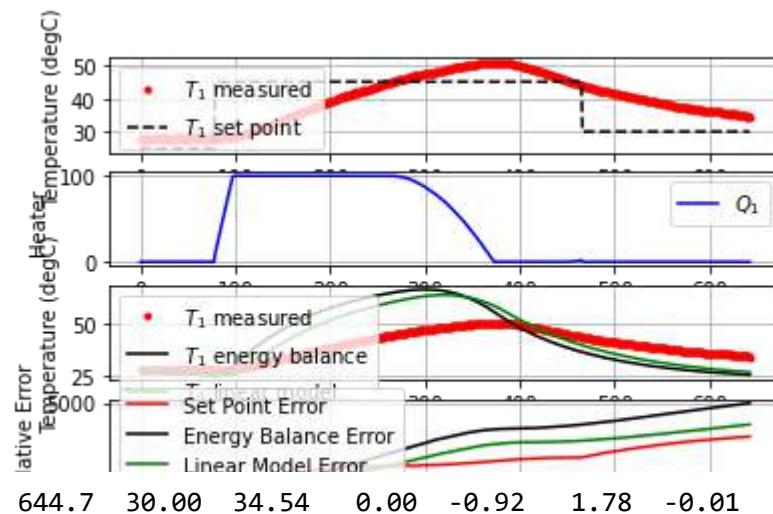
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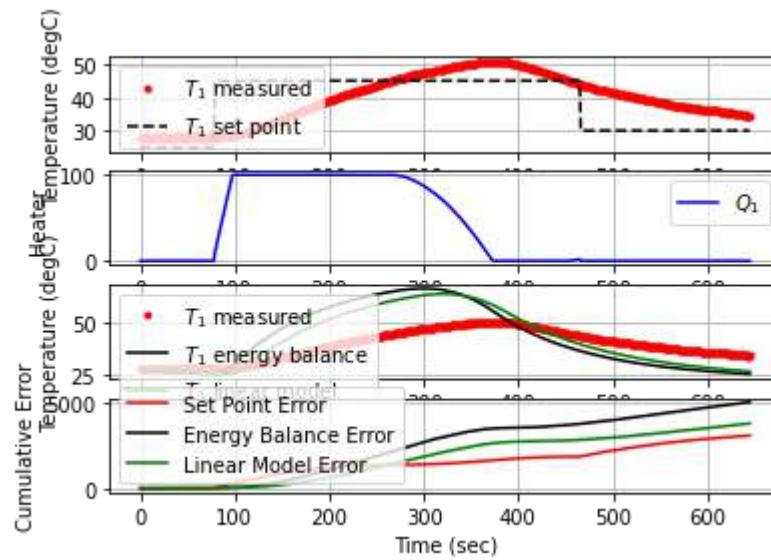




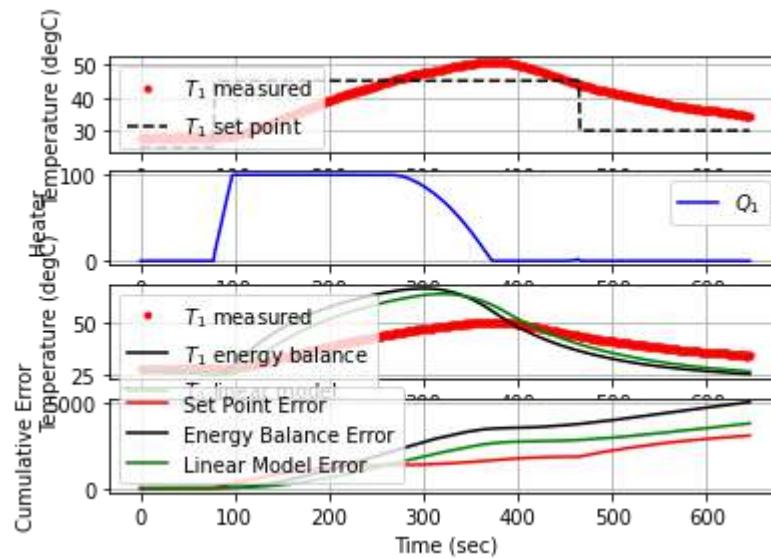
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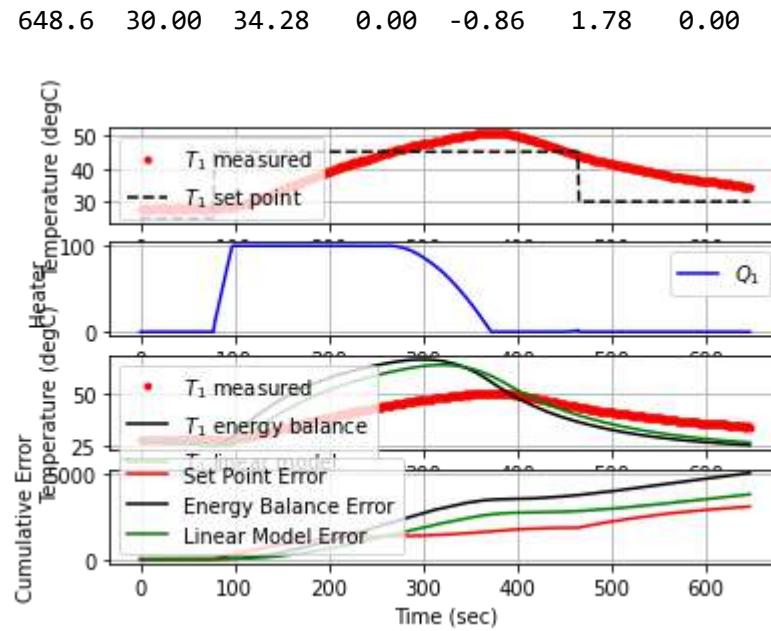


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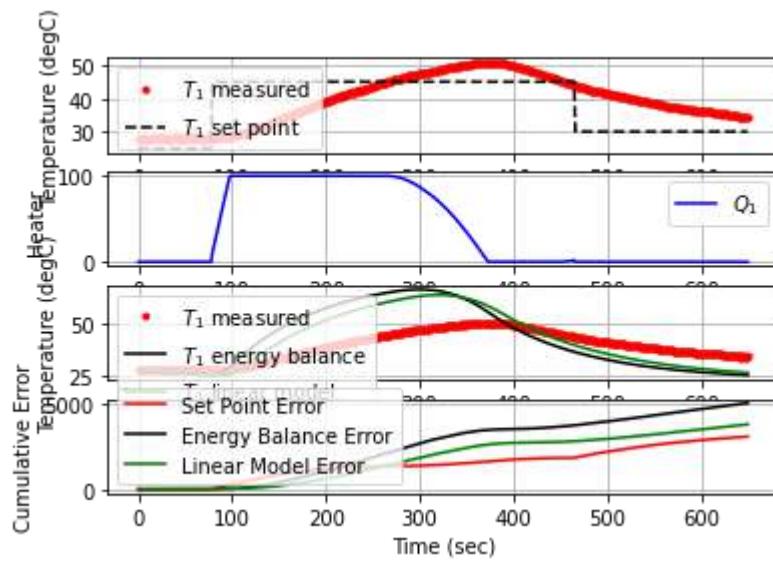
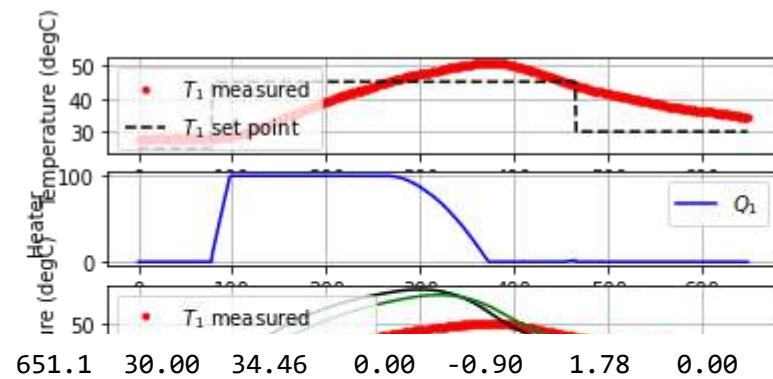


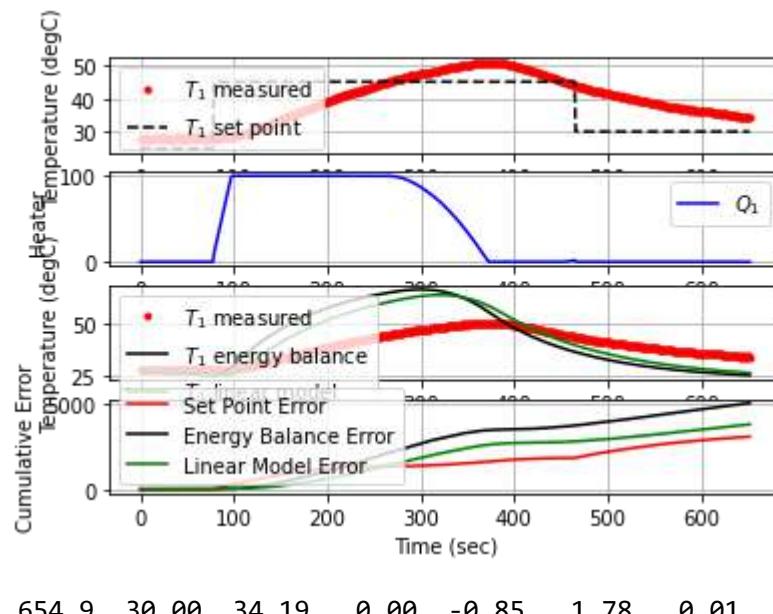
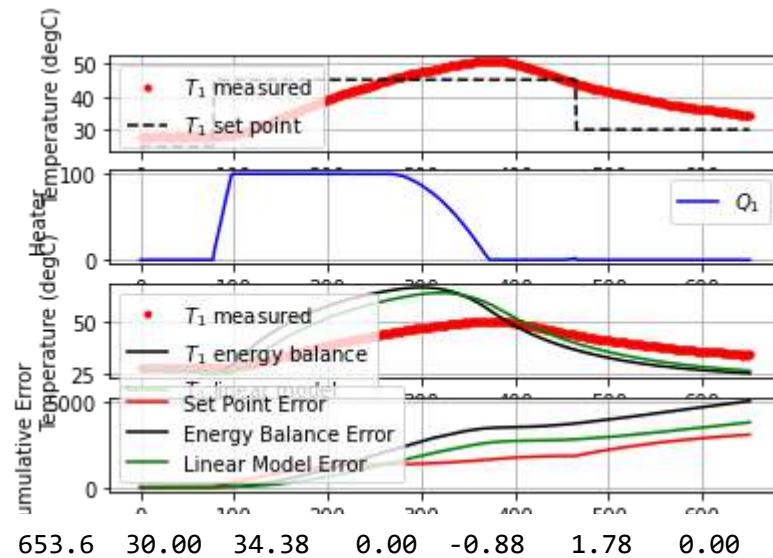
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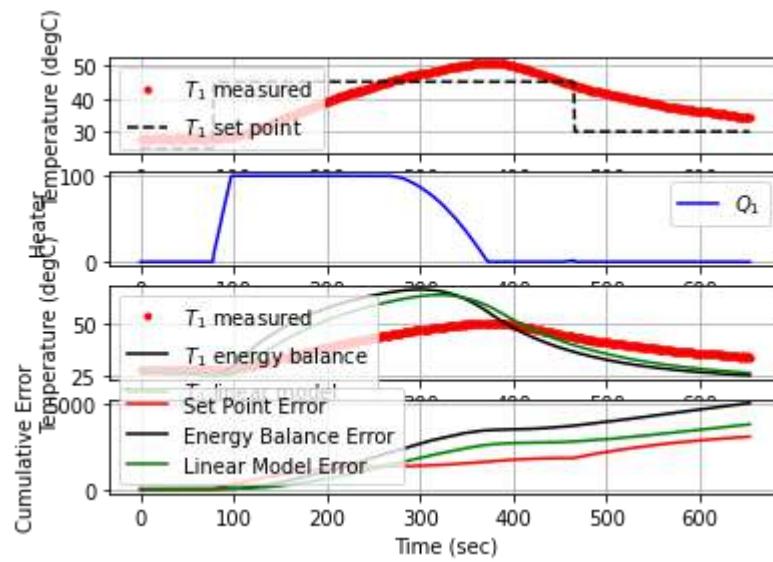




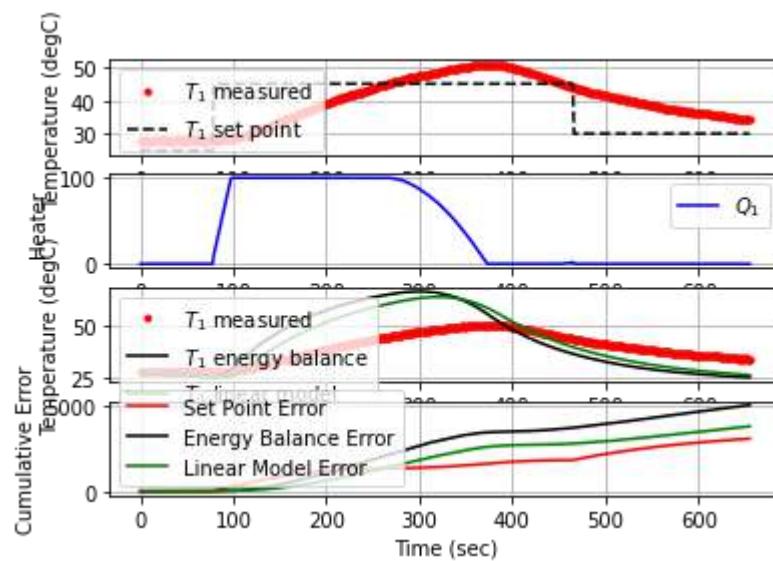
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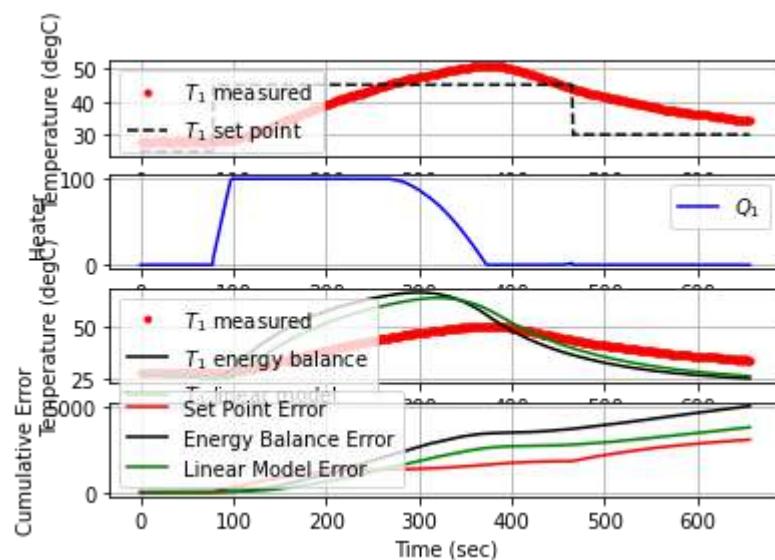




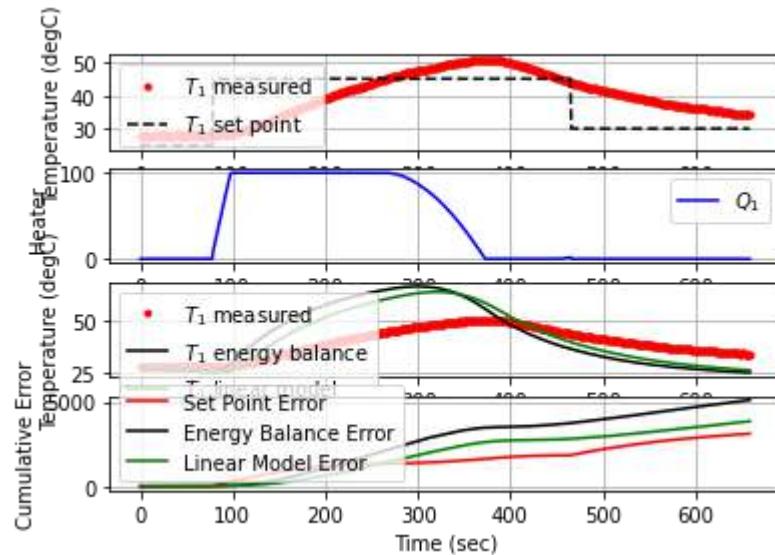
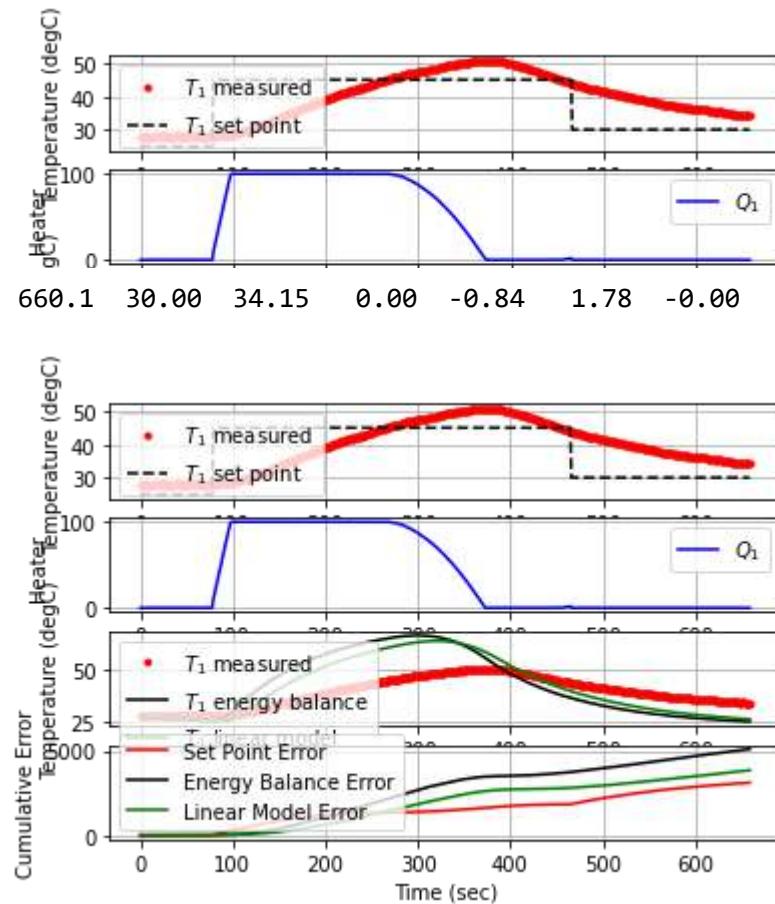
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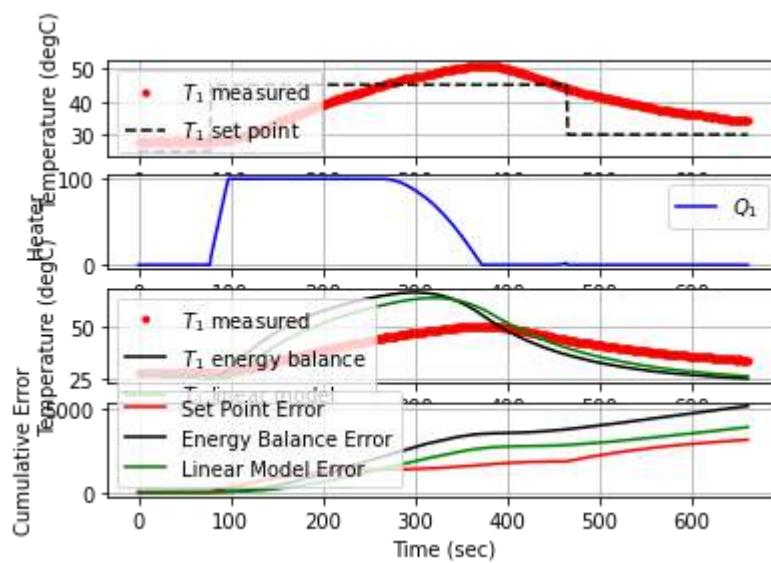
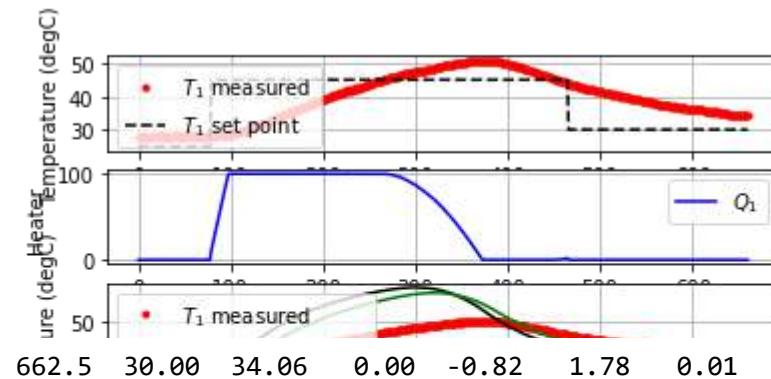
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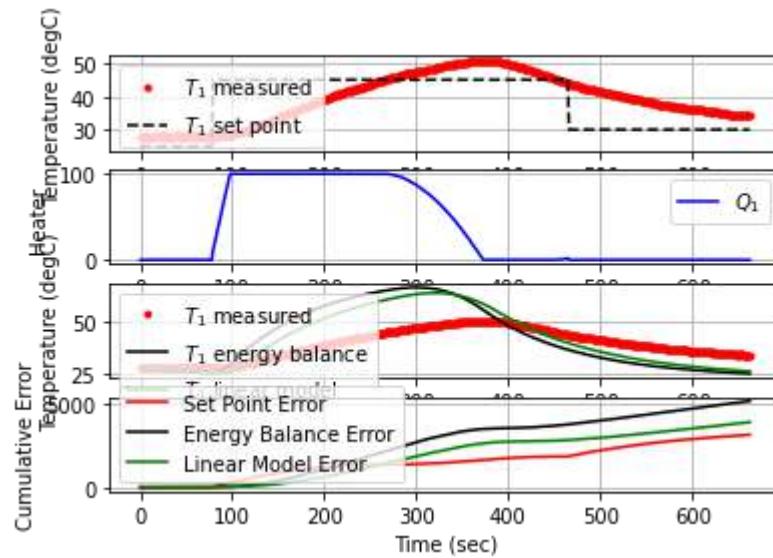
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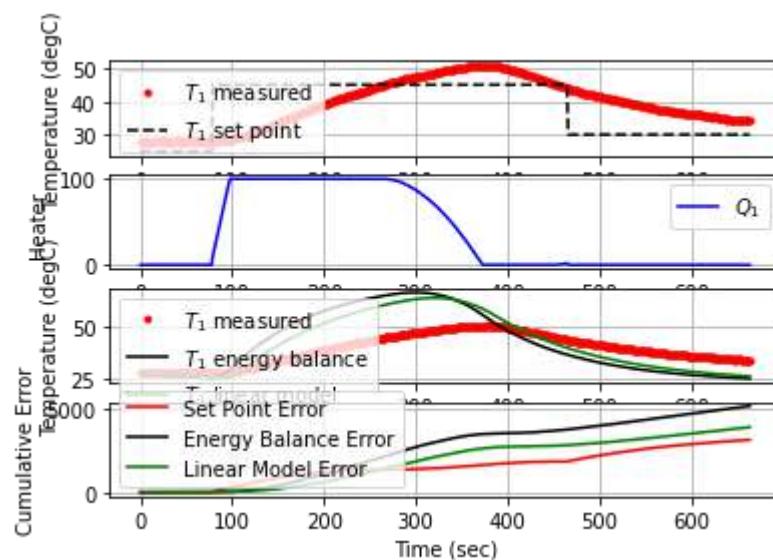
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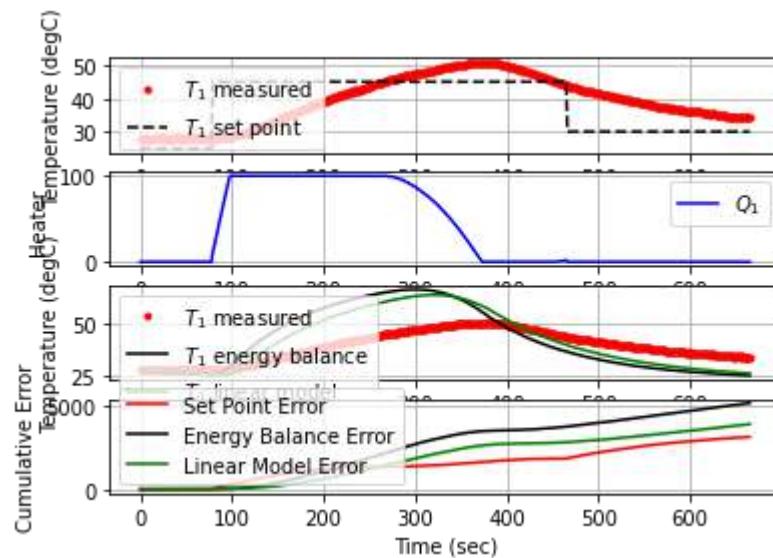
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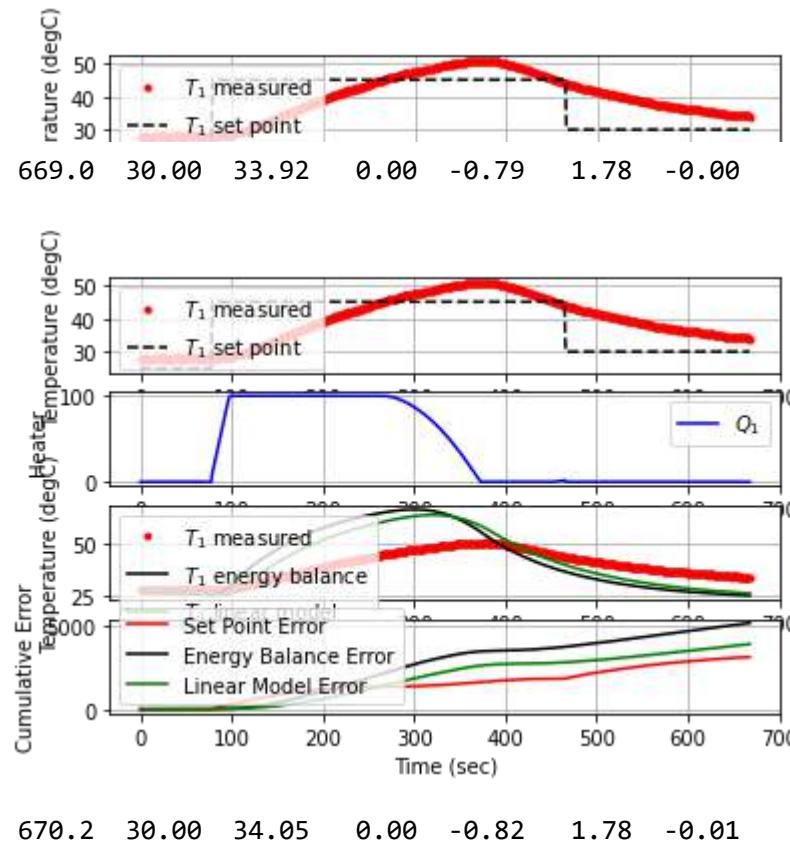
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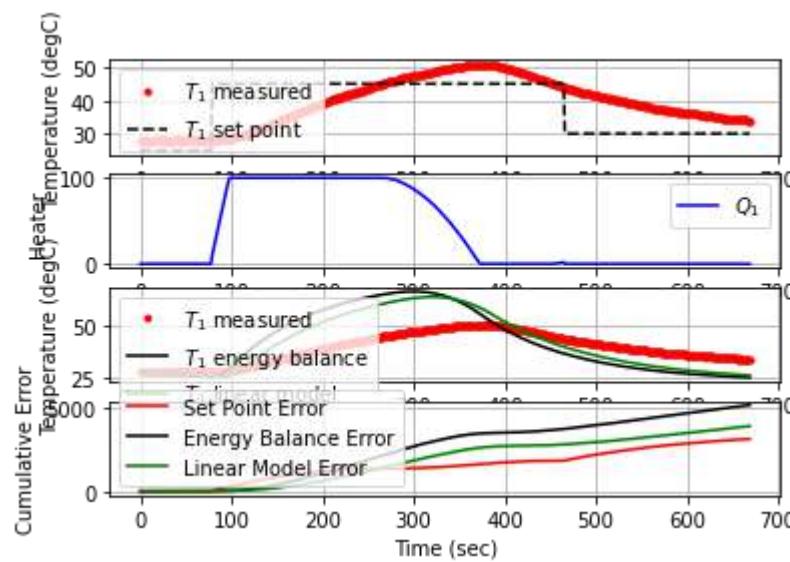
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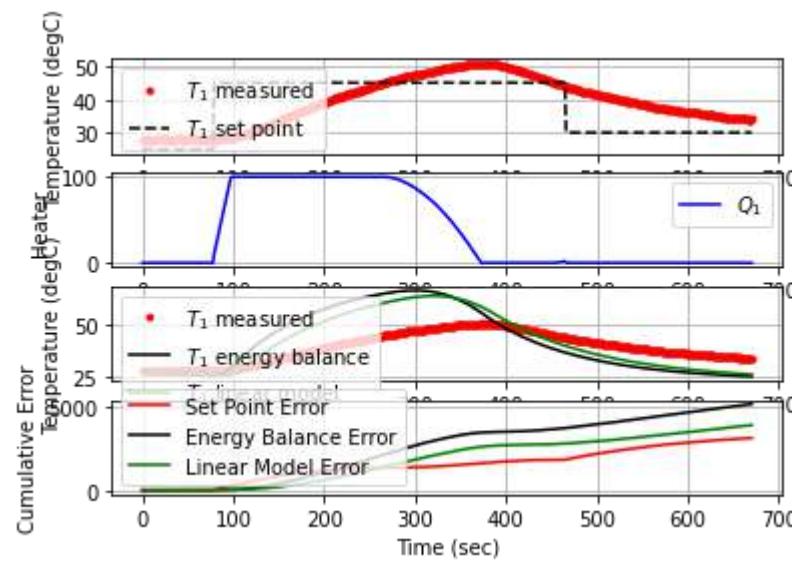
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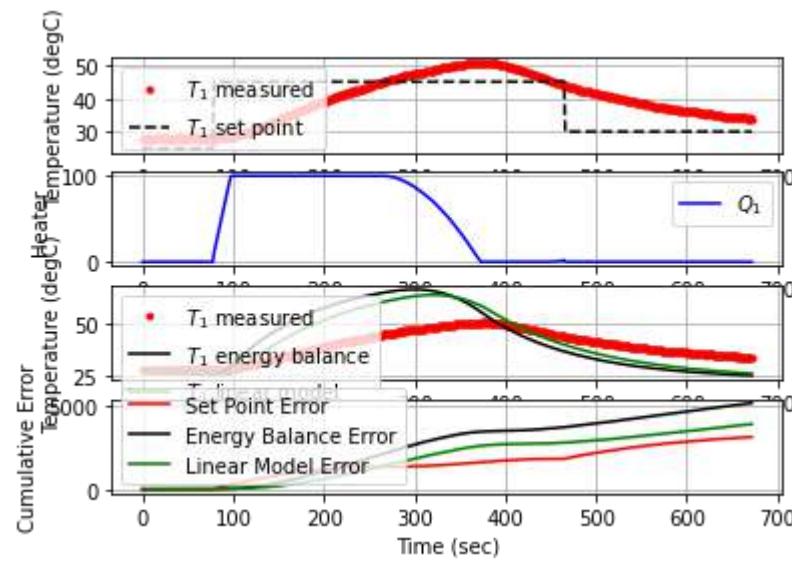
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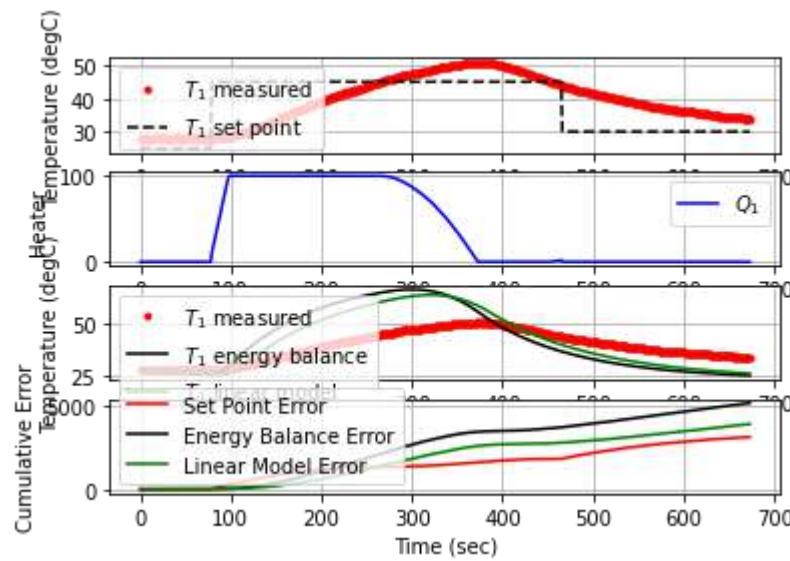
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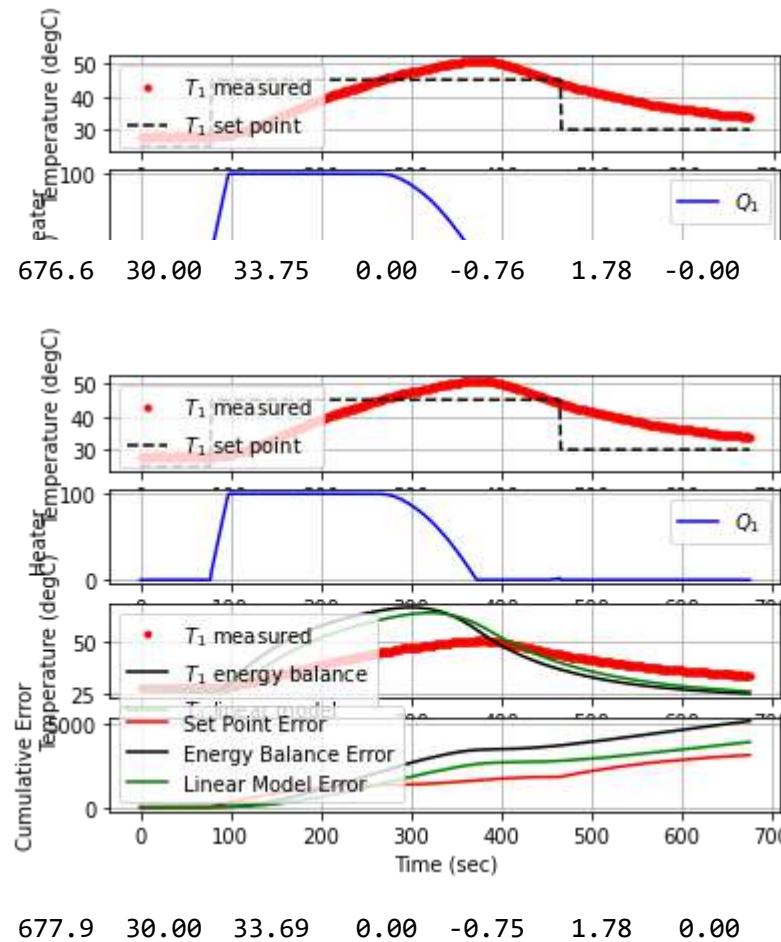
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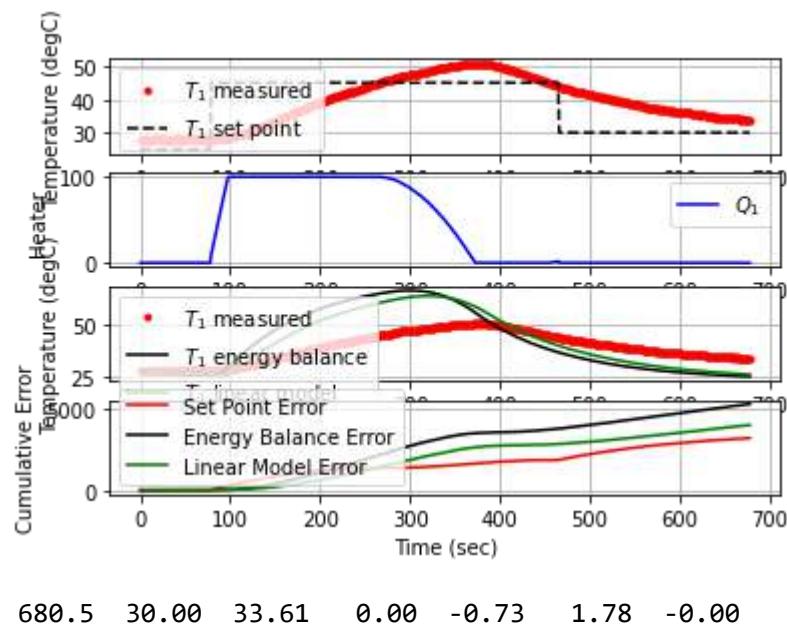
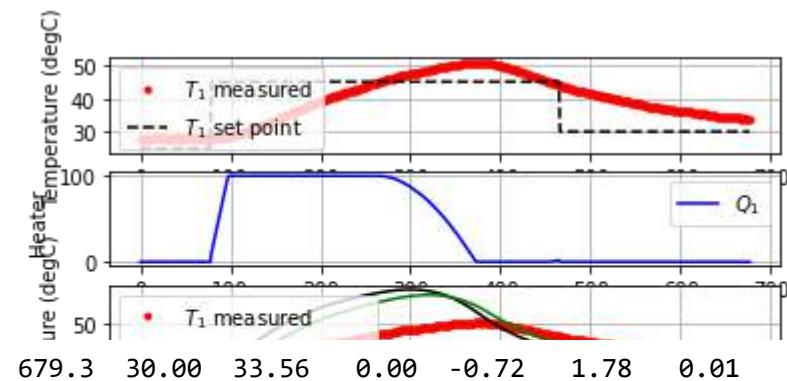


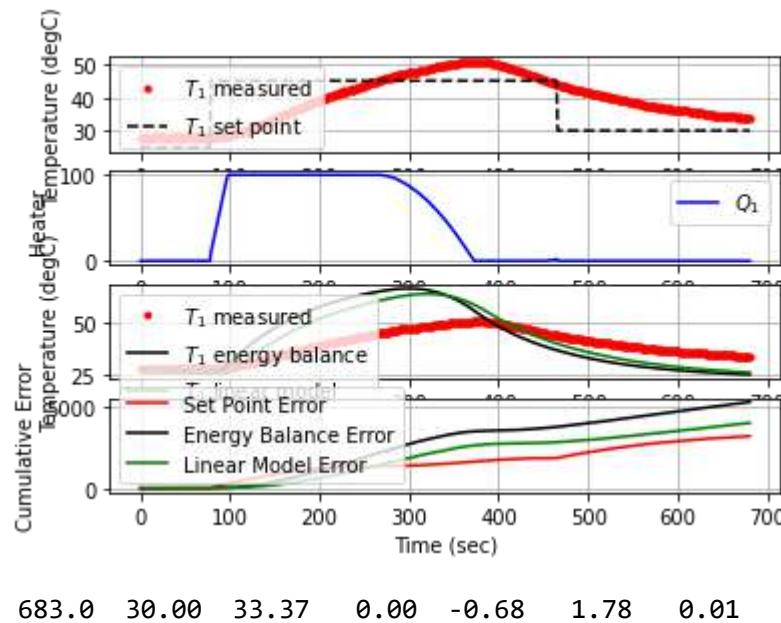
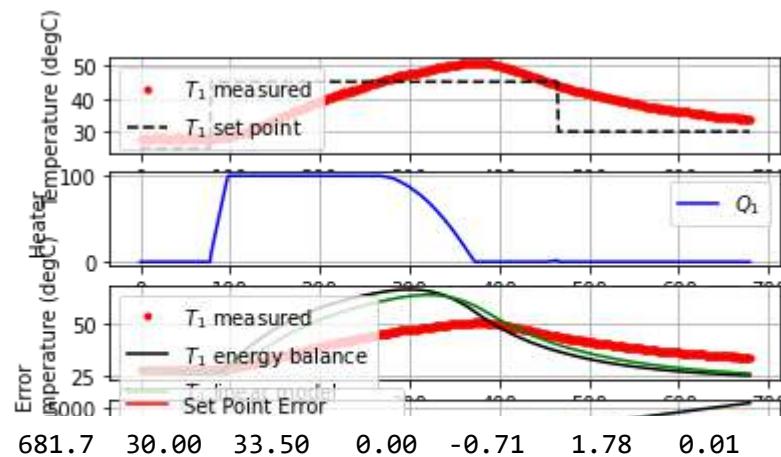
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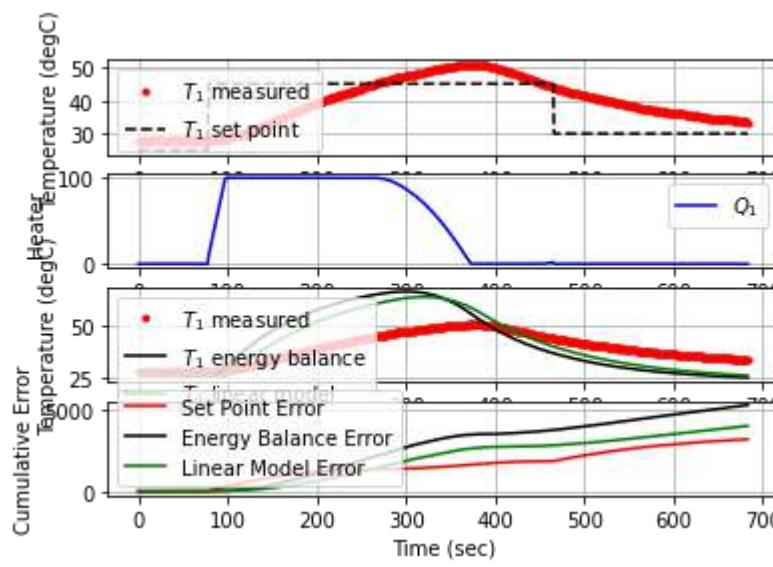
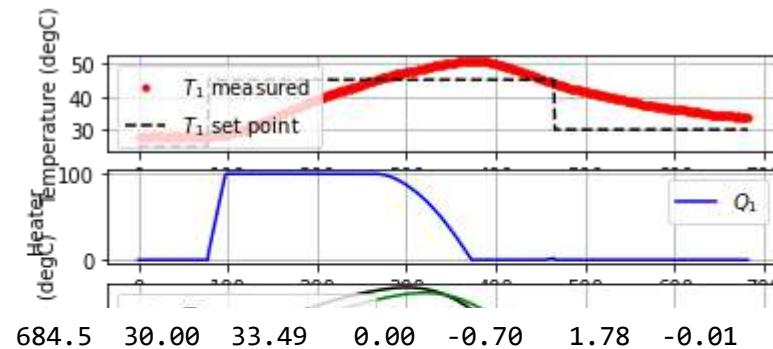


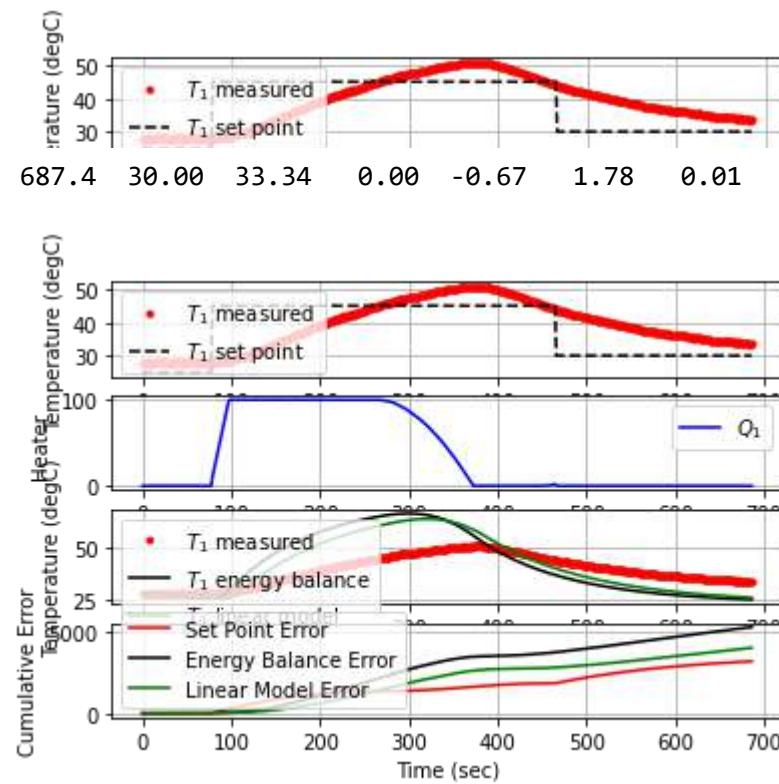
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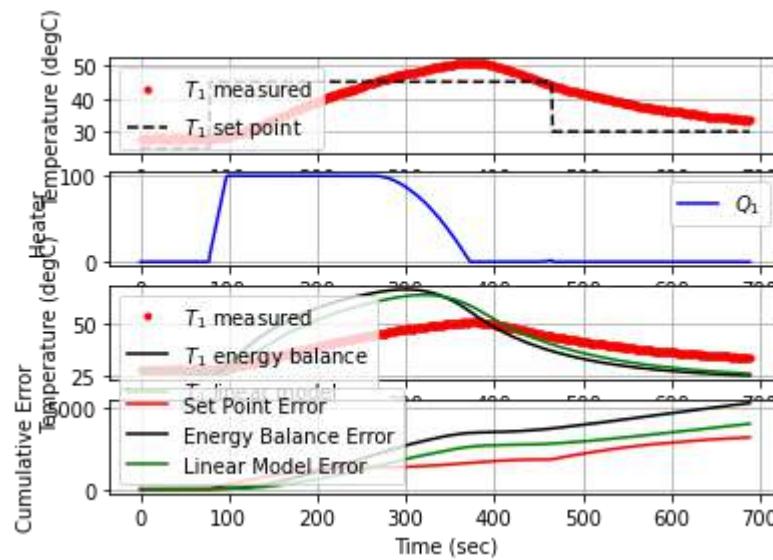
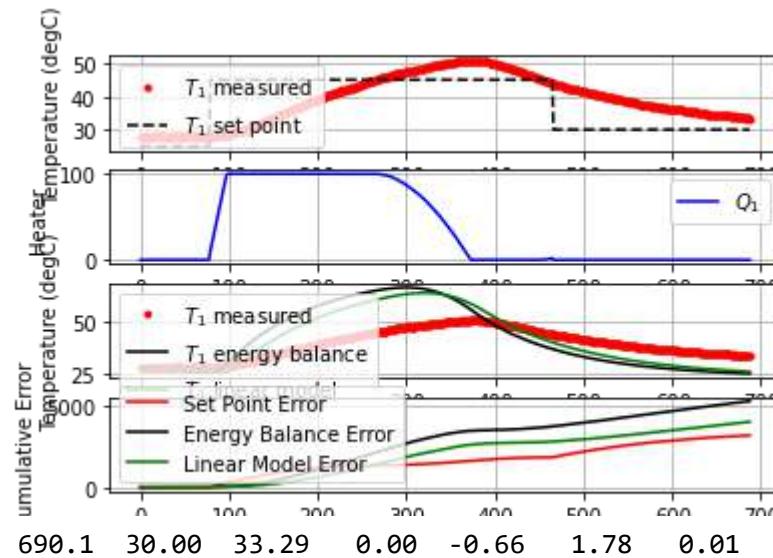


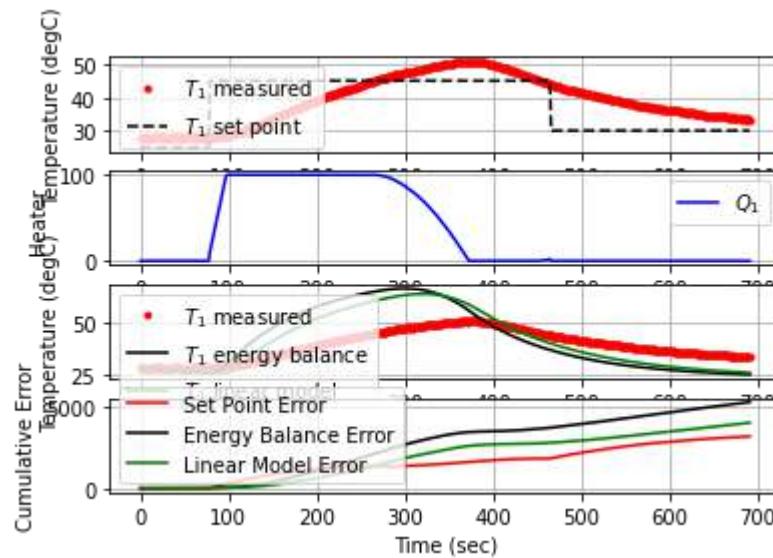
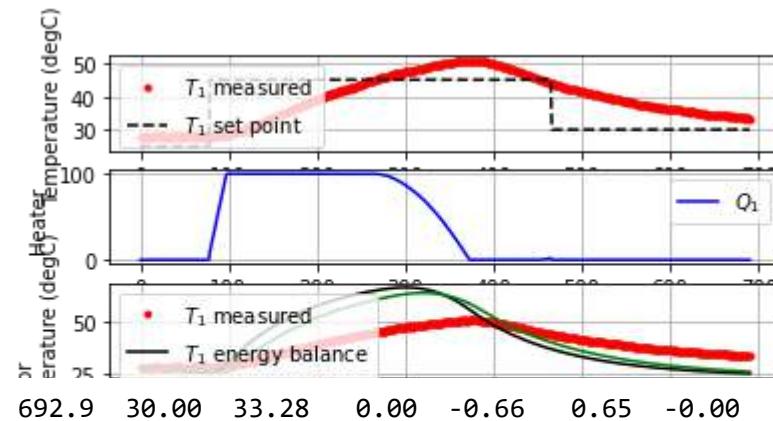




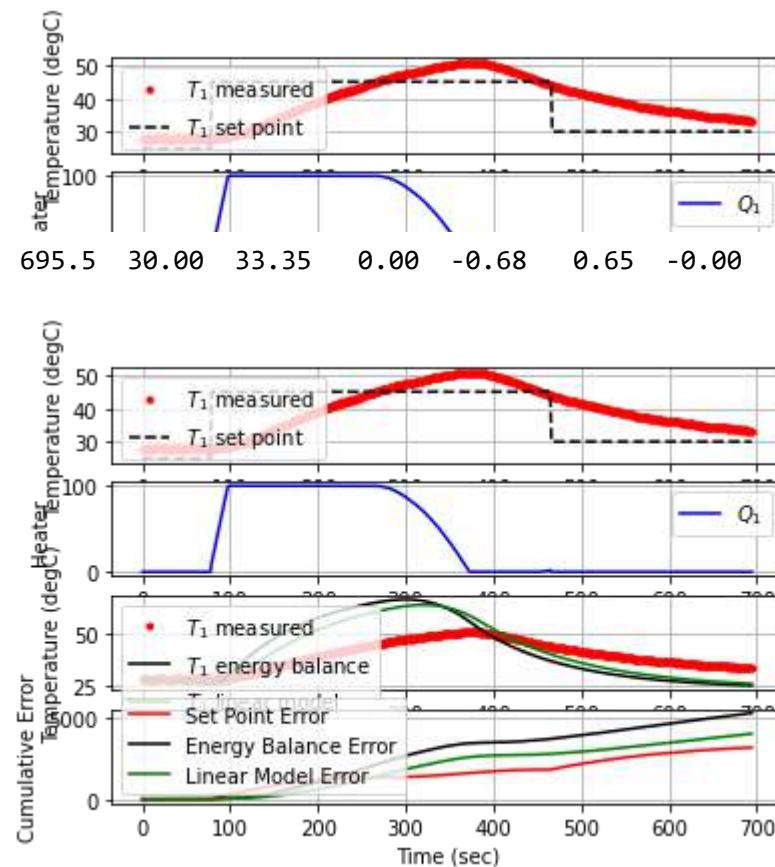


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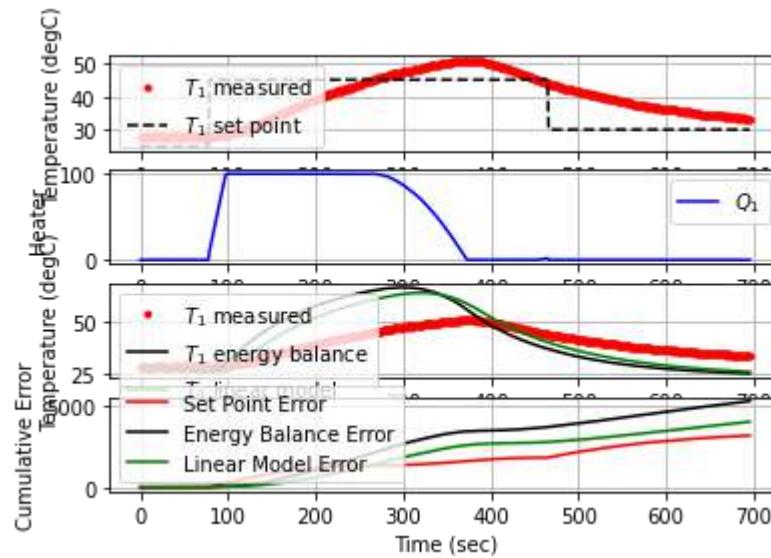




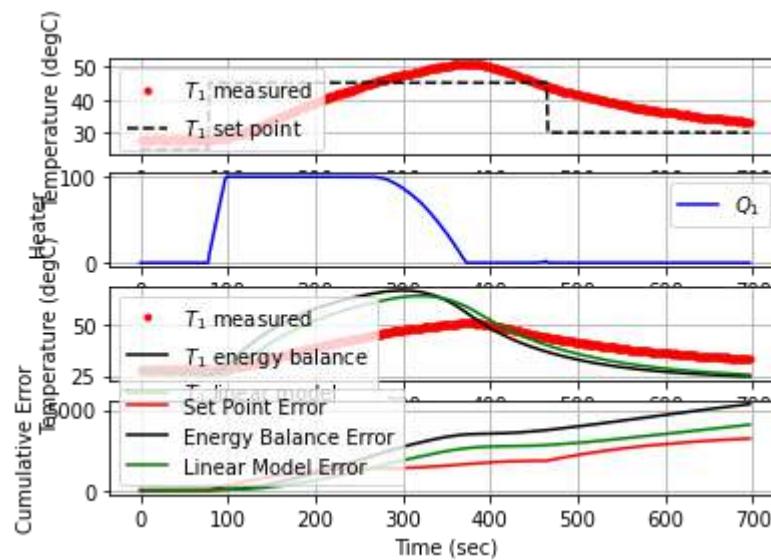
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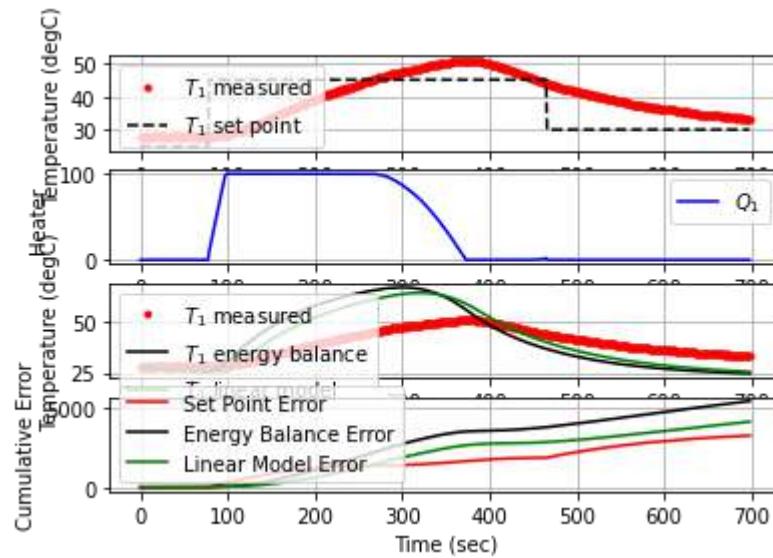
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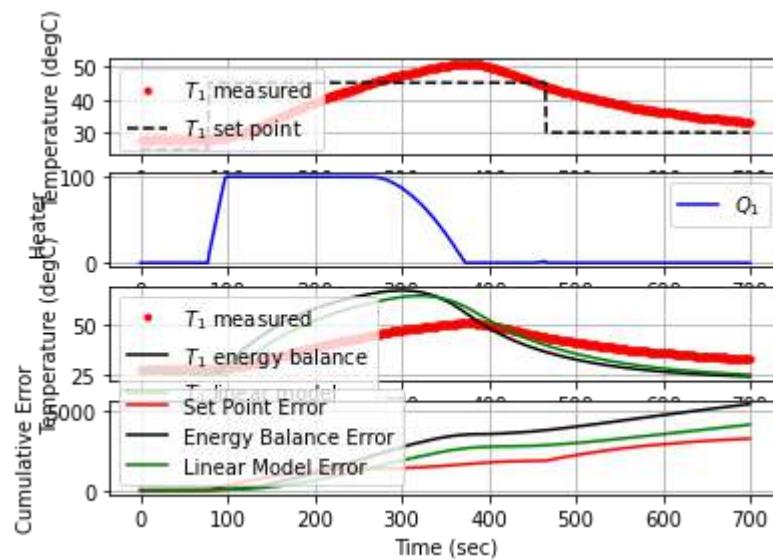
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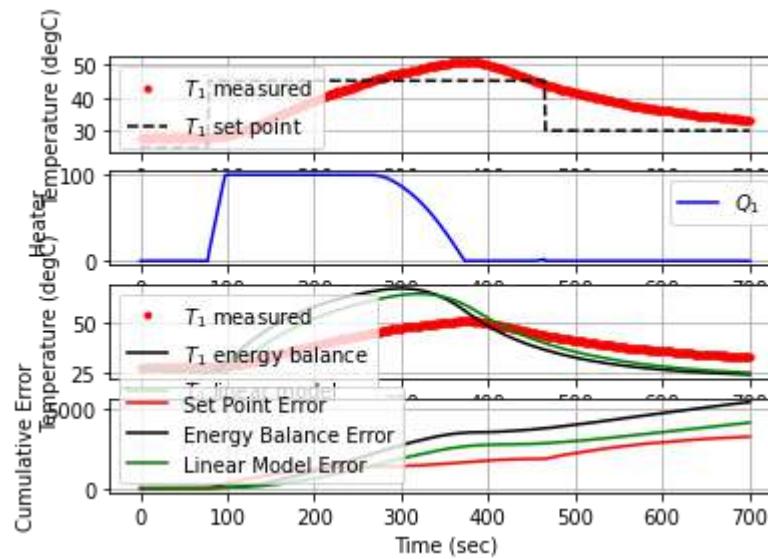
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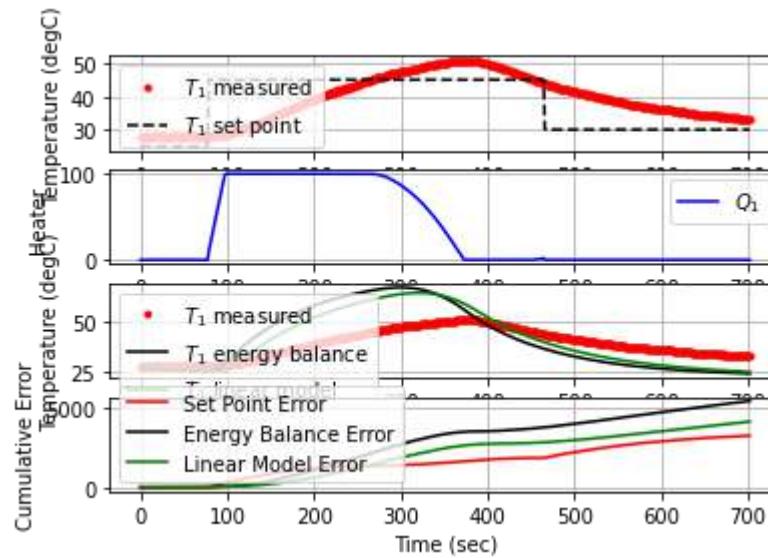
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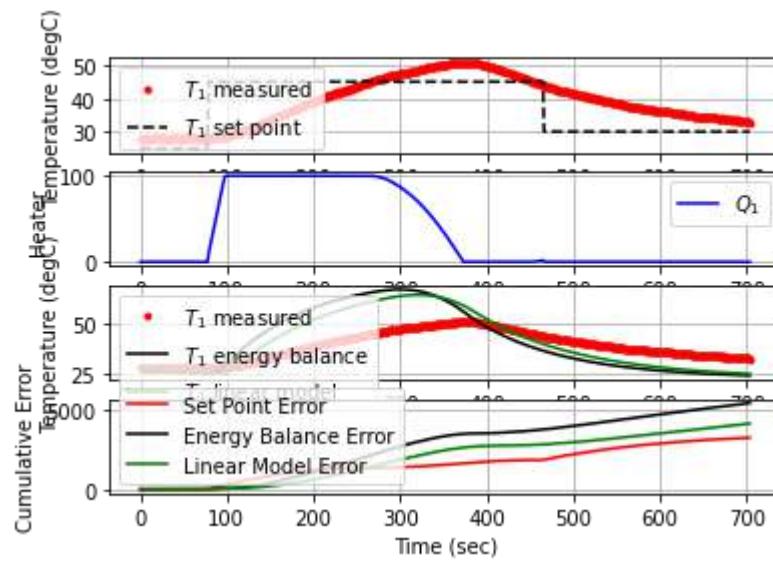
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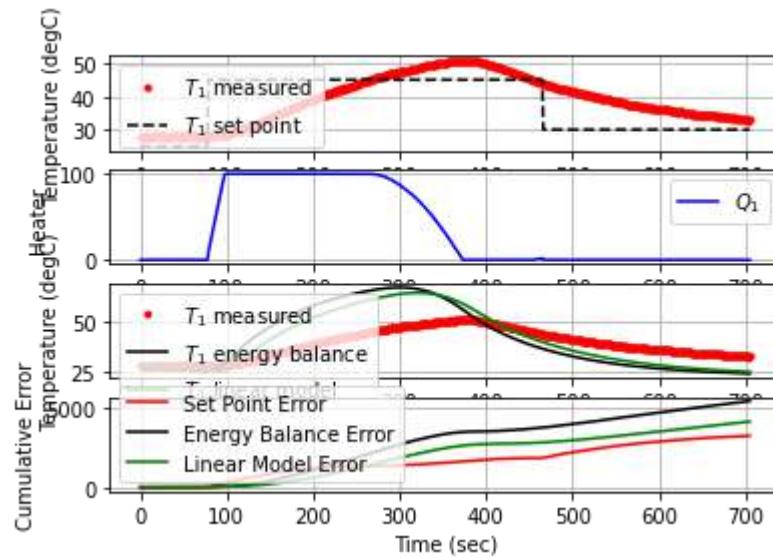
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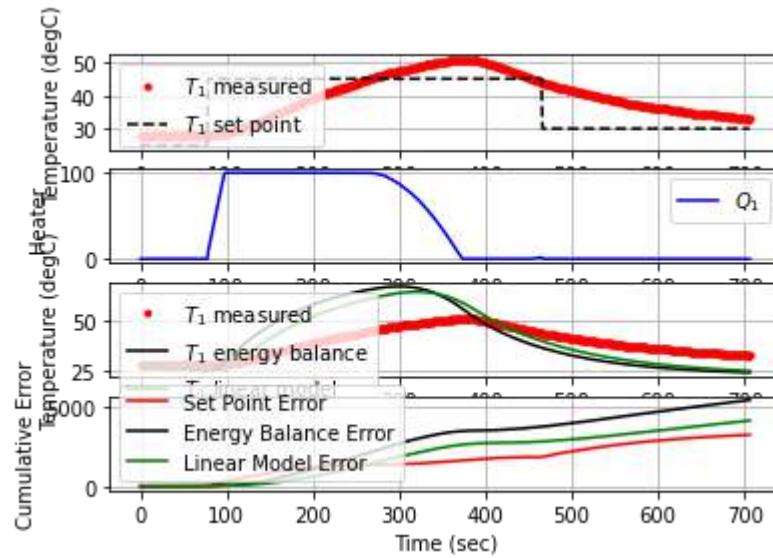
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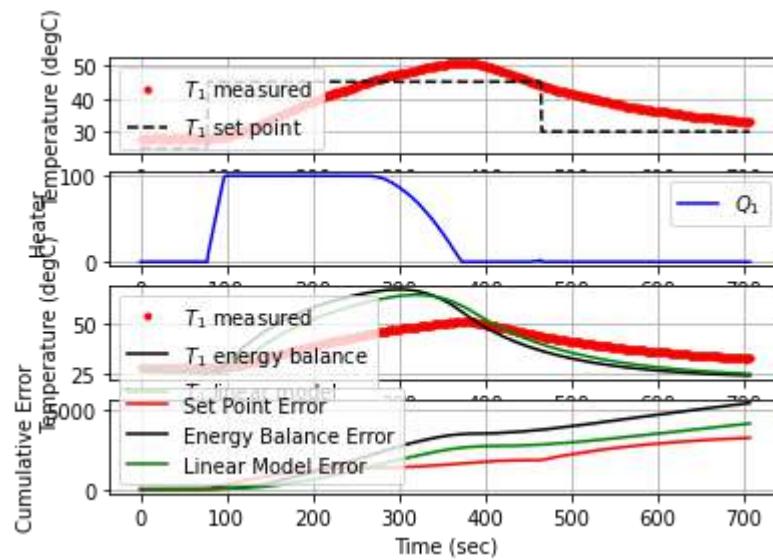
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707.4 30.00 32.94 0.00 -0.59 0.65 -0.00

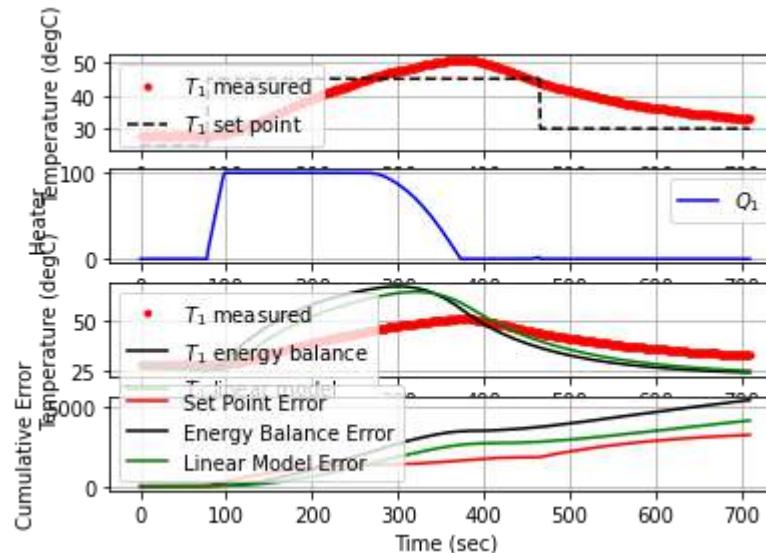


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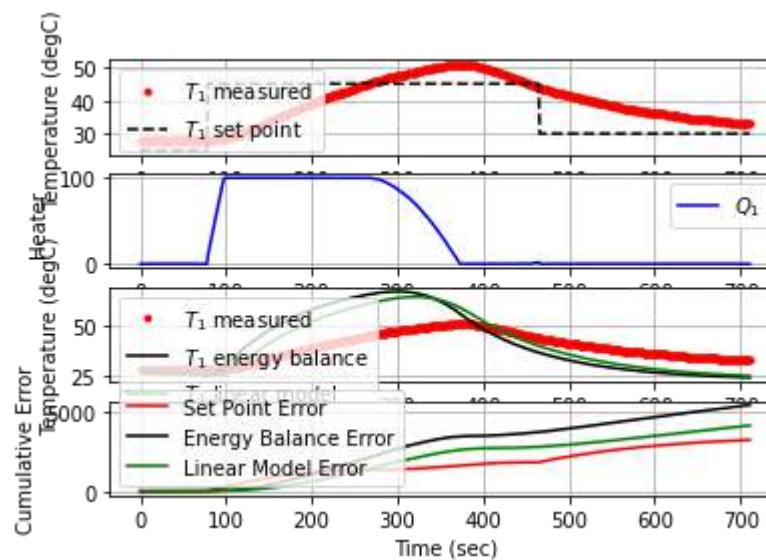


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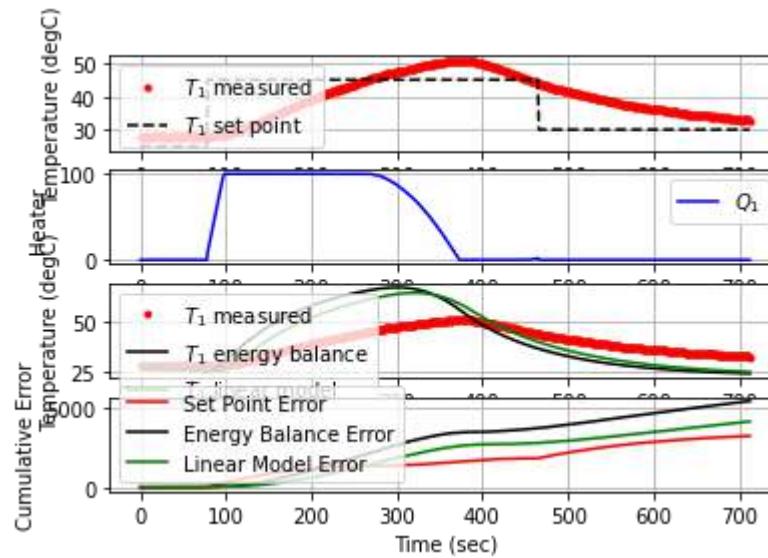
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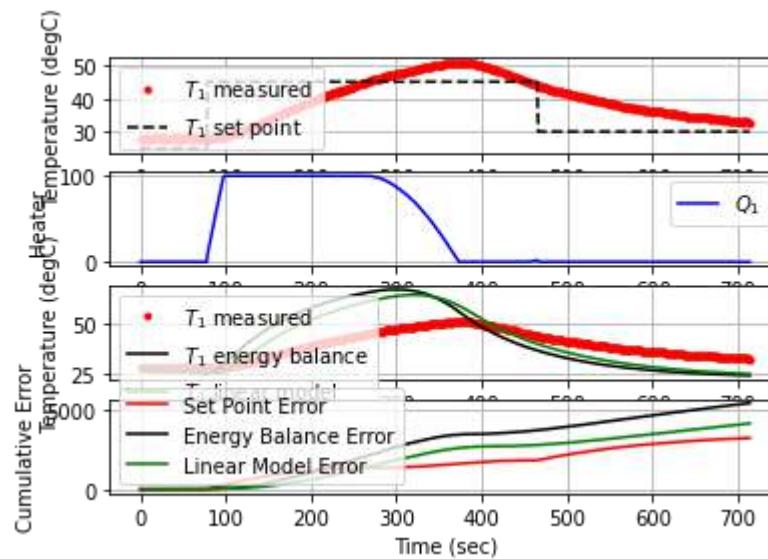
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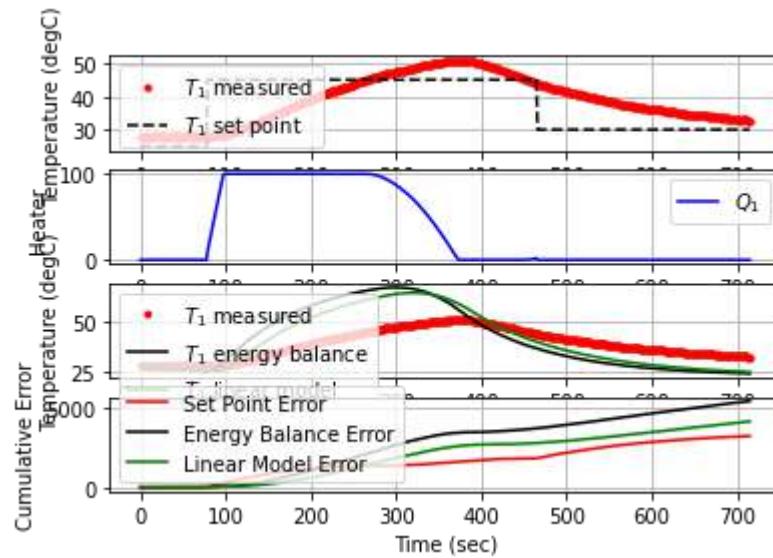
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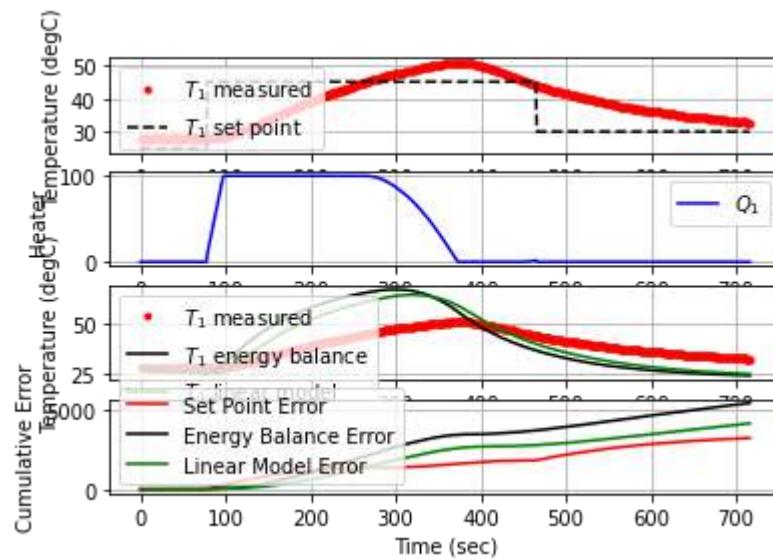
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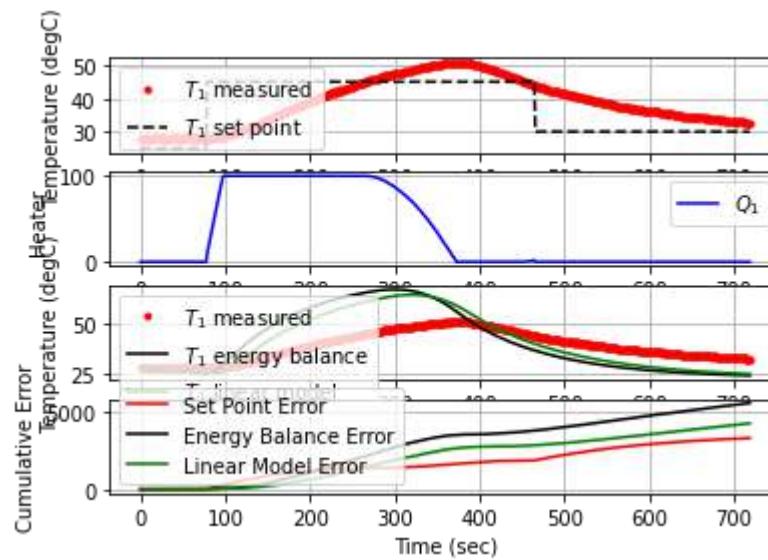
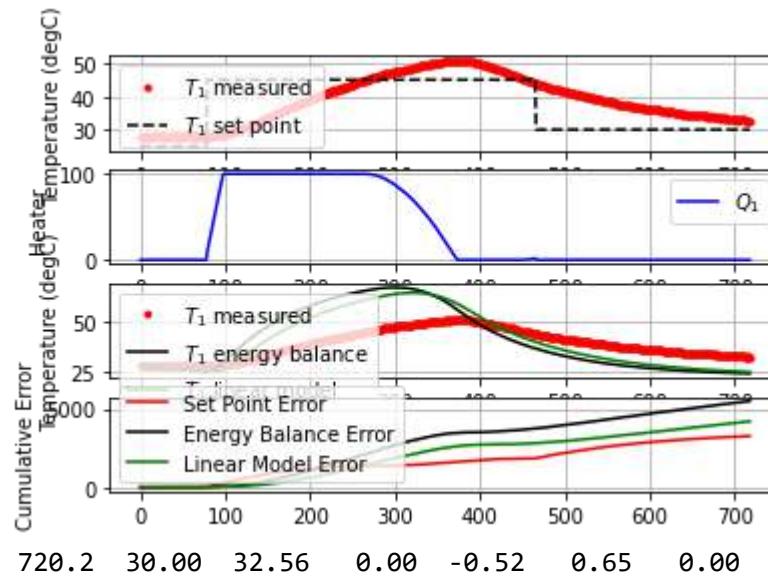
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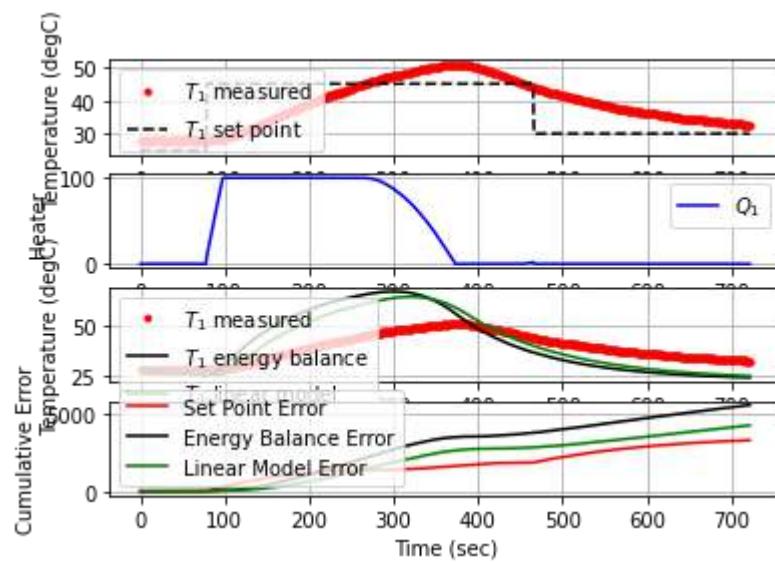
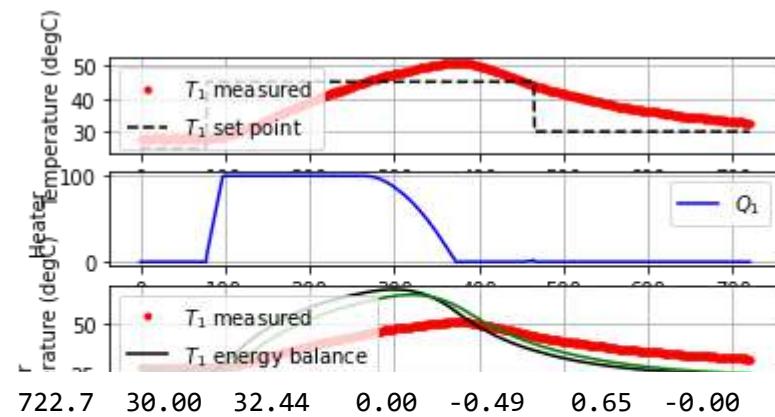


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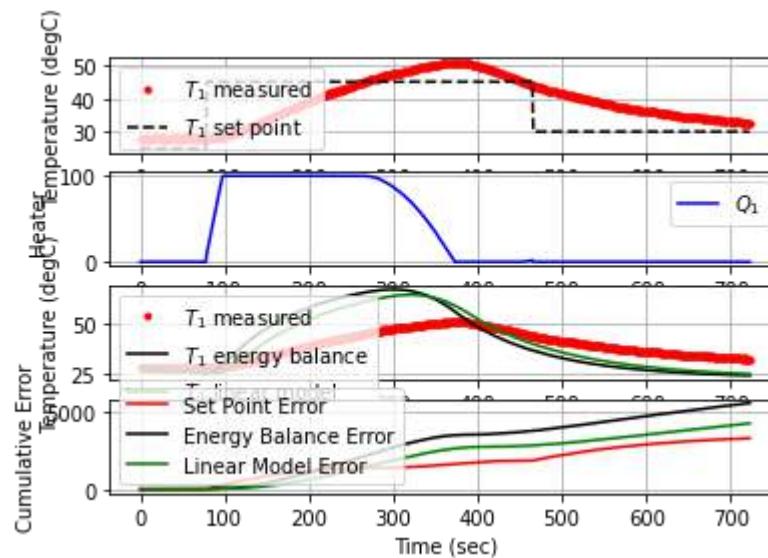


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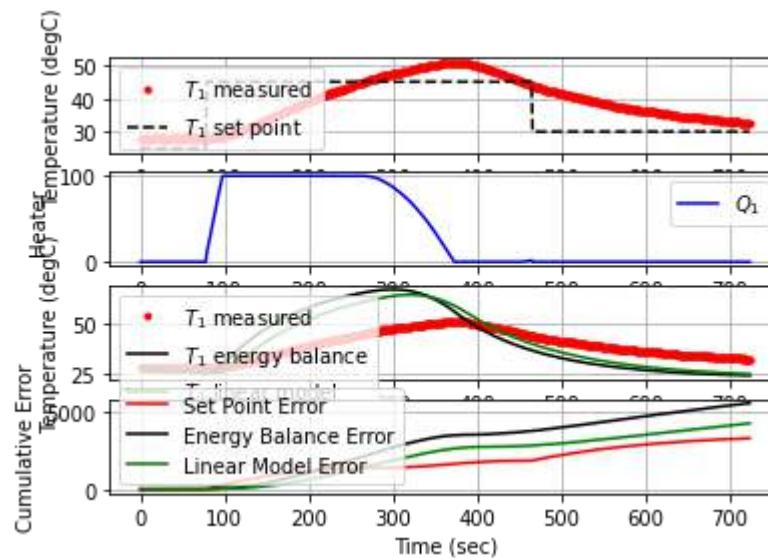




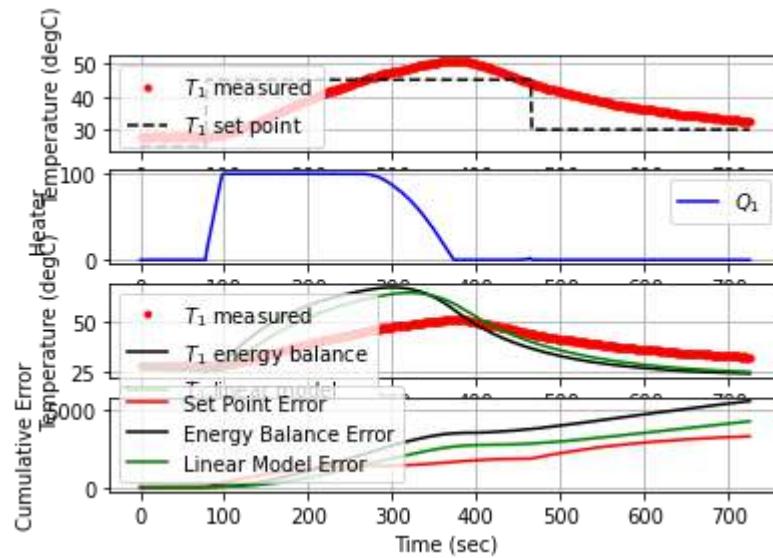
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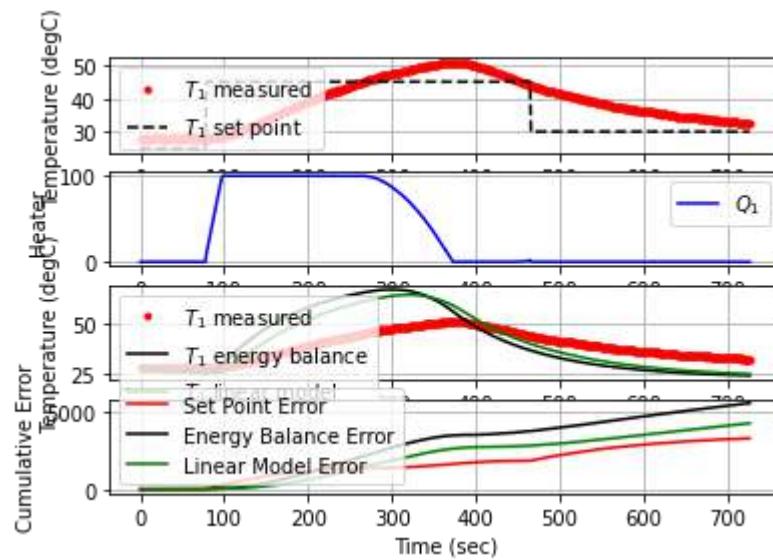
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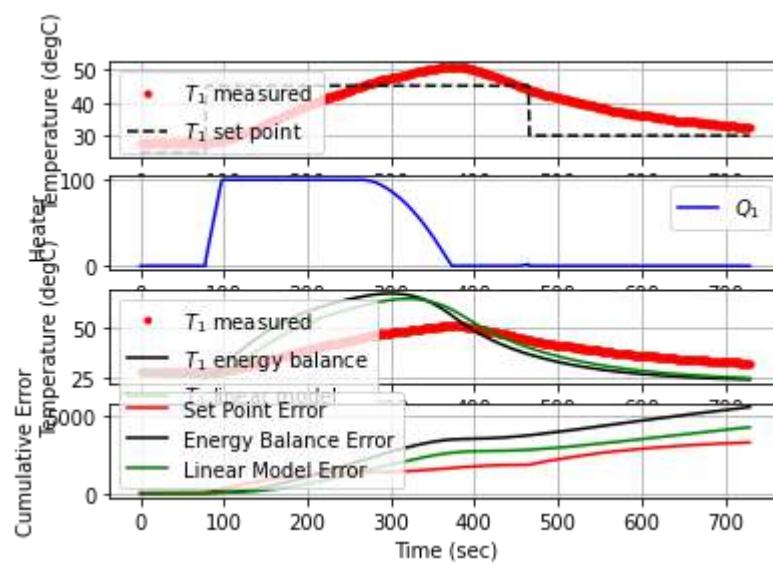
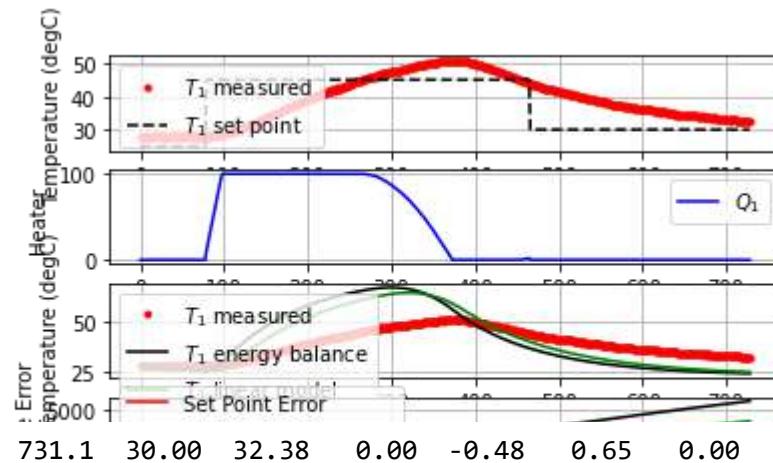
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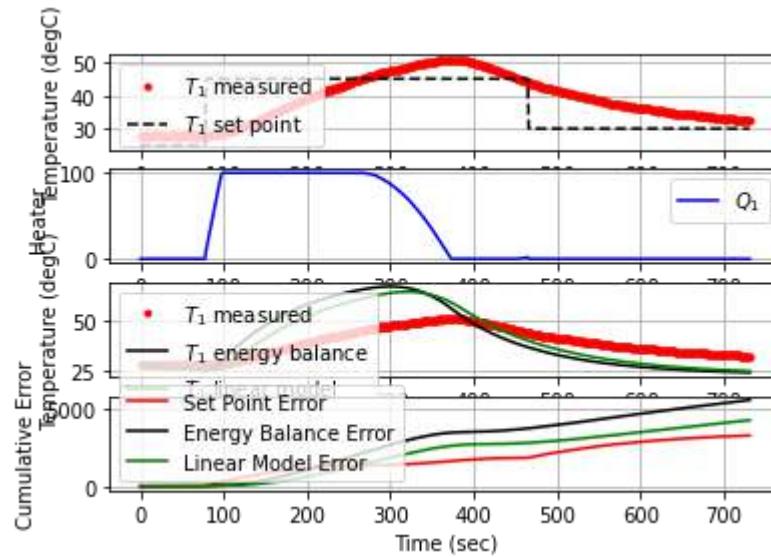
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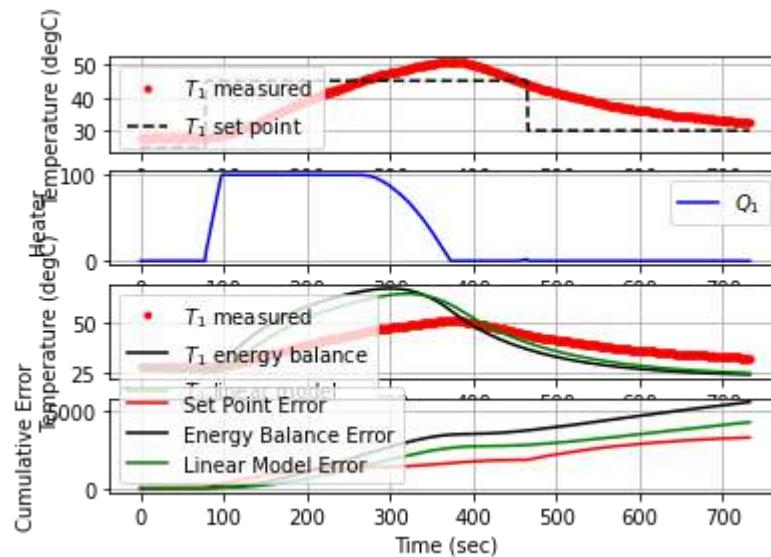
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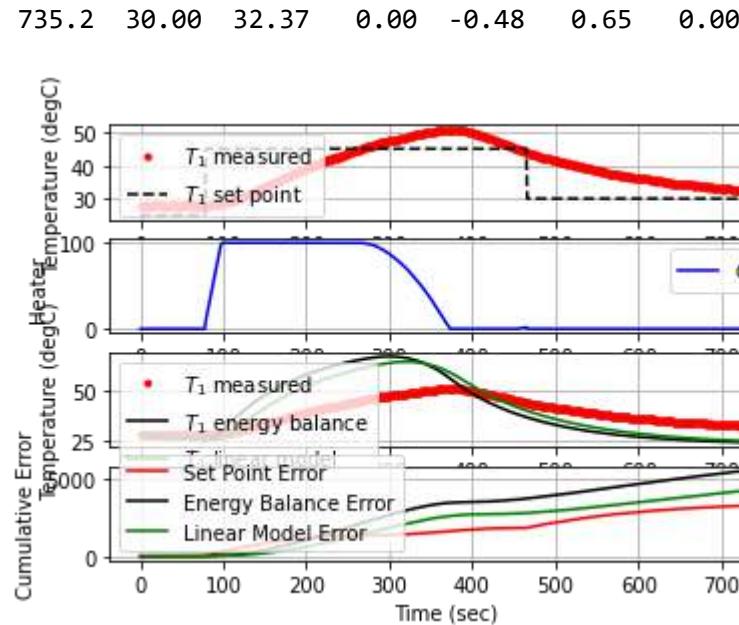


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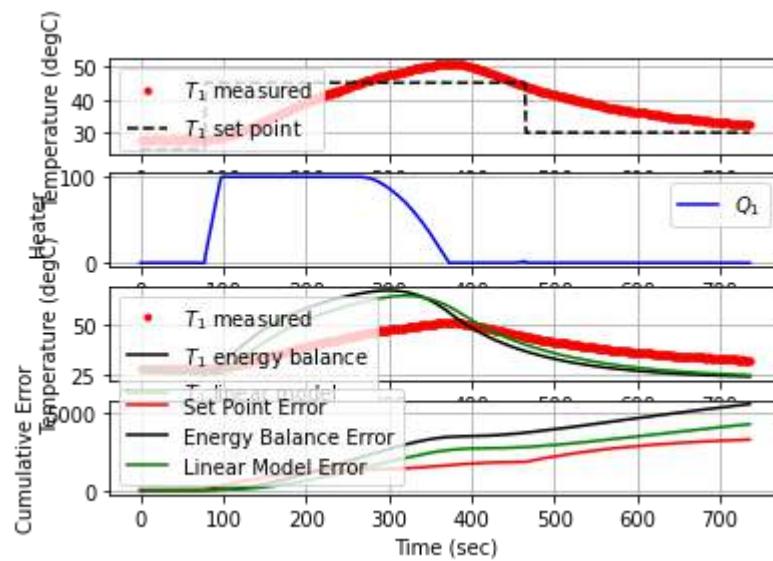
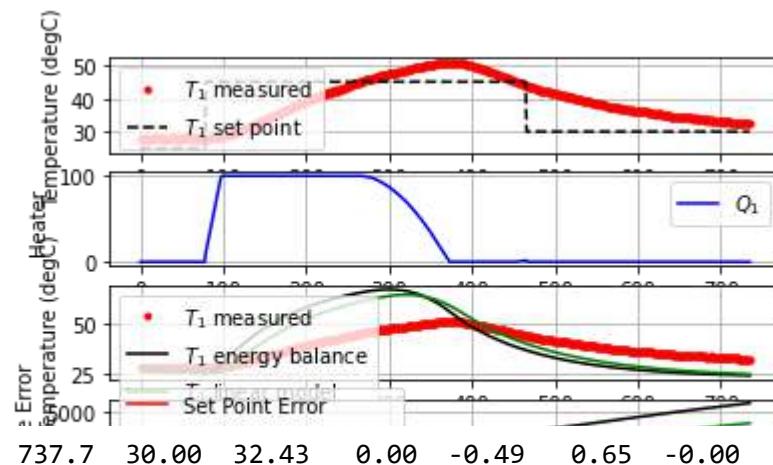


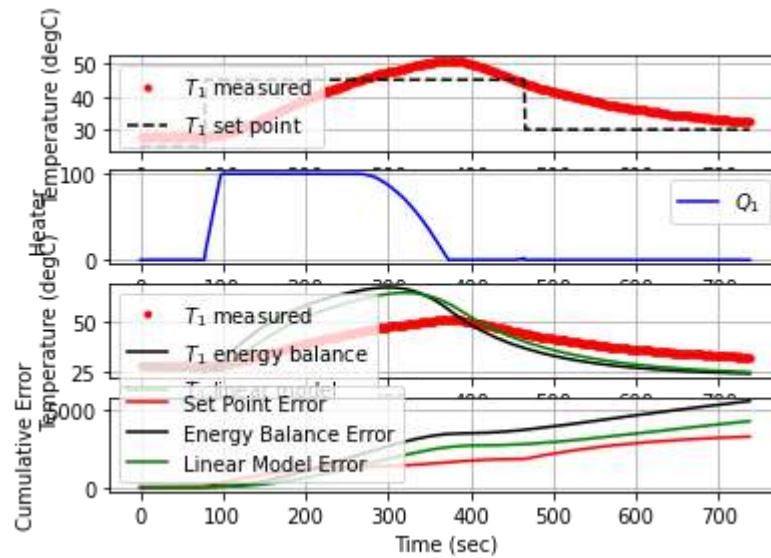
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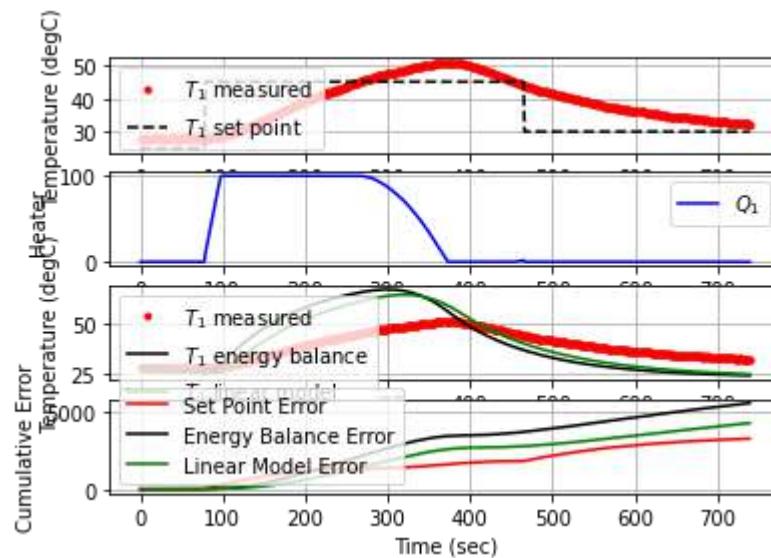


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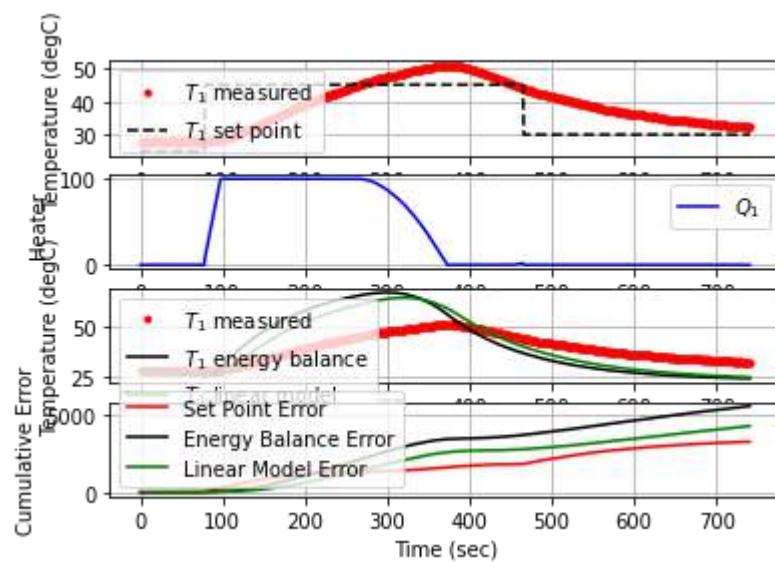




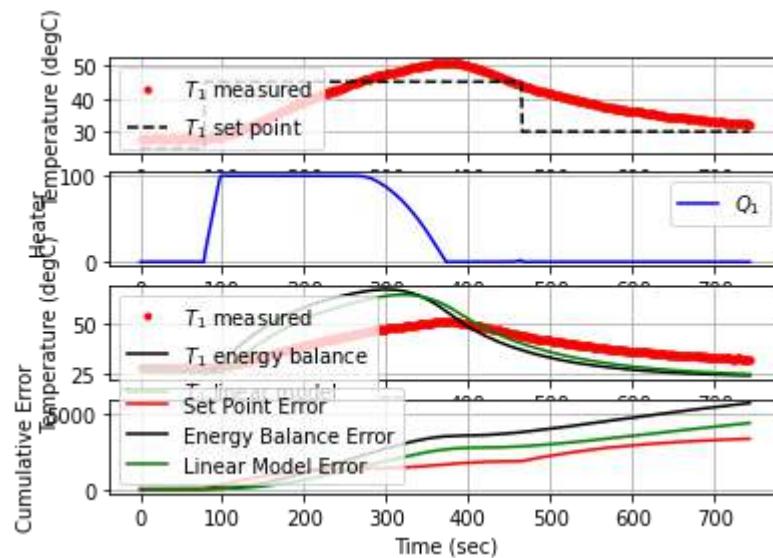
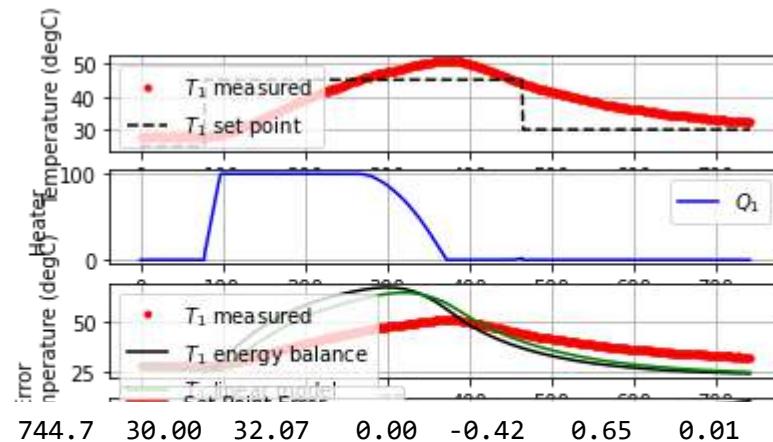
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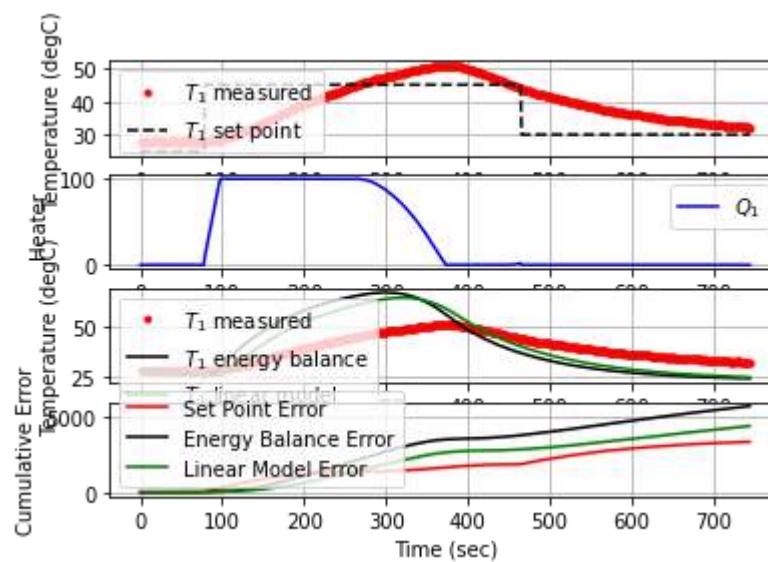
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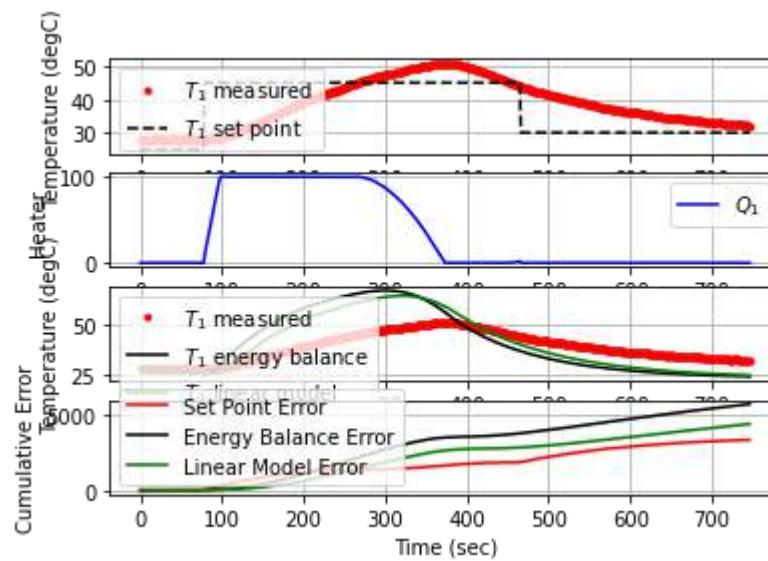
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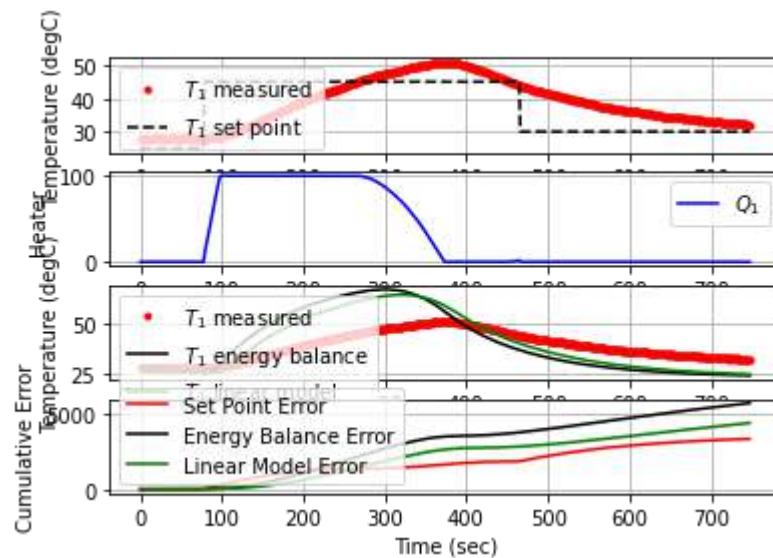
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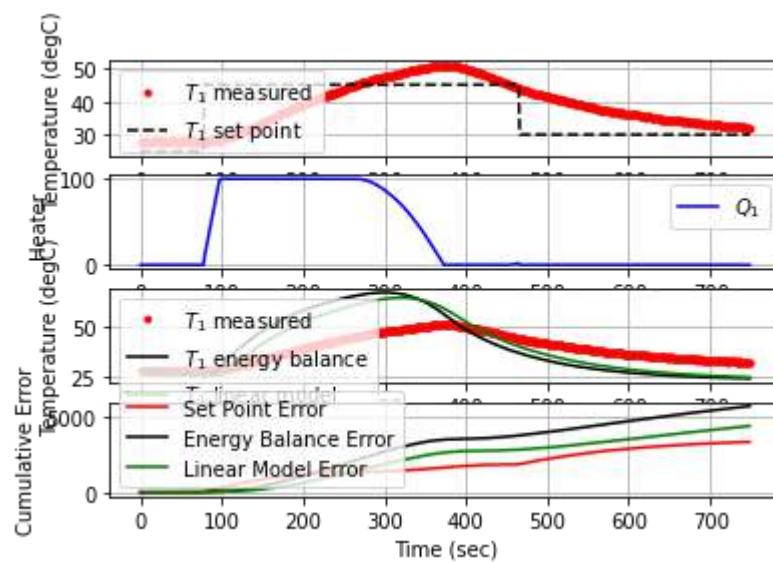
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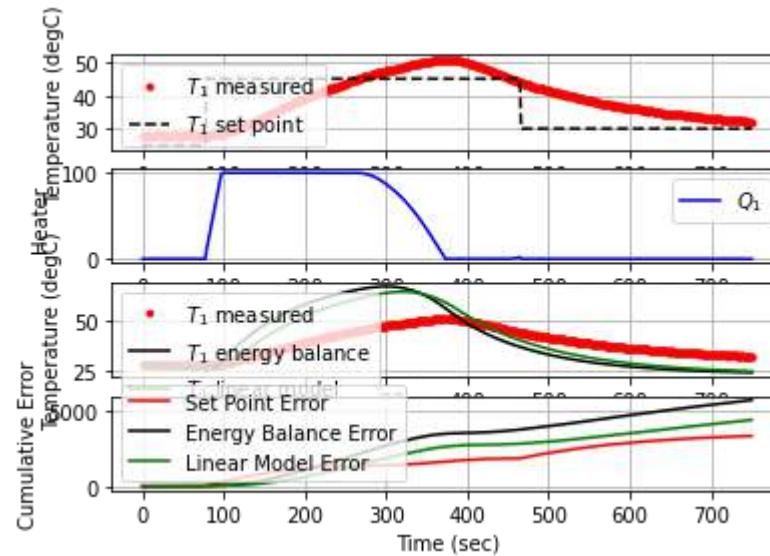
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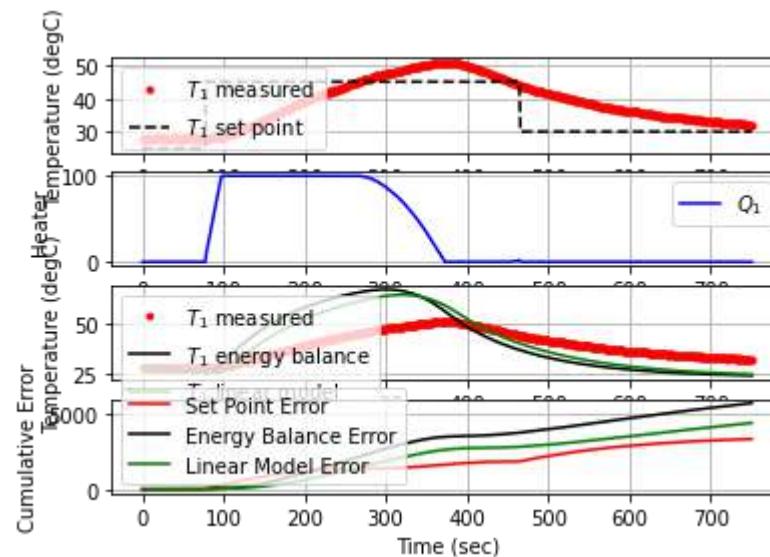
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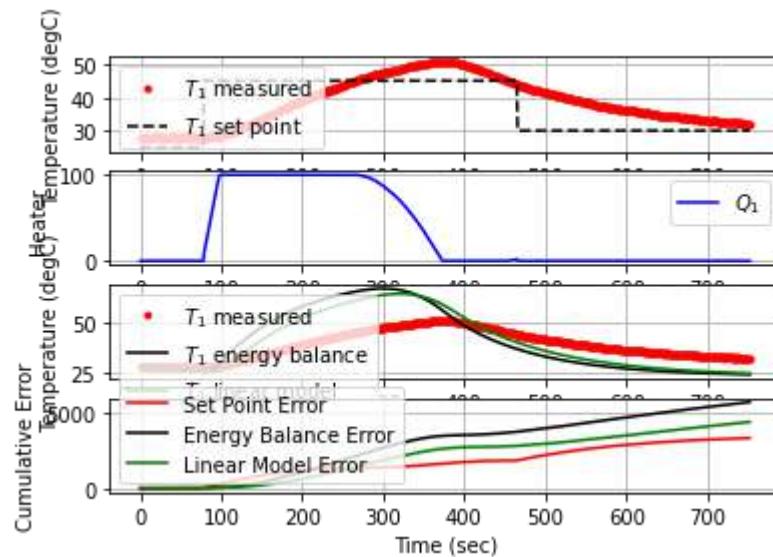
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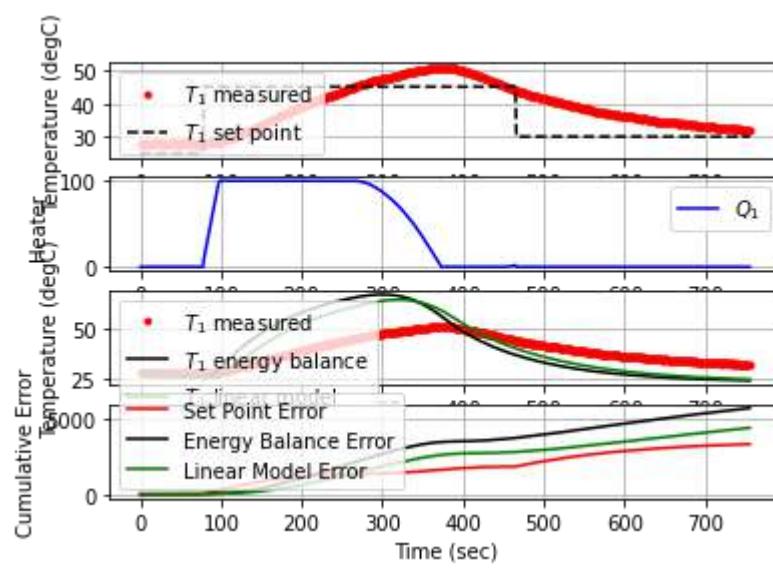
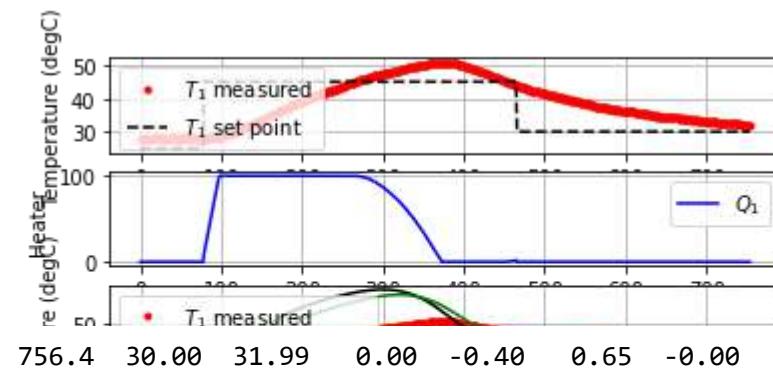
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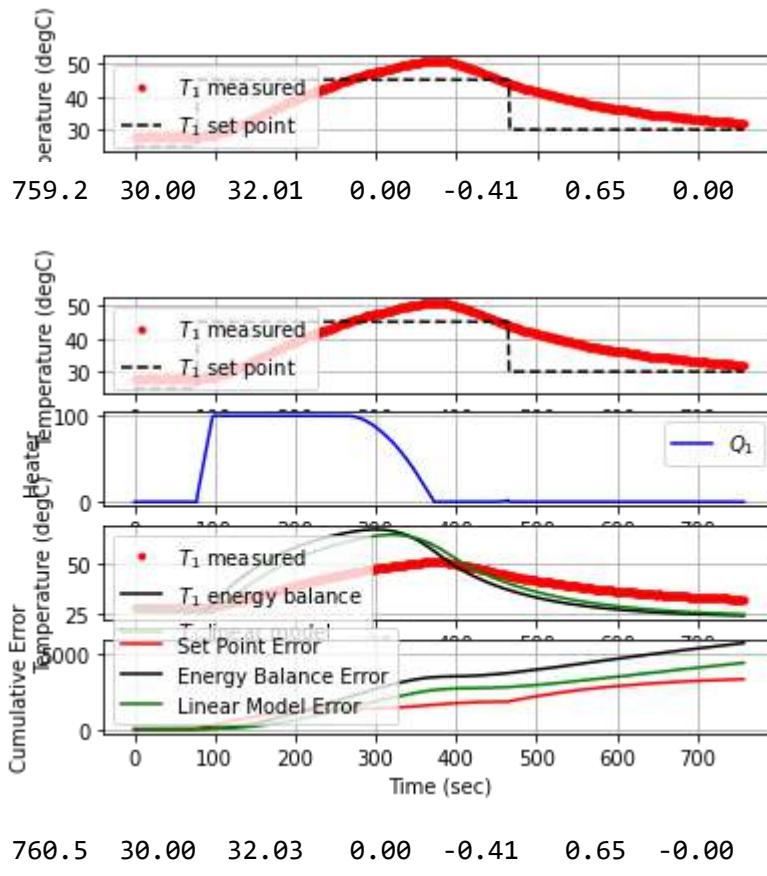


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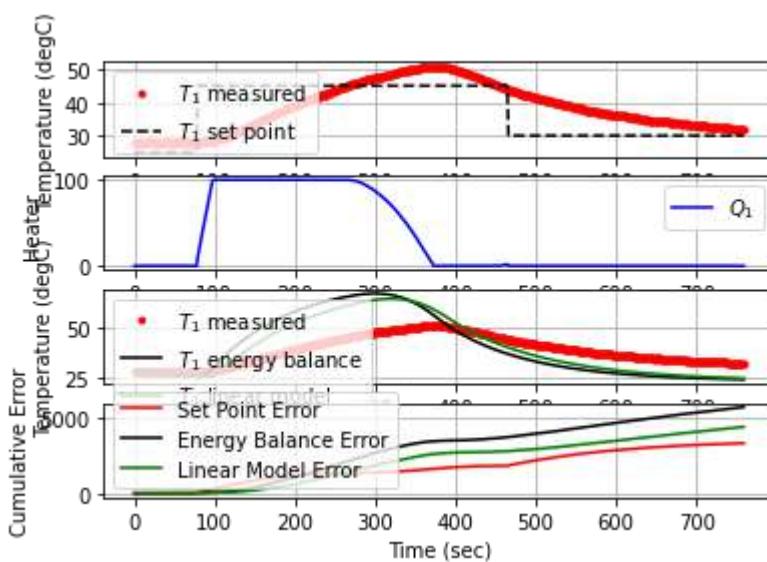


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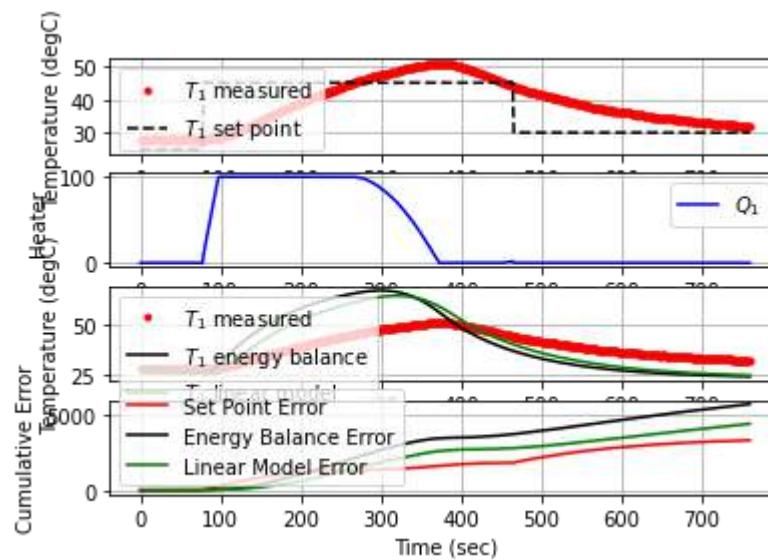




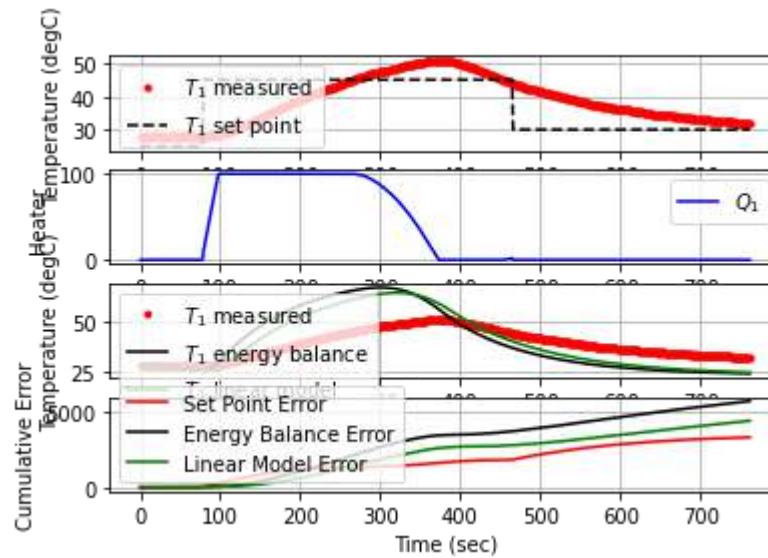
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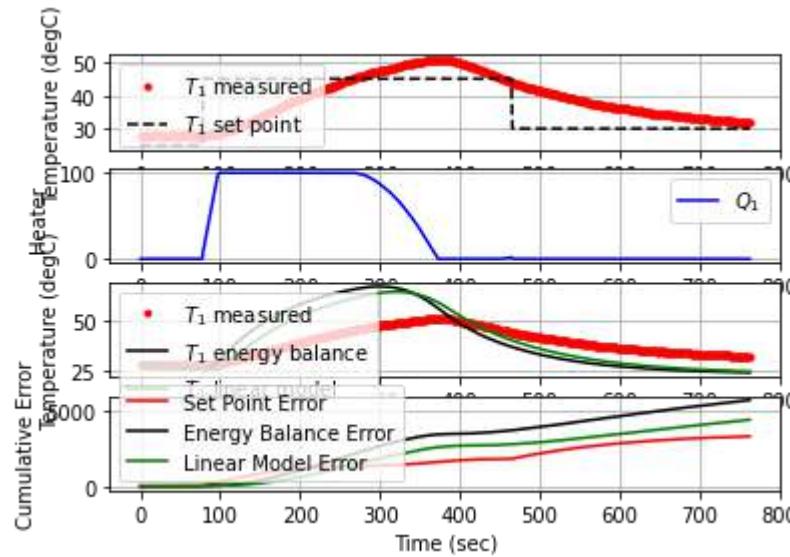
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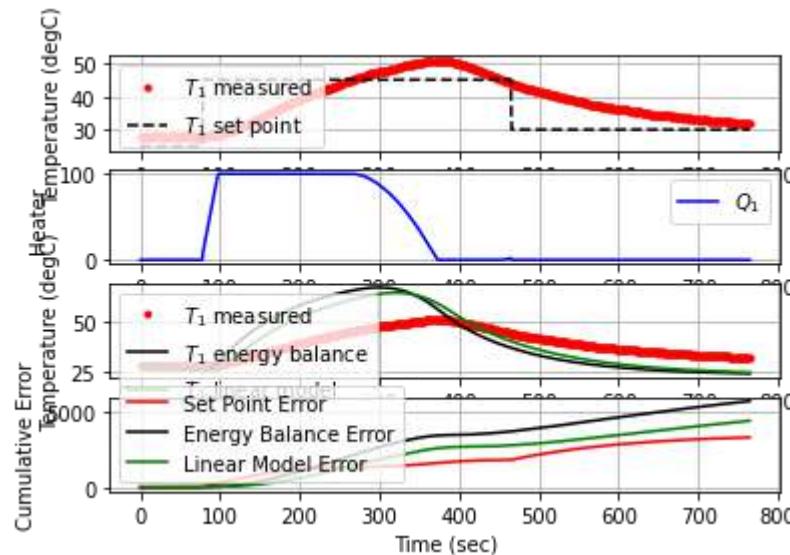
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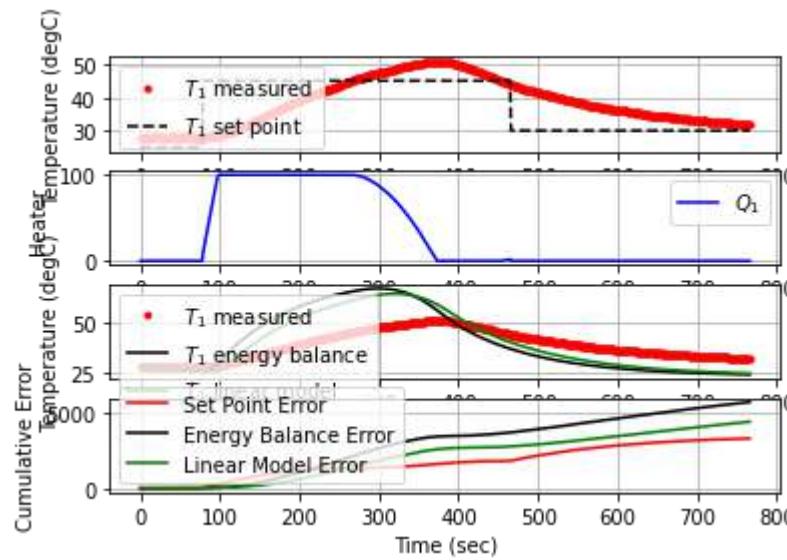
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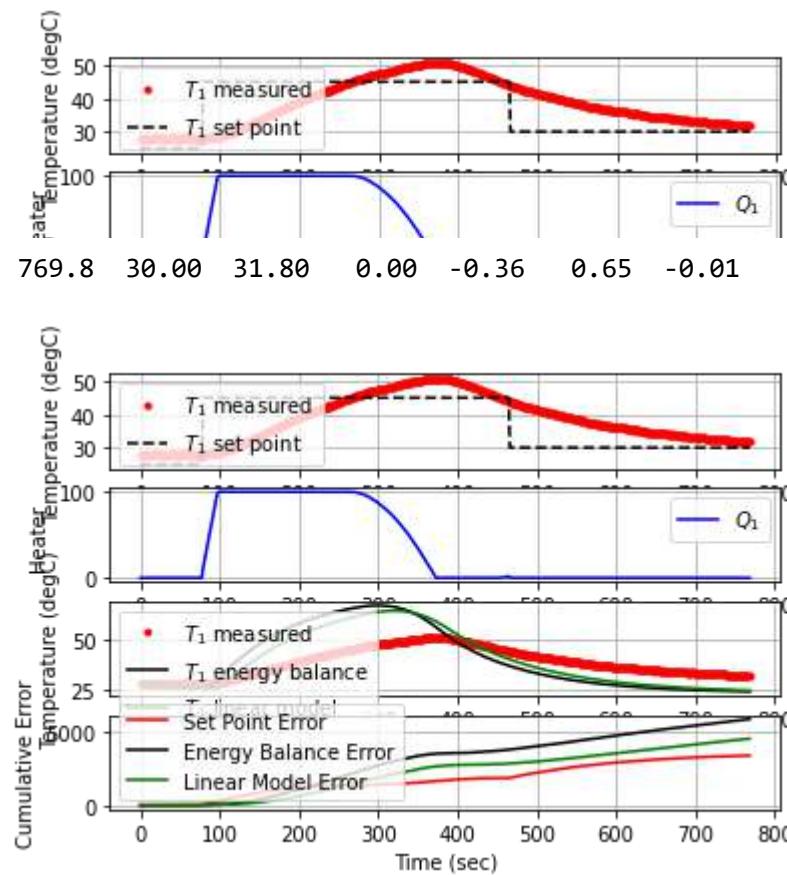
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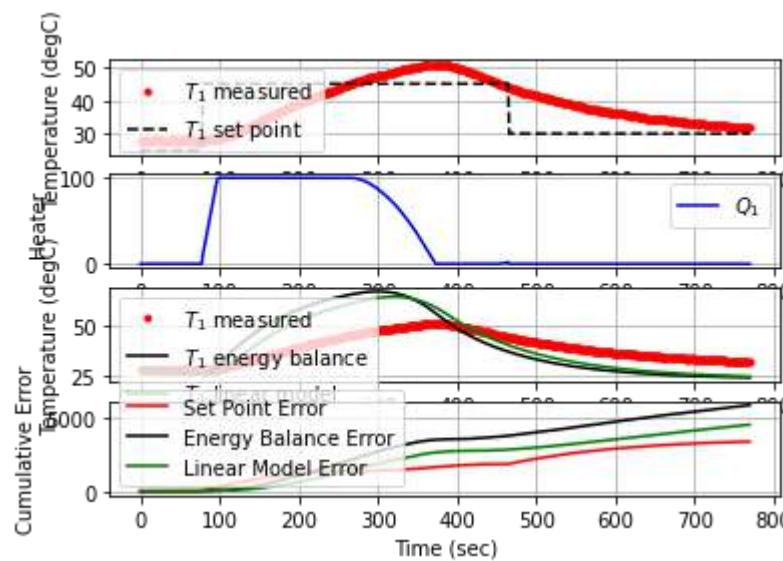
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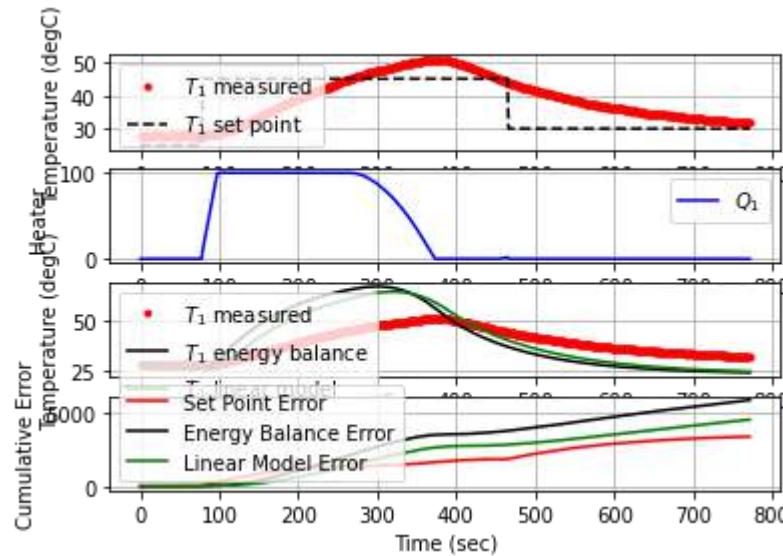
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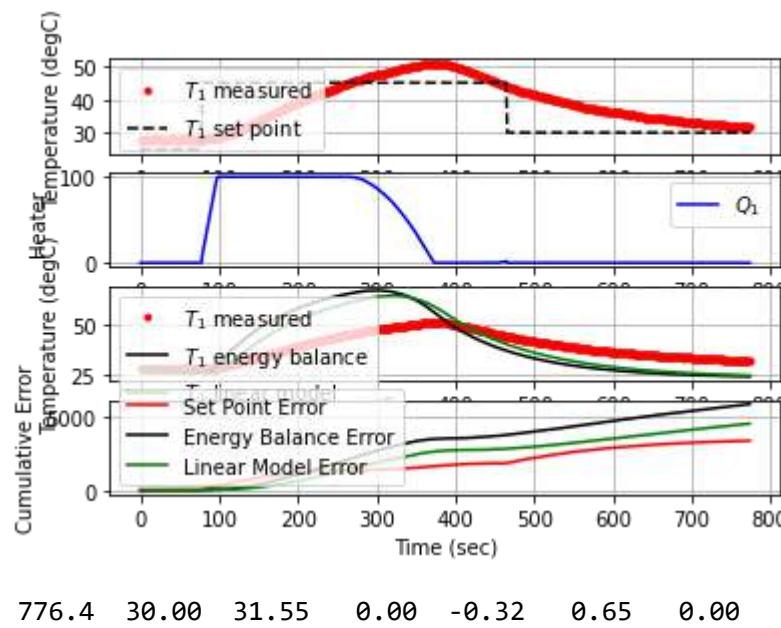
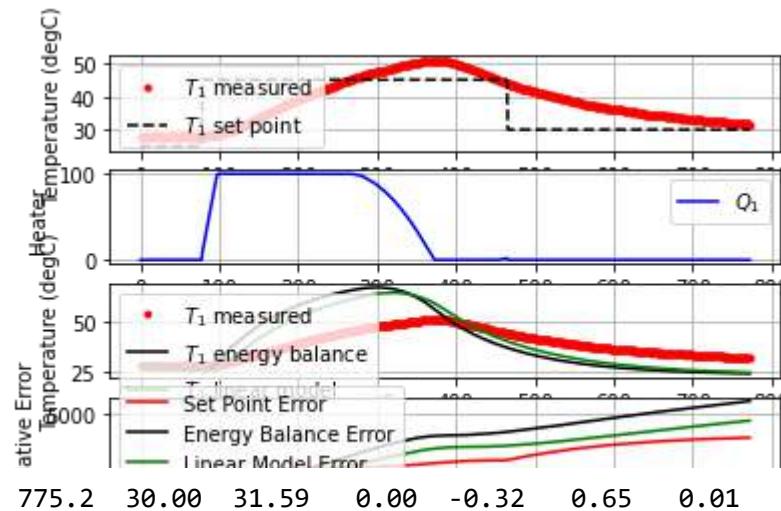
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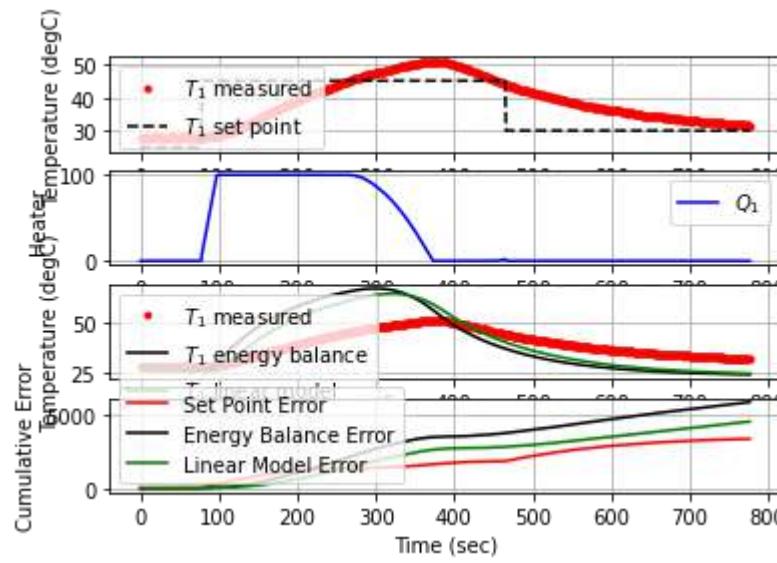
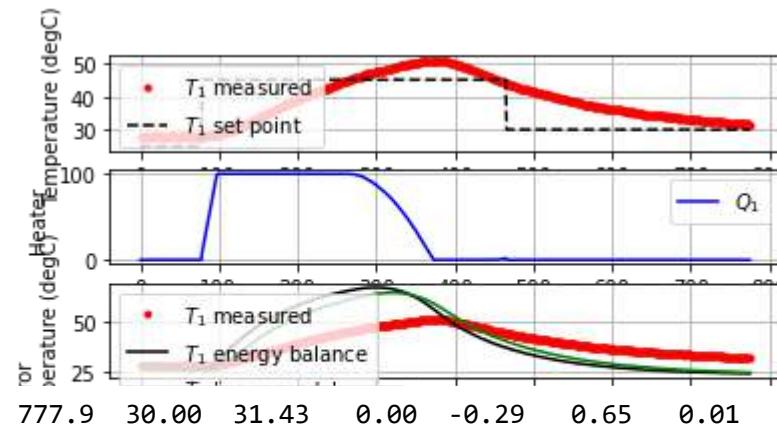


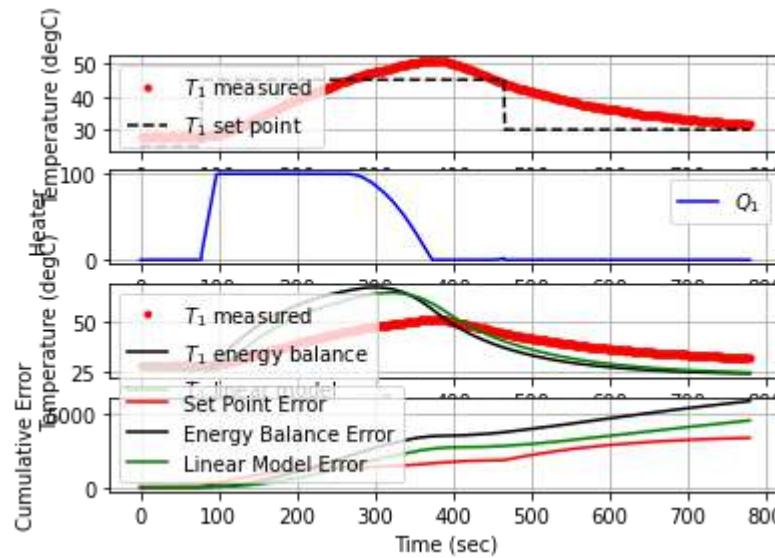
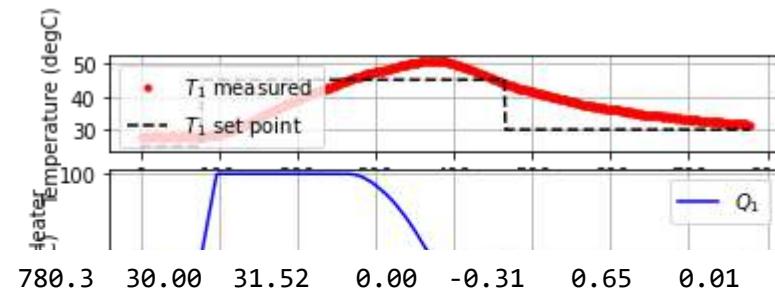
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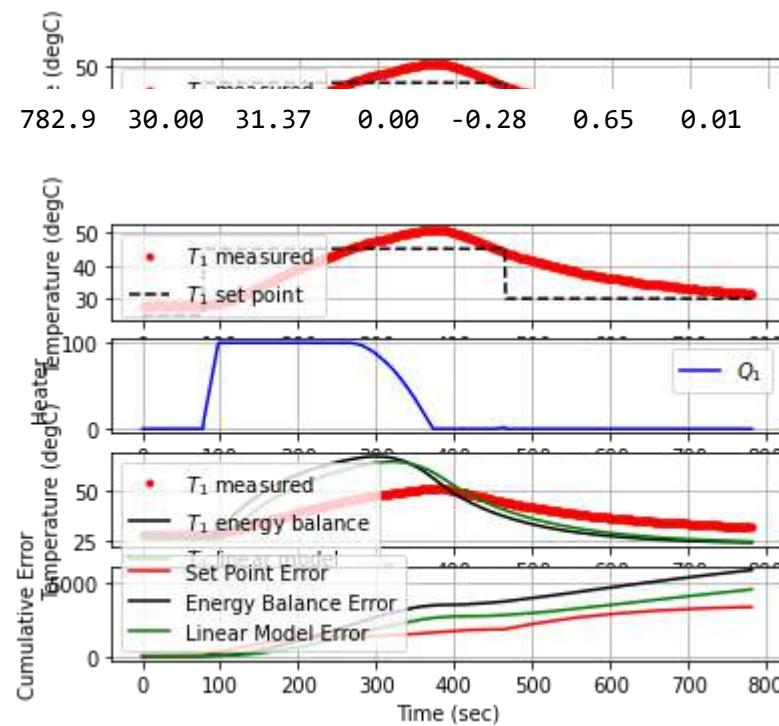


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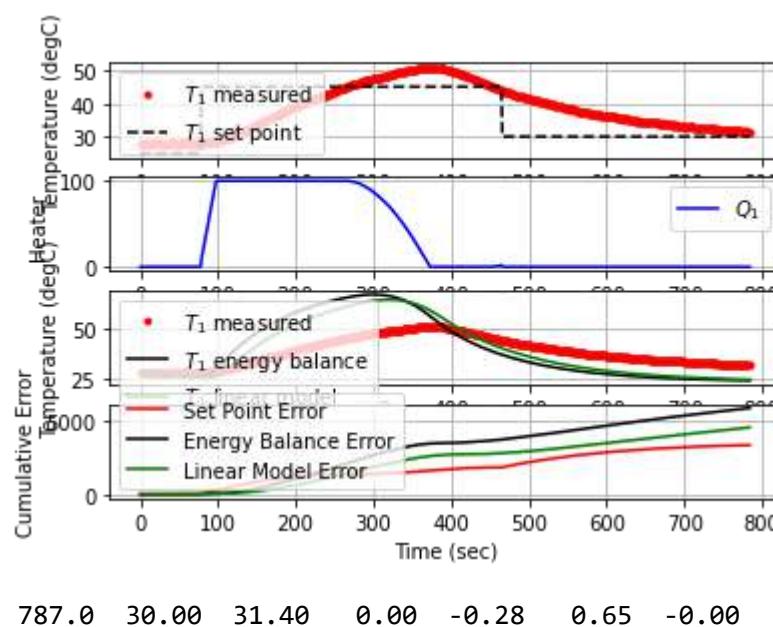
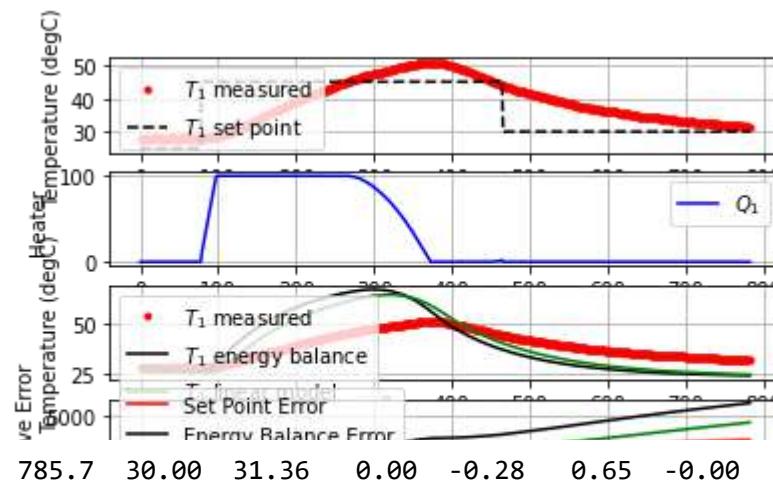


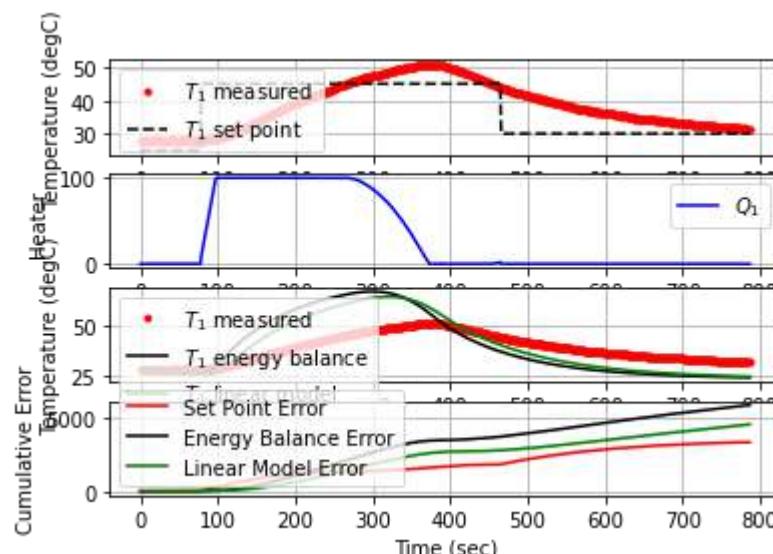
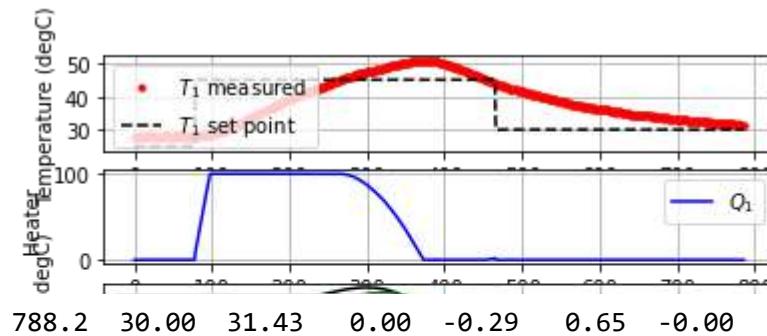


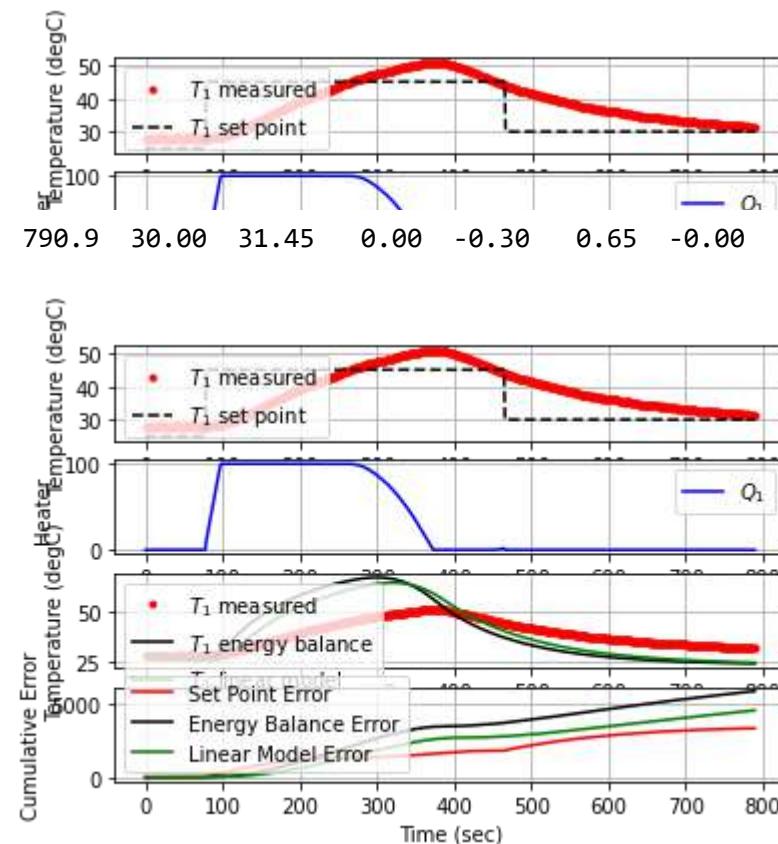




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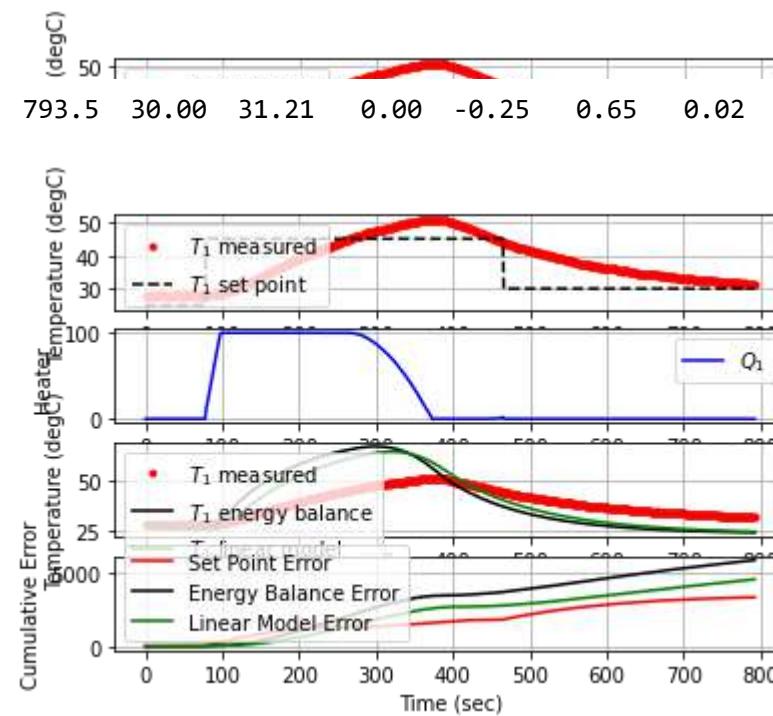




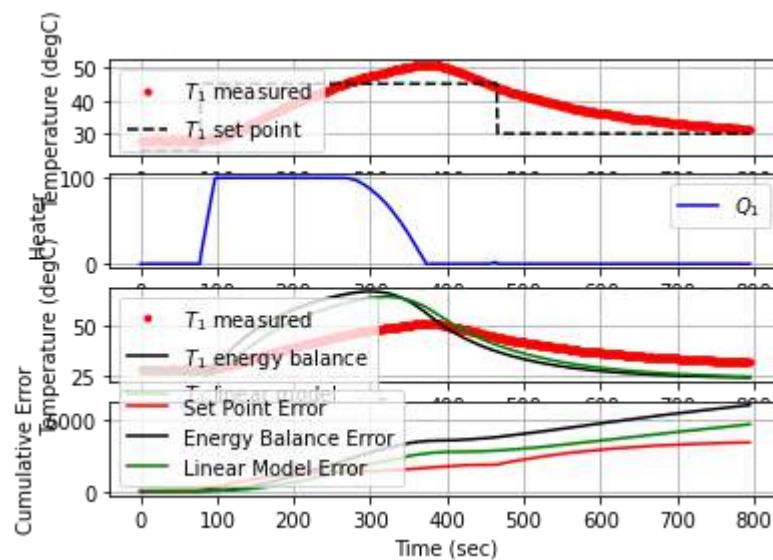
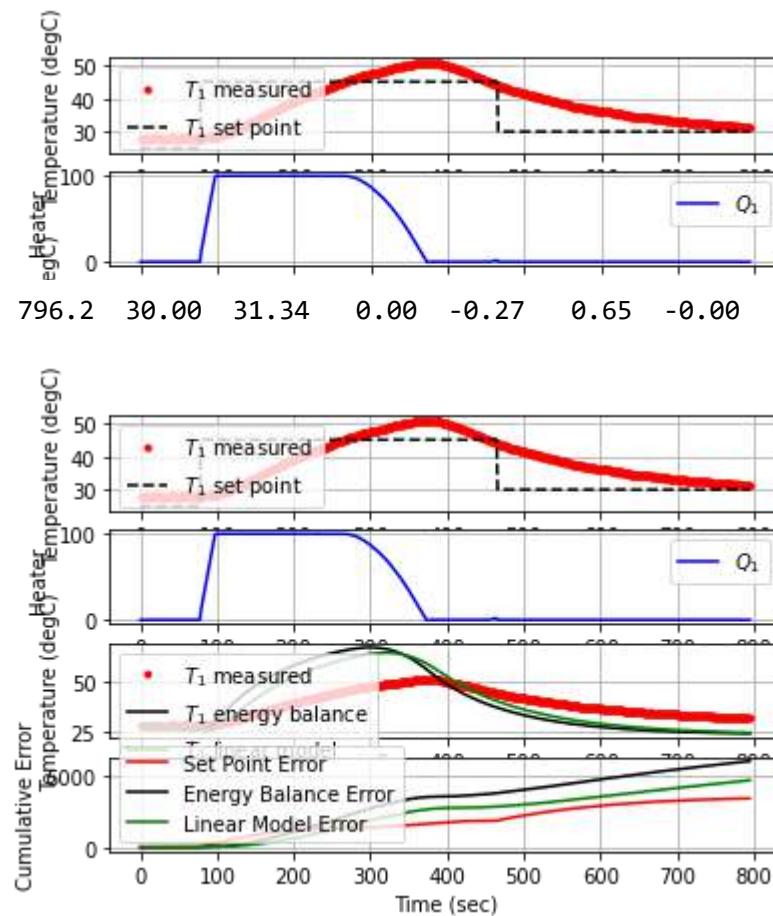


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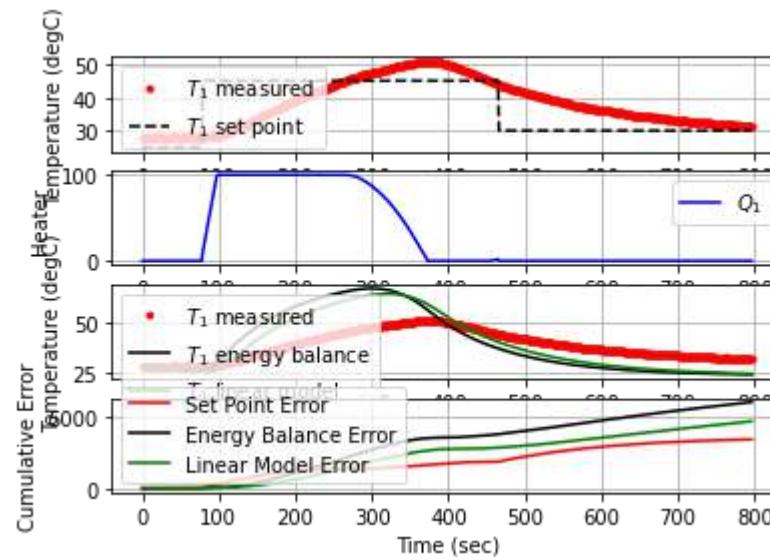




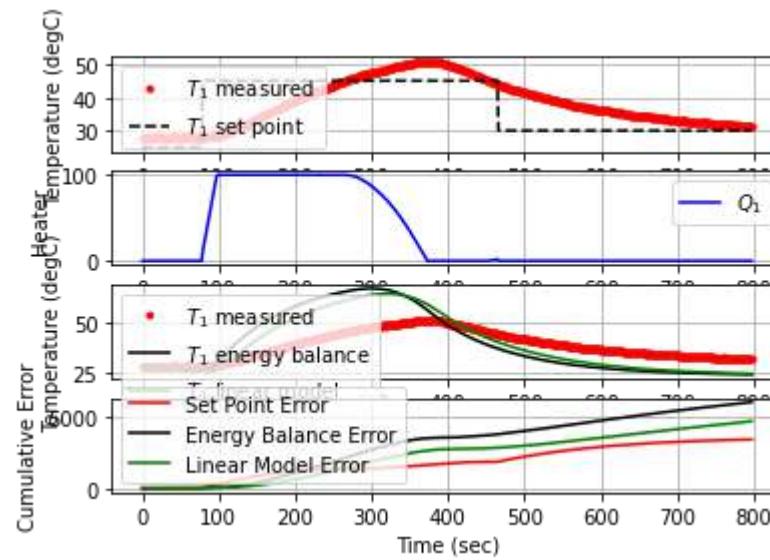
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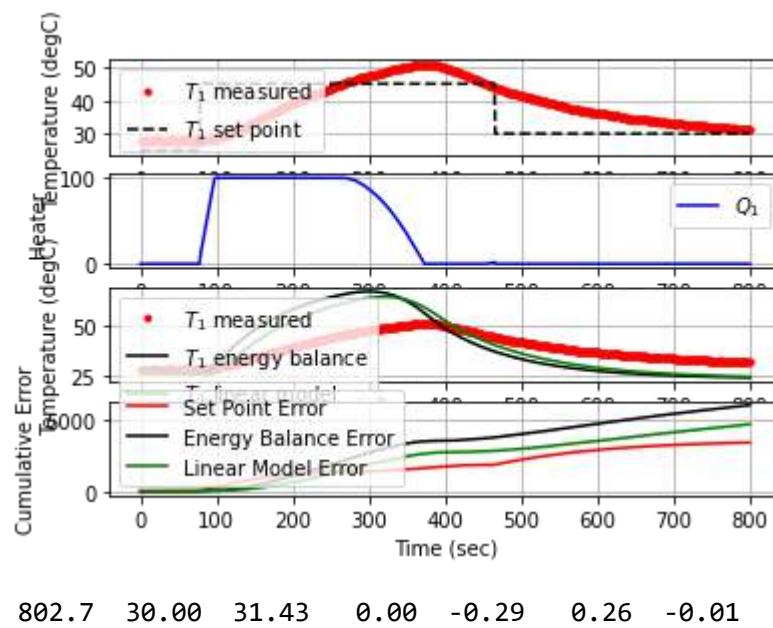
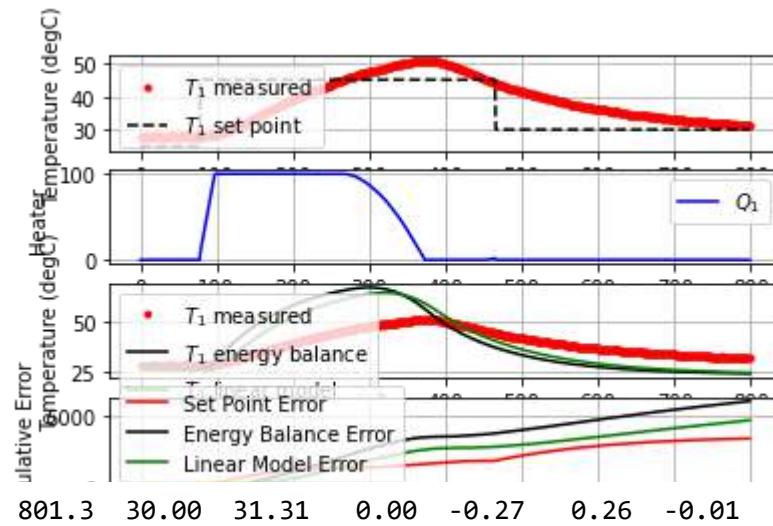
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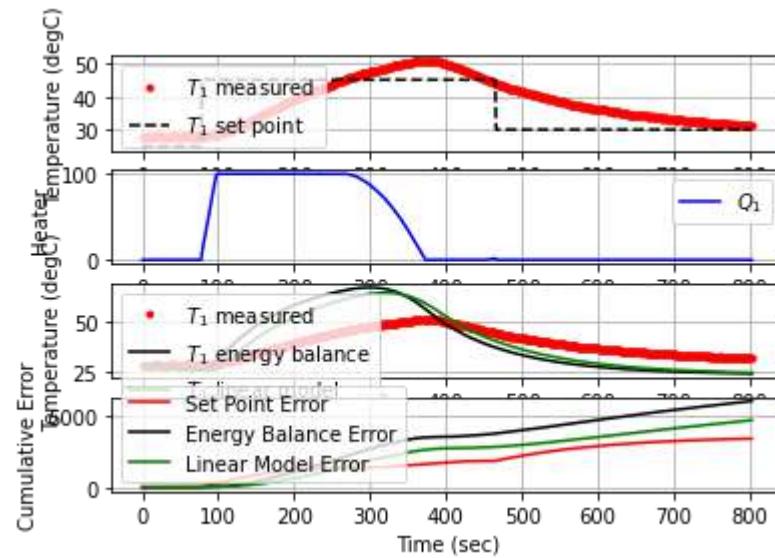
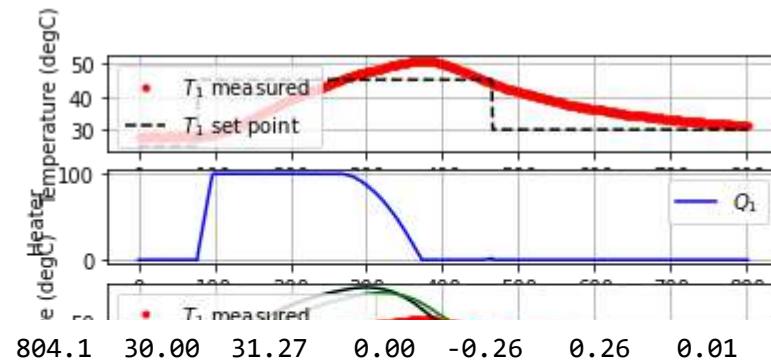


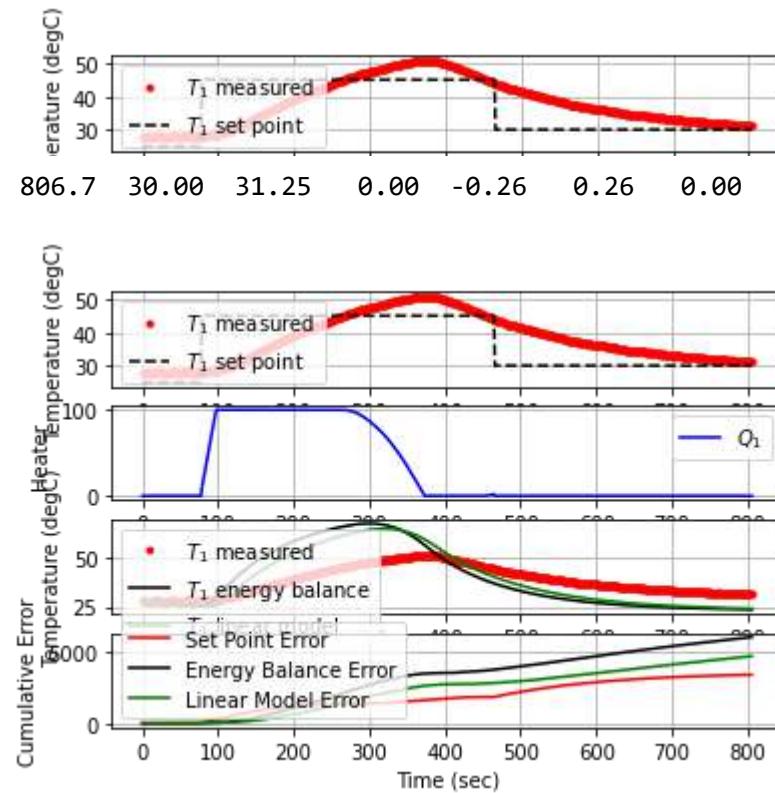
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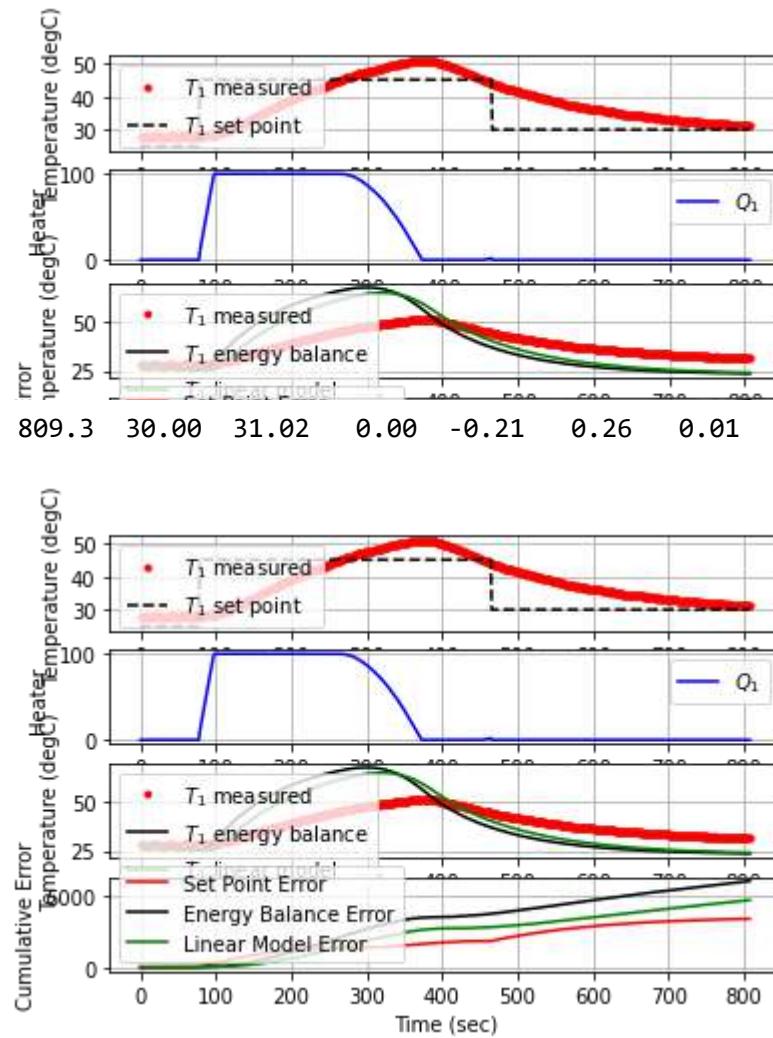
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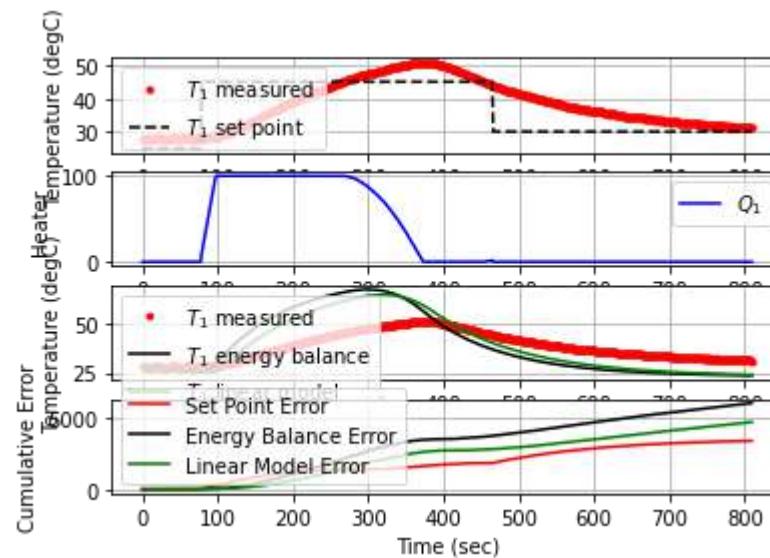




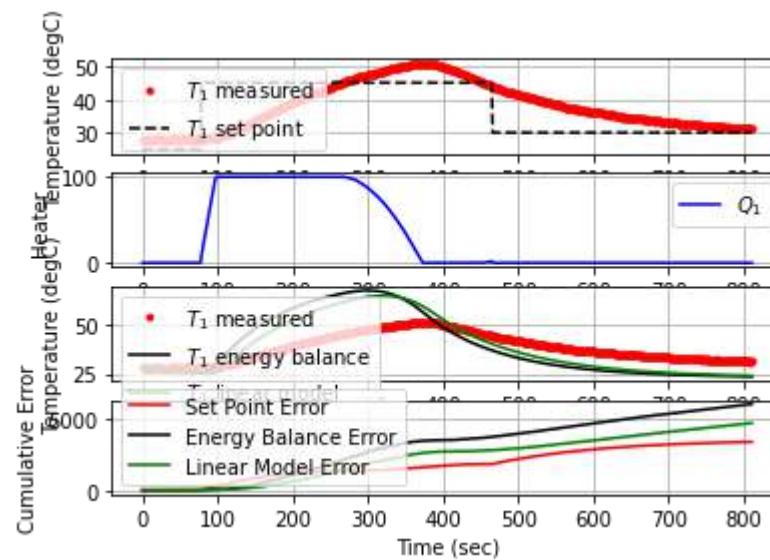
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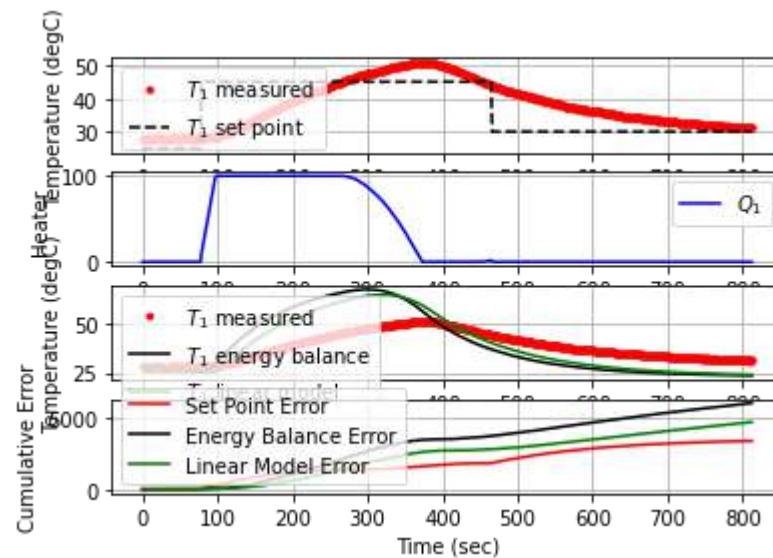
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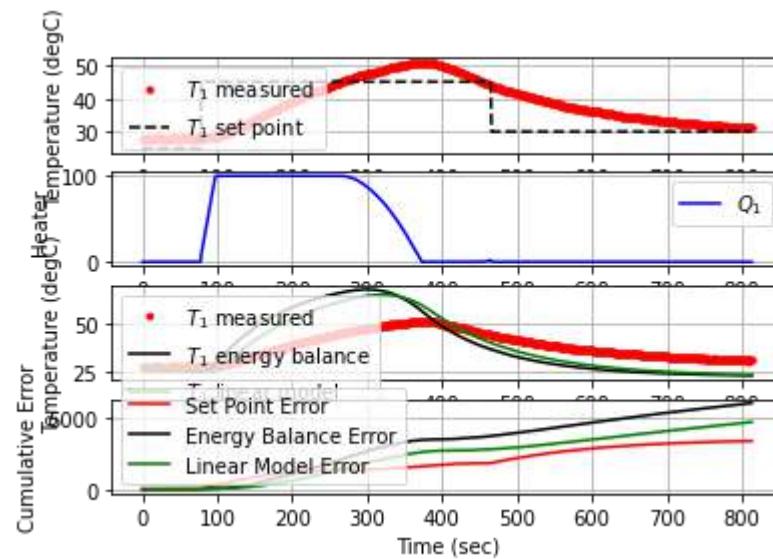
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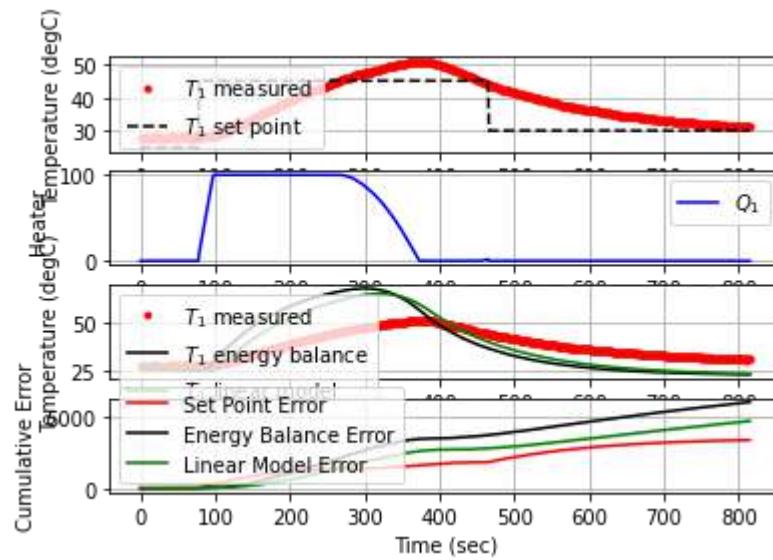
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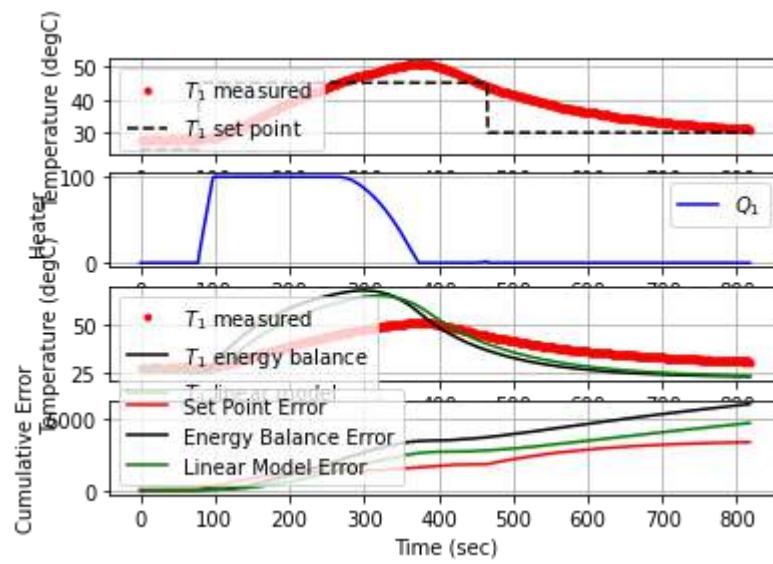
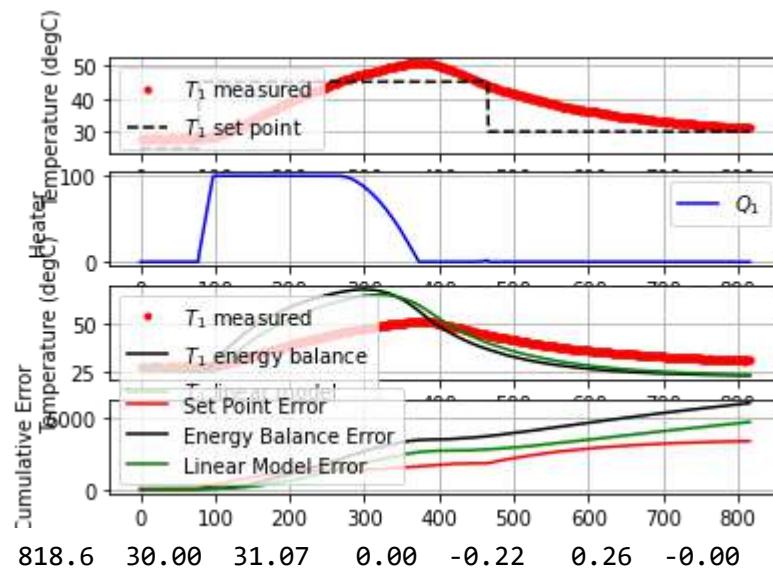
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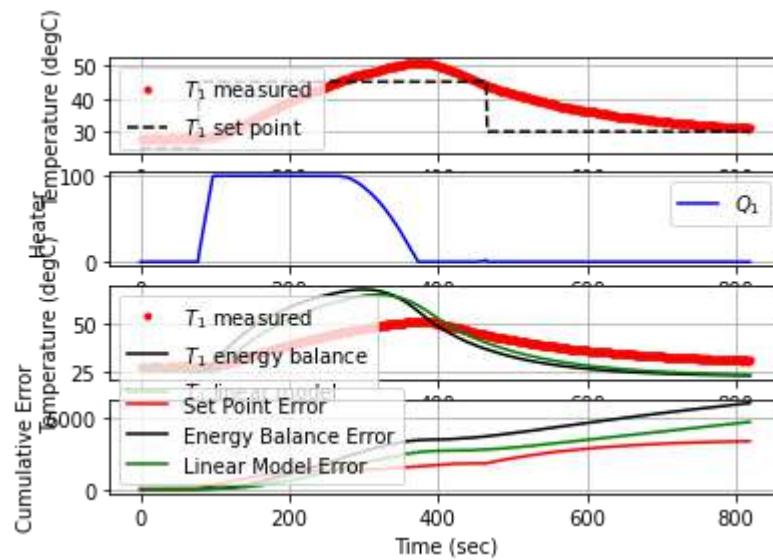


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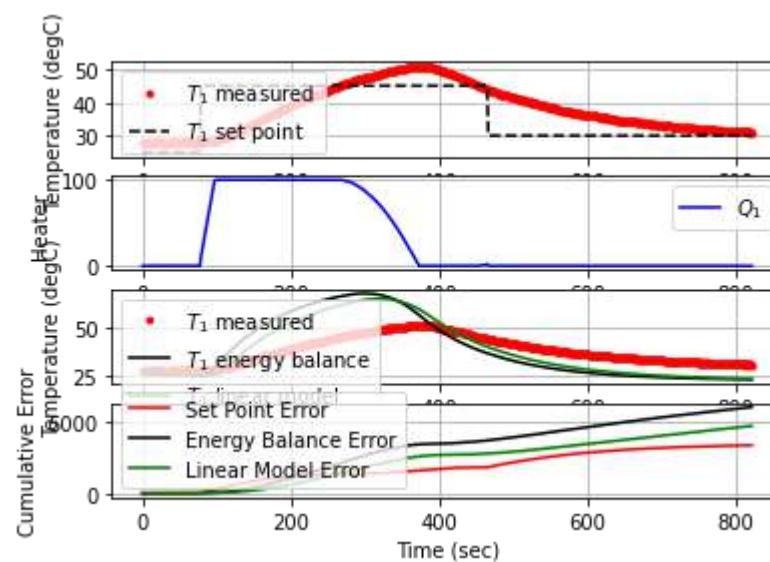
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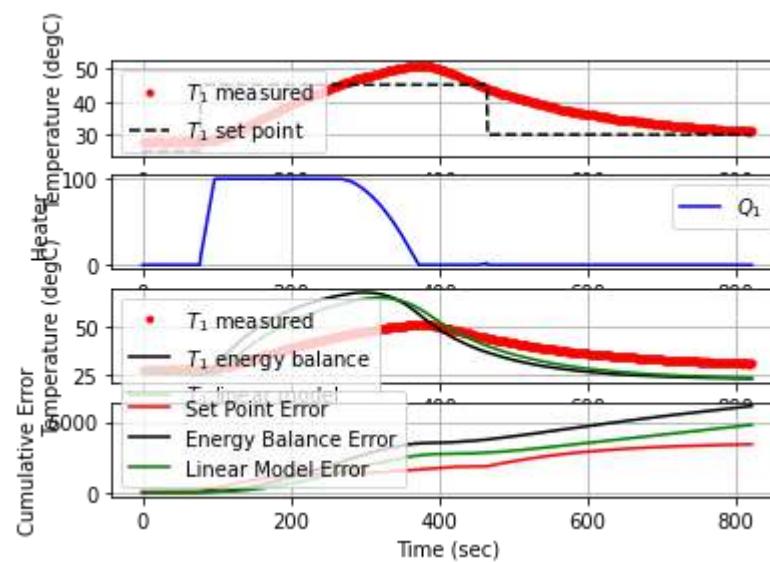


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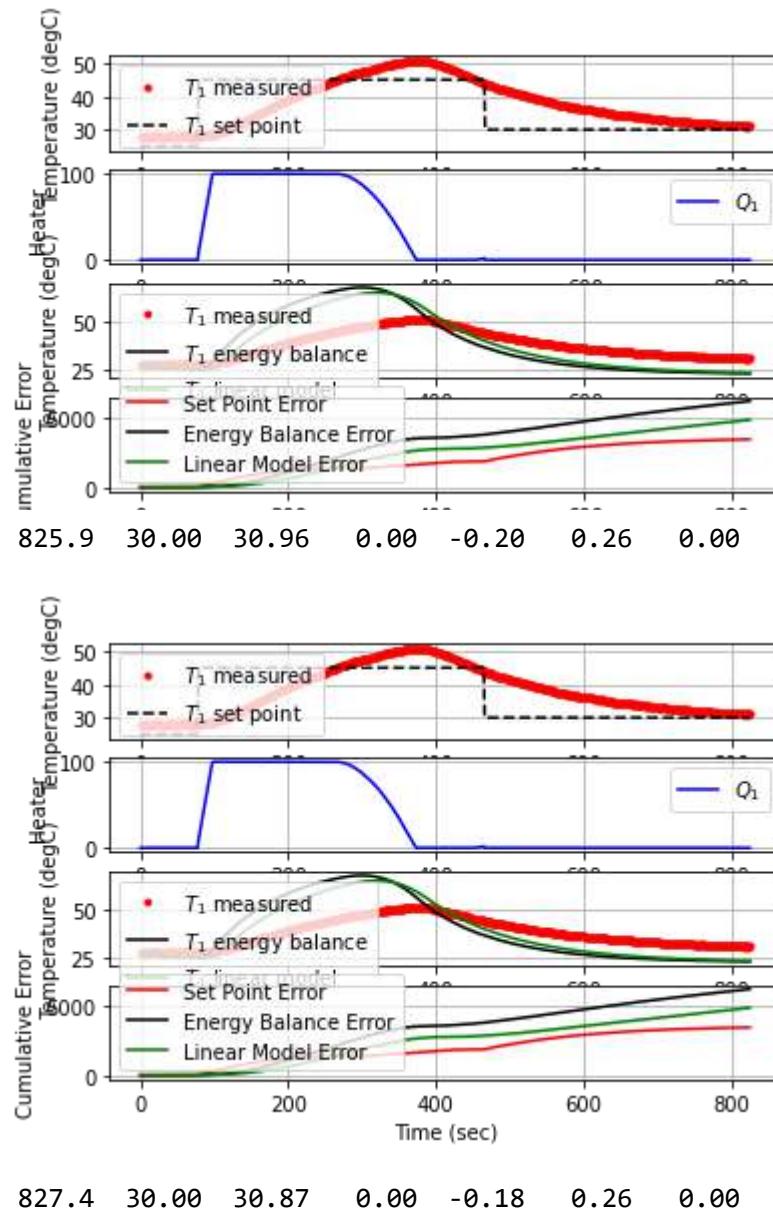
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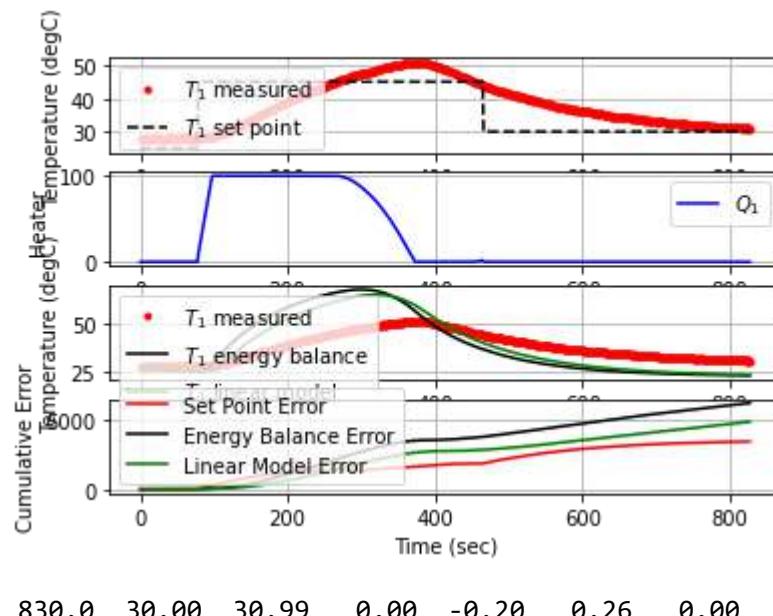
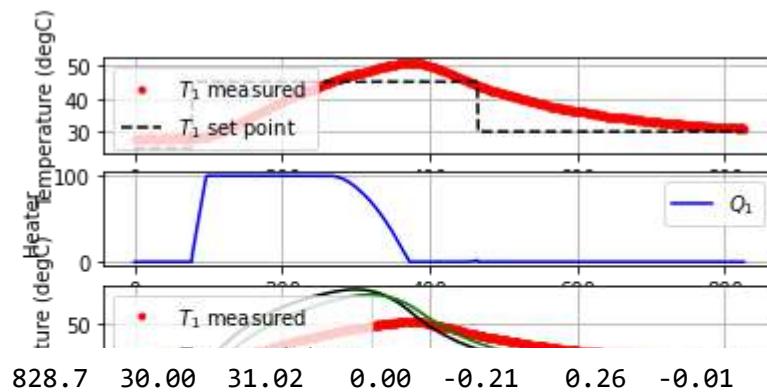


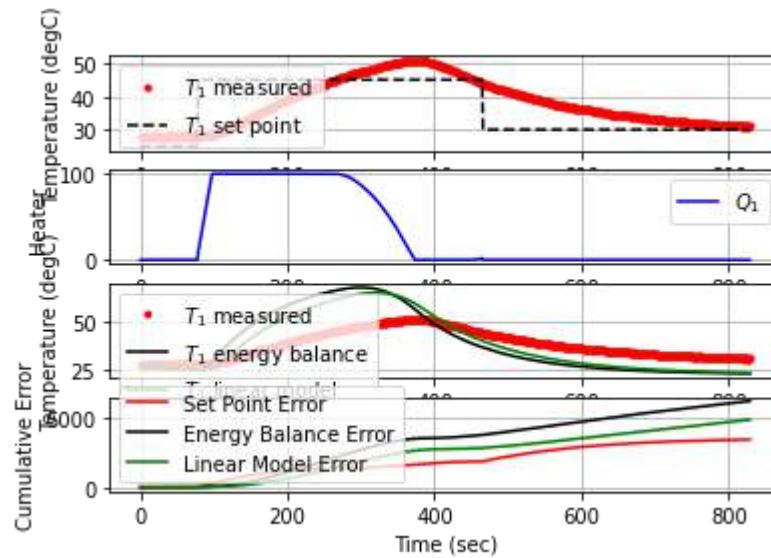
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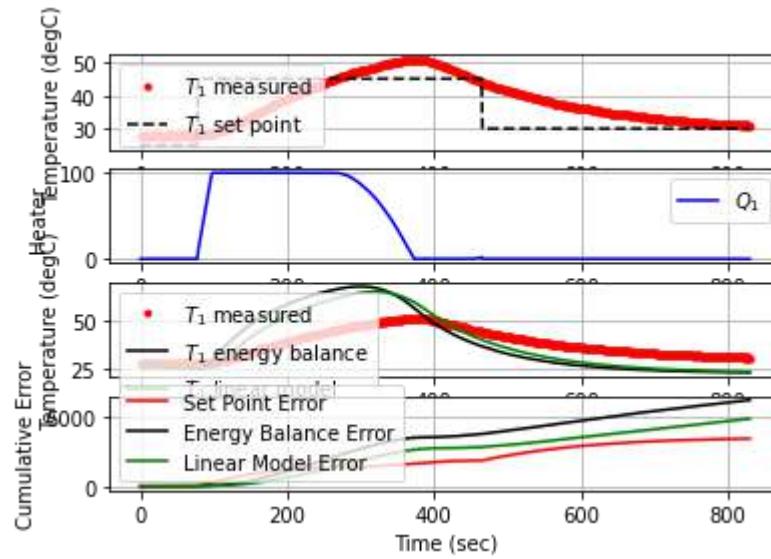
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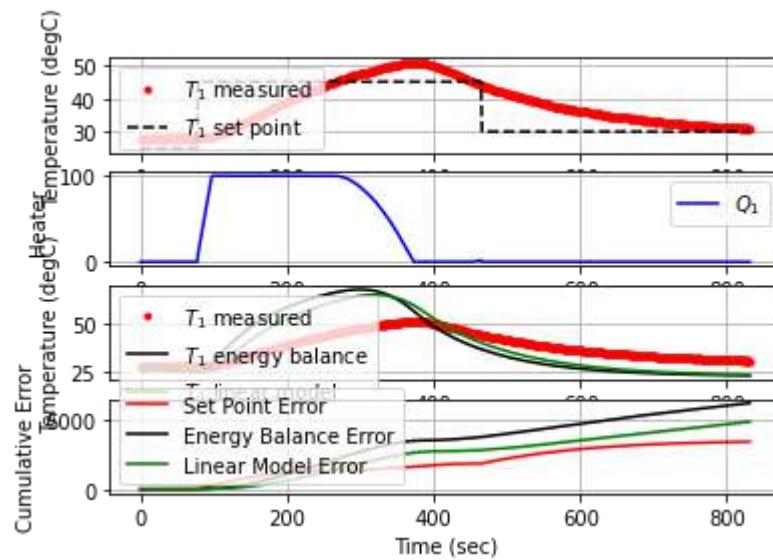




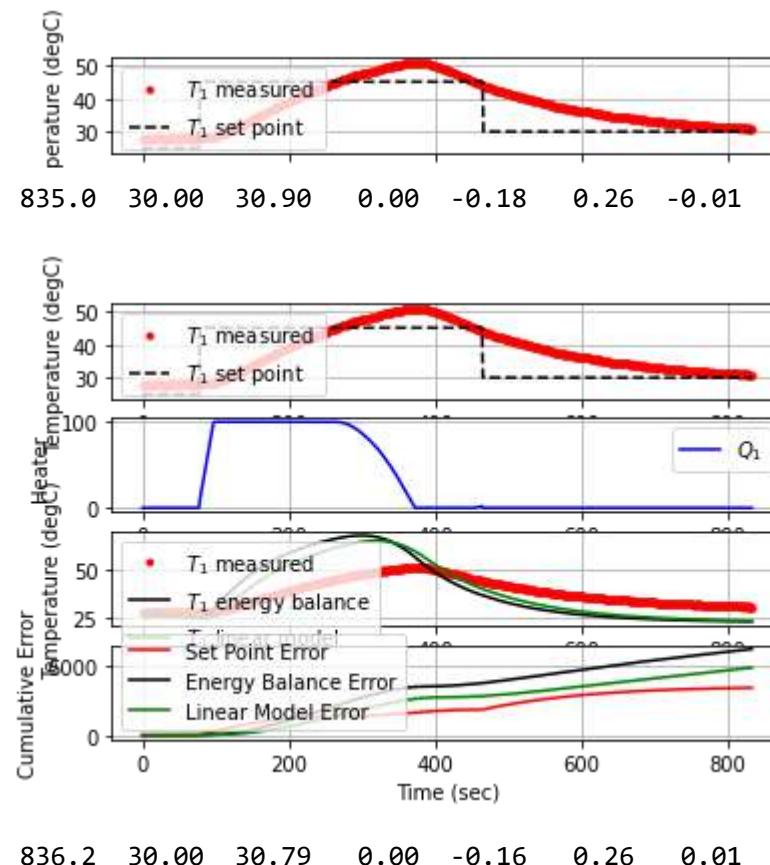
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832.5 30.00 30.90 0.00 -0.18 0.26 -0.00

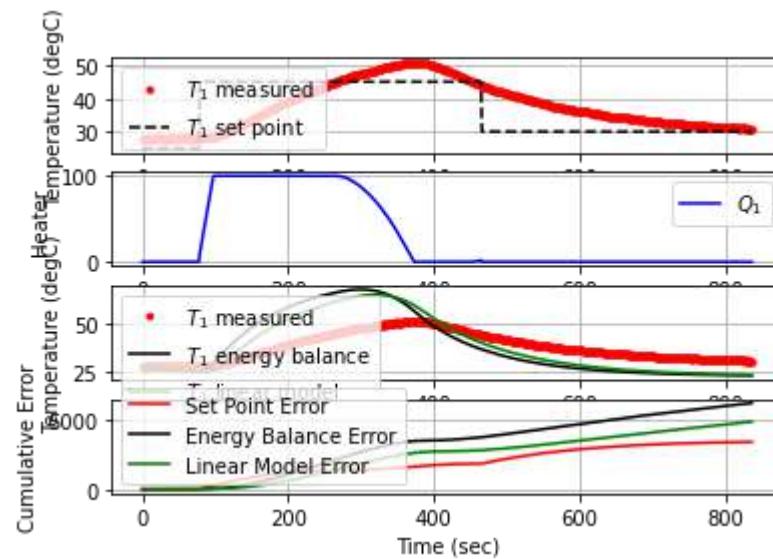


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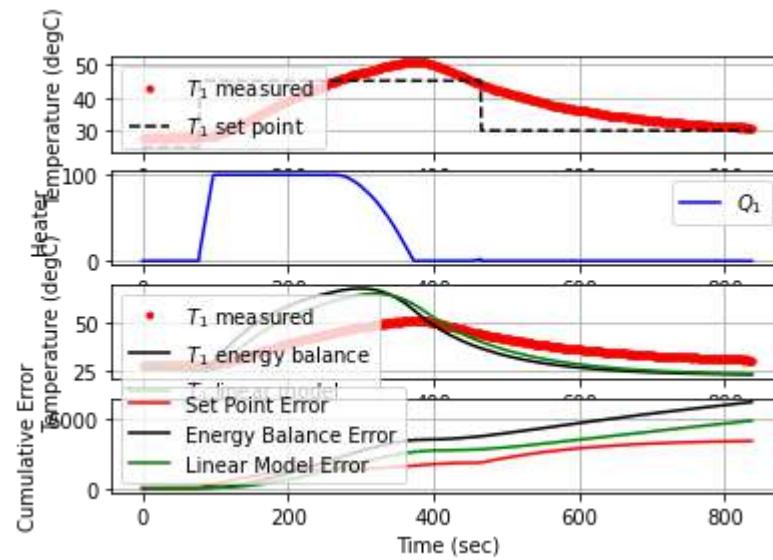


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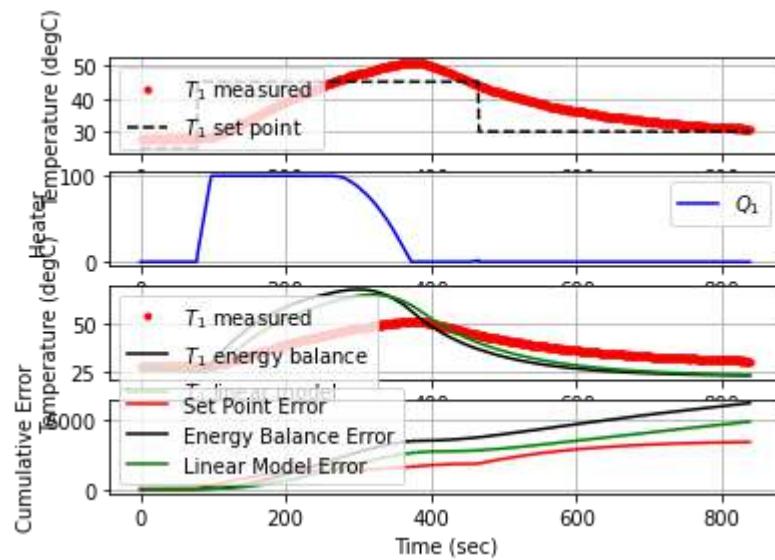
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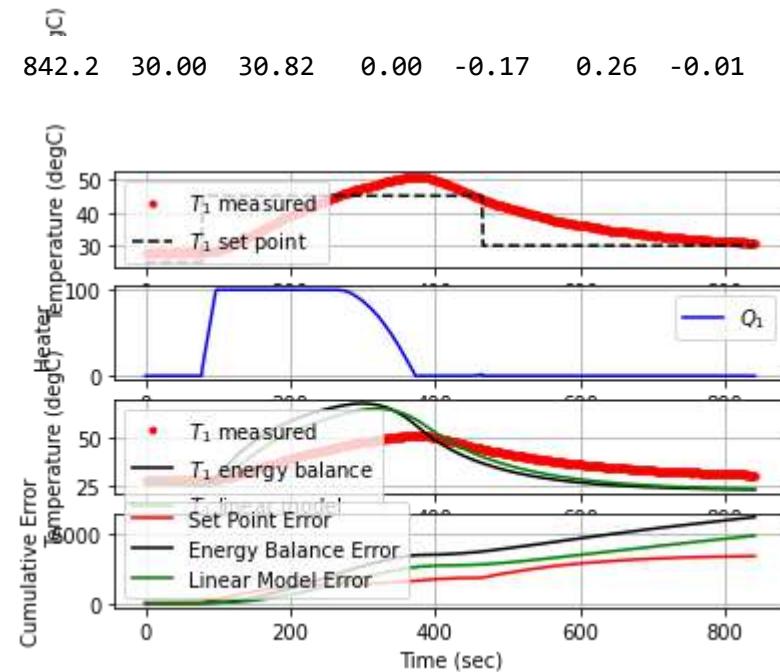
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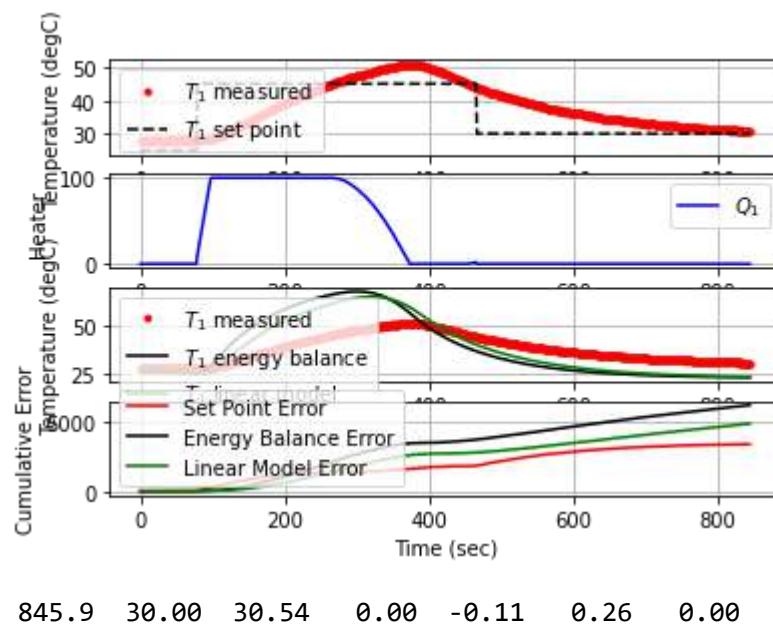
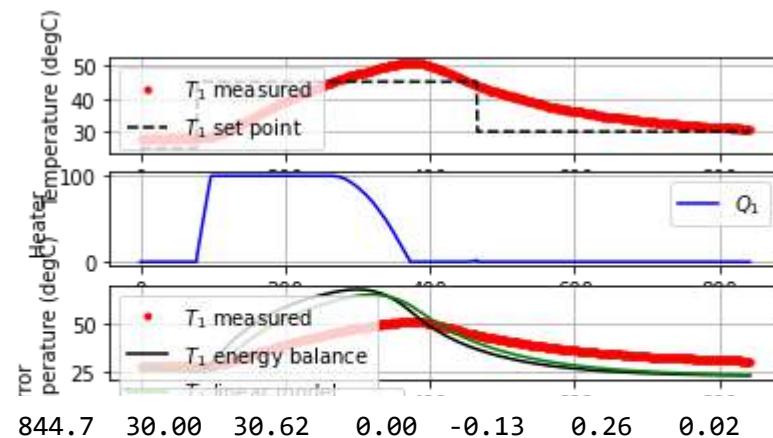
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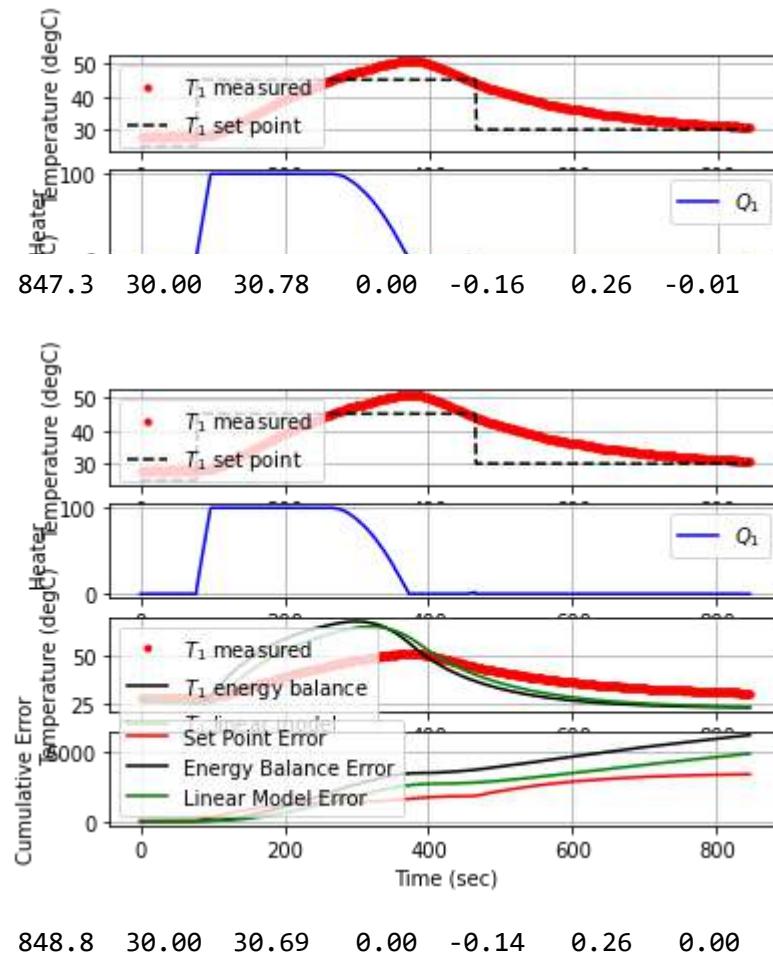


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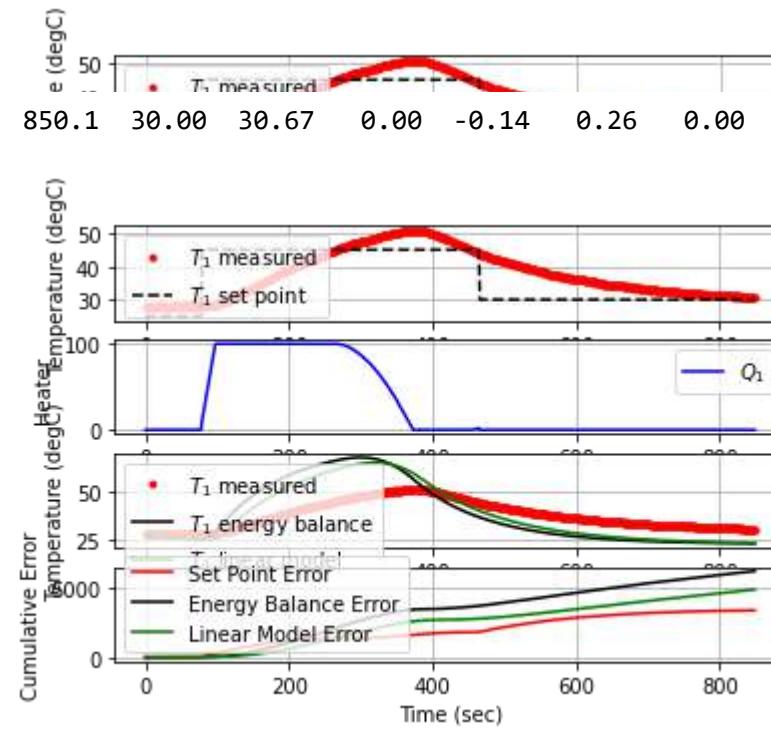


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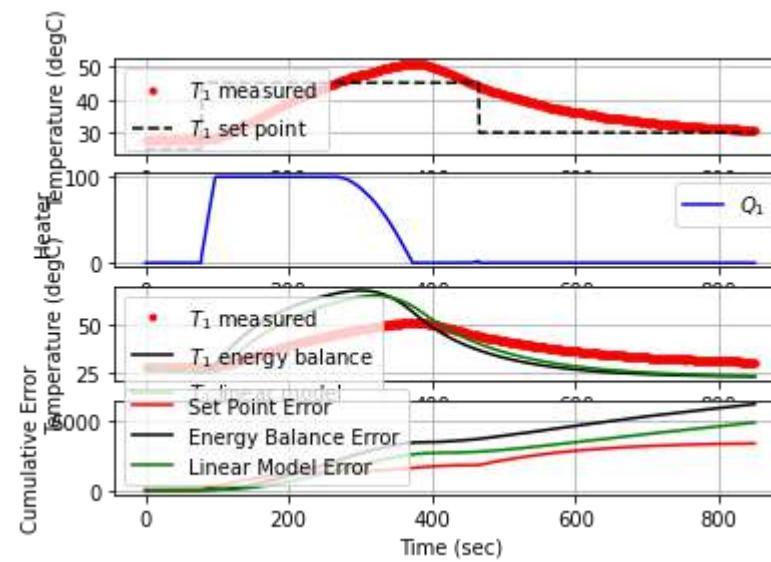




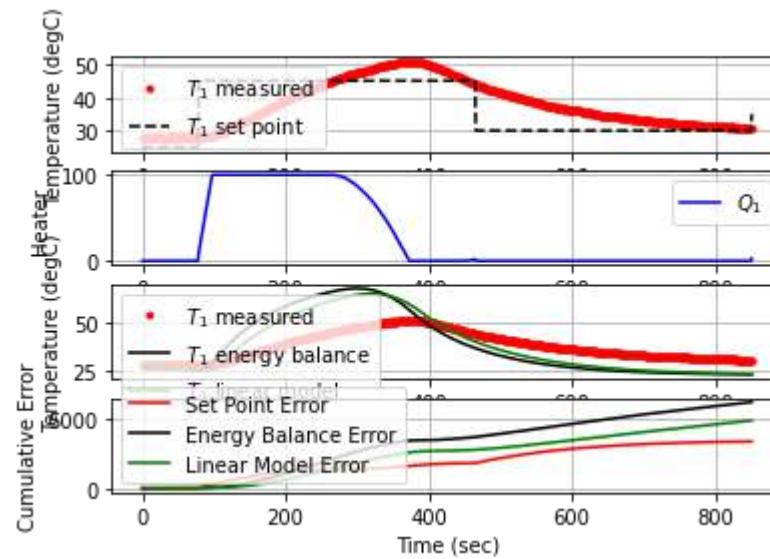
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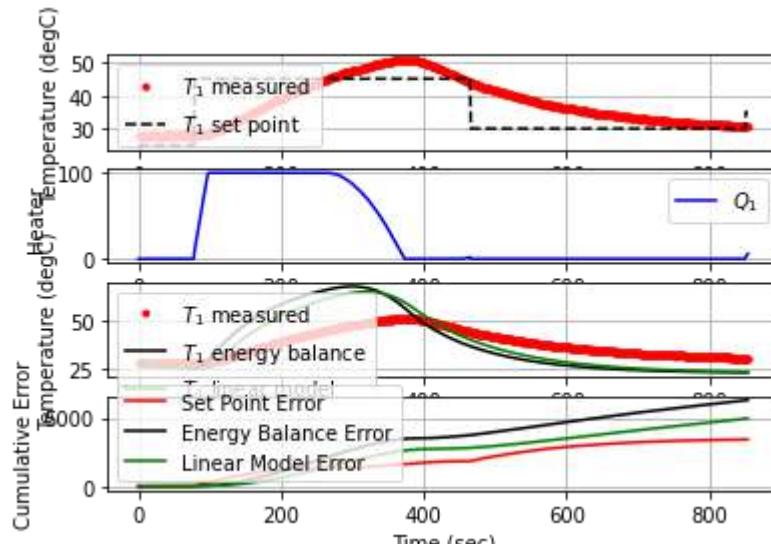
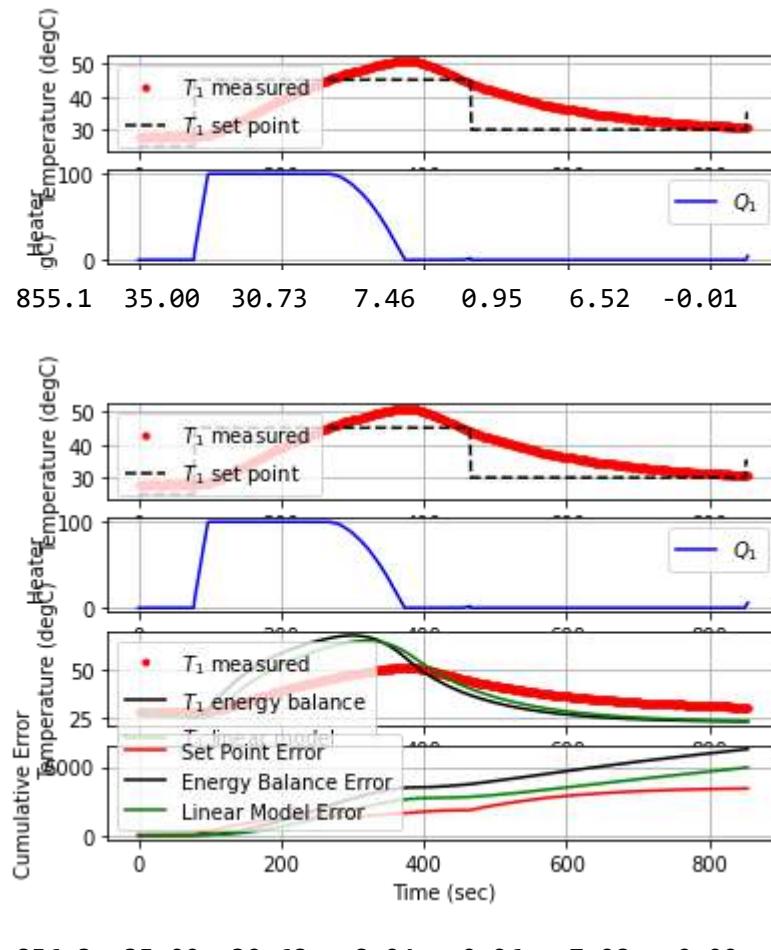
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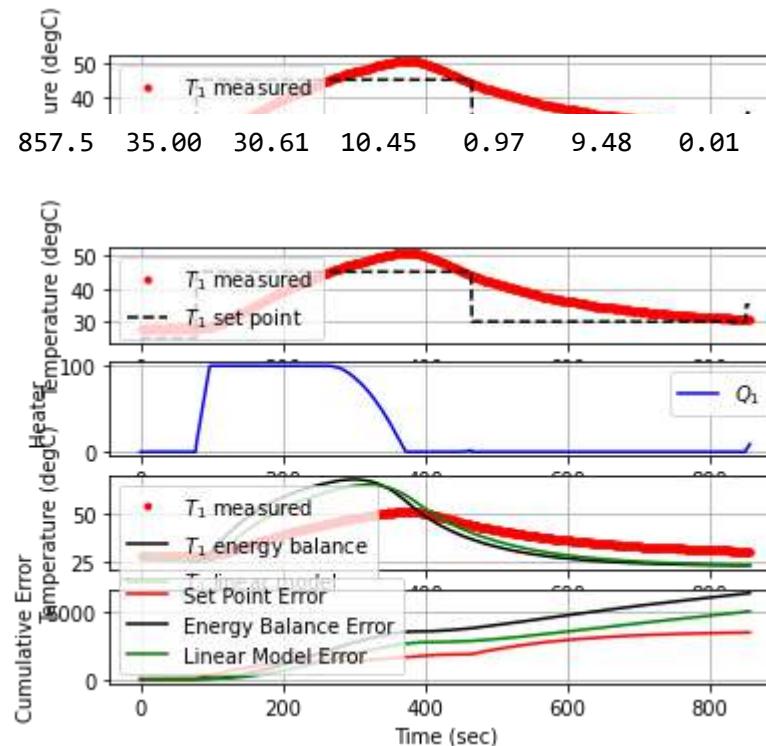
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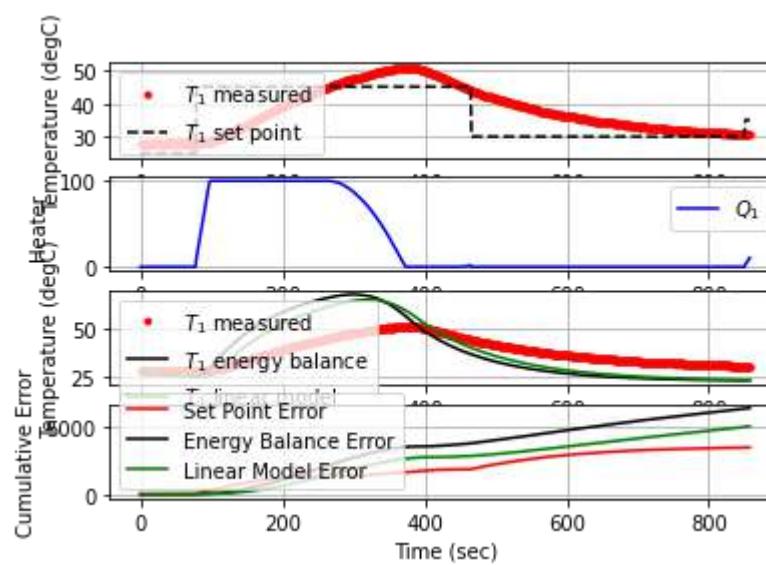
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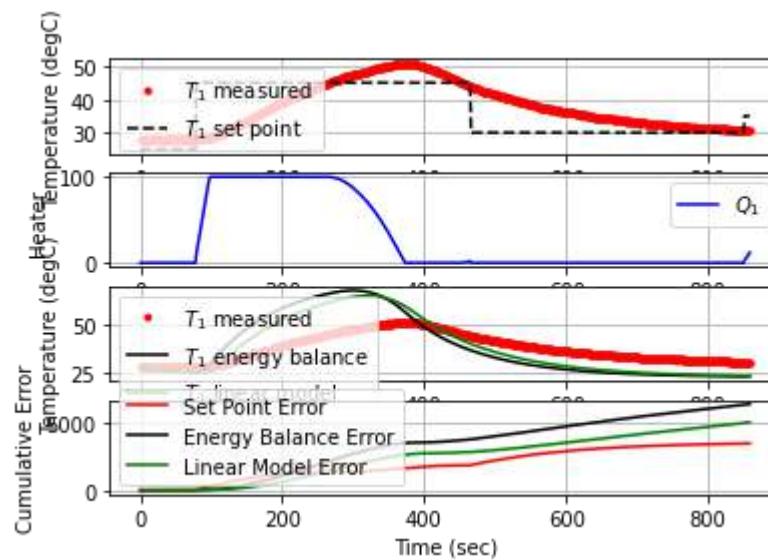
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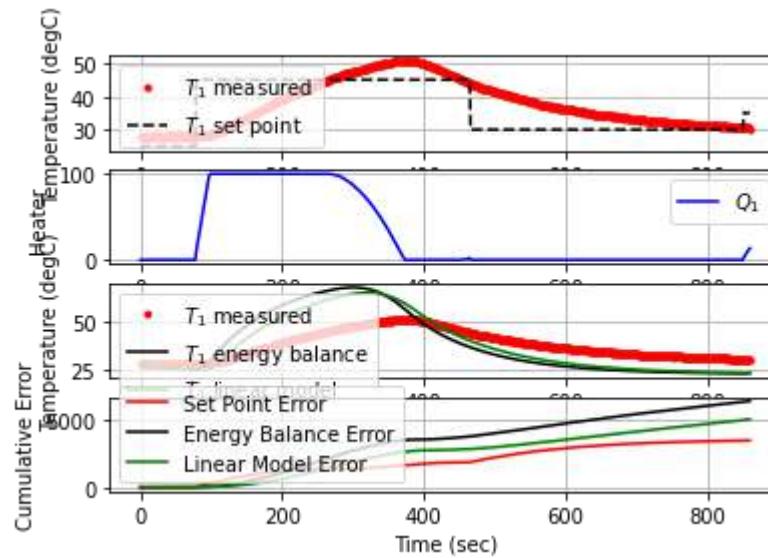
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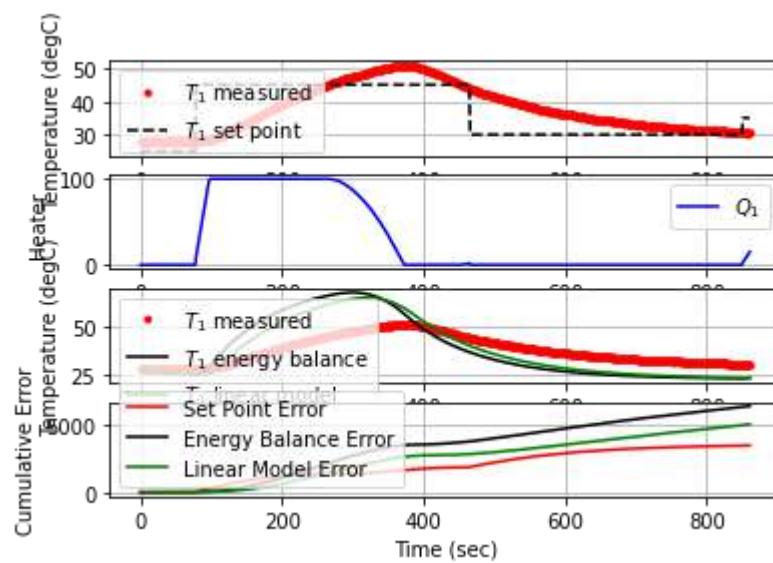
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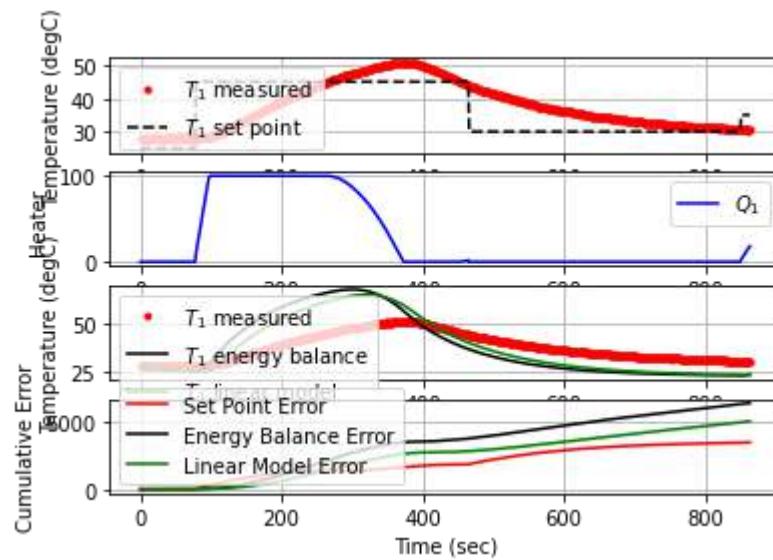
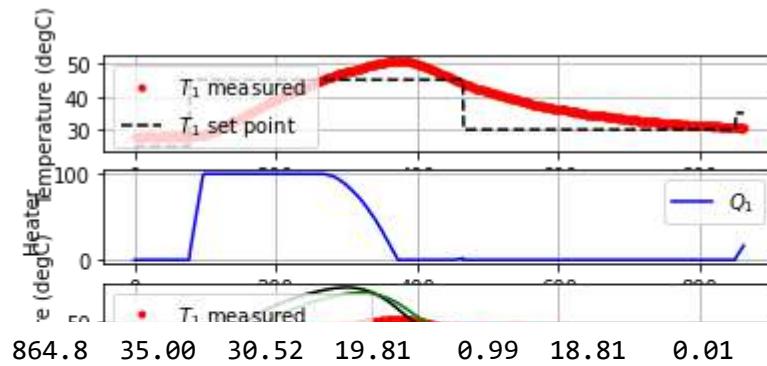
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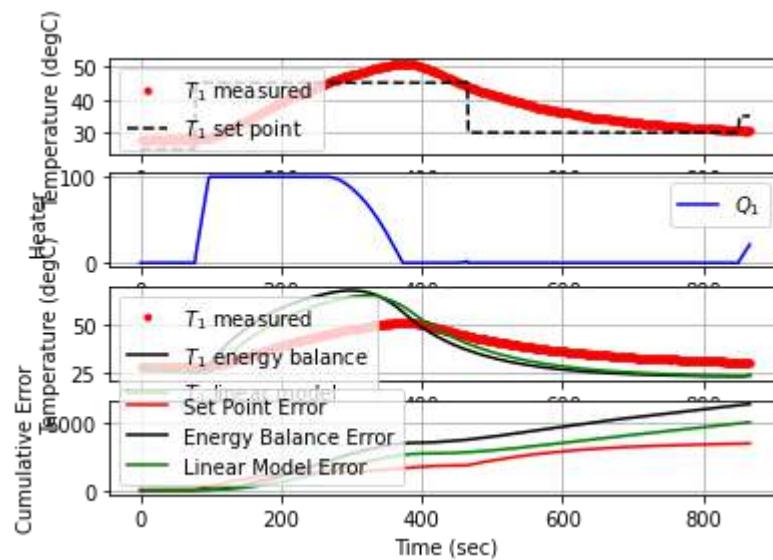
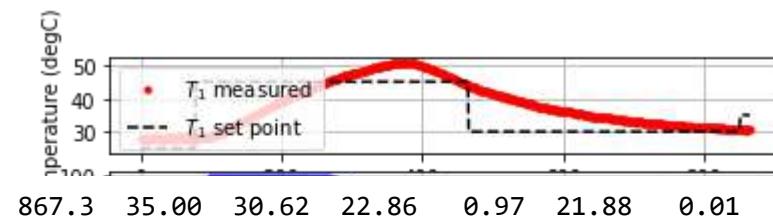


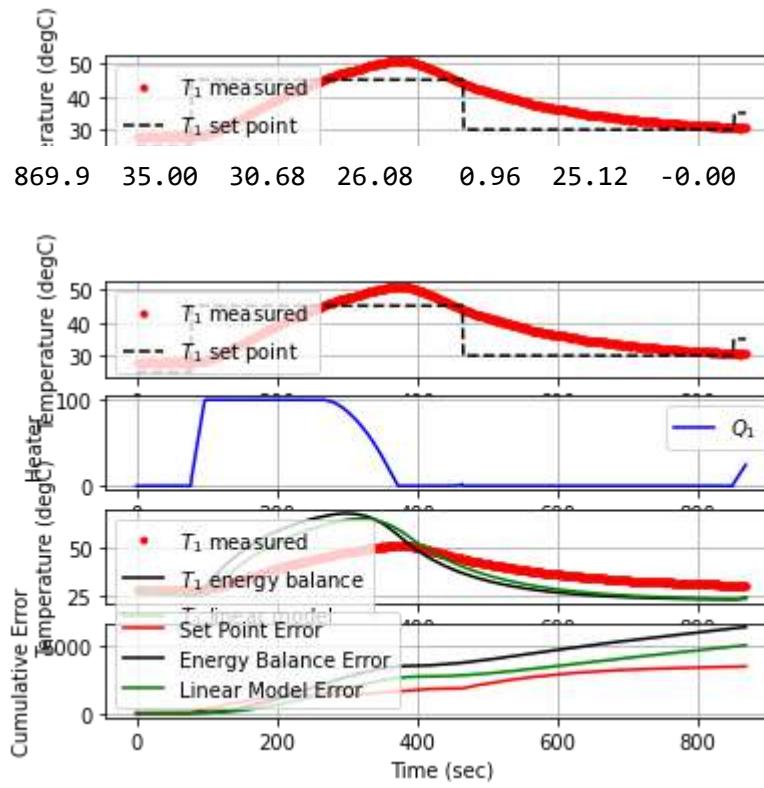
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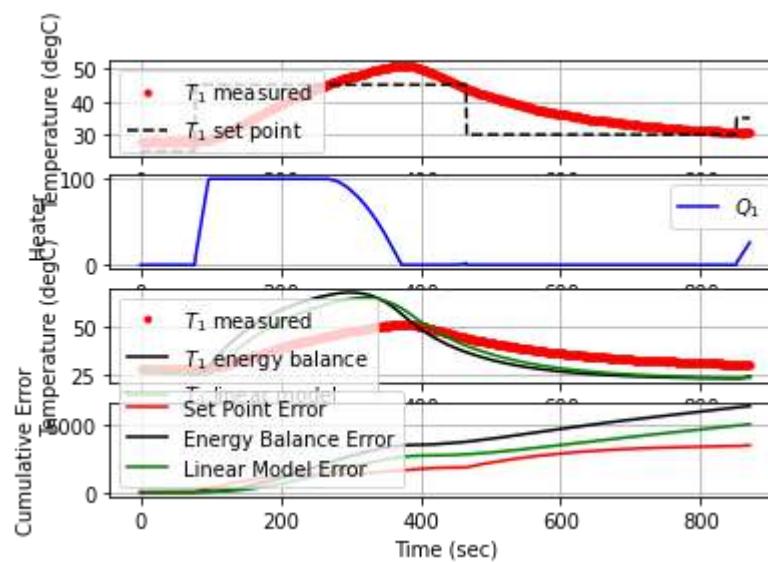
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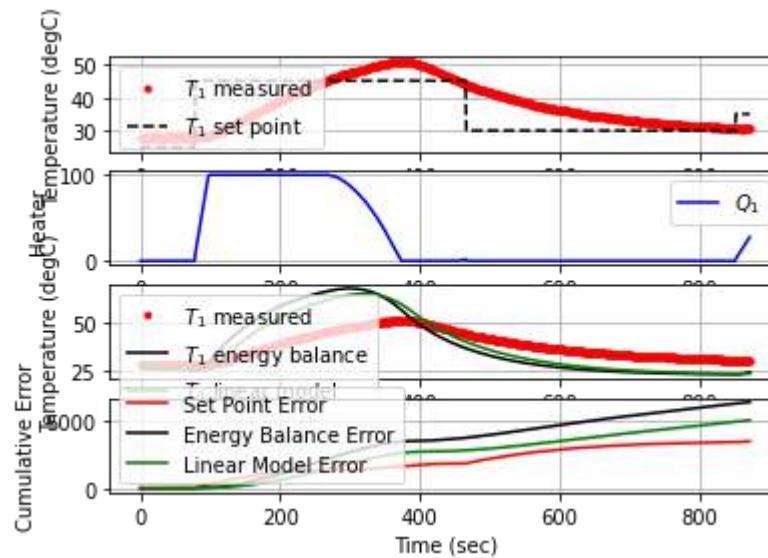




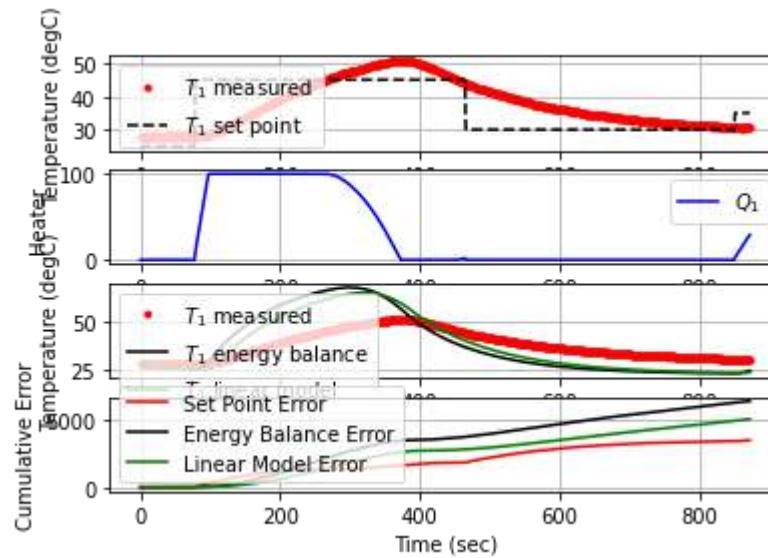
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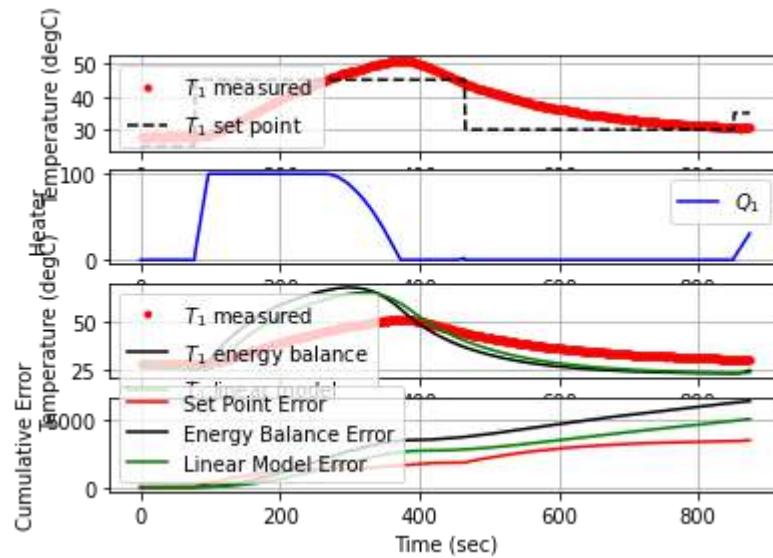
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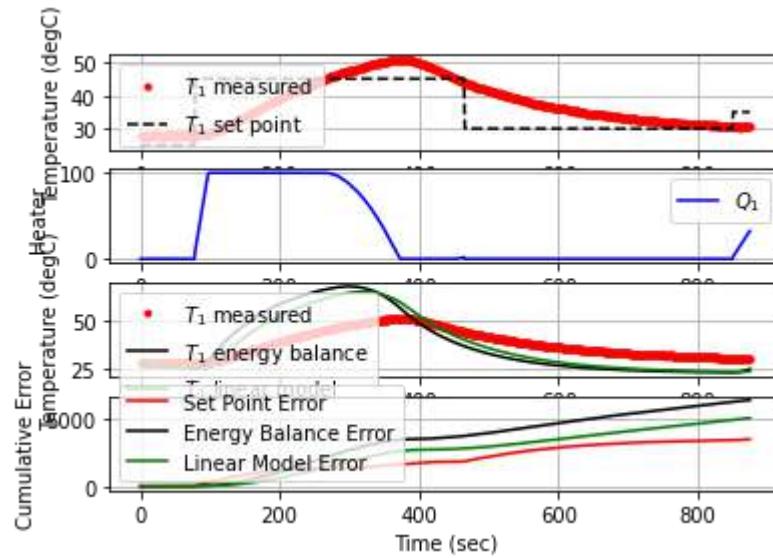
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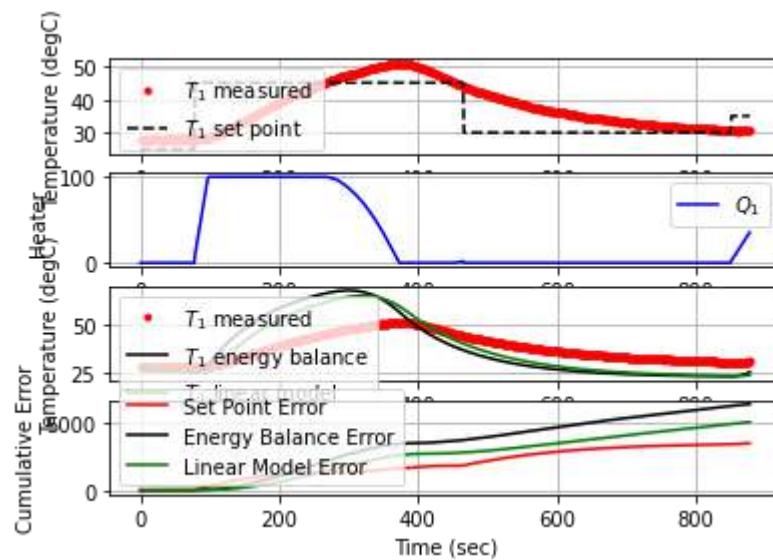
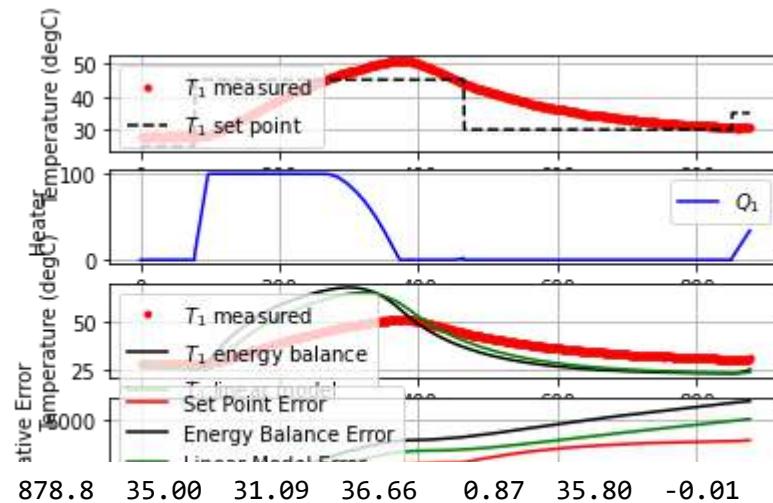
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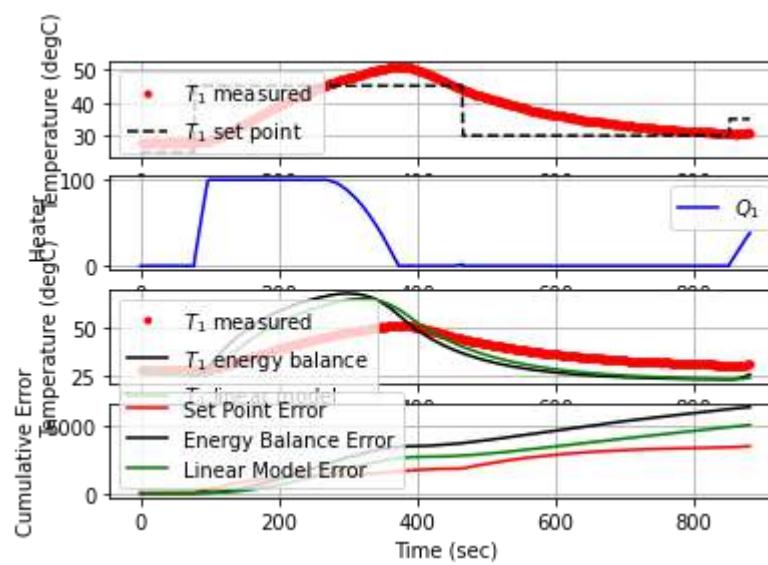
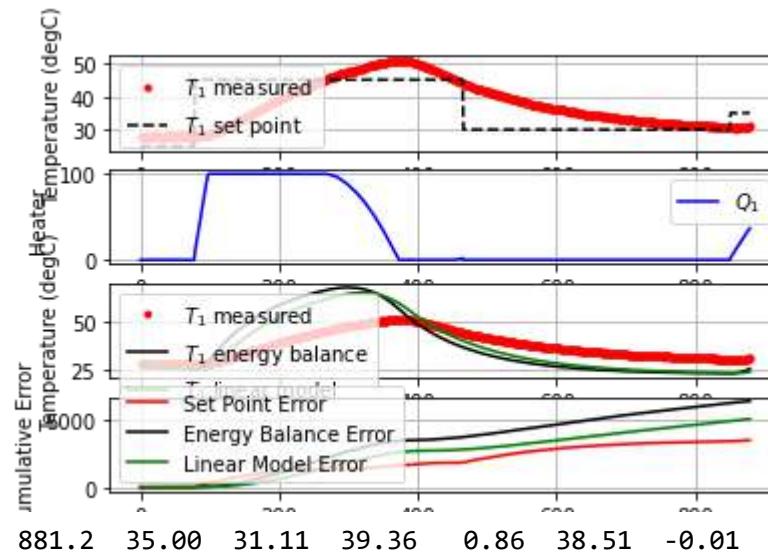


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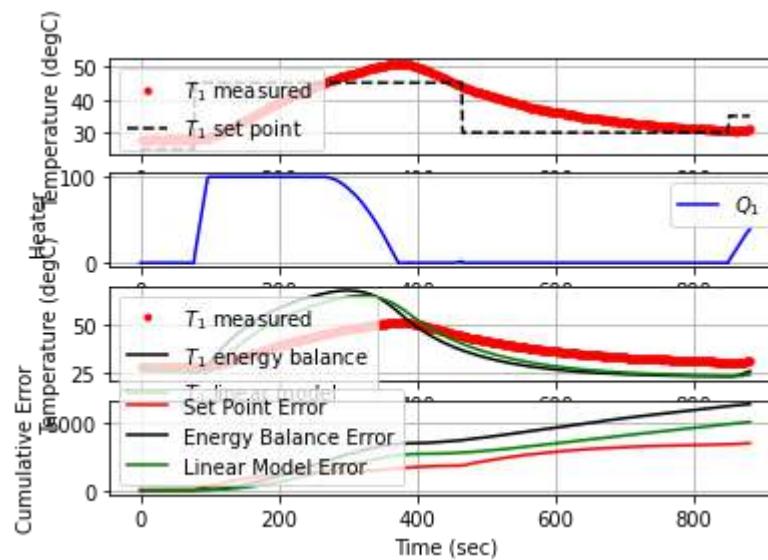


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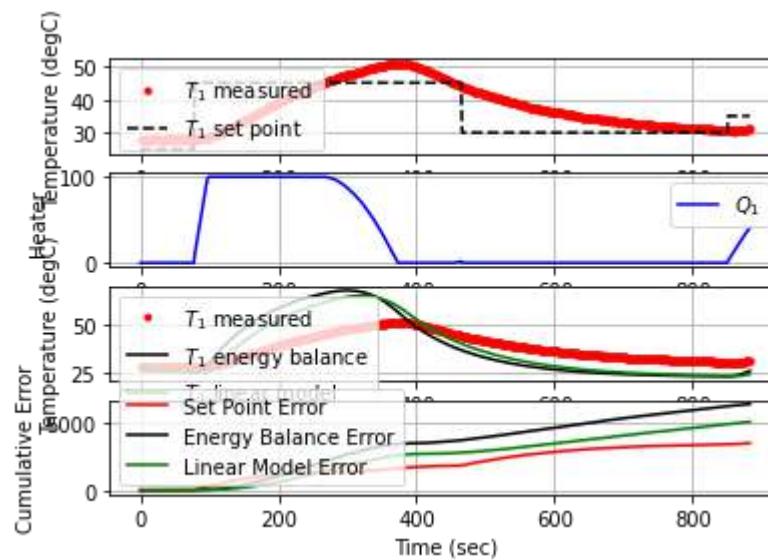




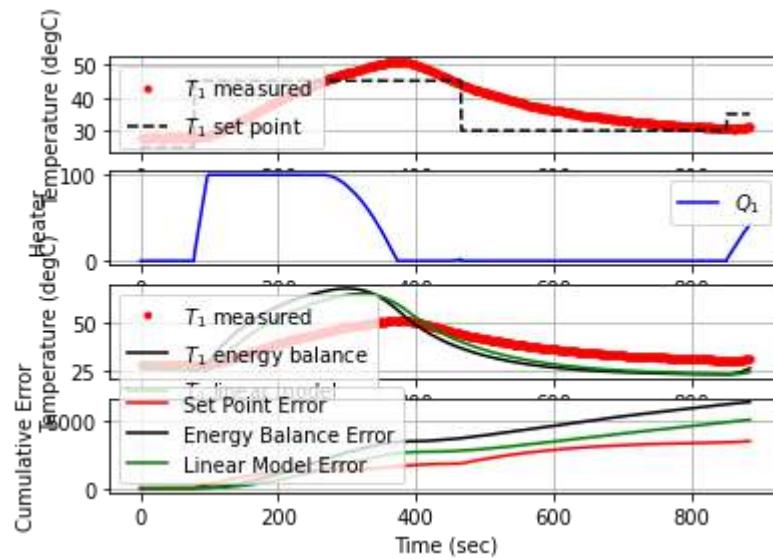
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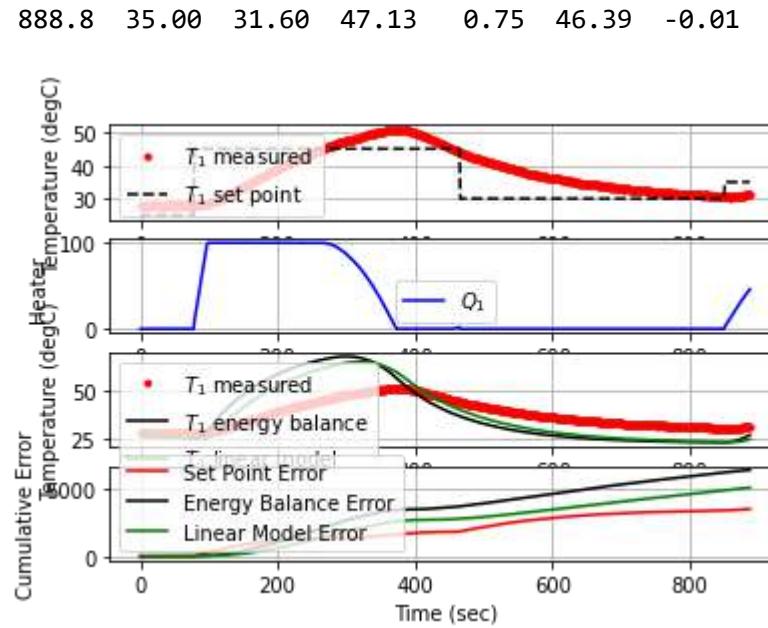
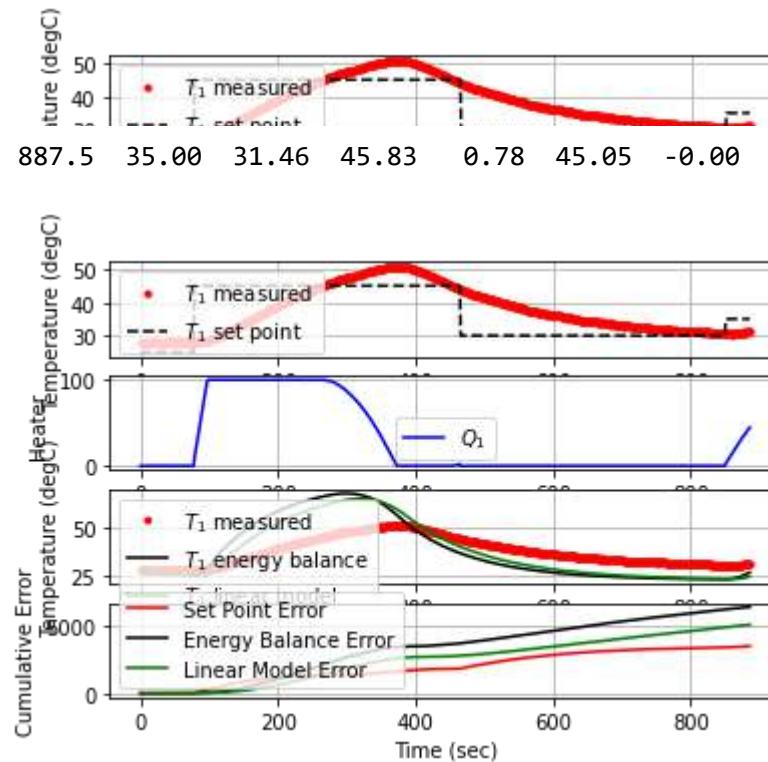
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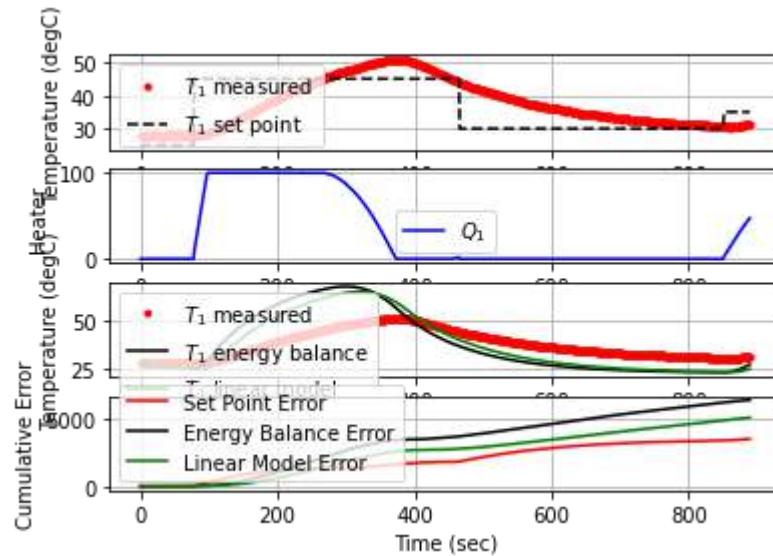
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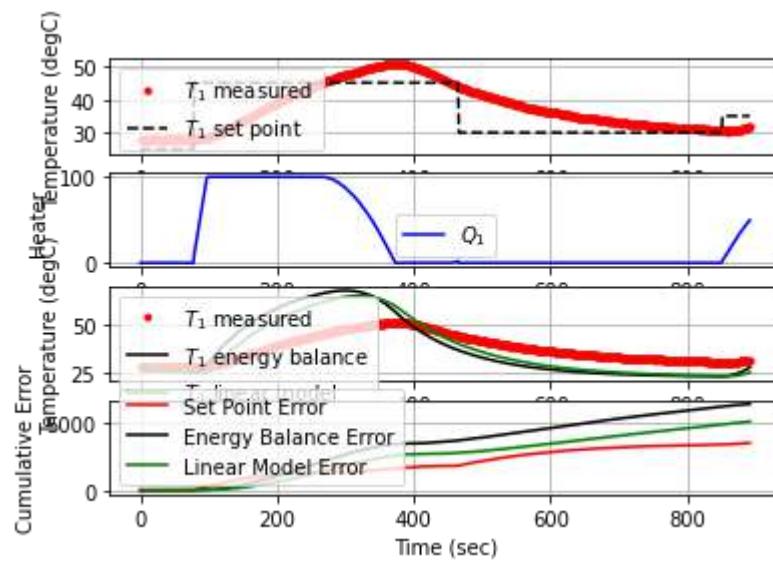
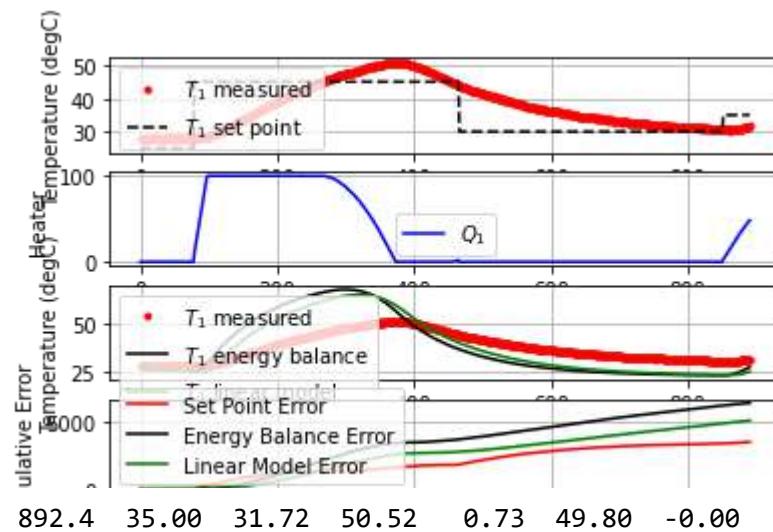
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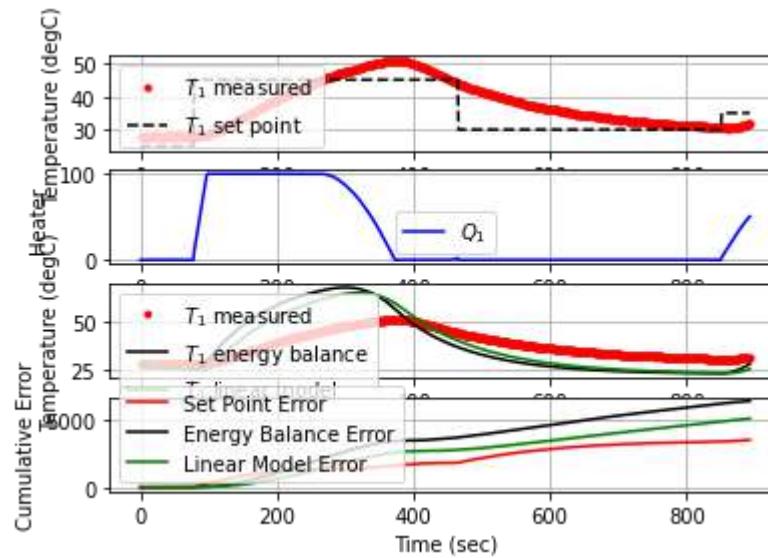


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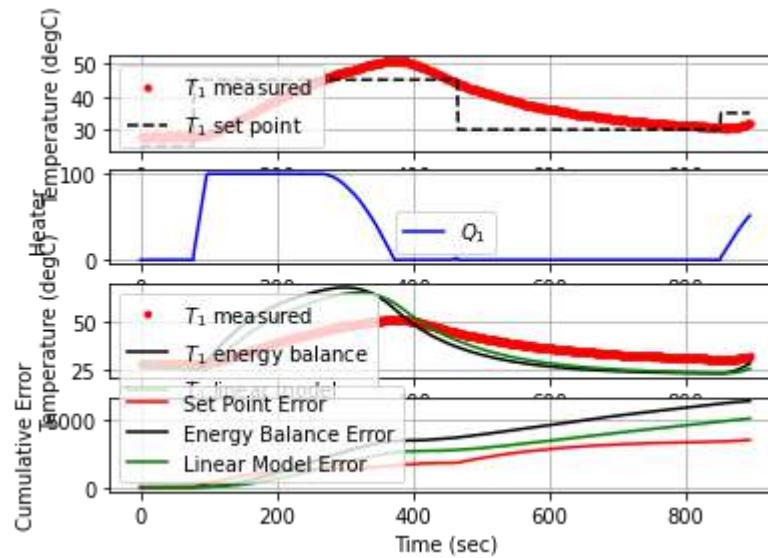


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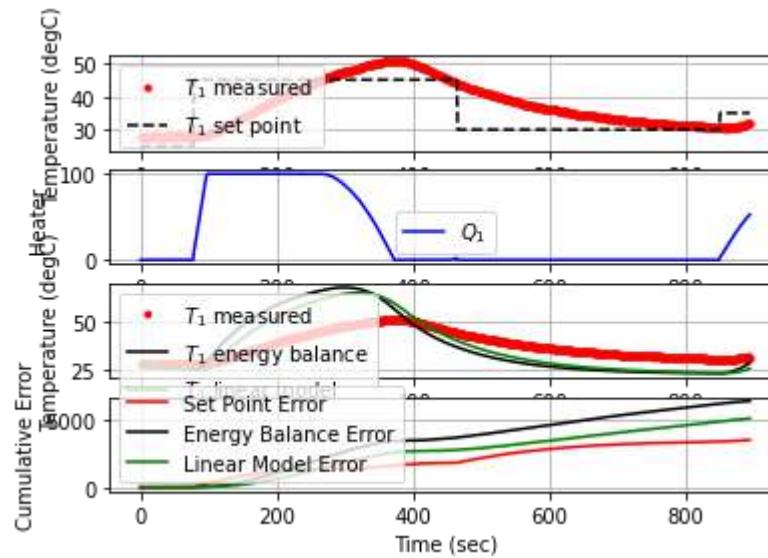




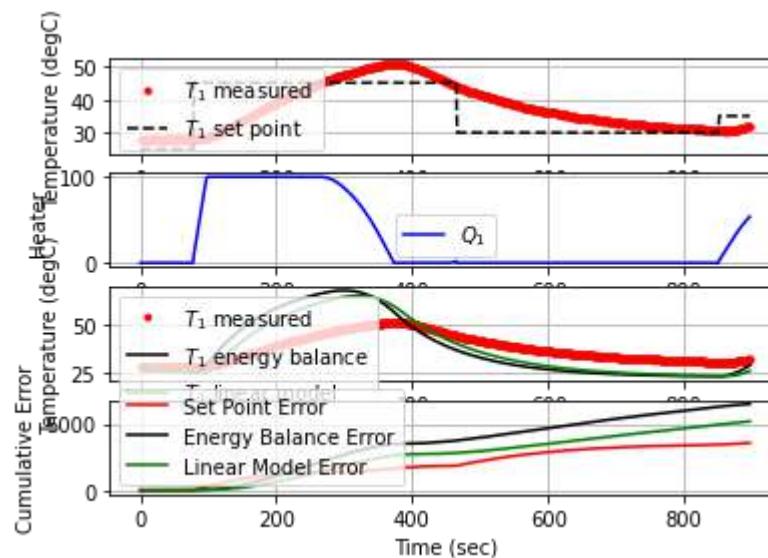
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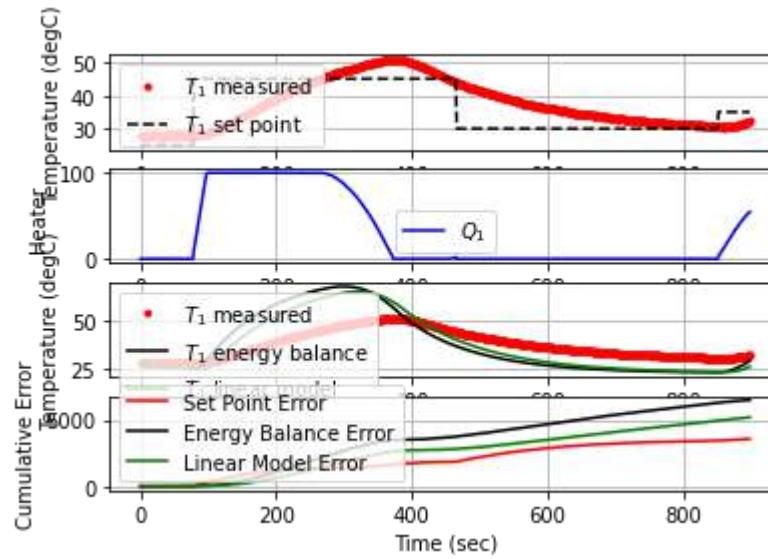
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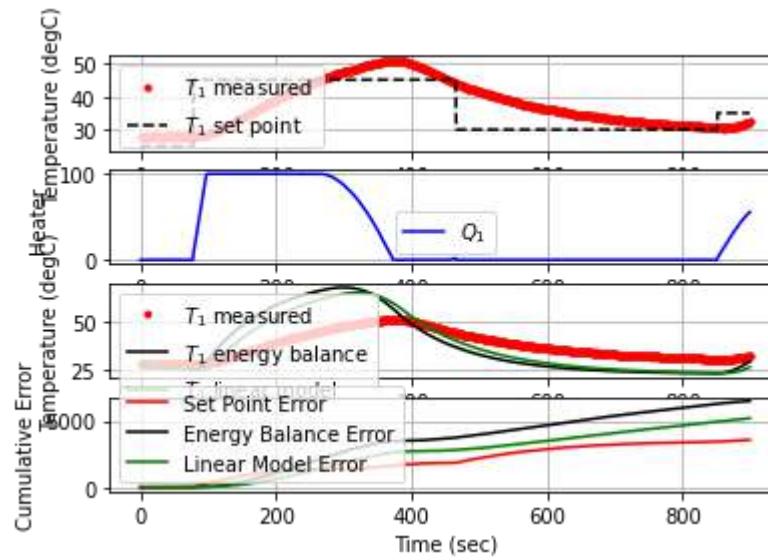
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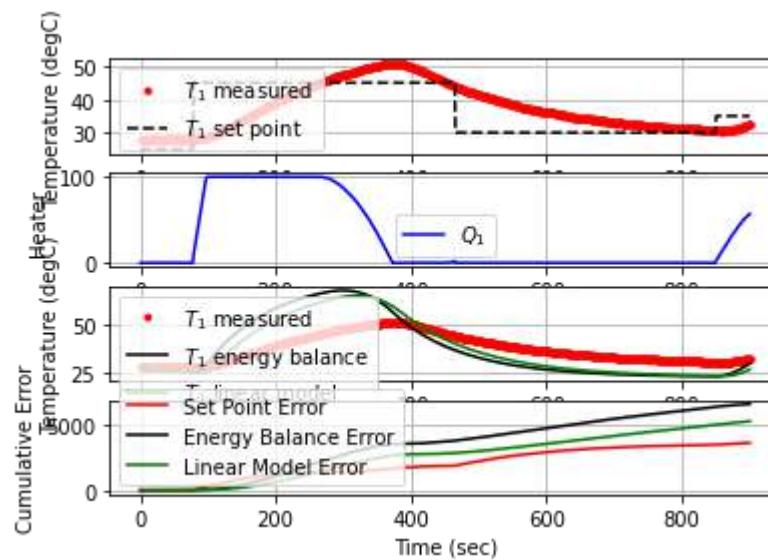
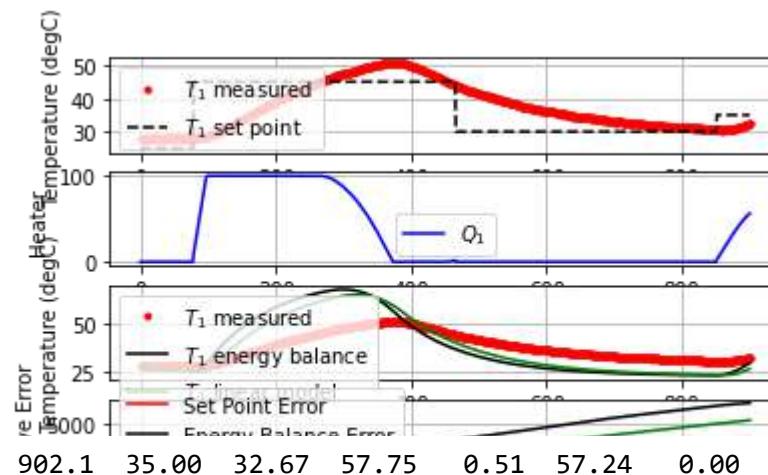
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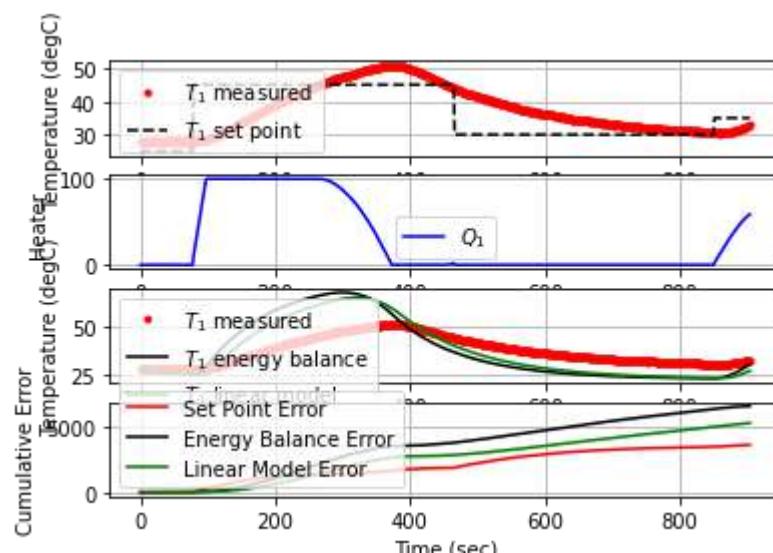
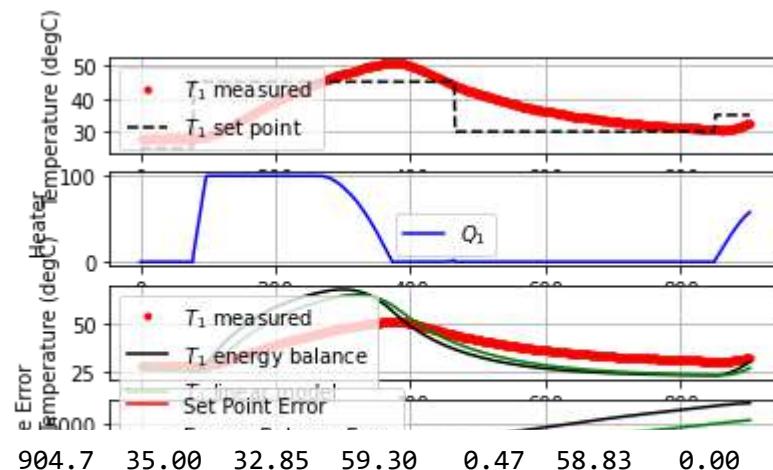
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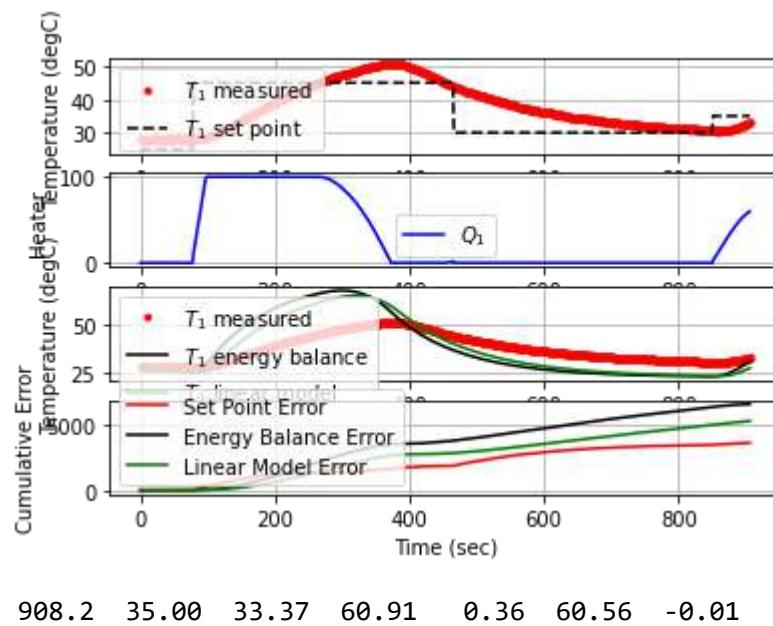
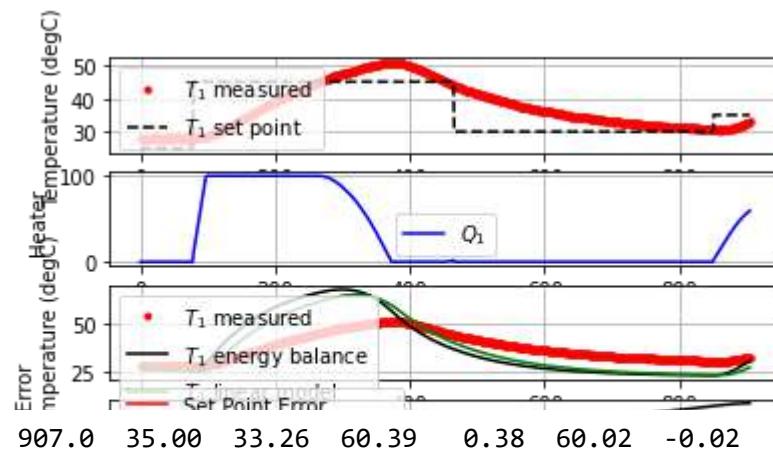
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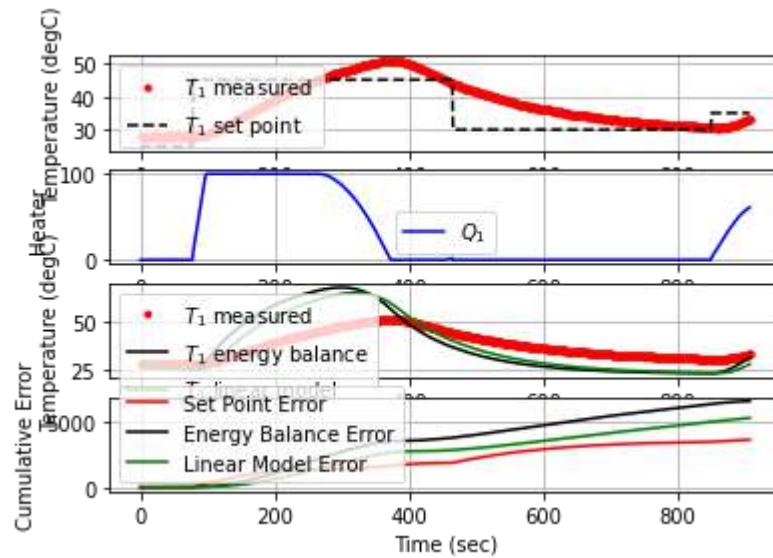
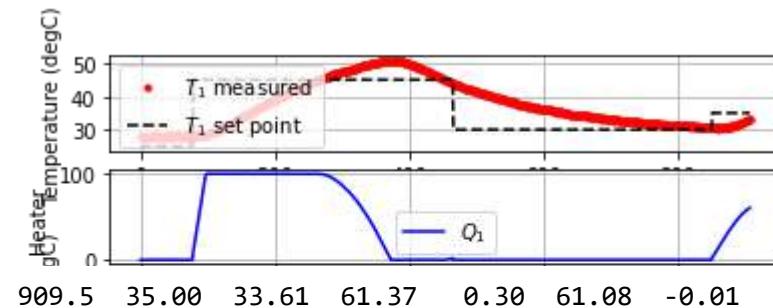


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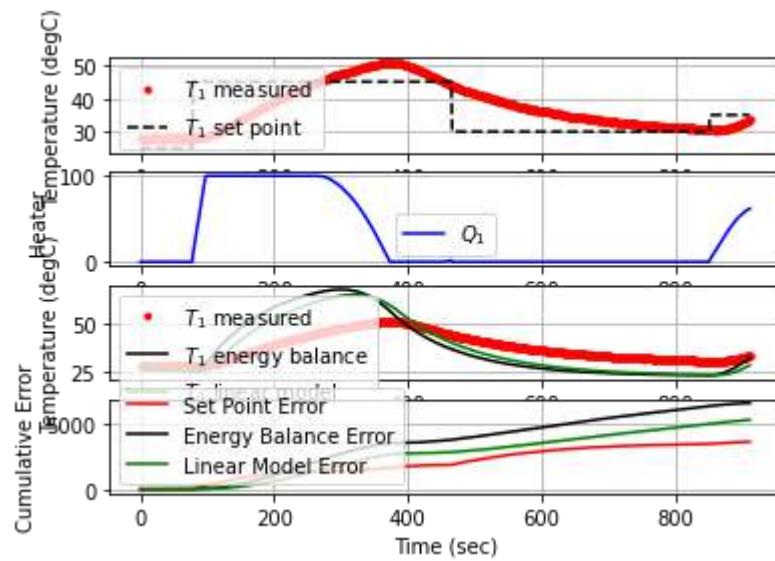
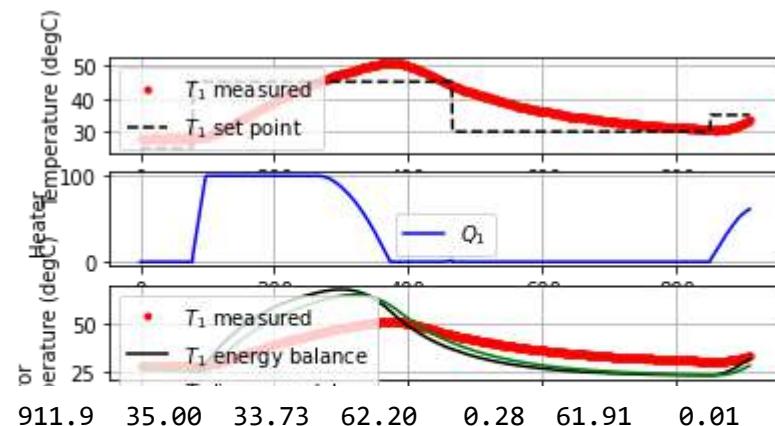


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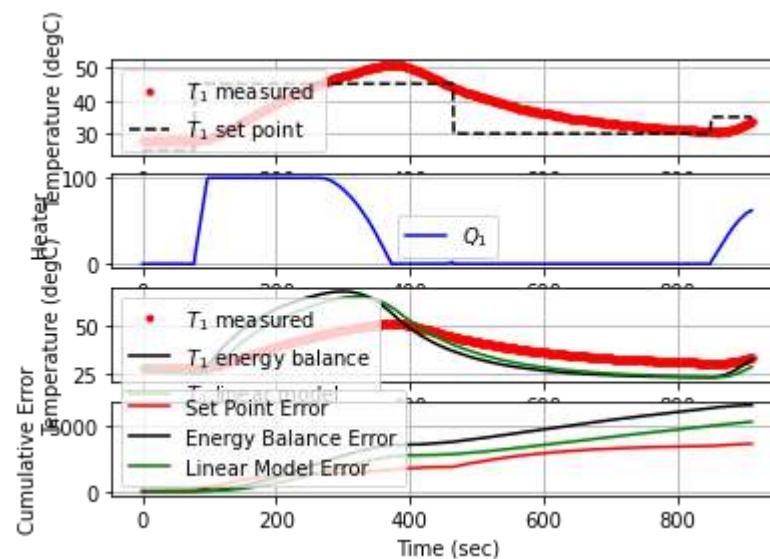




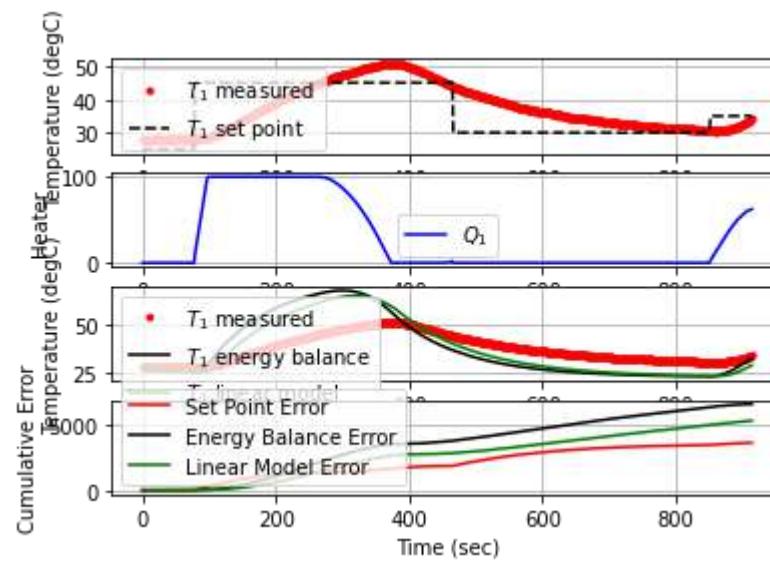
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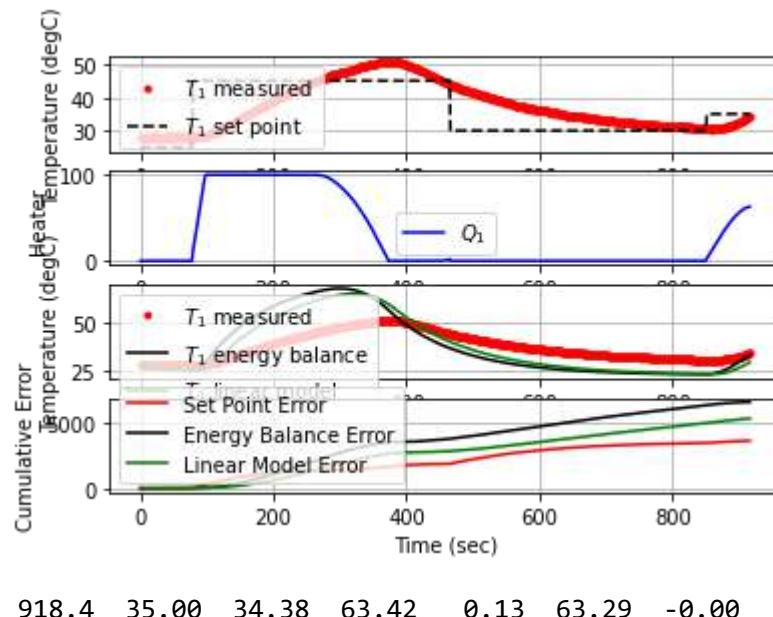
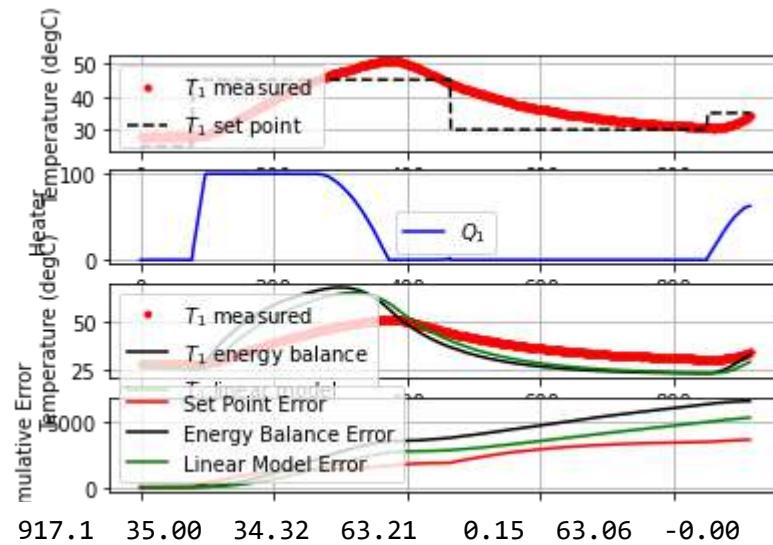
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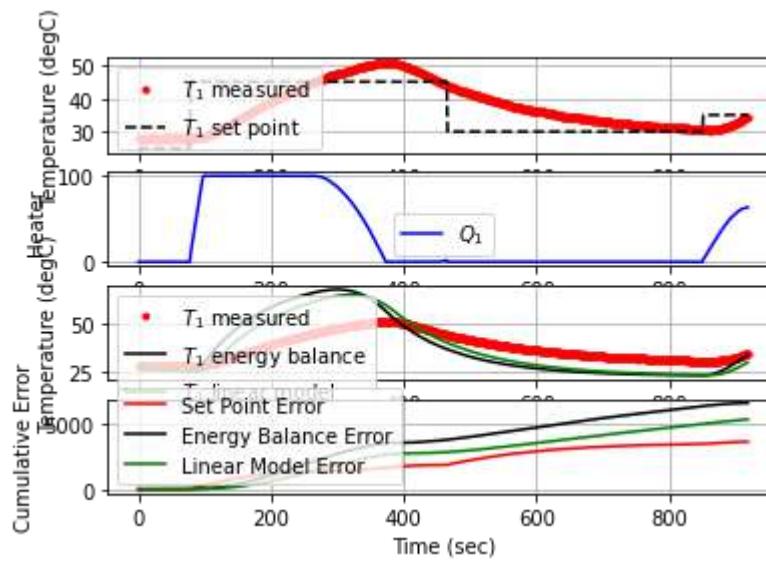
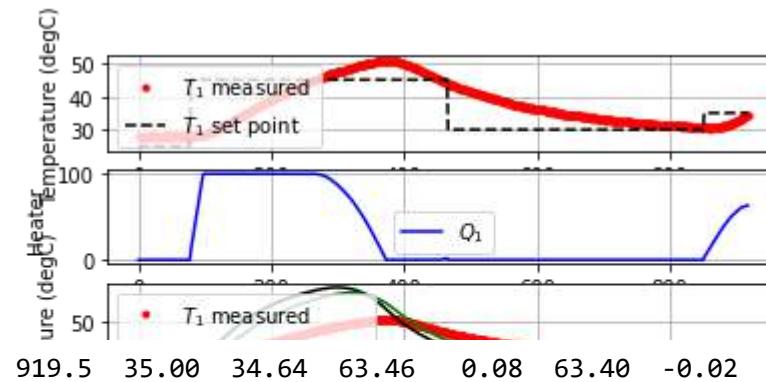


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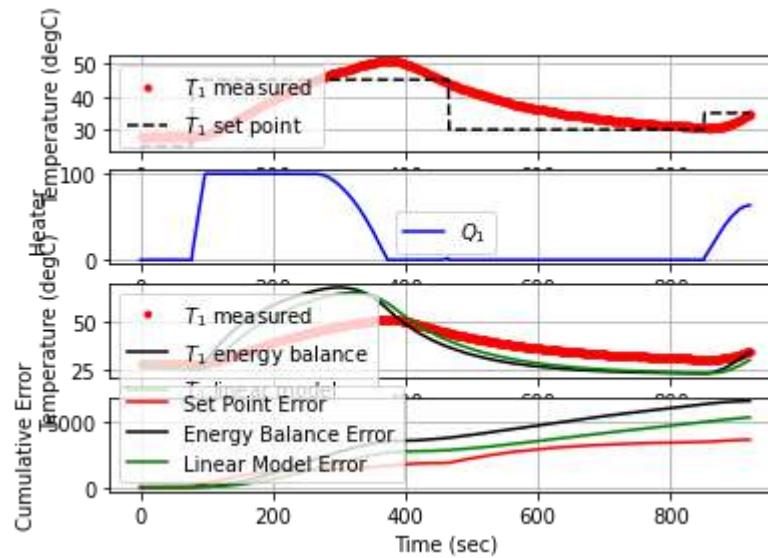


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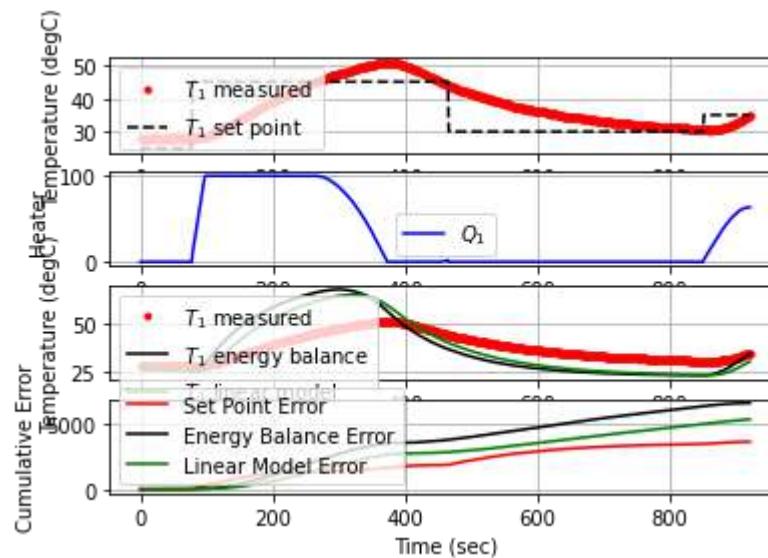




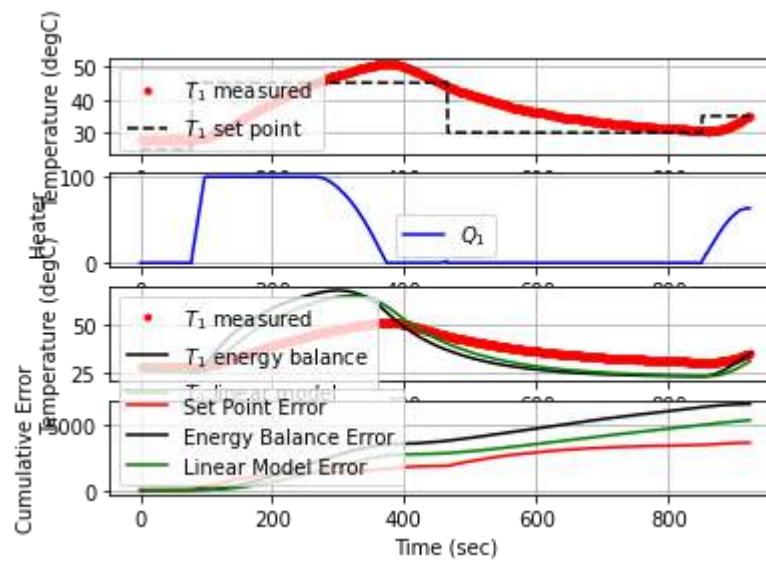
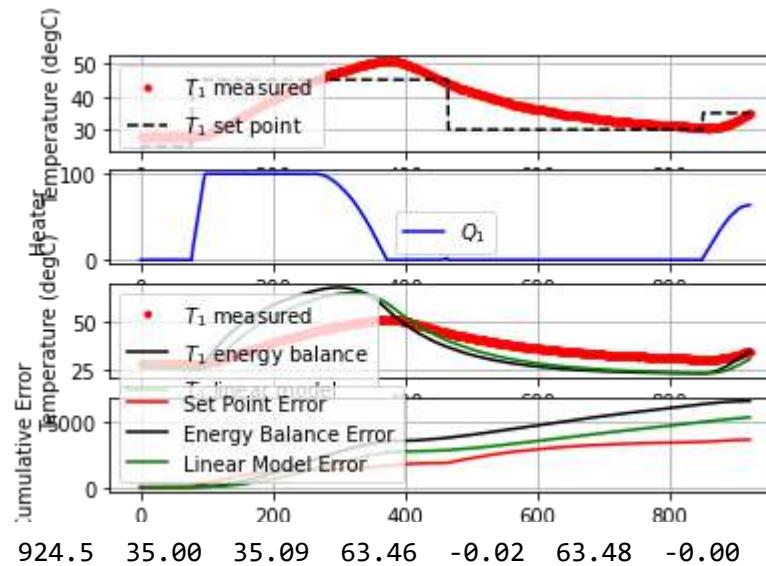
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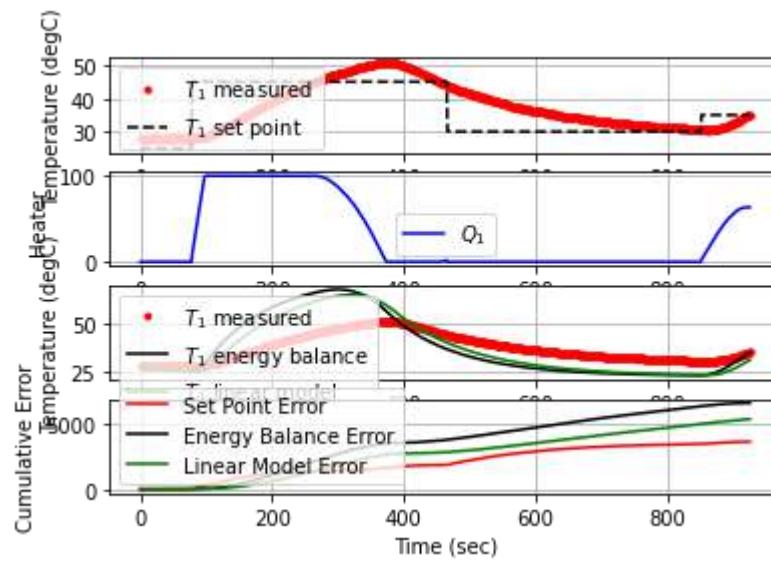
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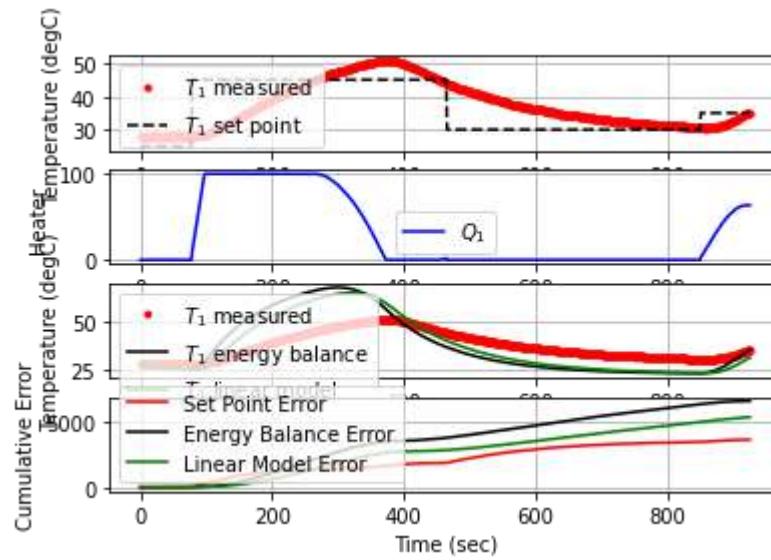
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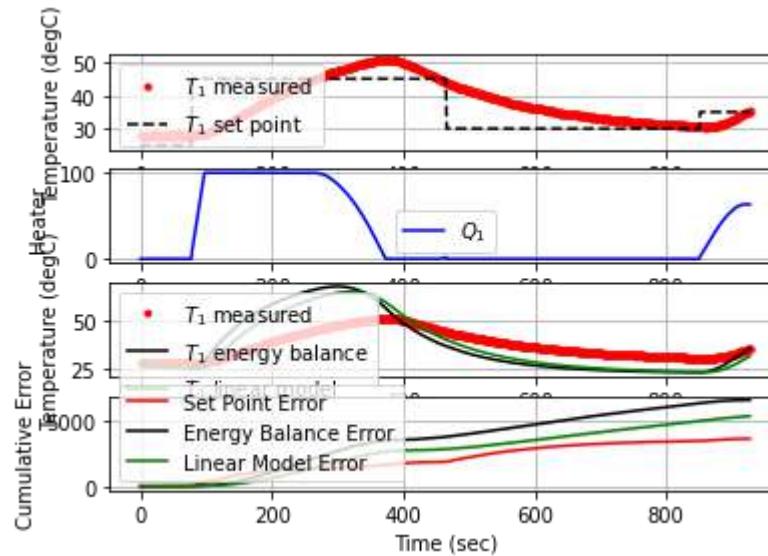
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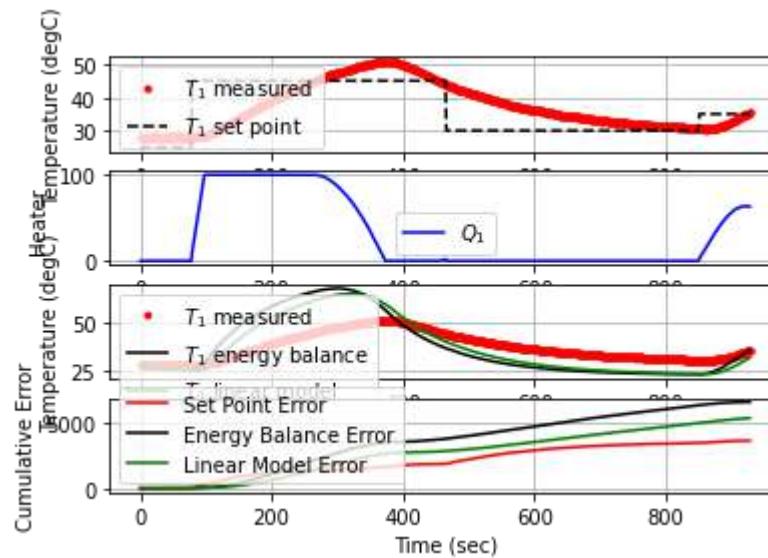
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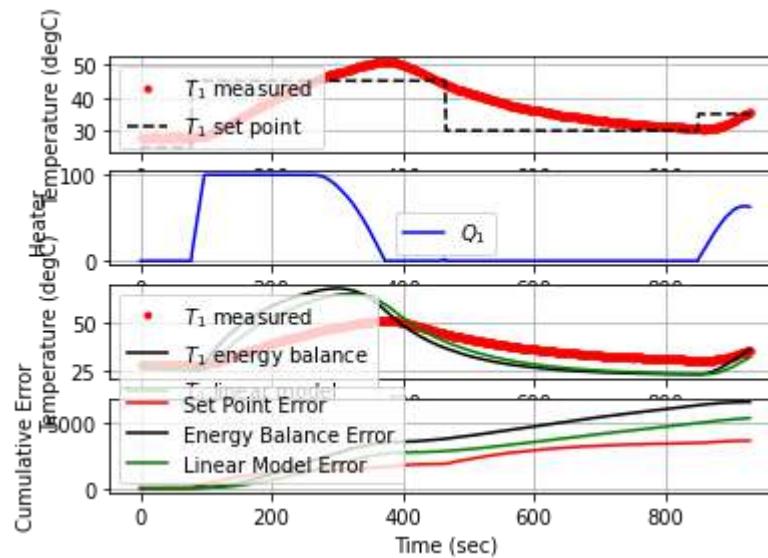
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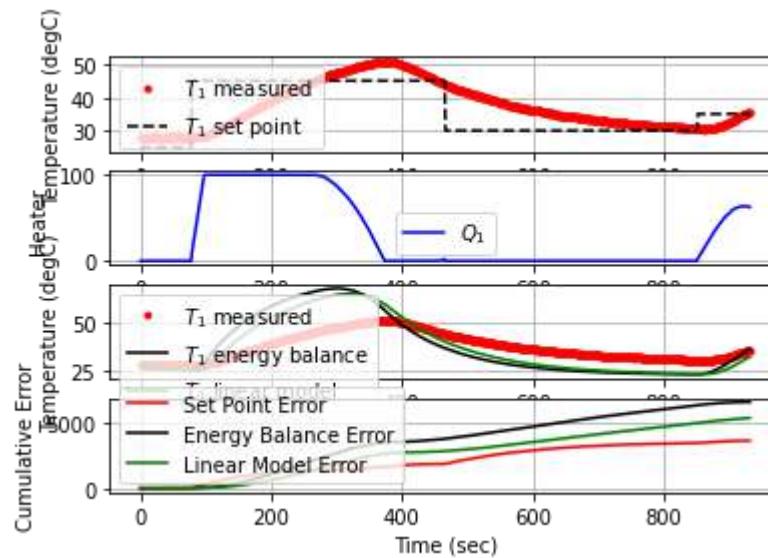
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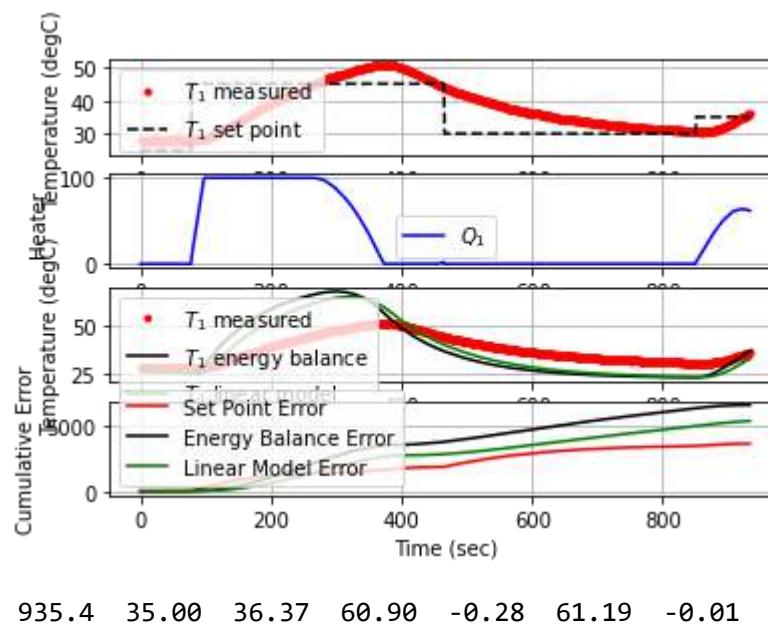
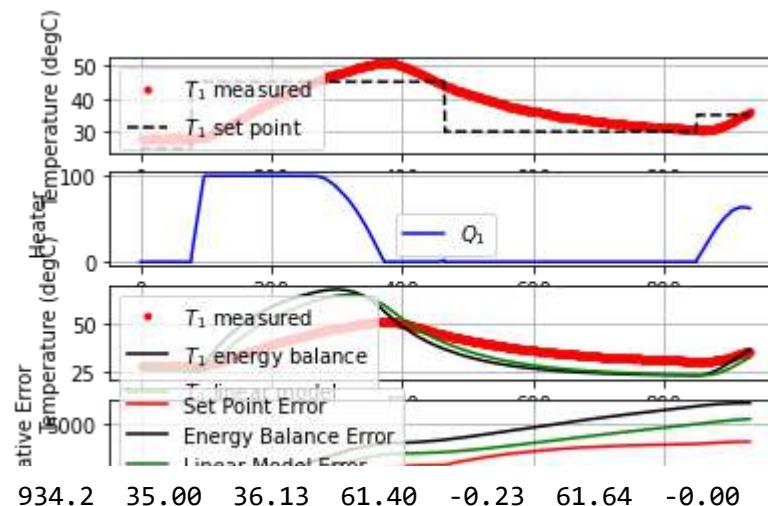
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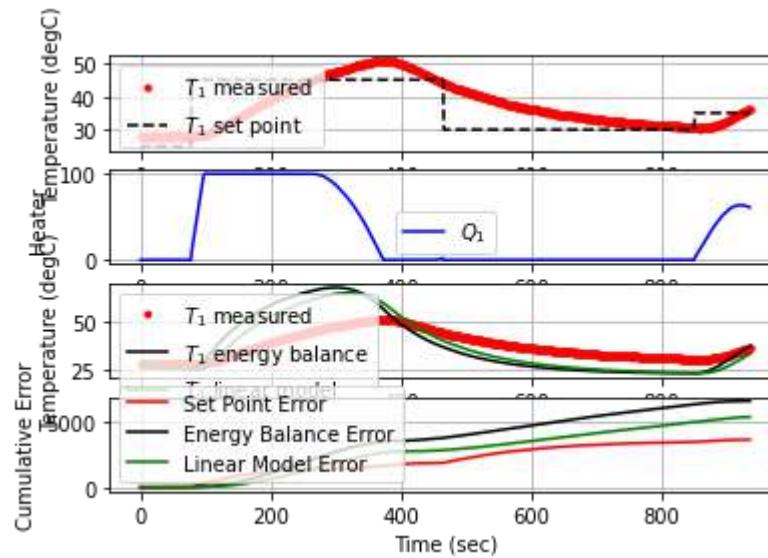
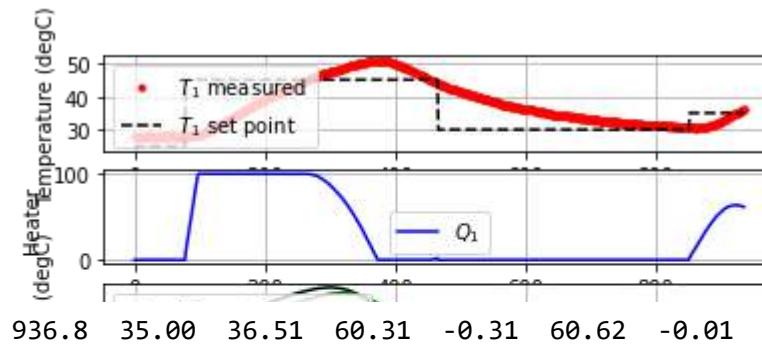


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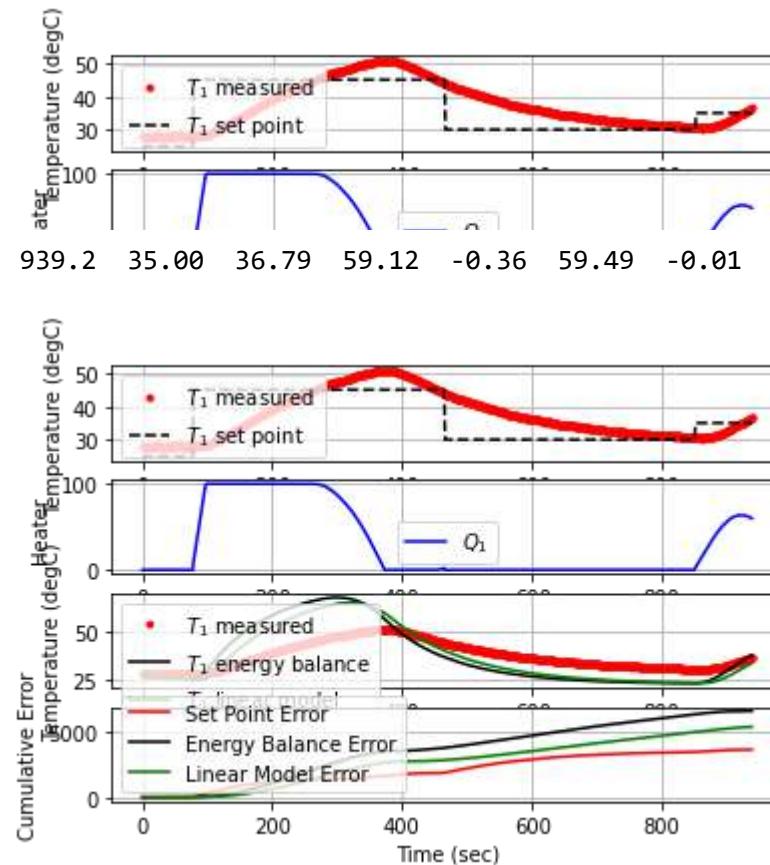


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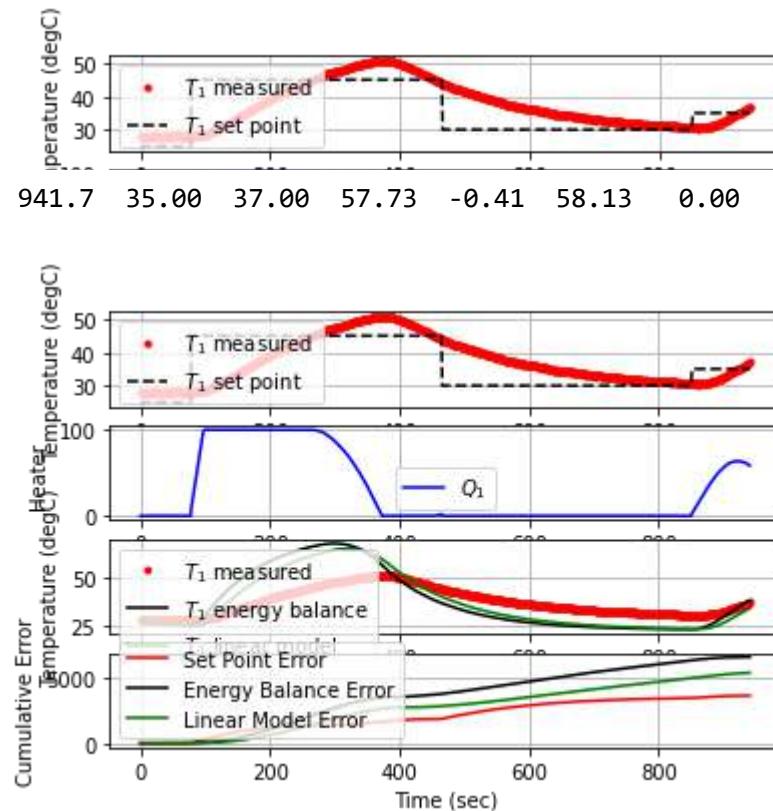




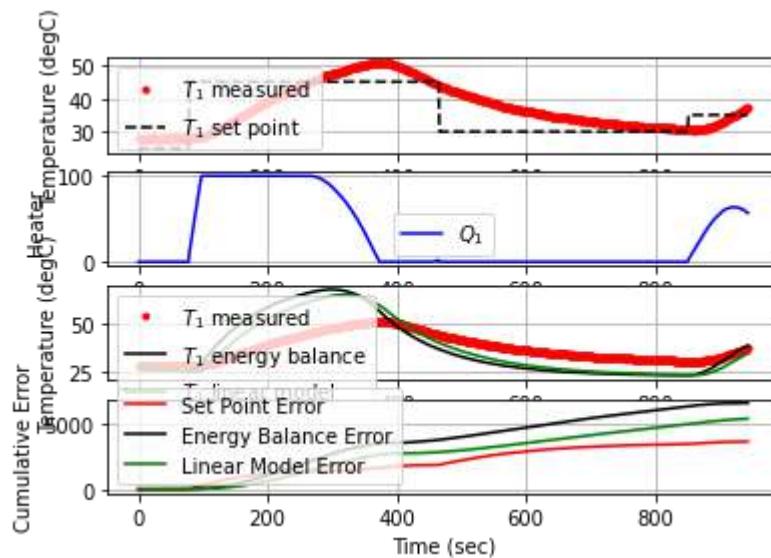
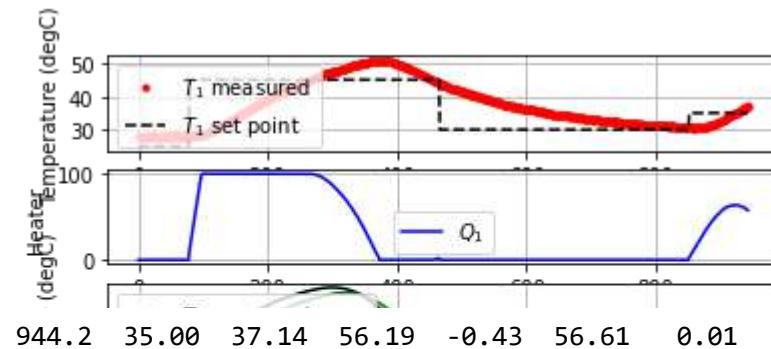
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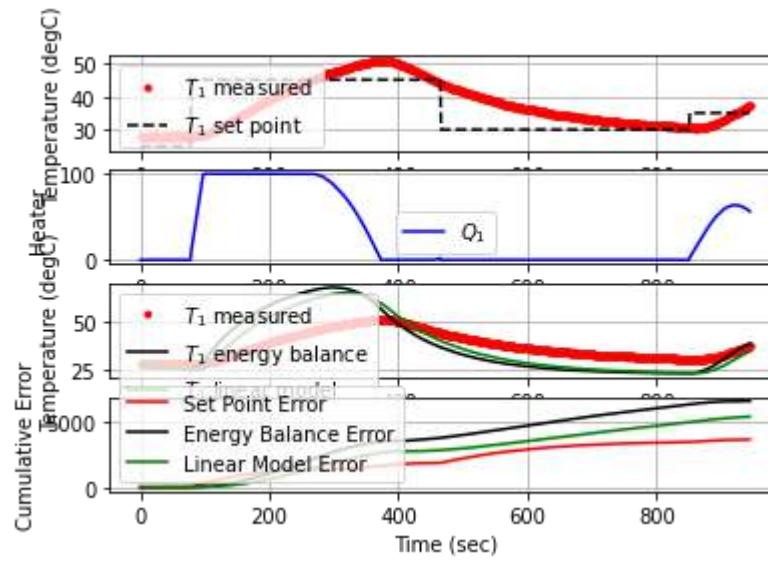
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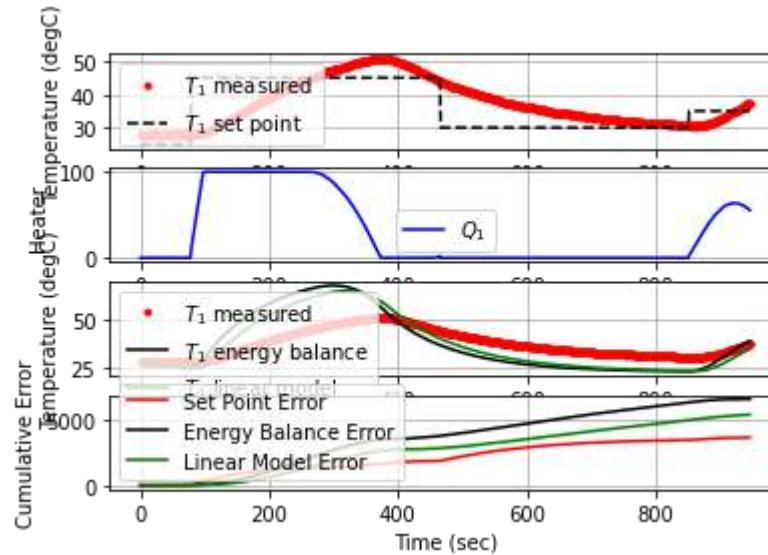
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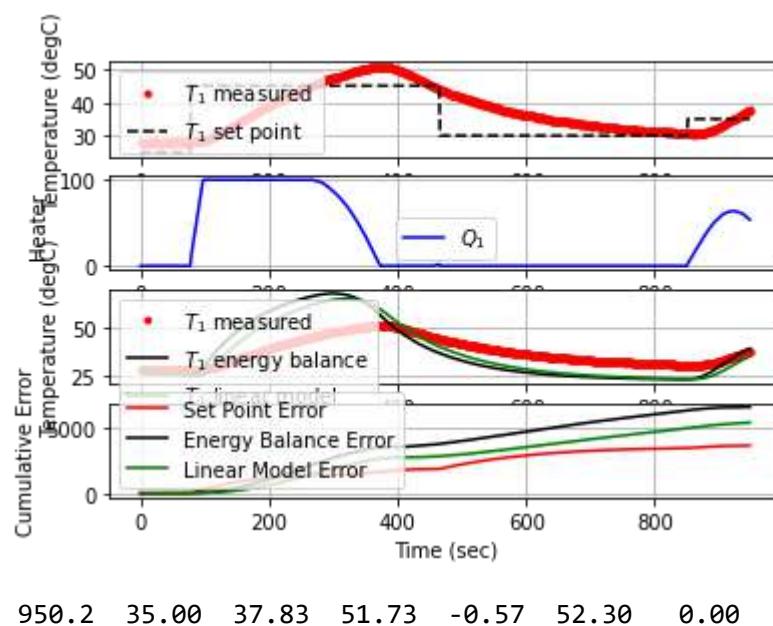
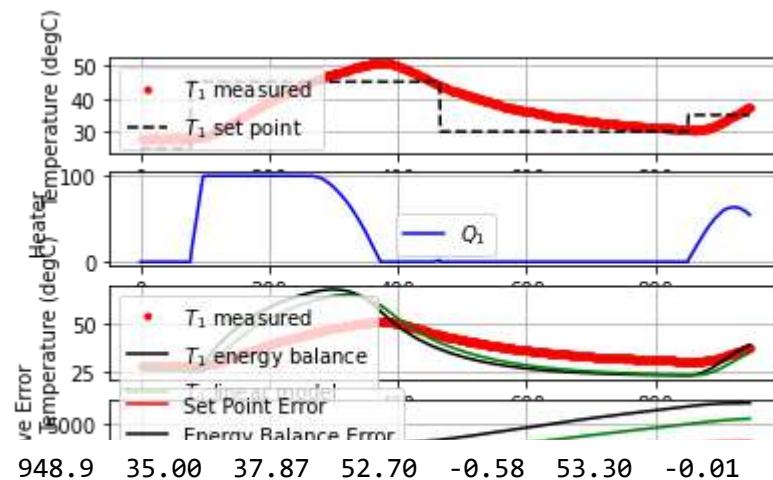
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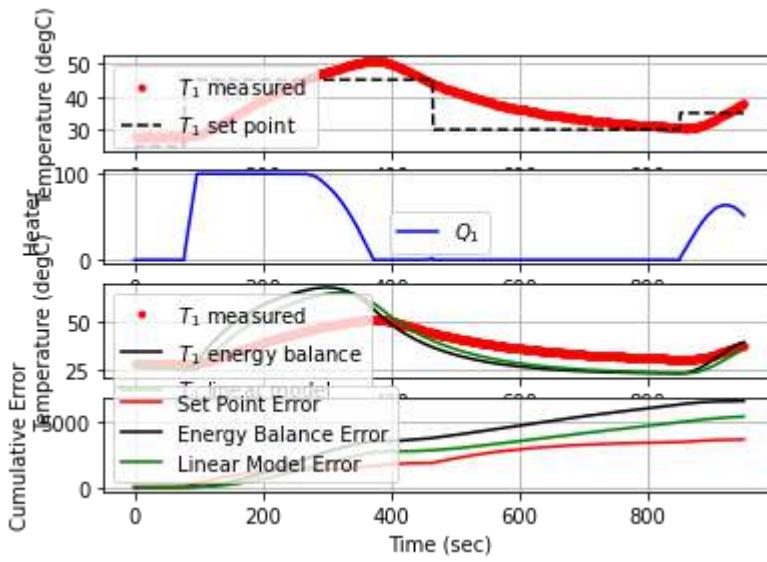
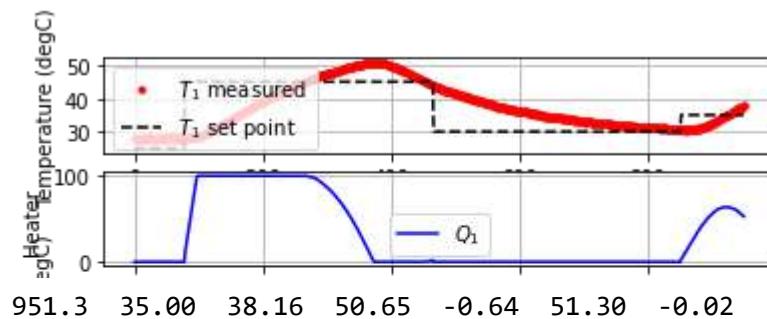


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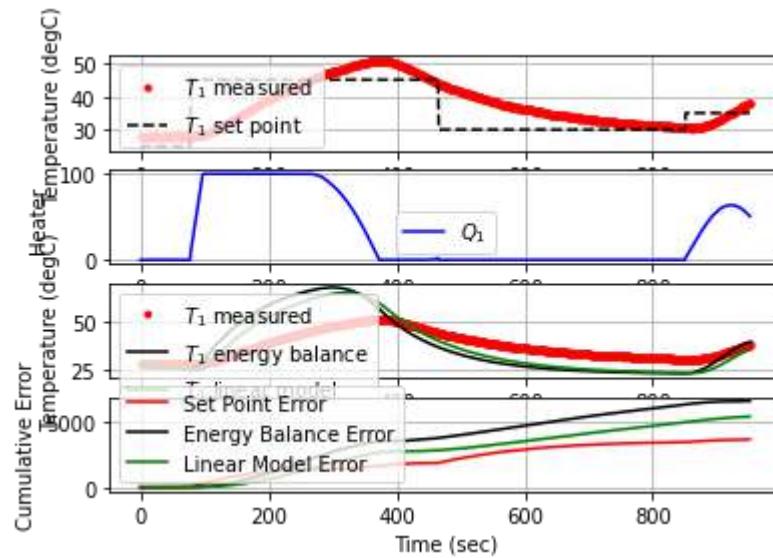


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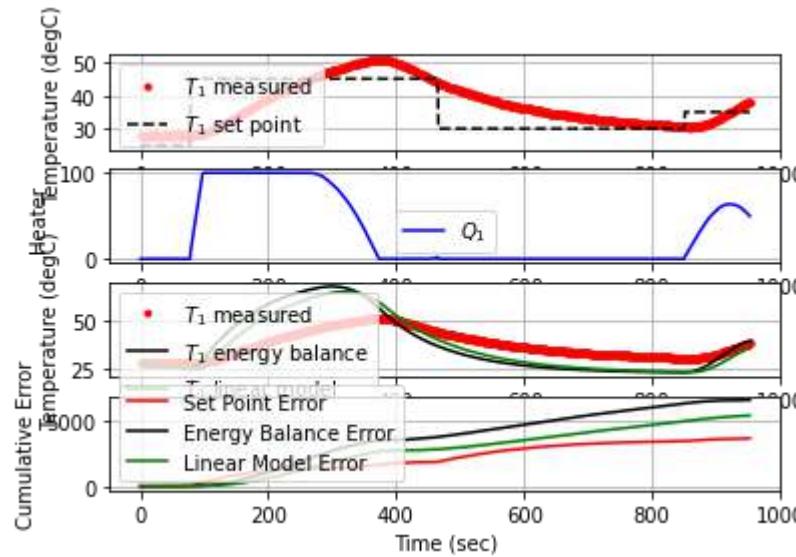




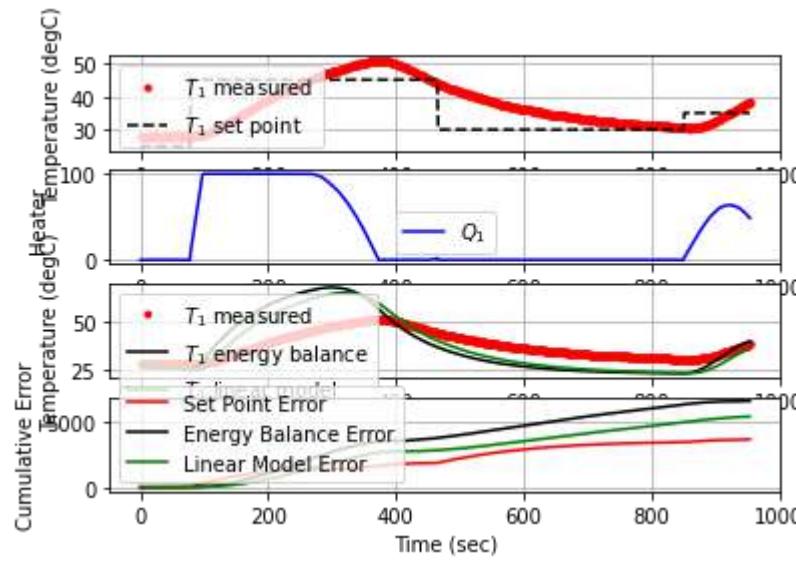
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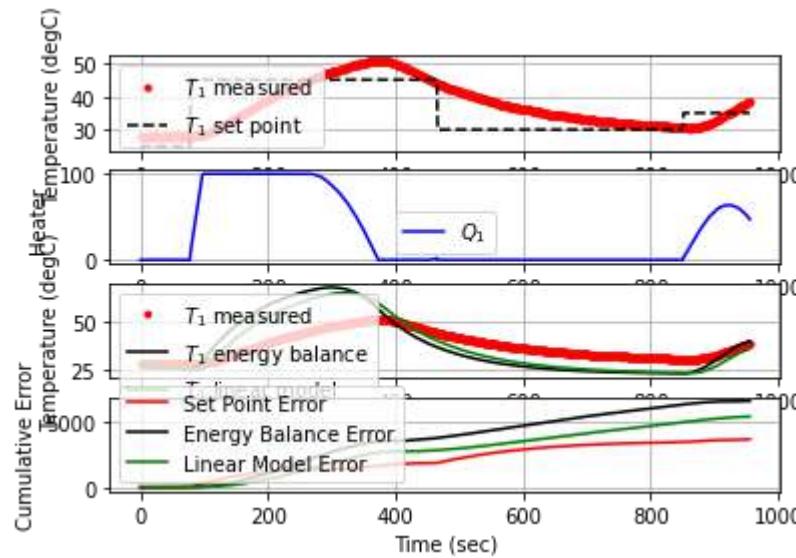
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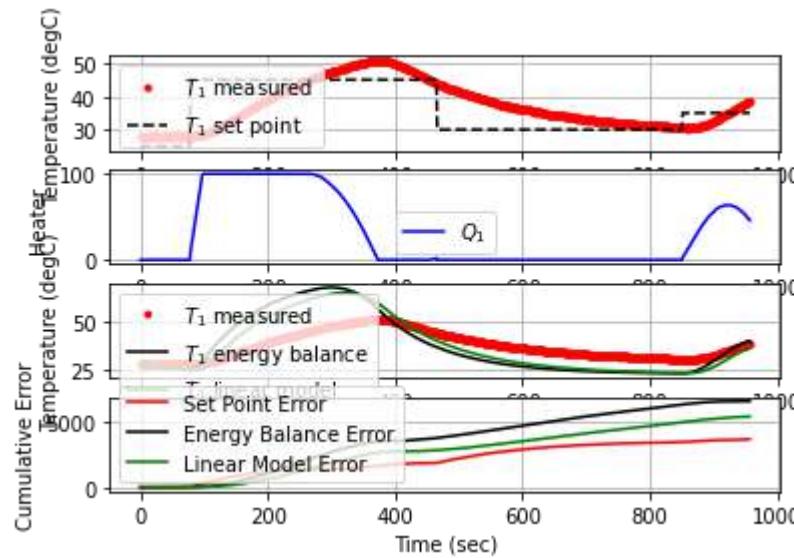
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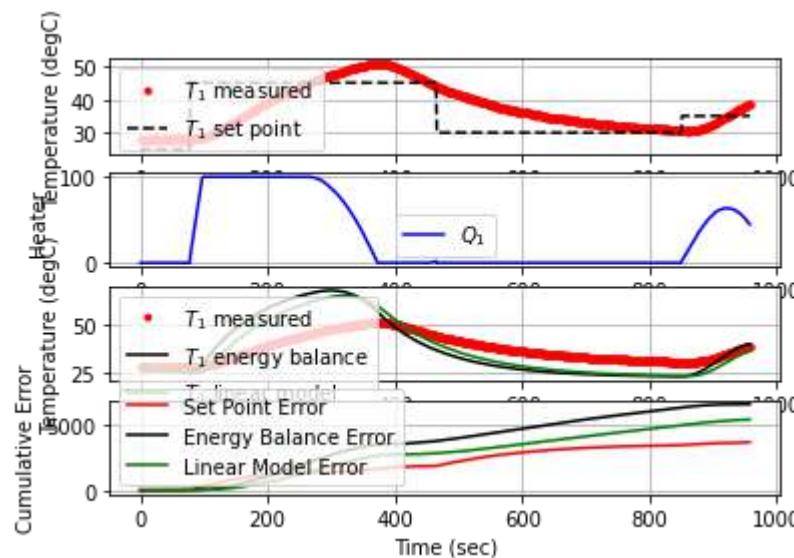
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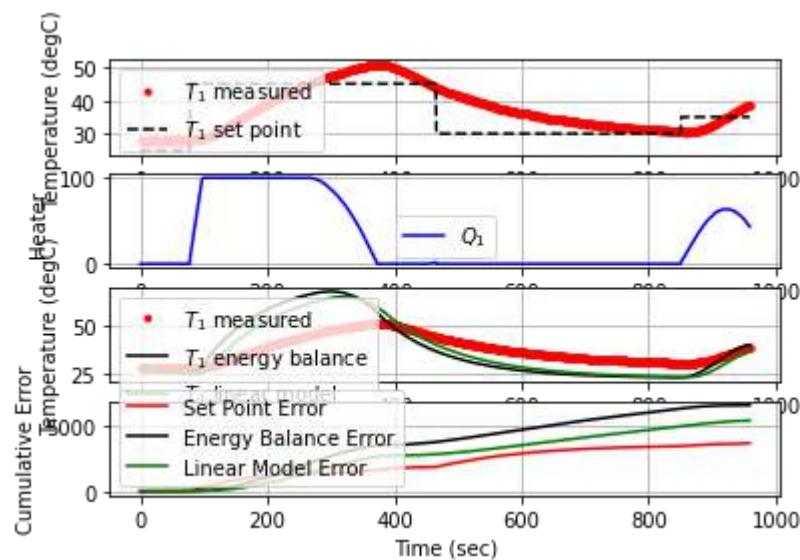
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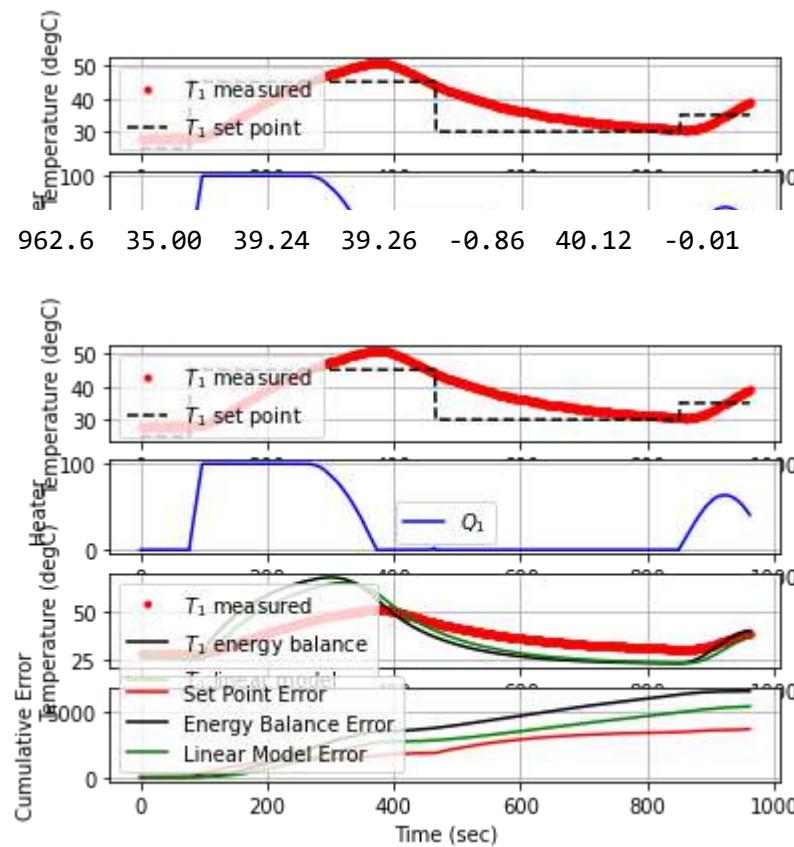
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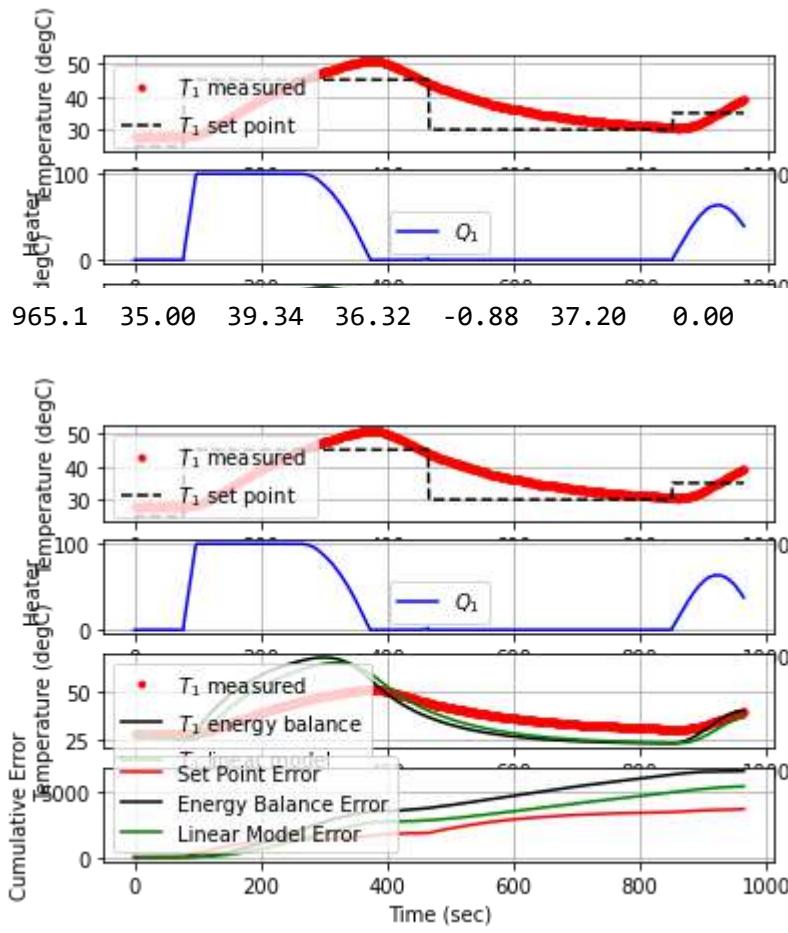
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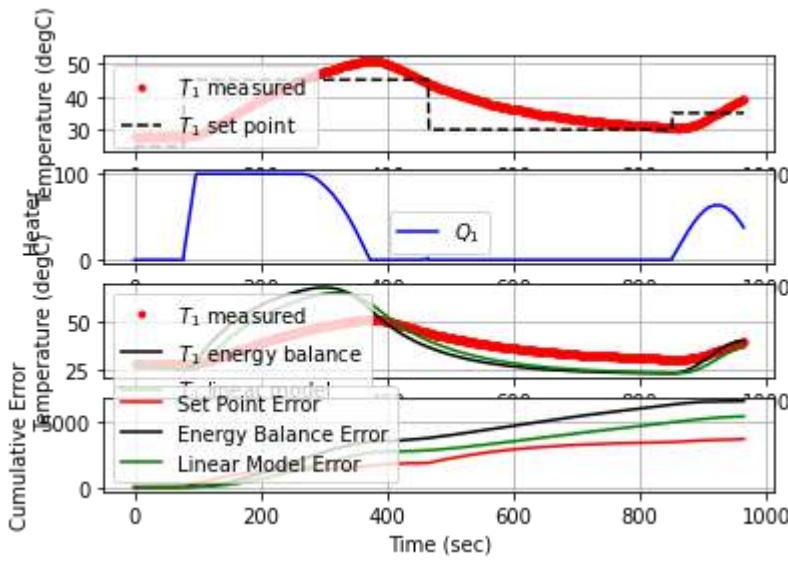
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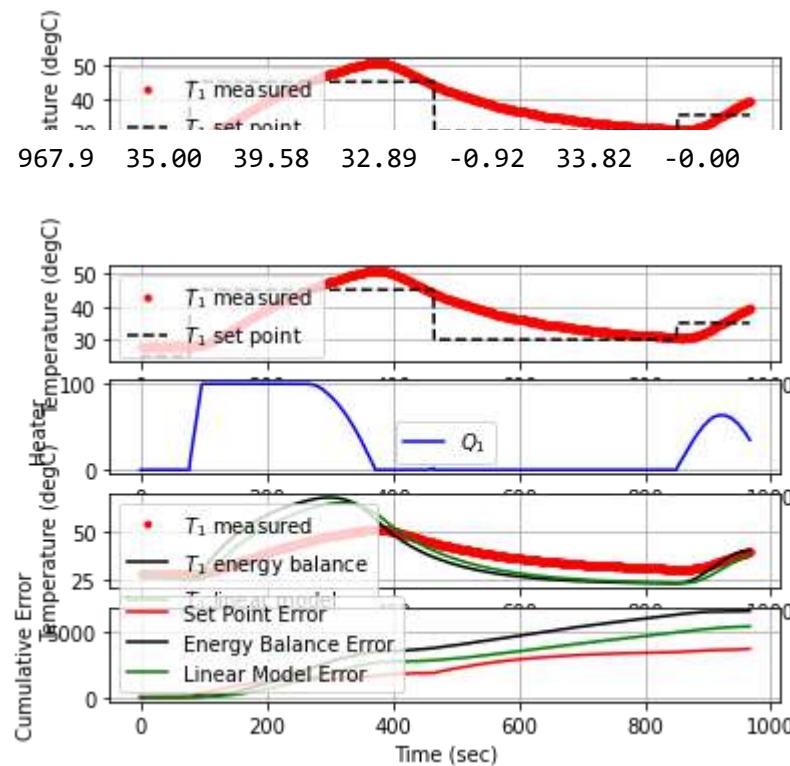


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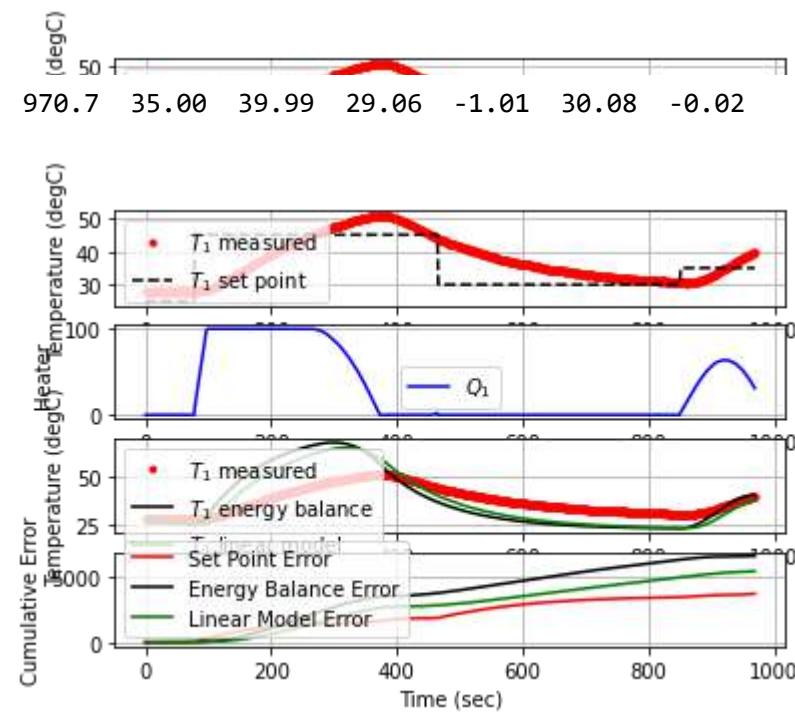


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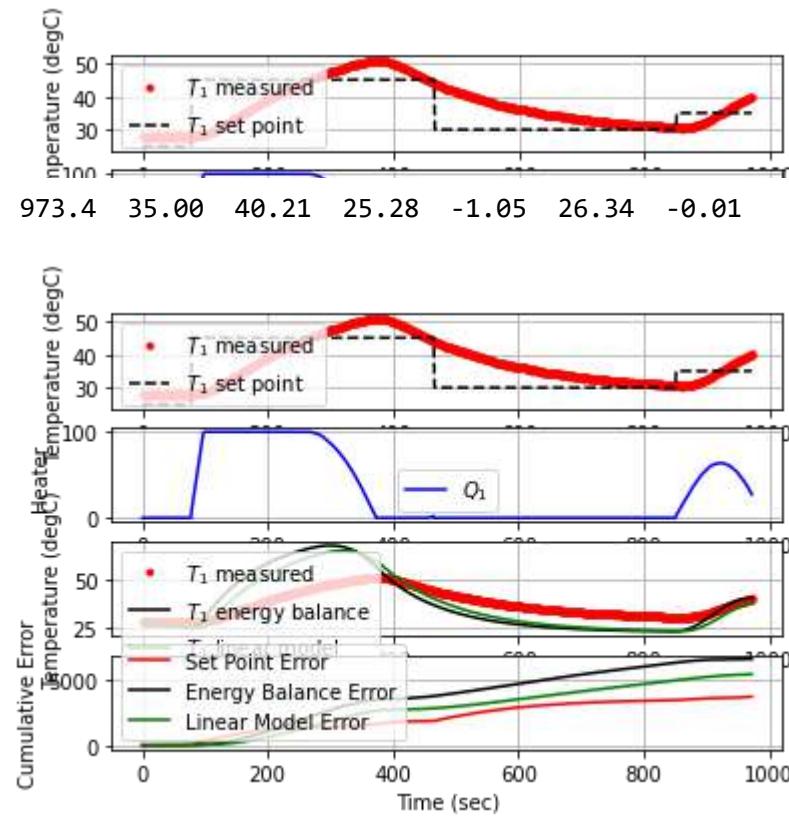




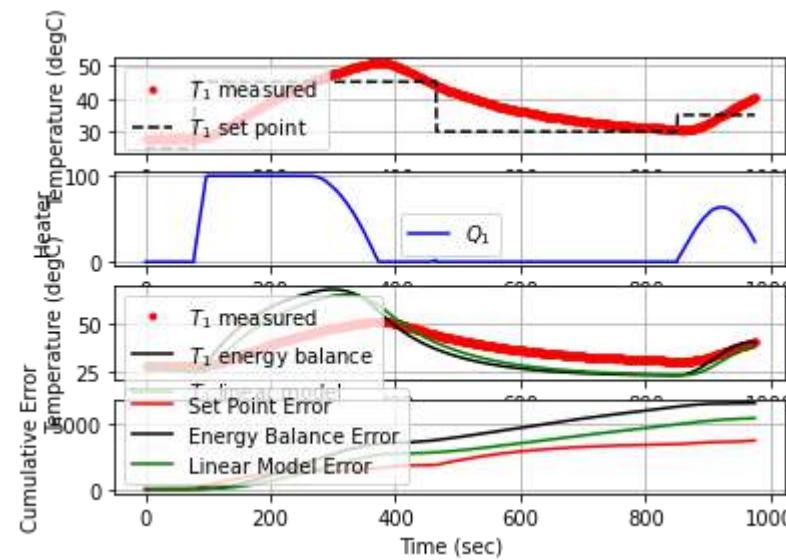
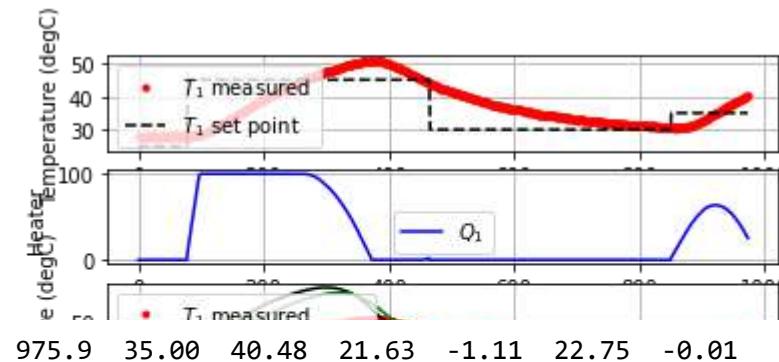
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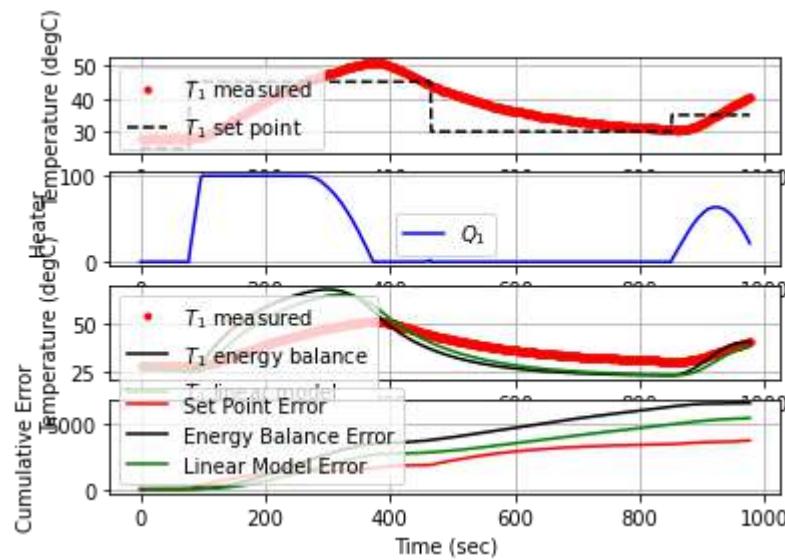


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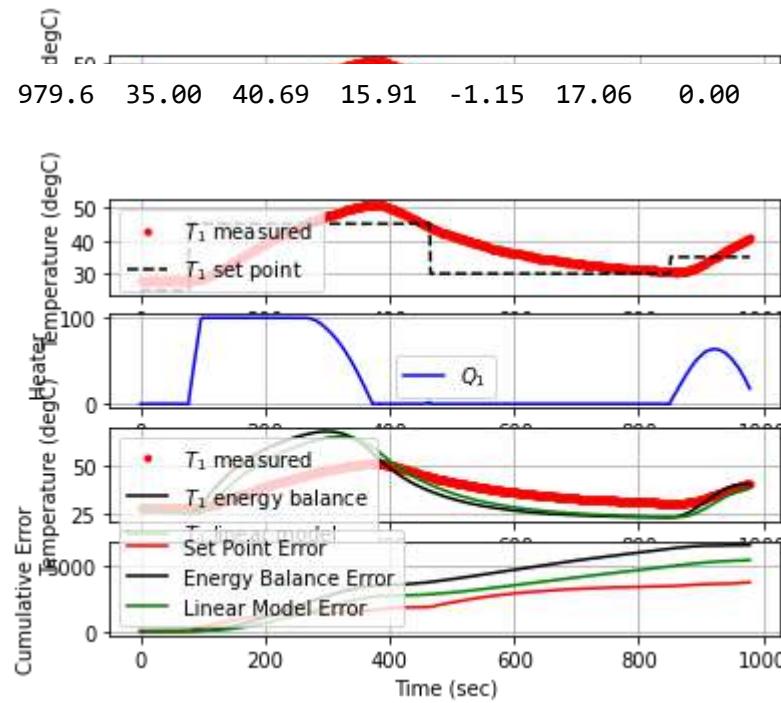


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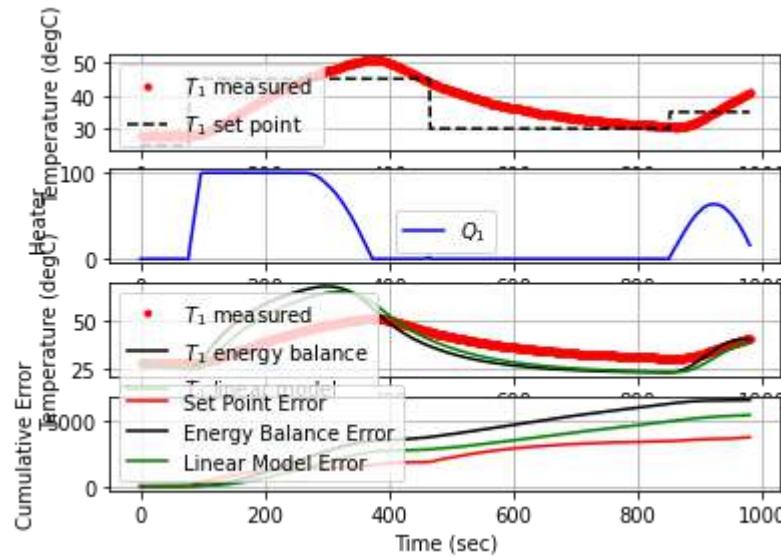




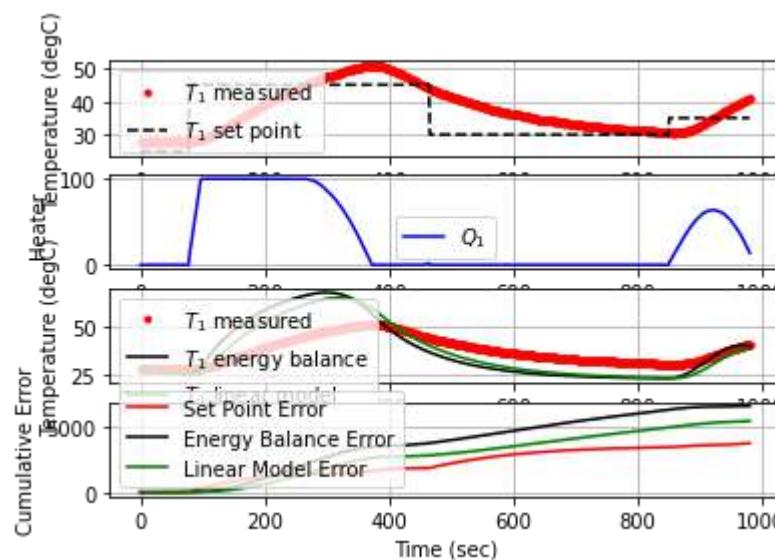
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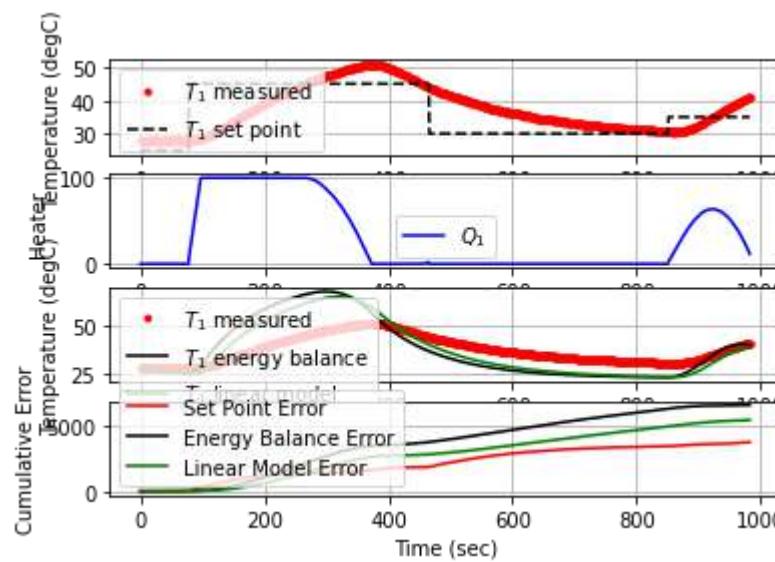
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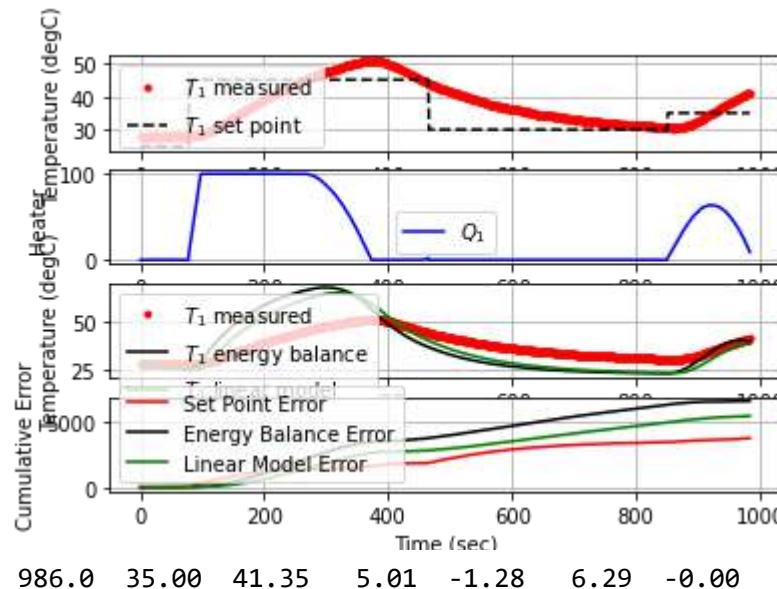
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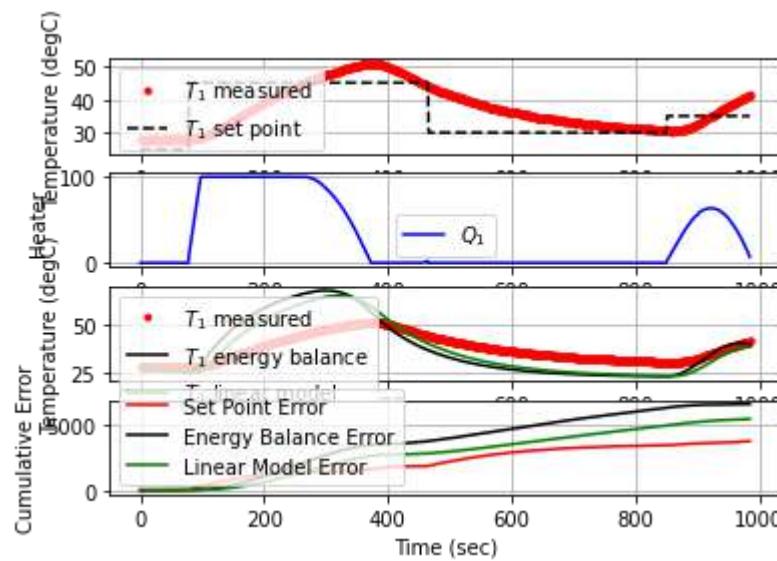
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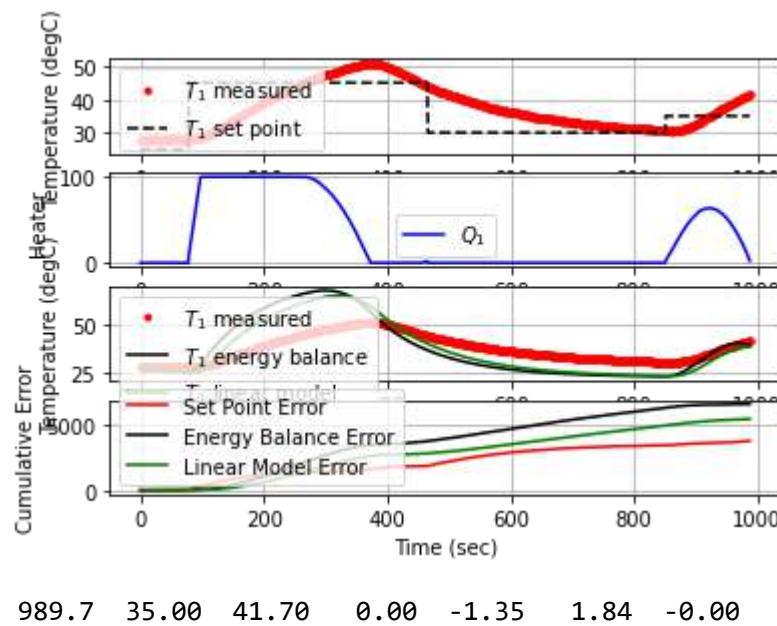
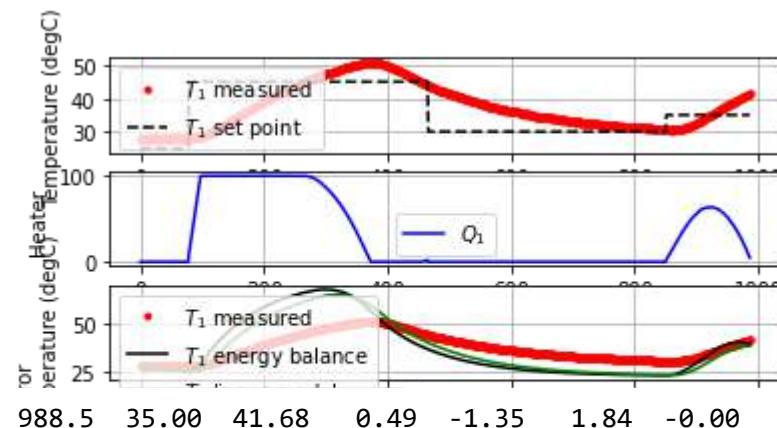
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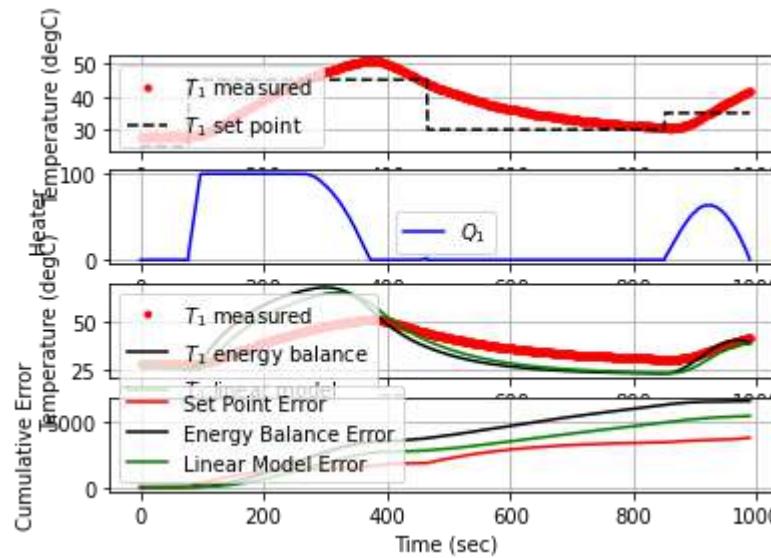


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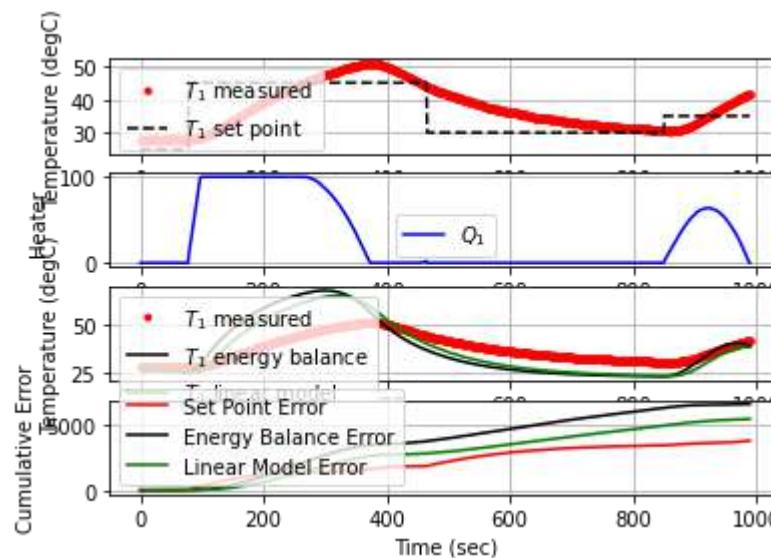


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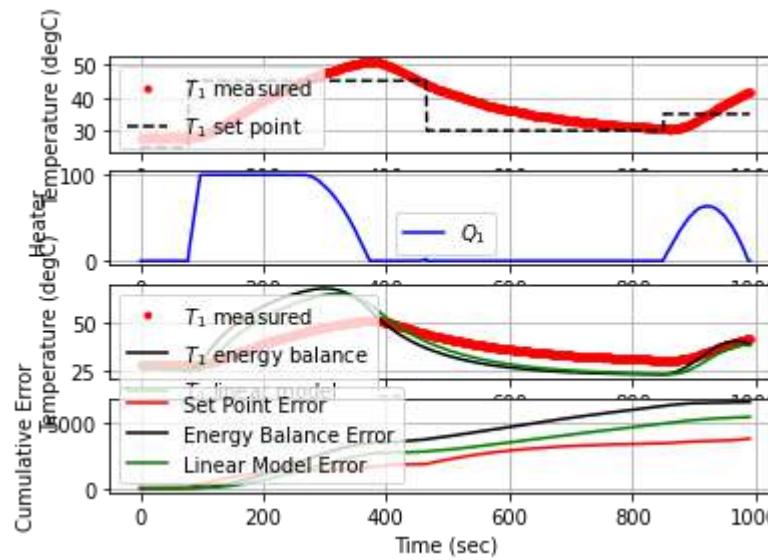




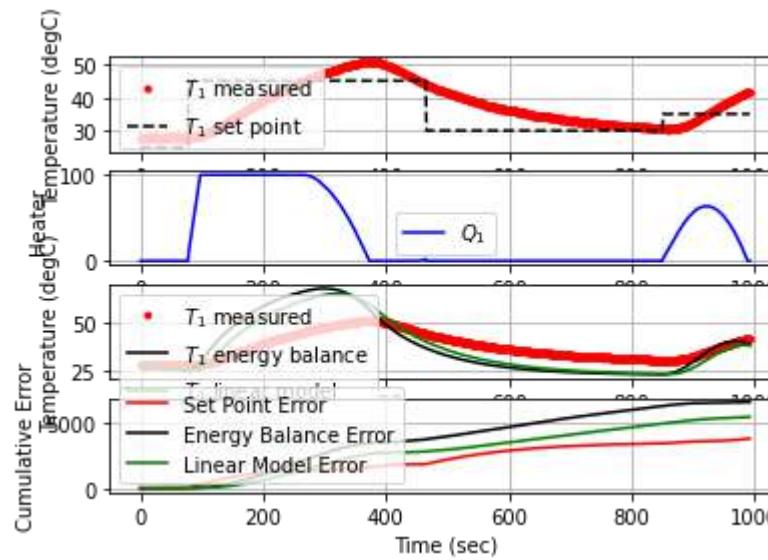
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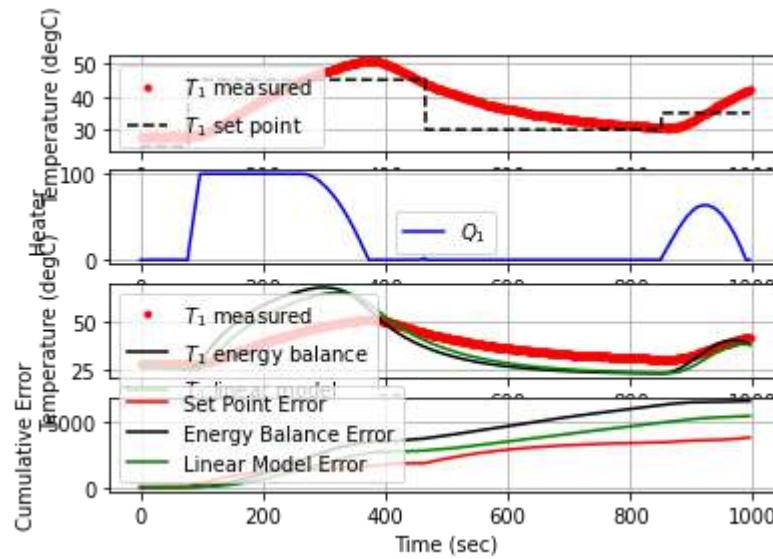
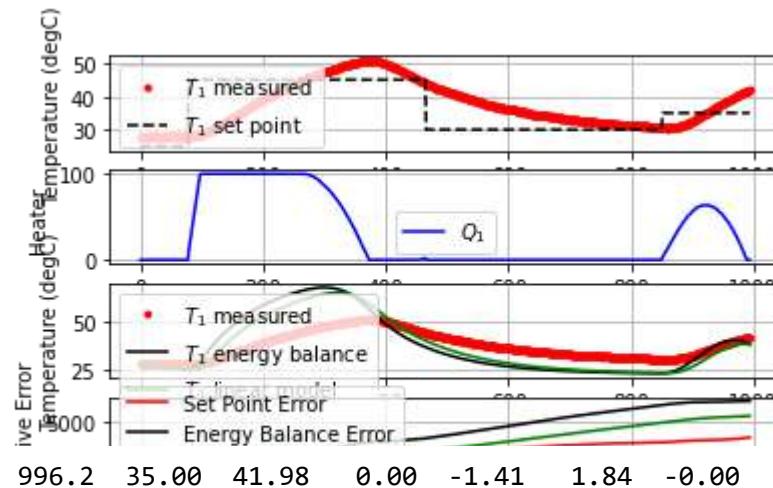
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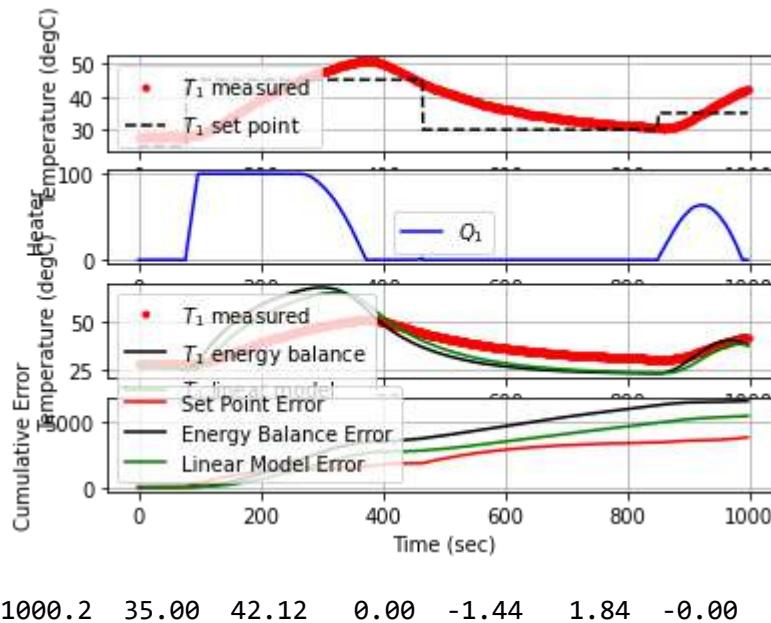
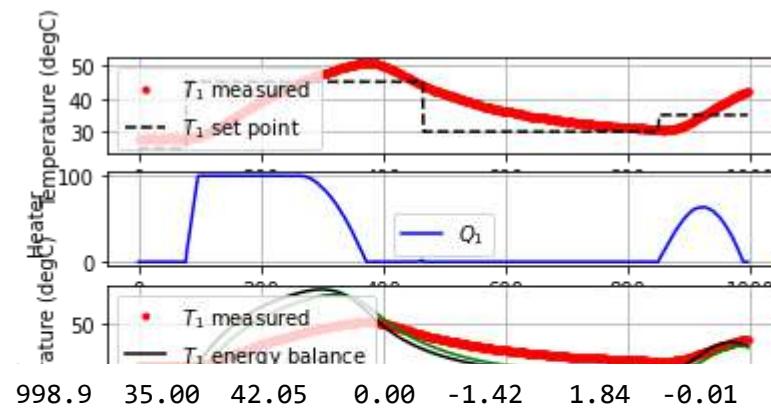


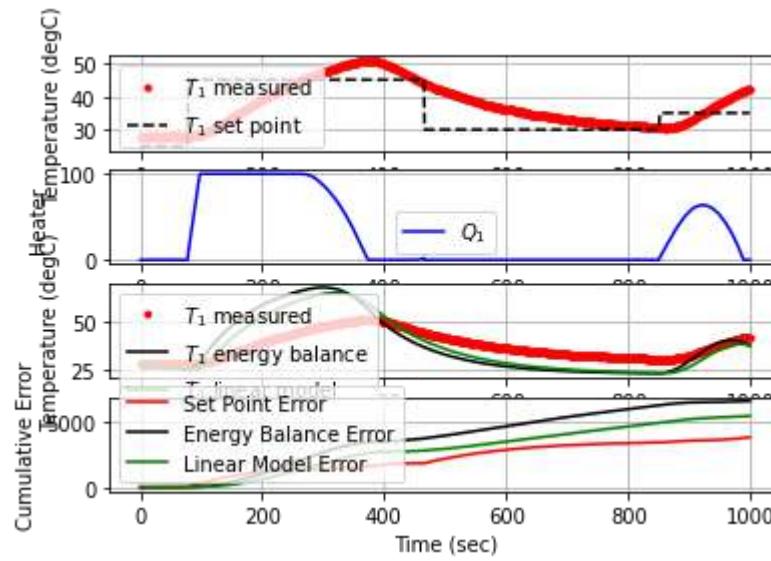
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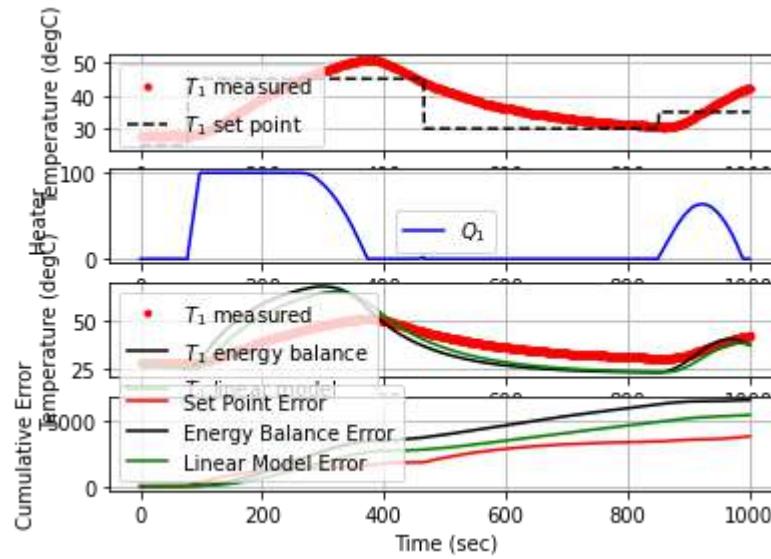
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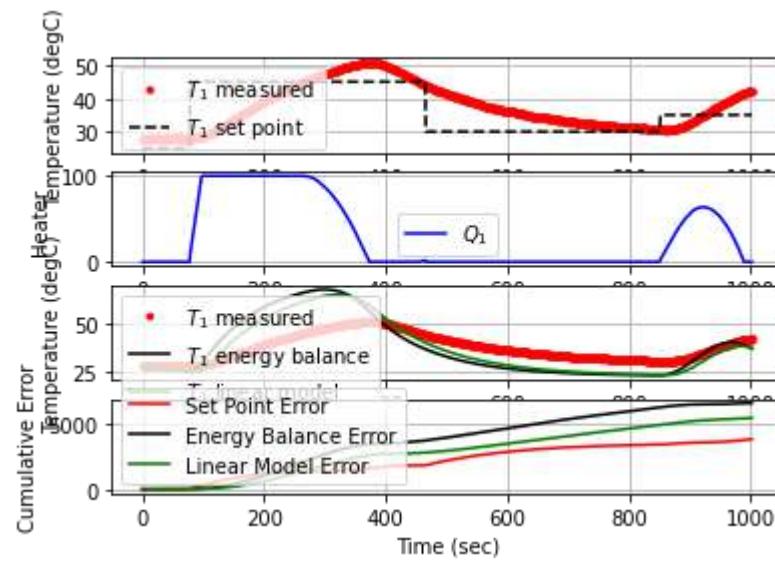




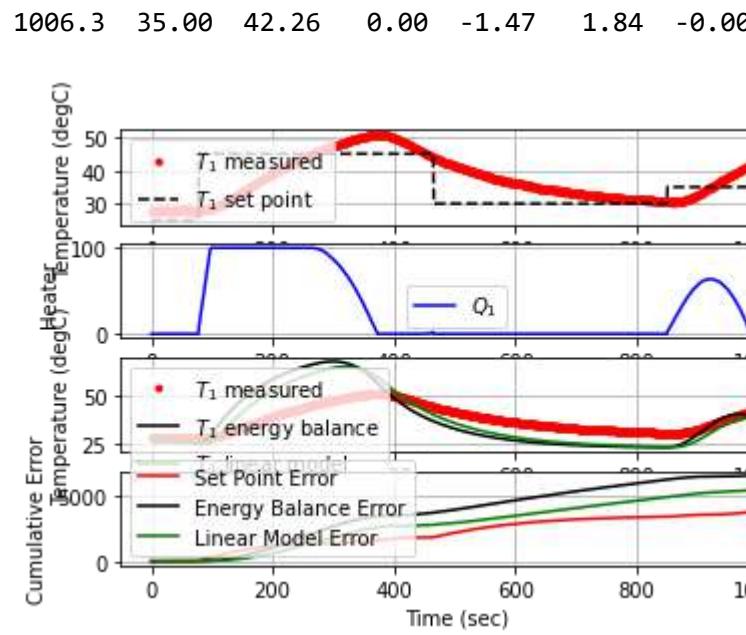
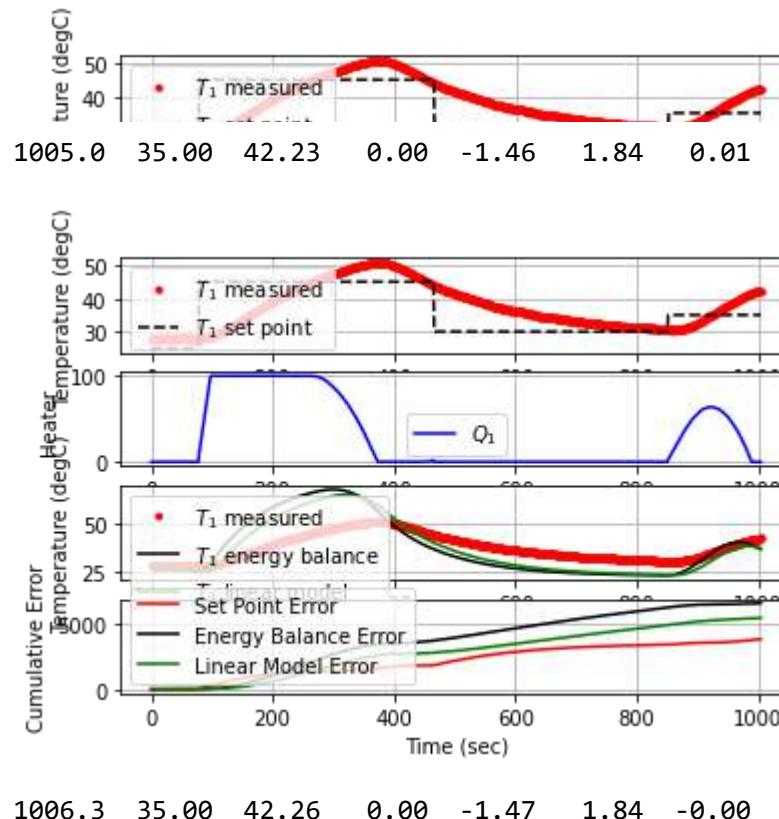
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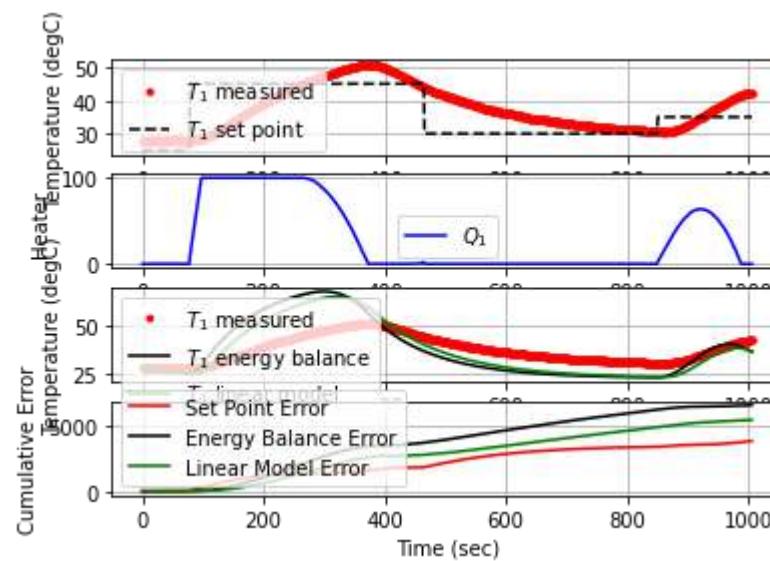
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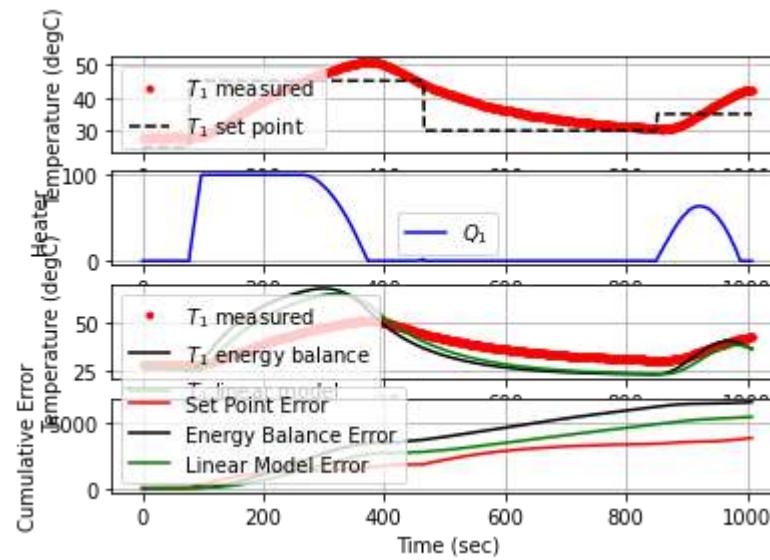
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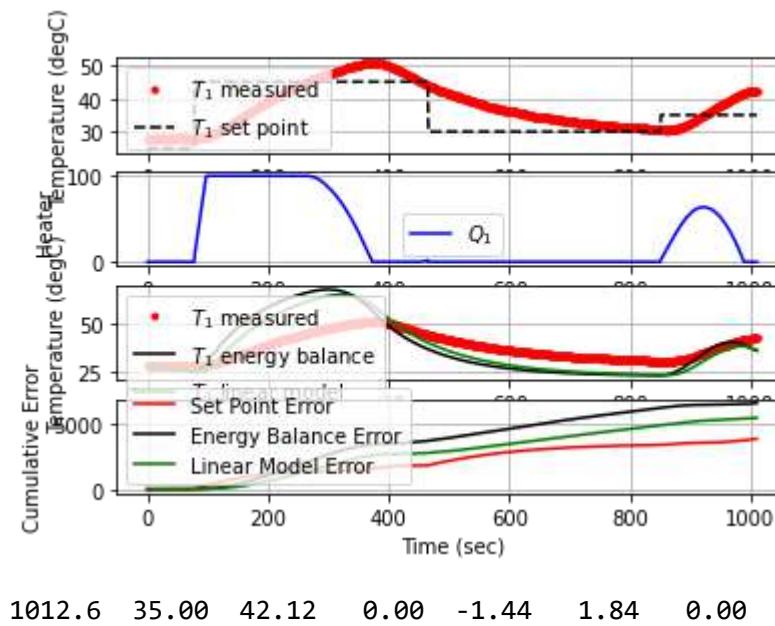
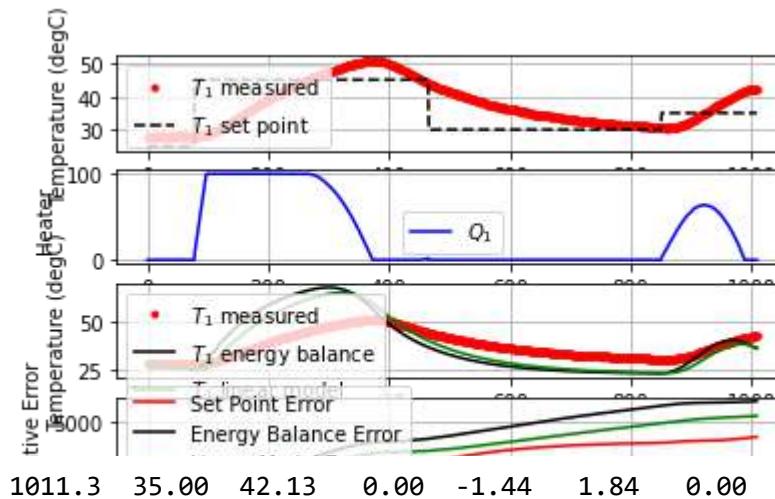
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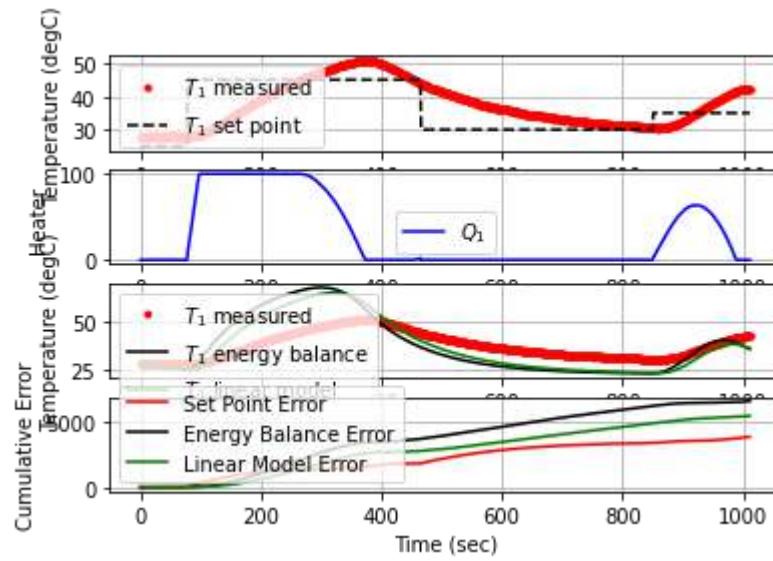


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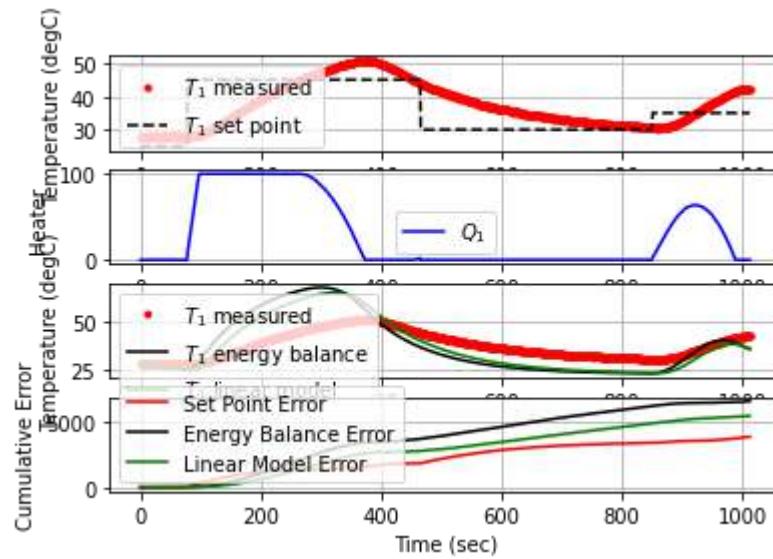


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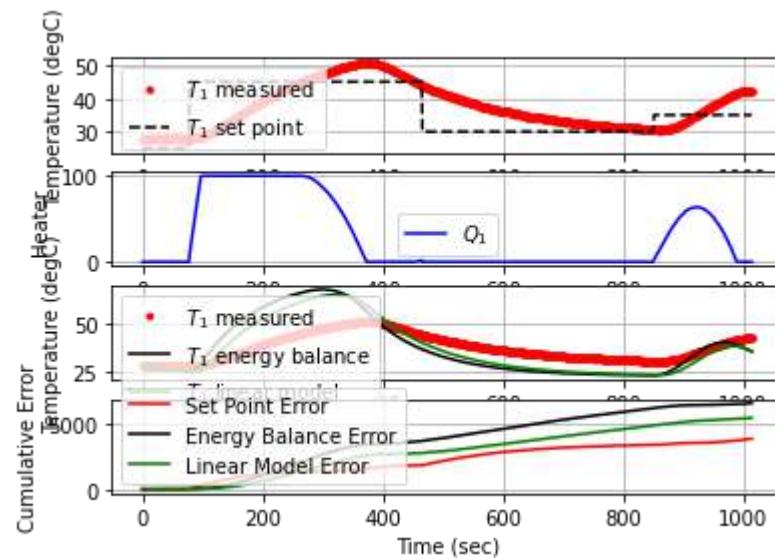




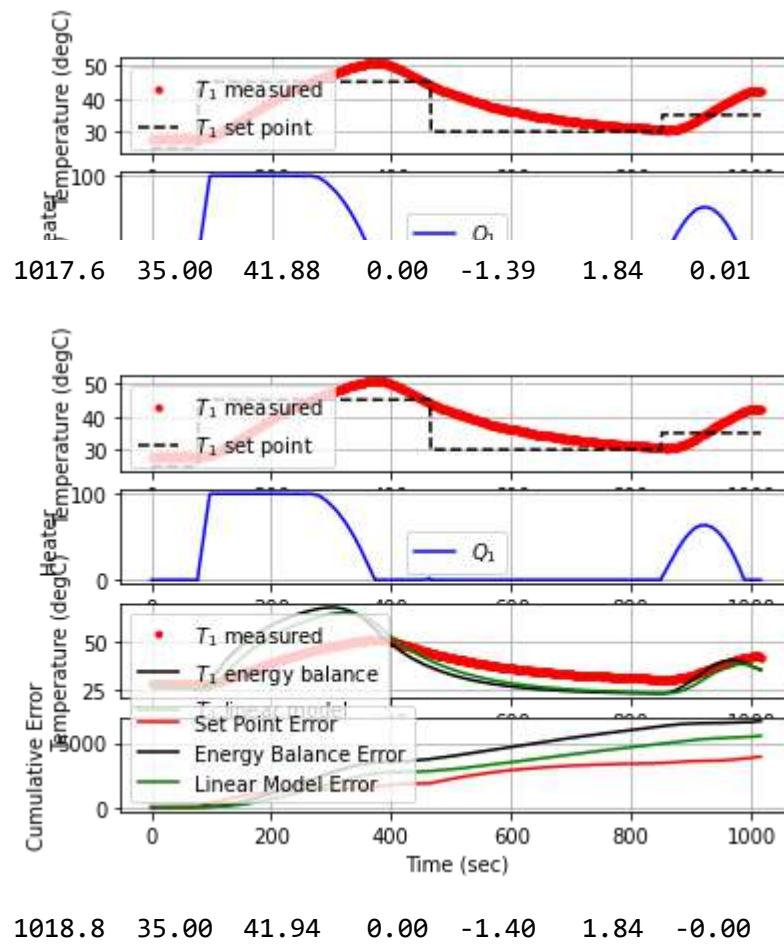
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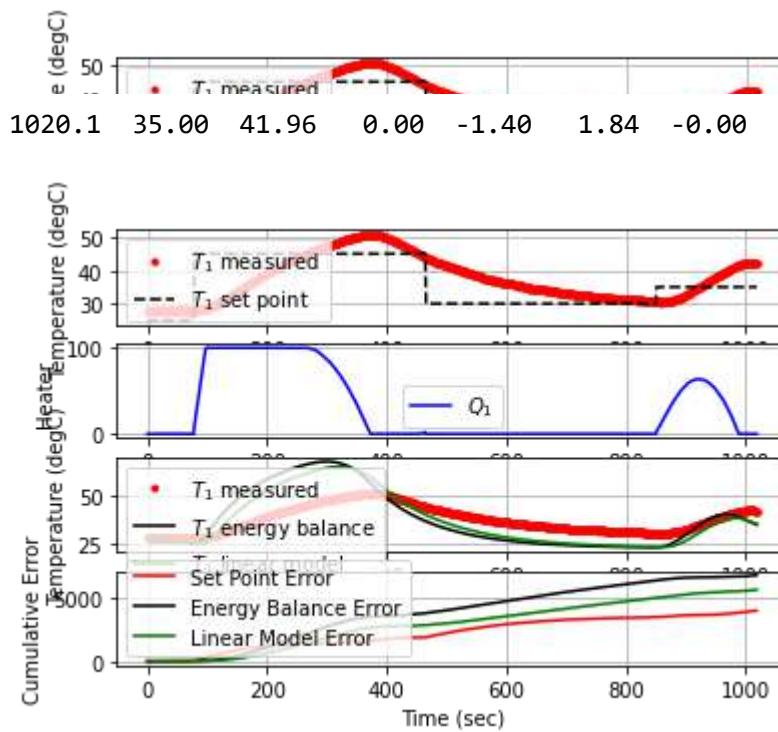


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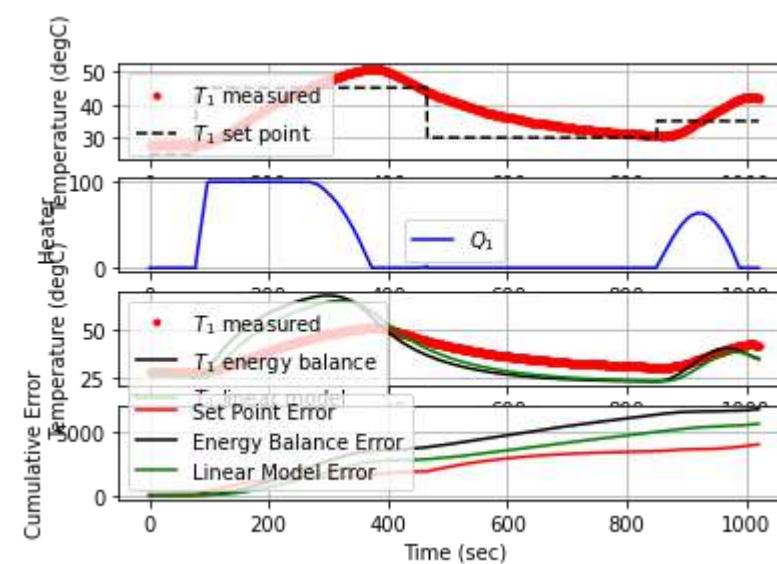
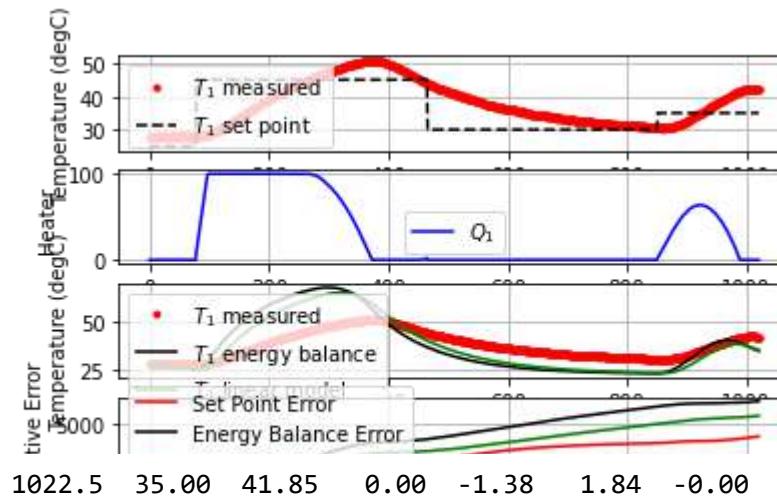


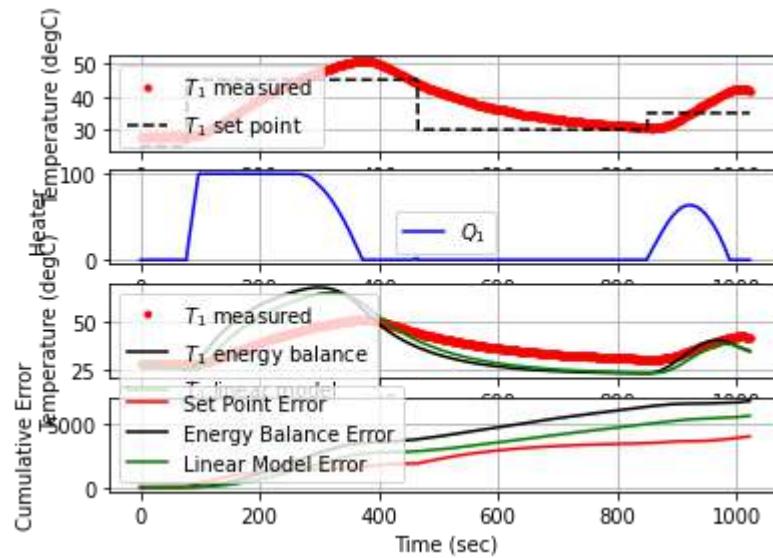
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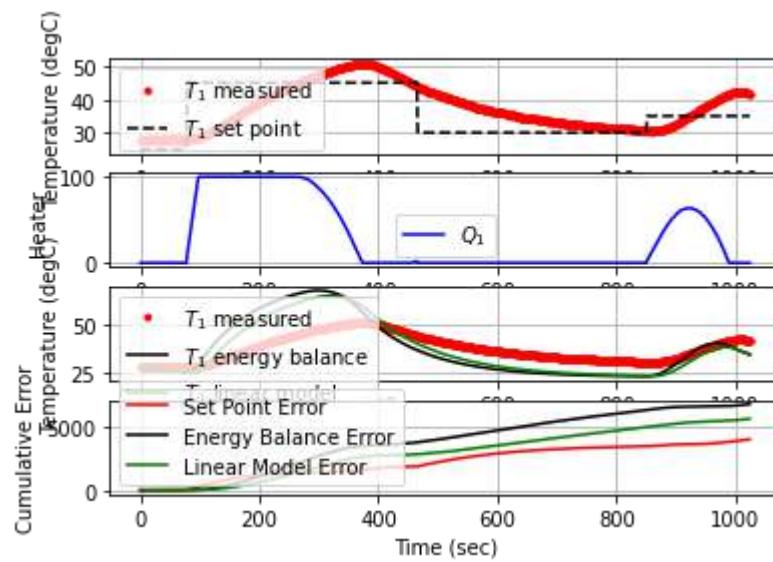


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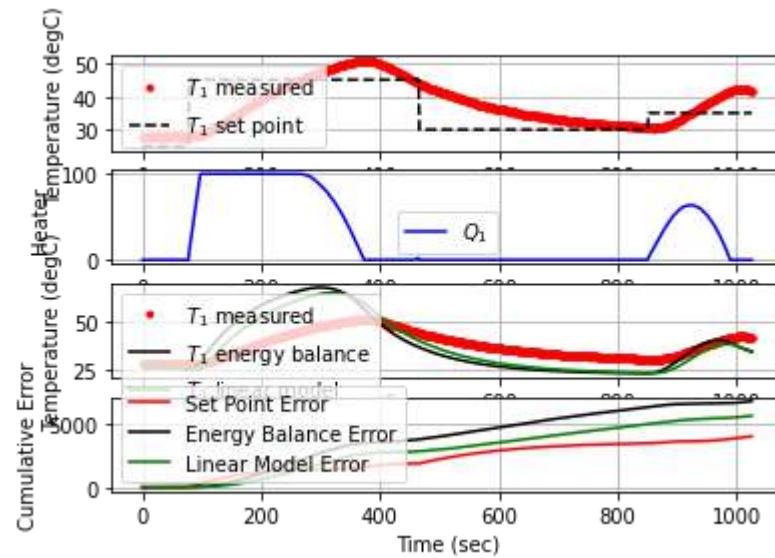




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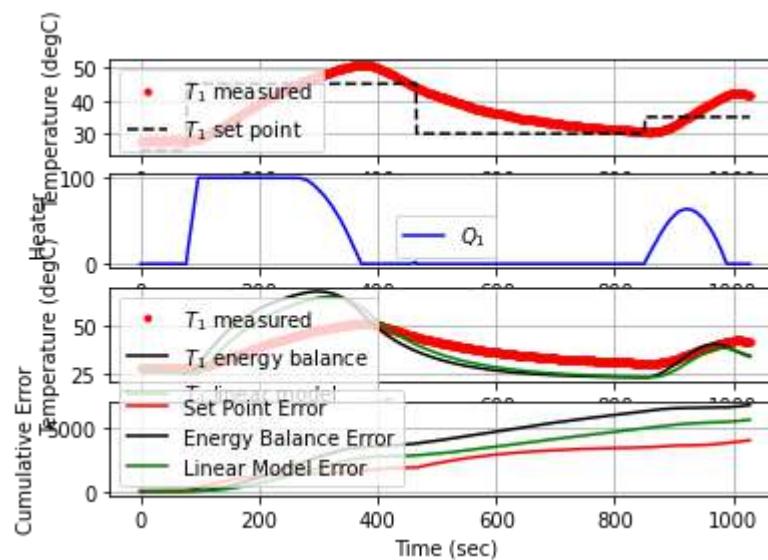


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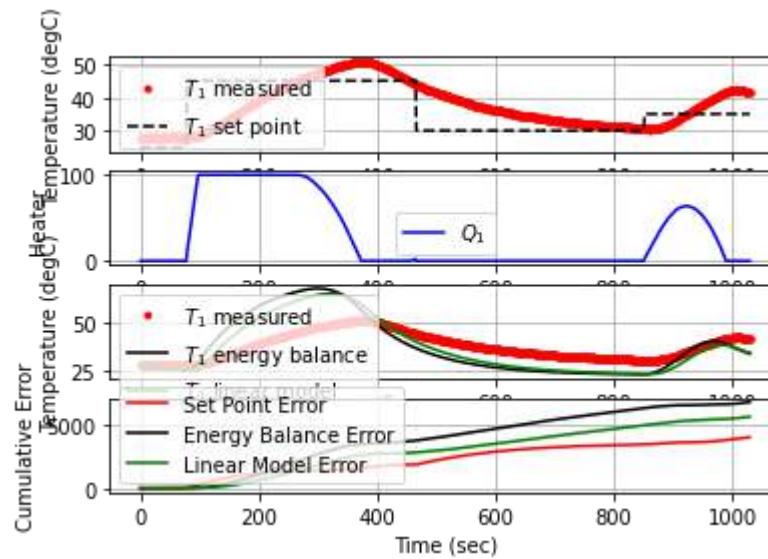


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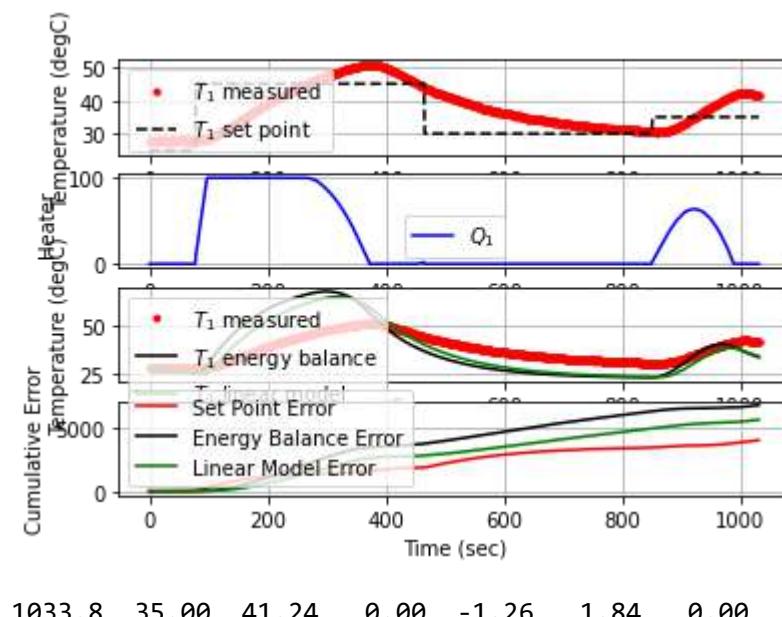
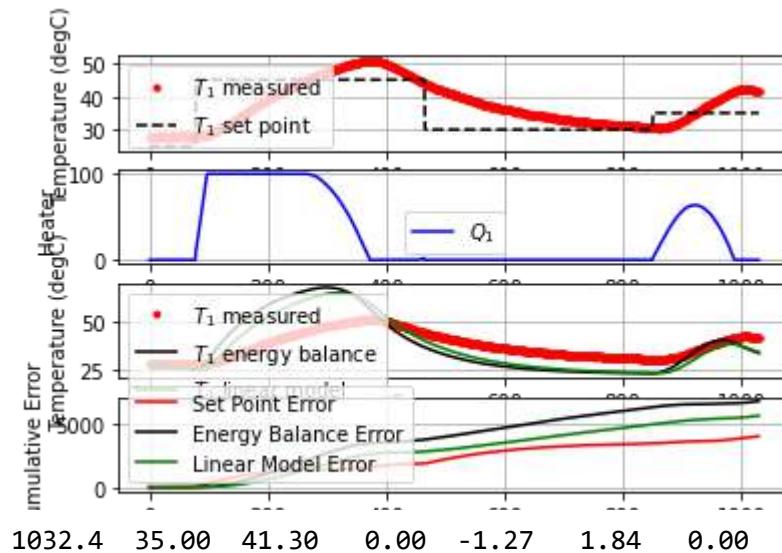
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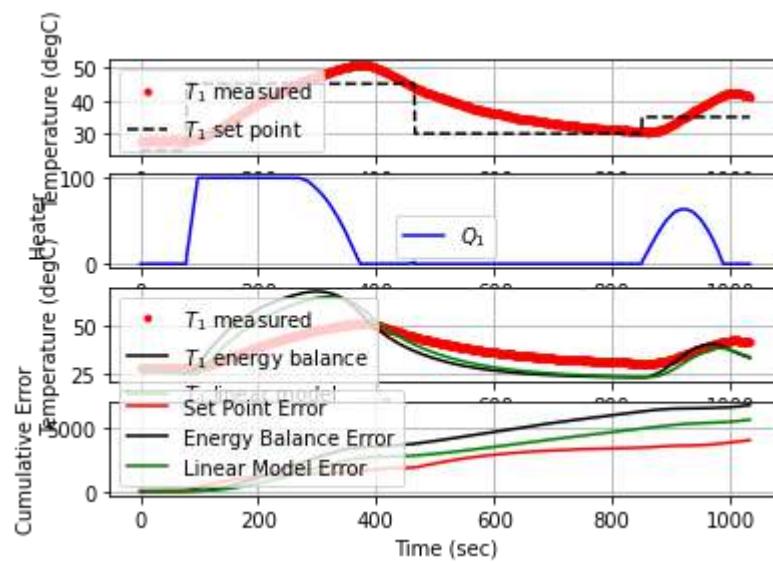
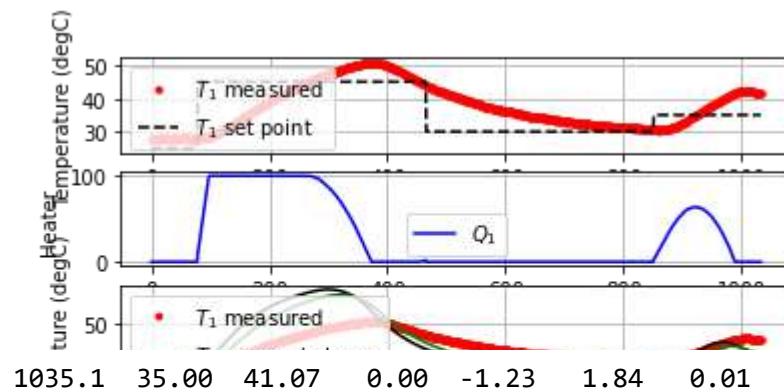


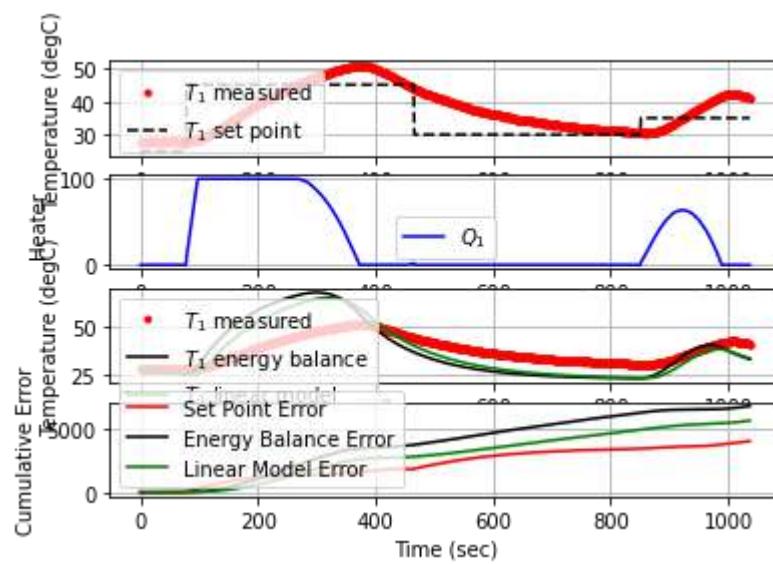
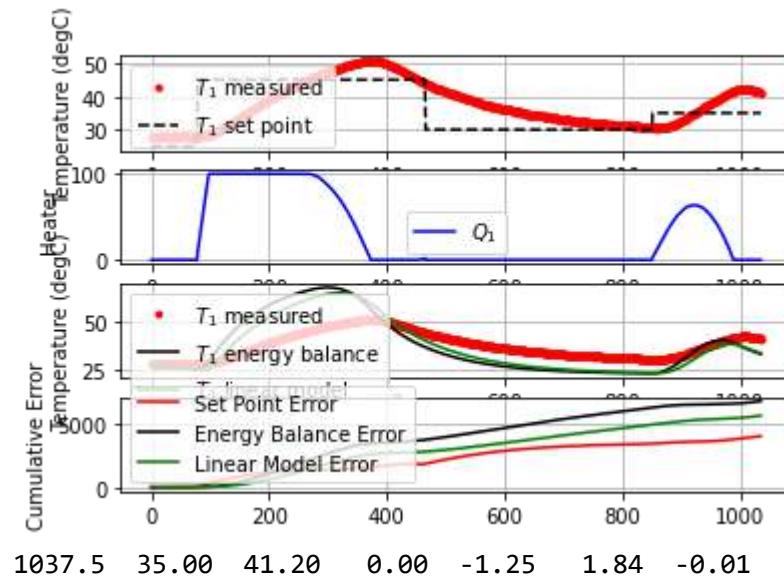
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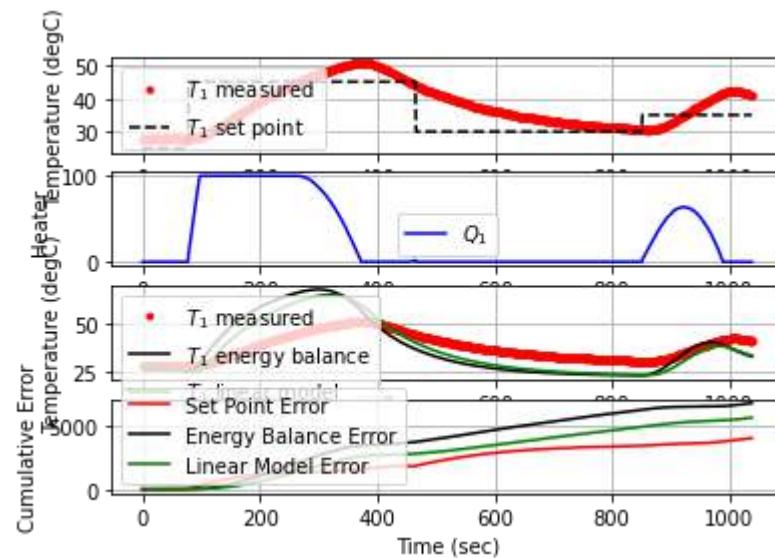
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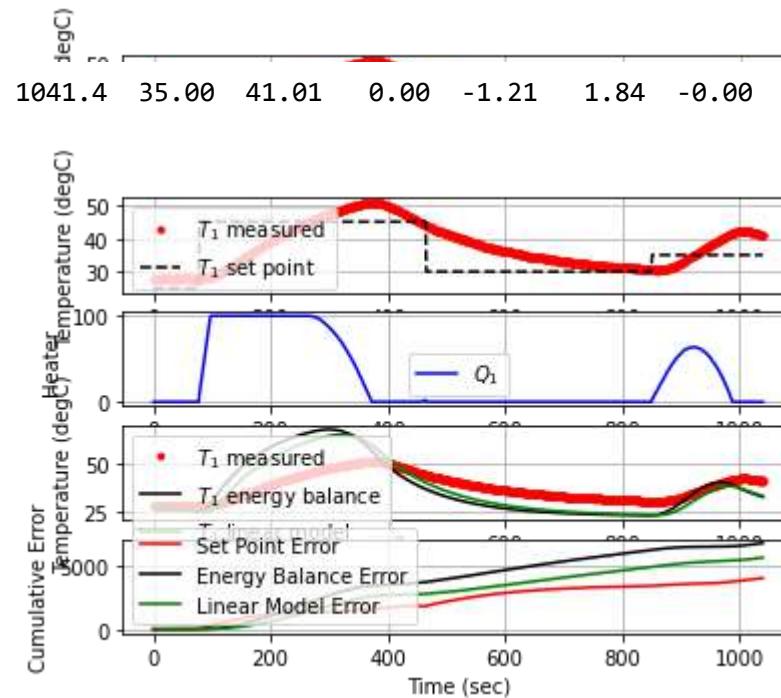




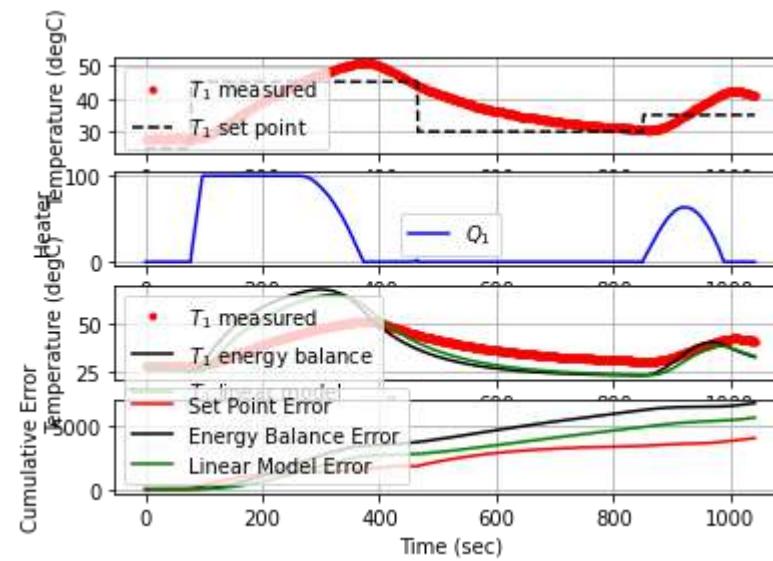
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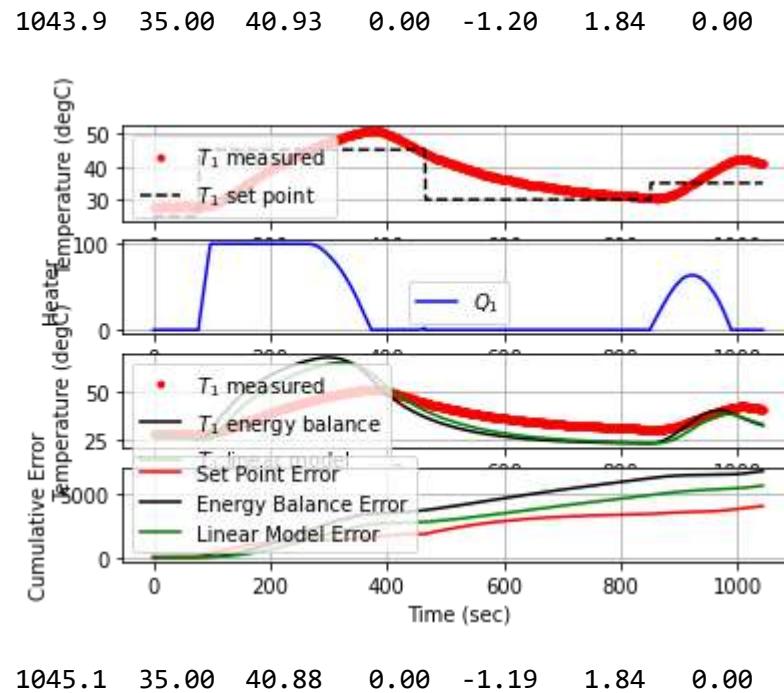


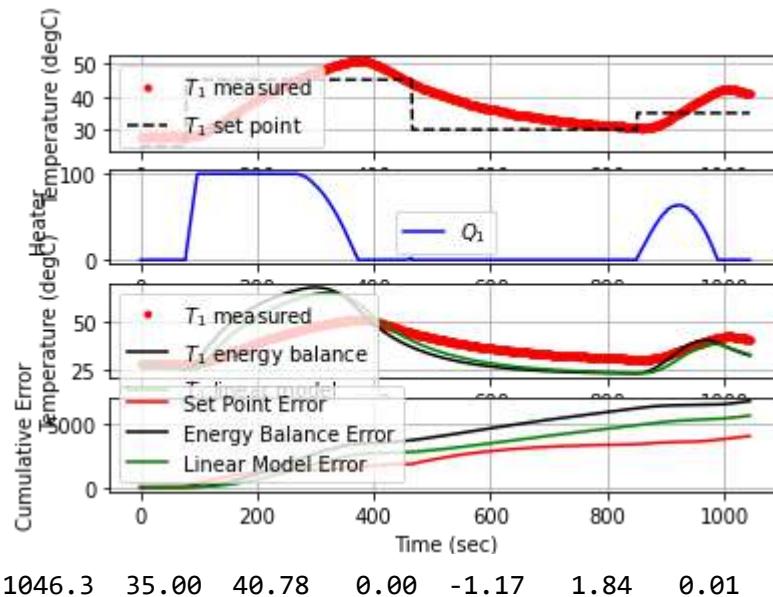
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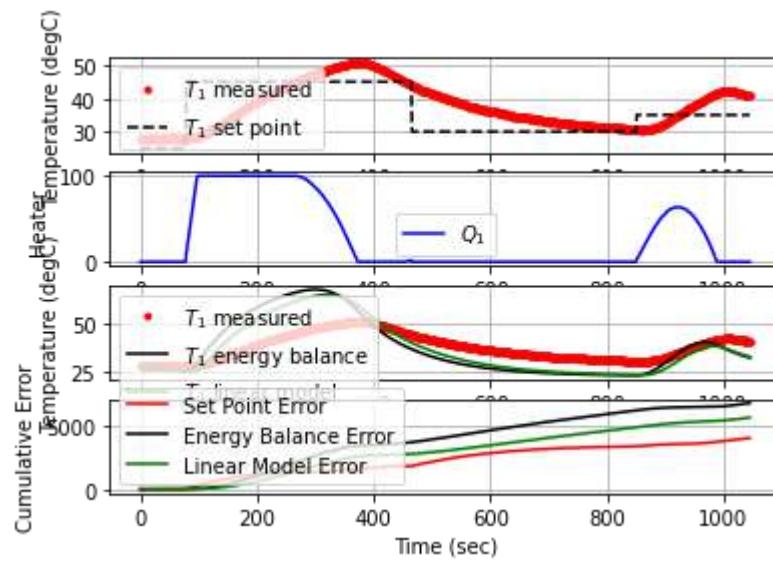
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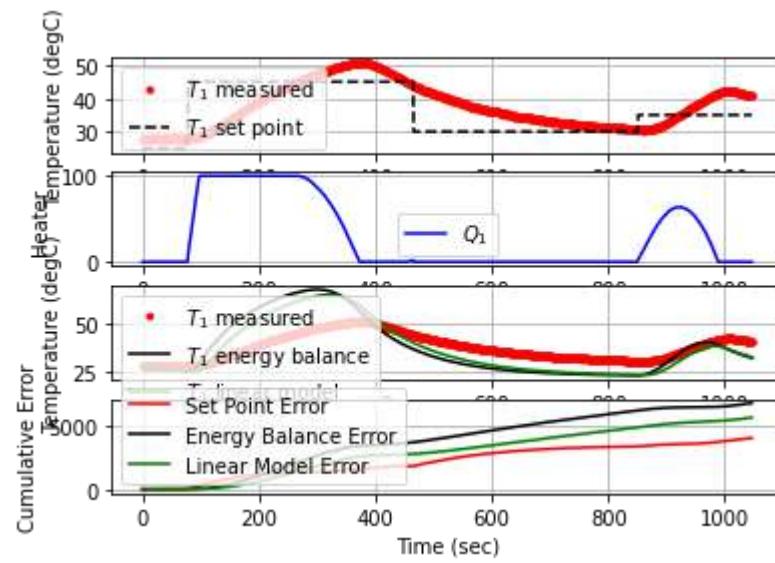




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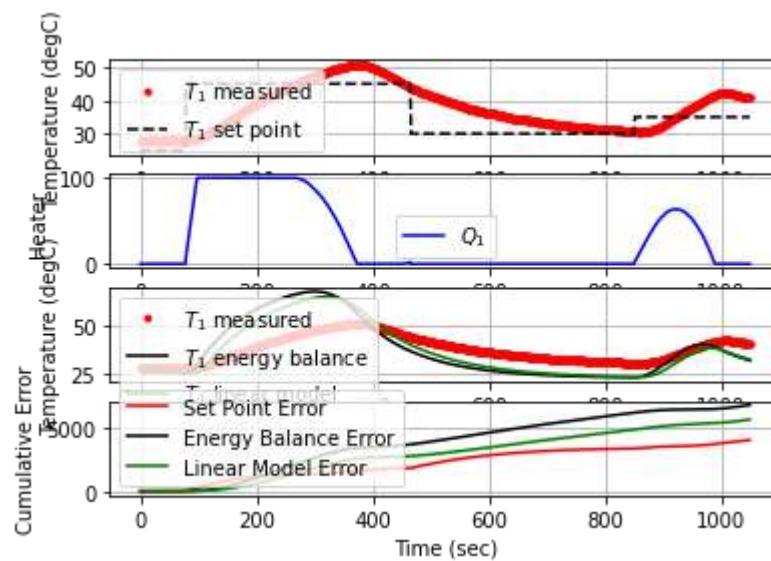


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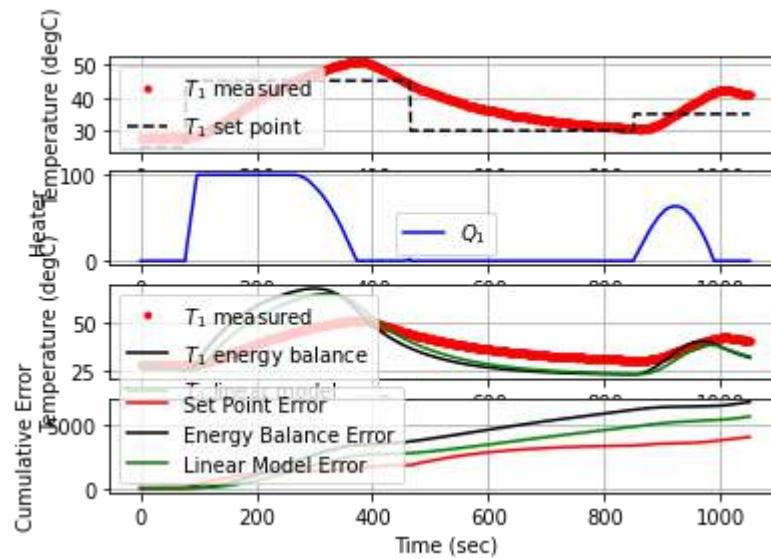


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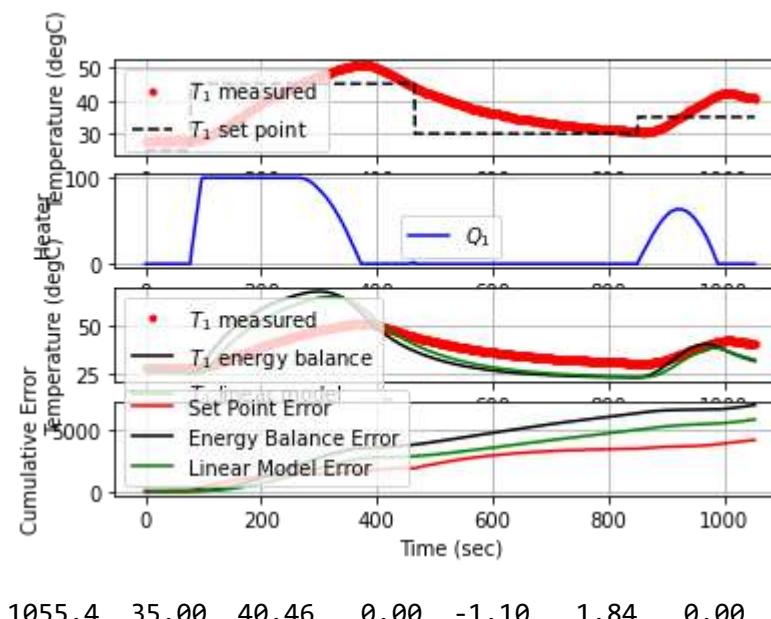
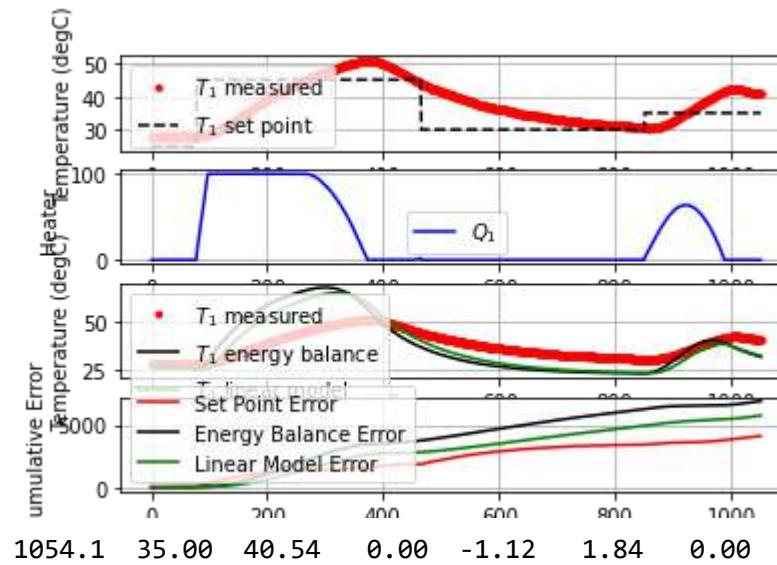
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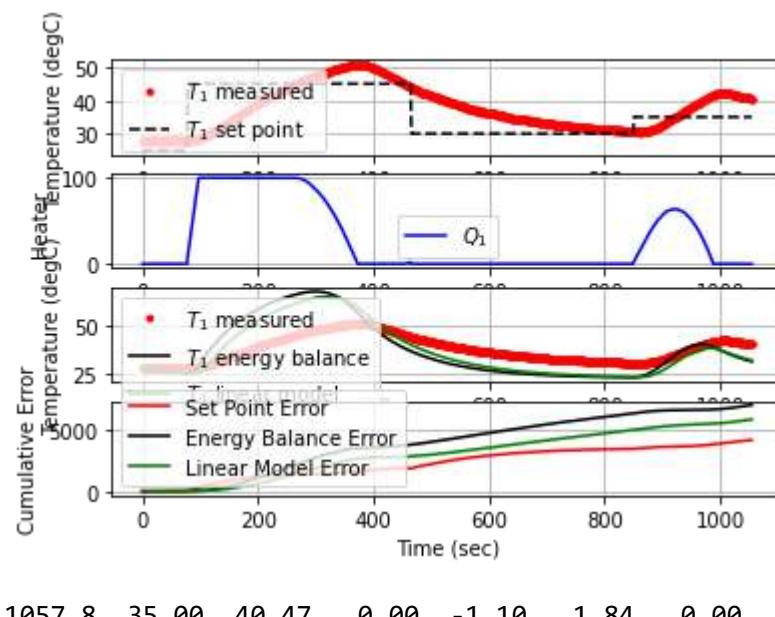
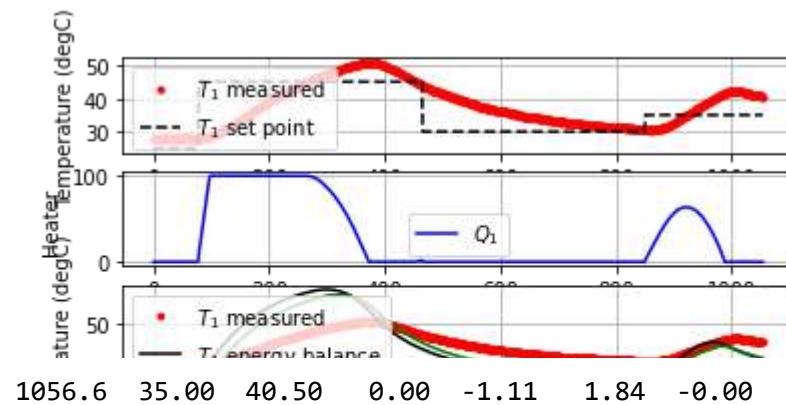


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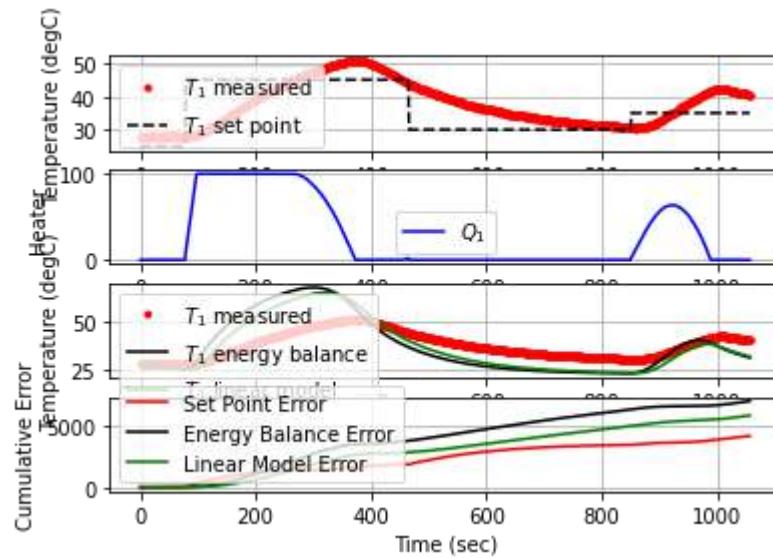


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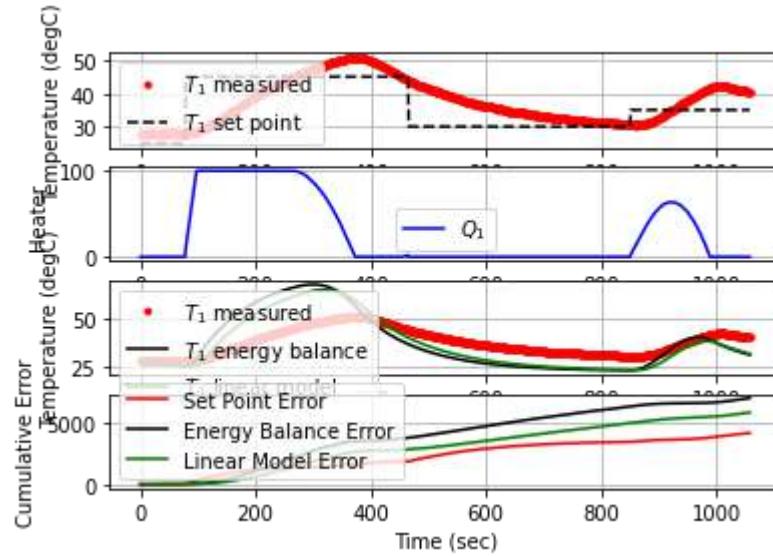




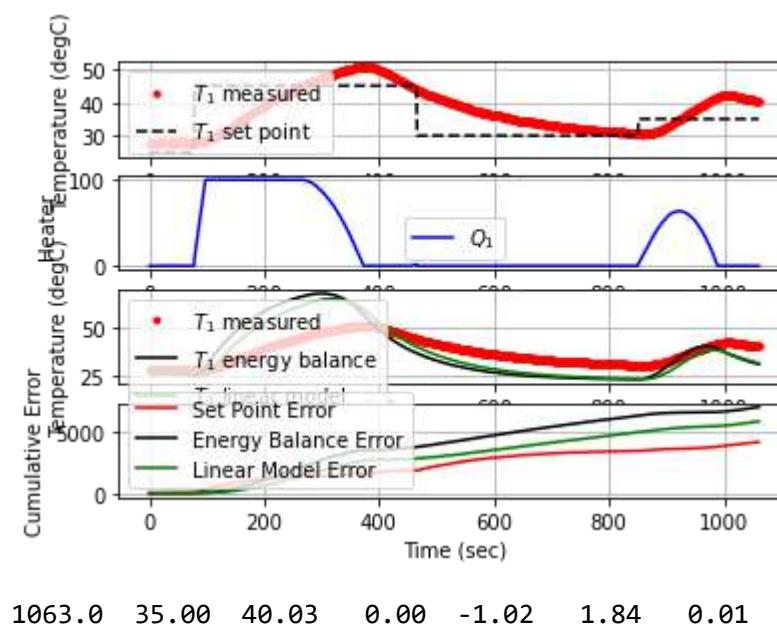
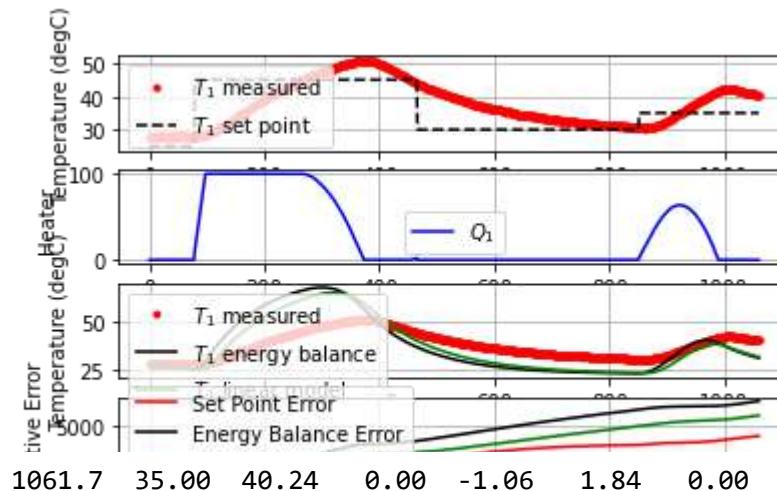
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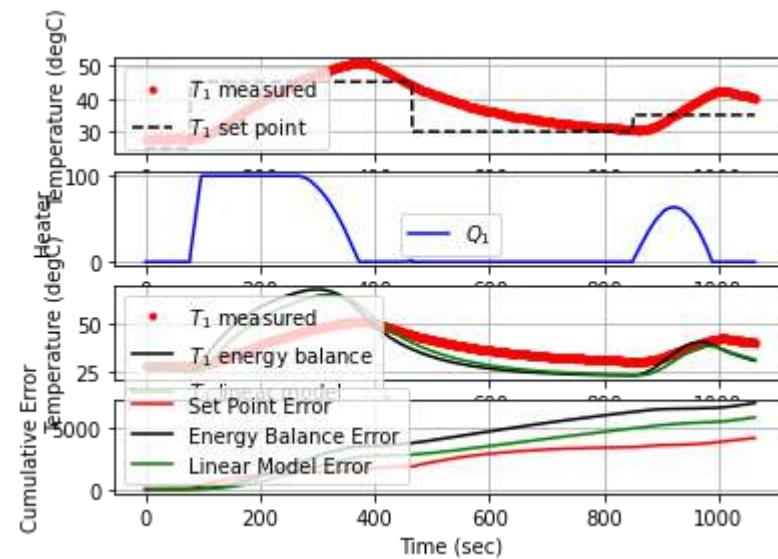
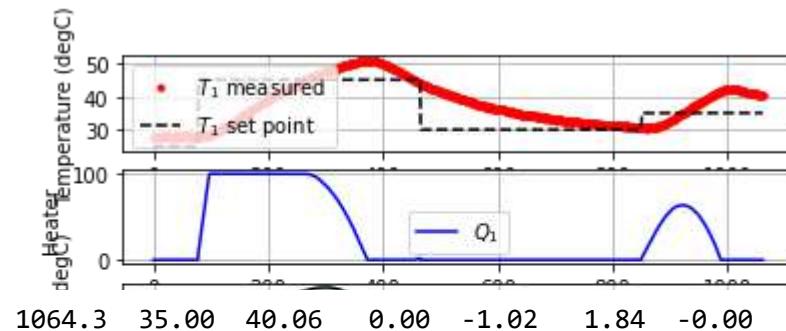


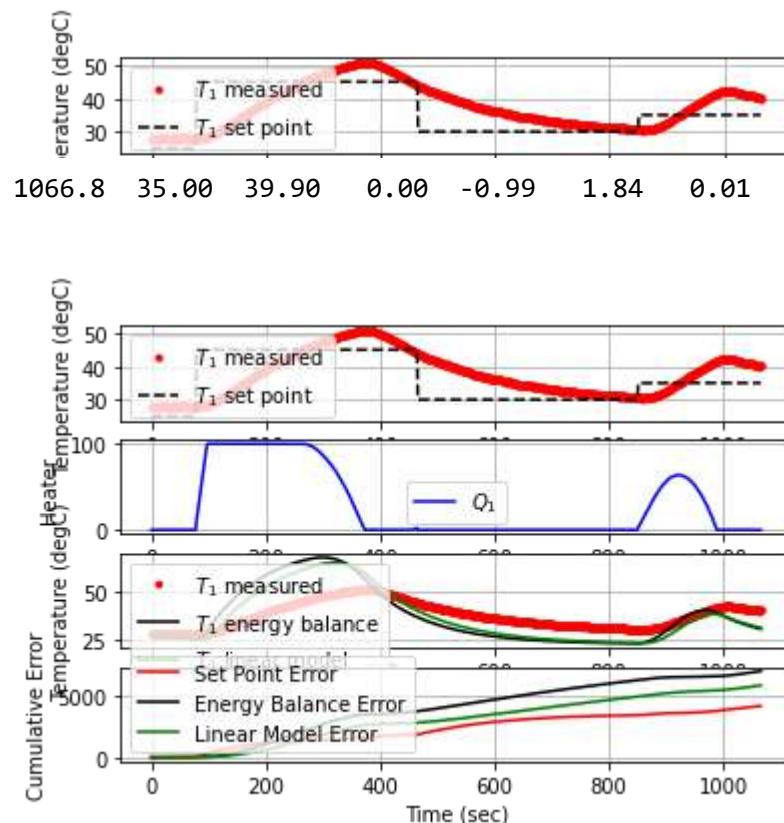
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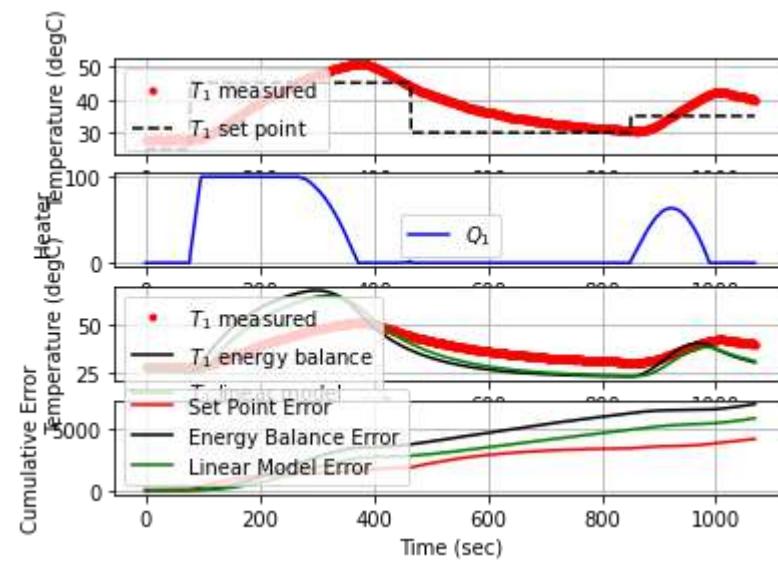
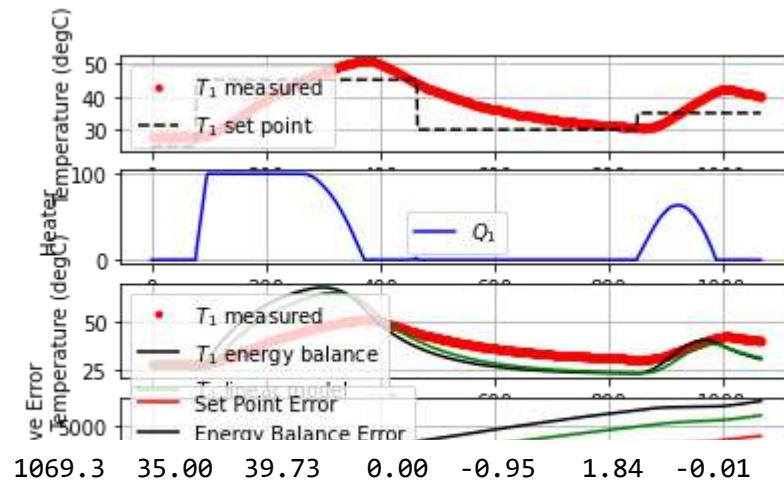
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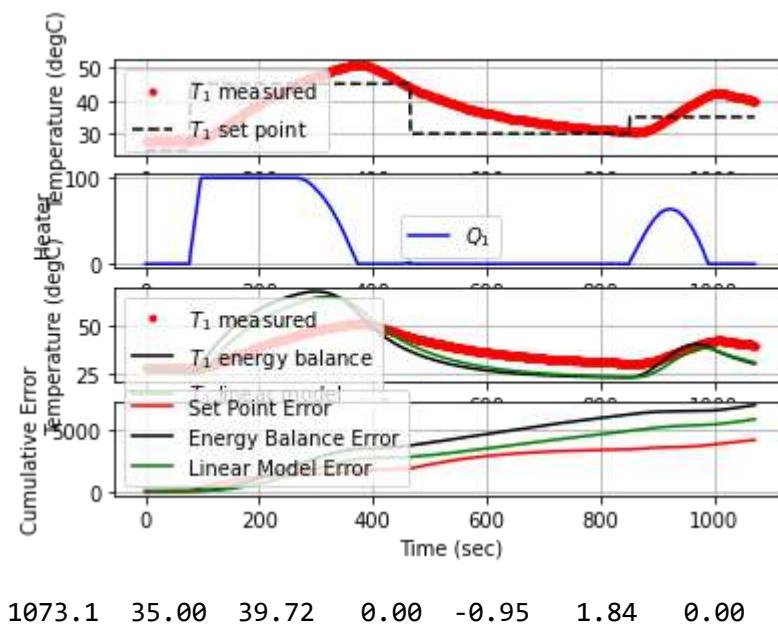
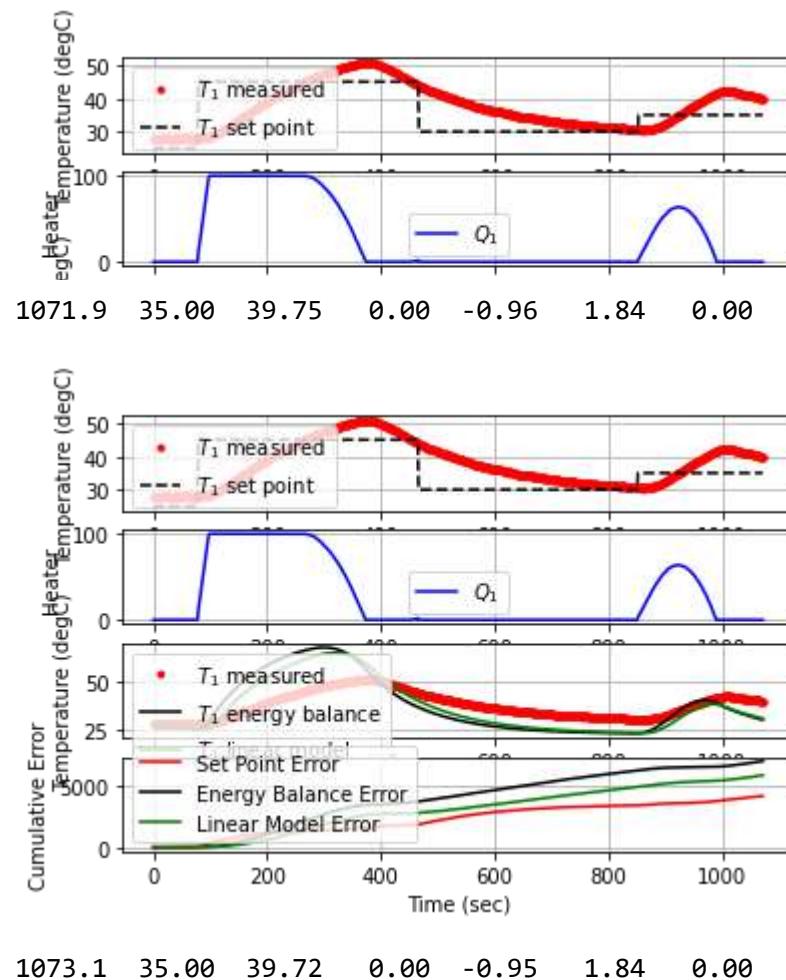


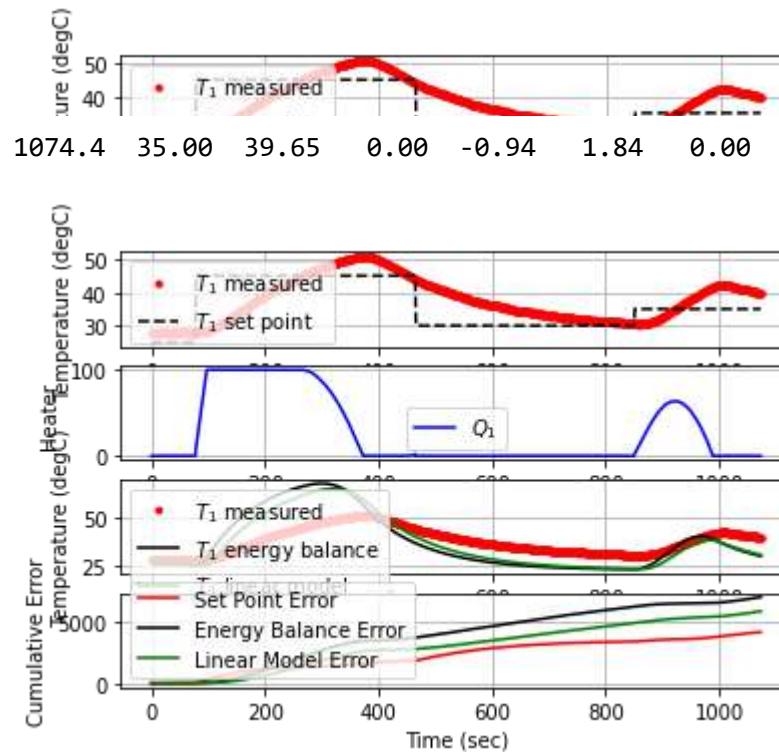




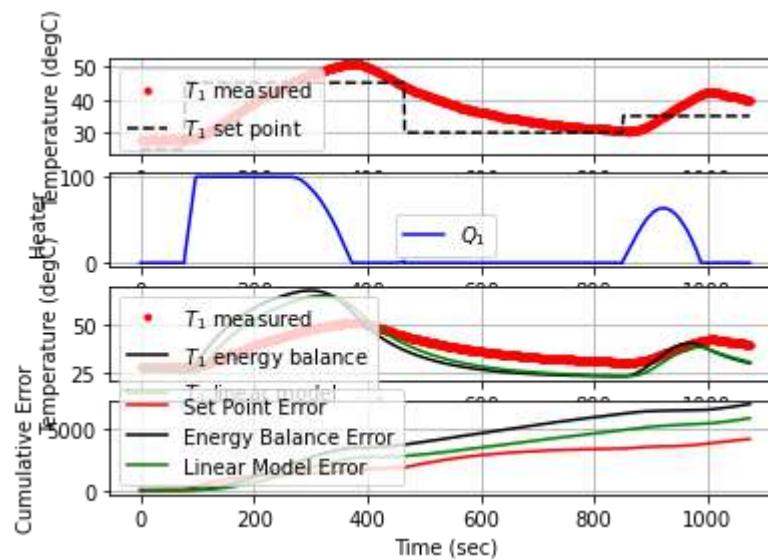
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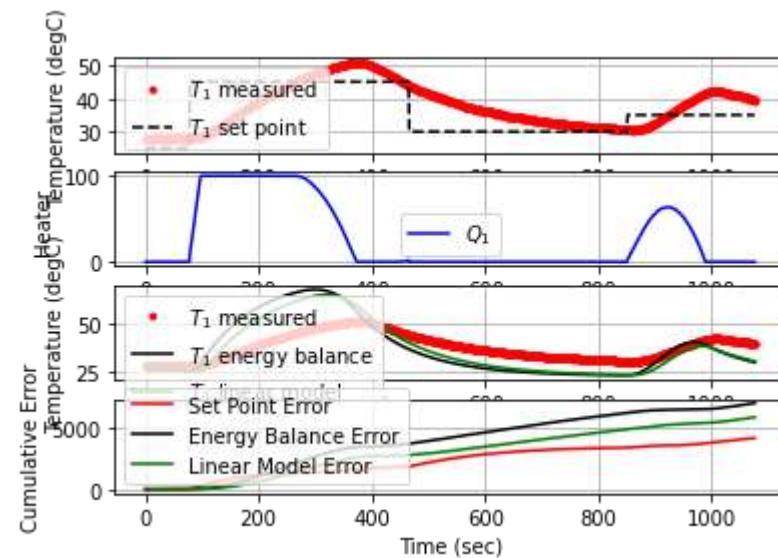




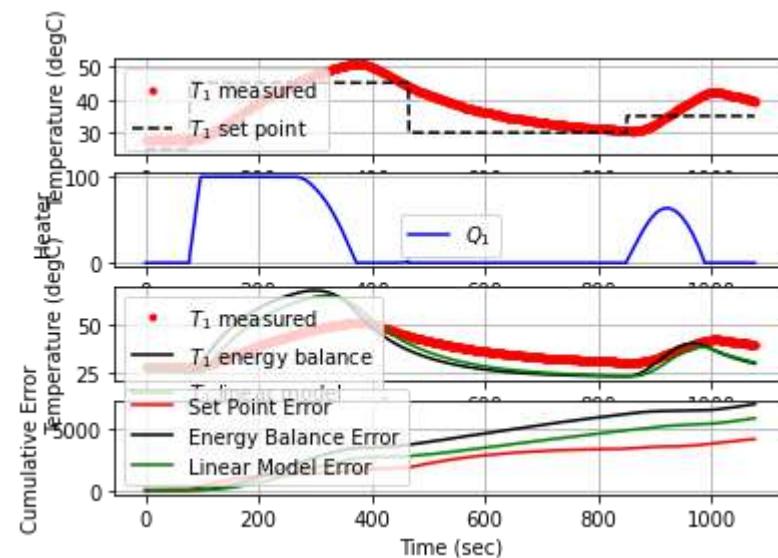
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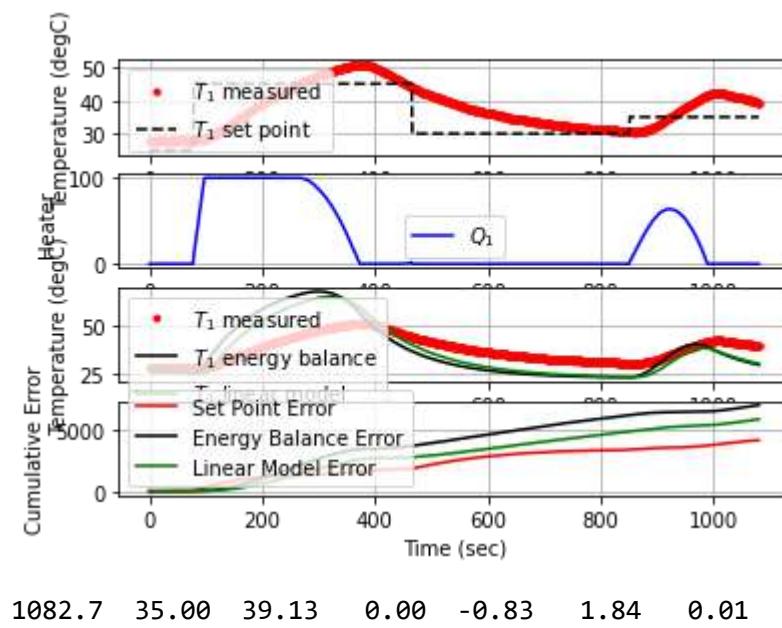
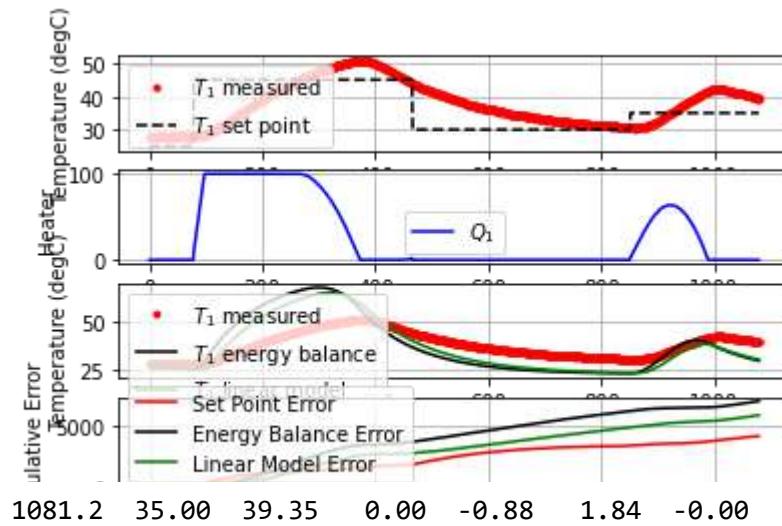
1077.0 35.00 39.49 0.00 -0.91 1.84 -0.01

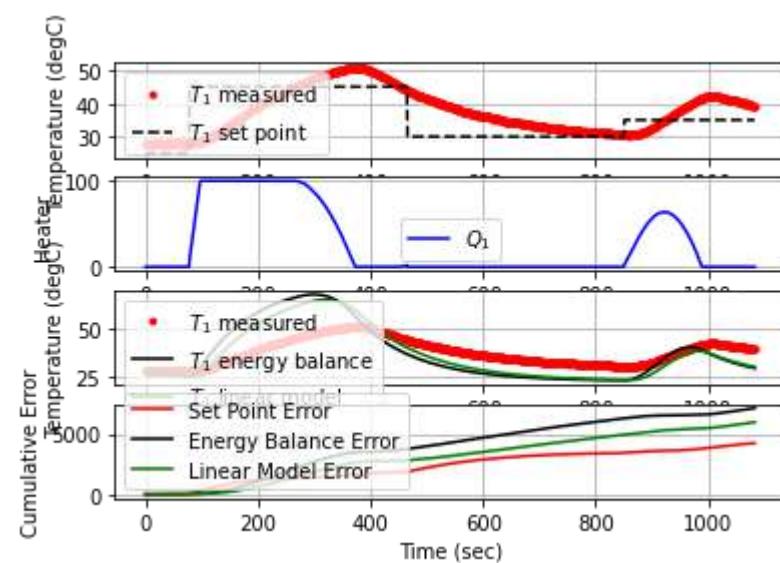
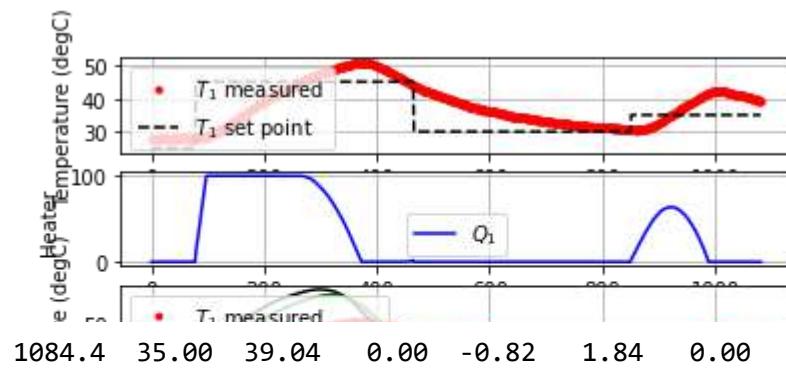


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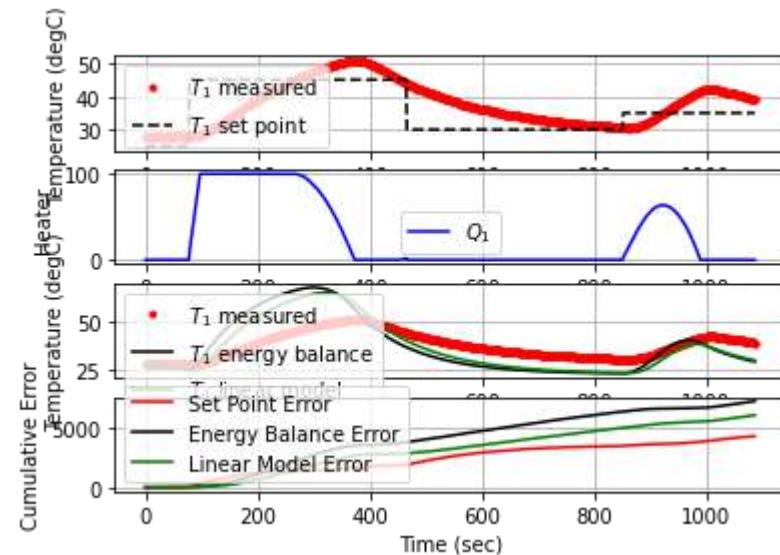
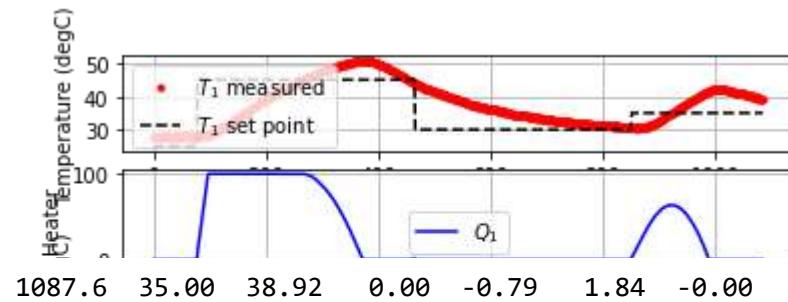


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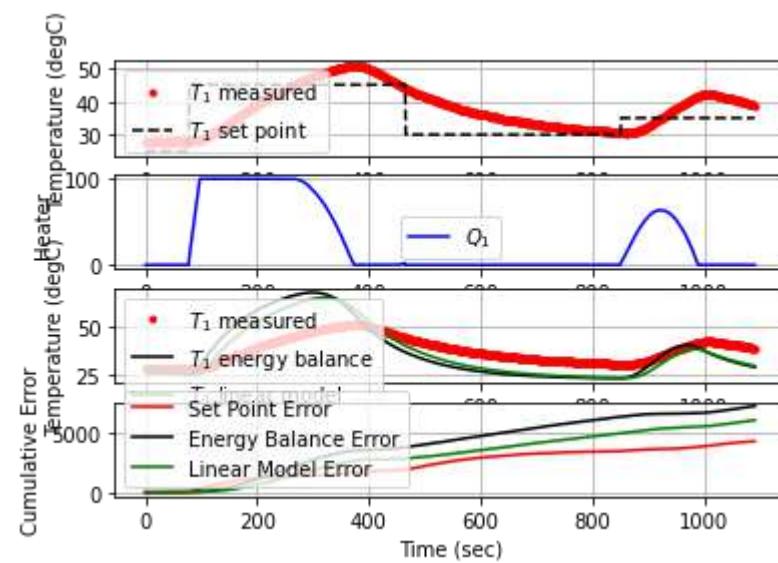
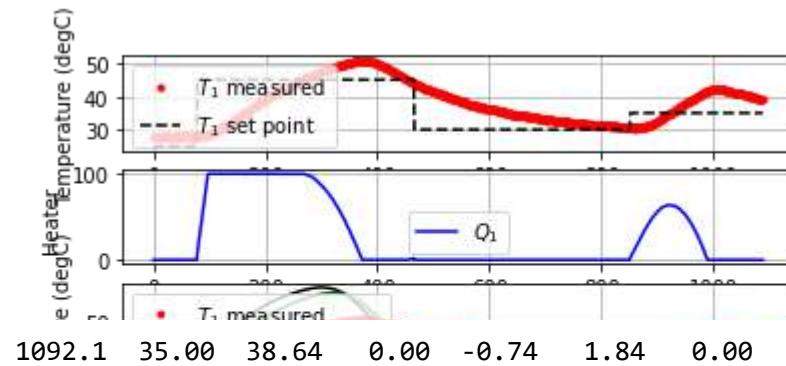


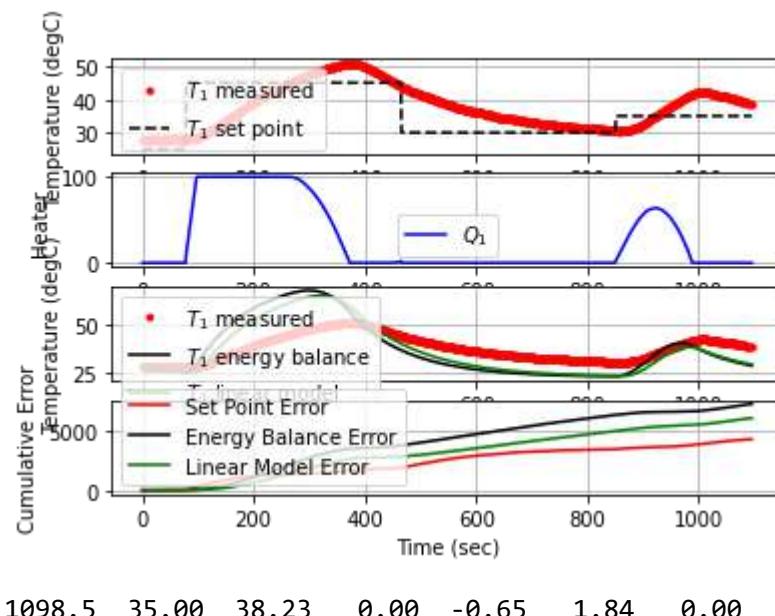
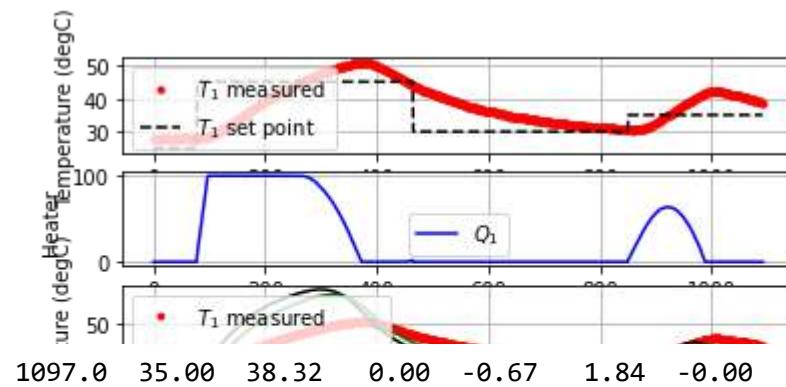


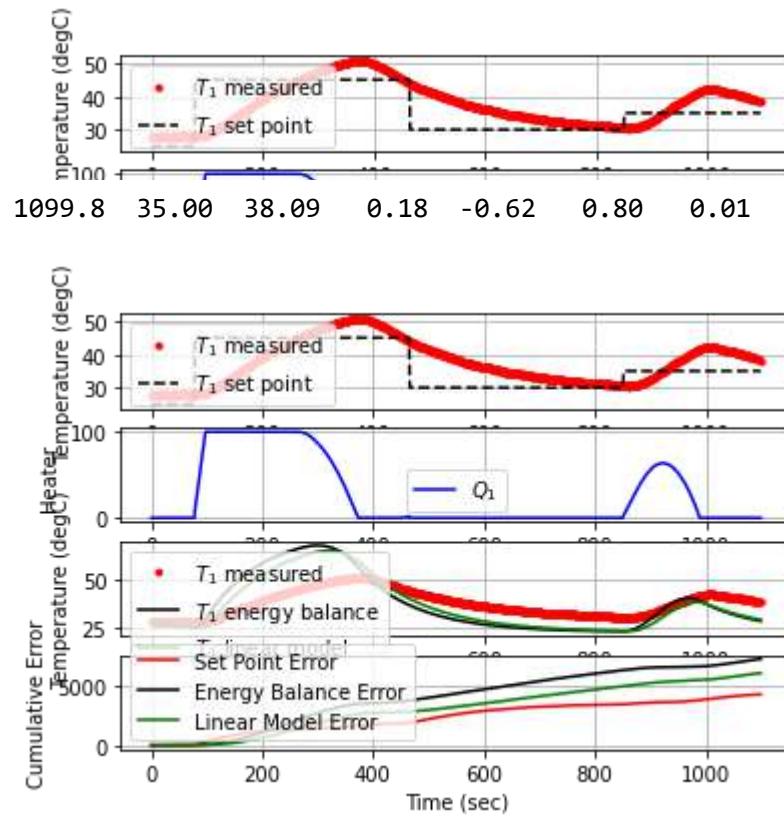
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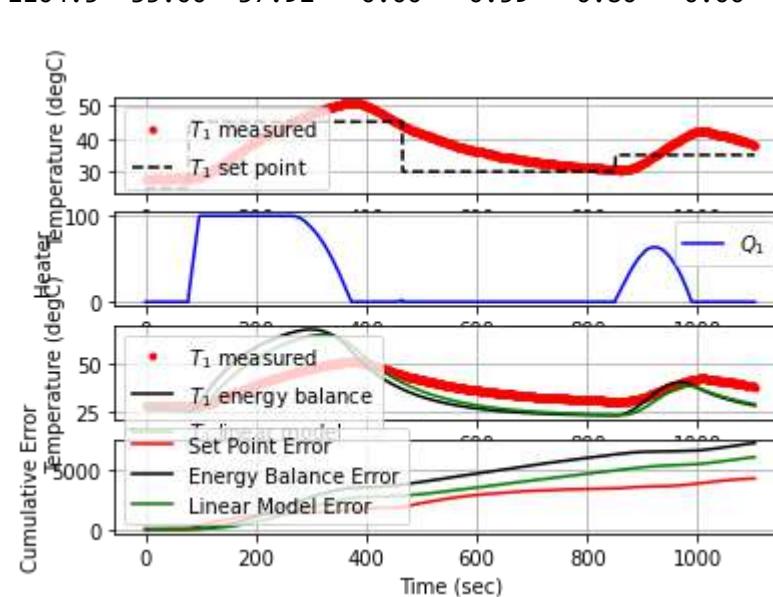
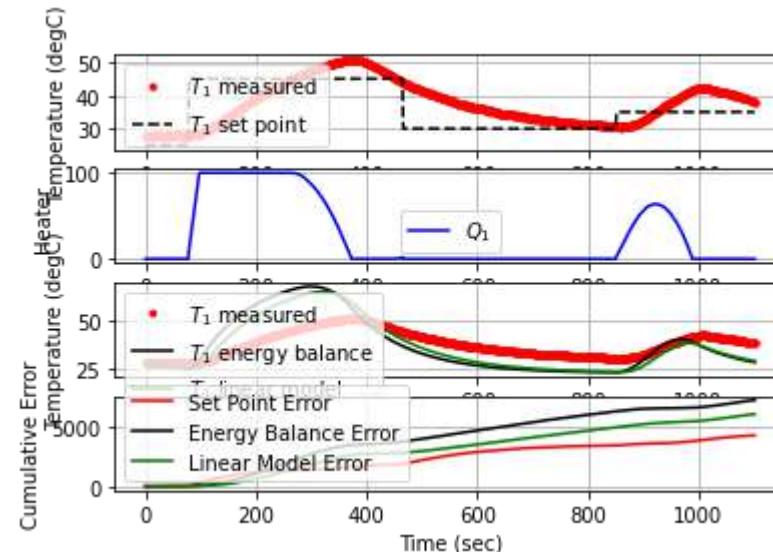
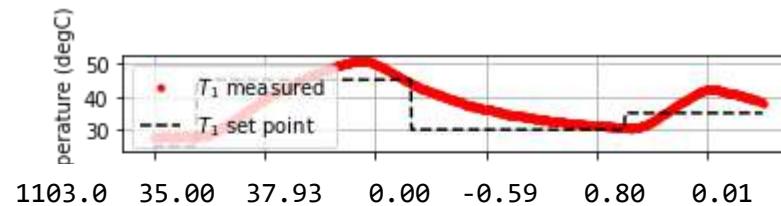
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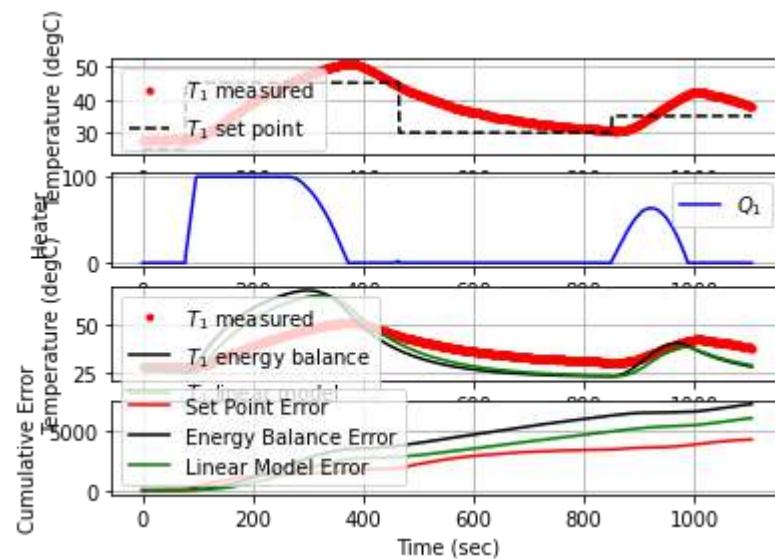




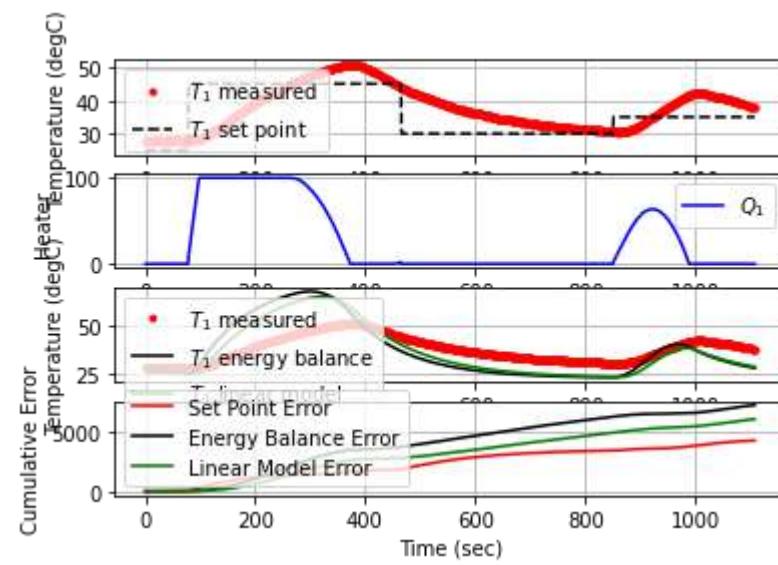
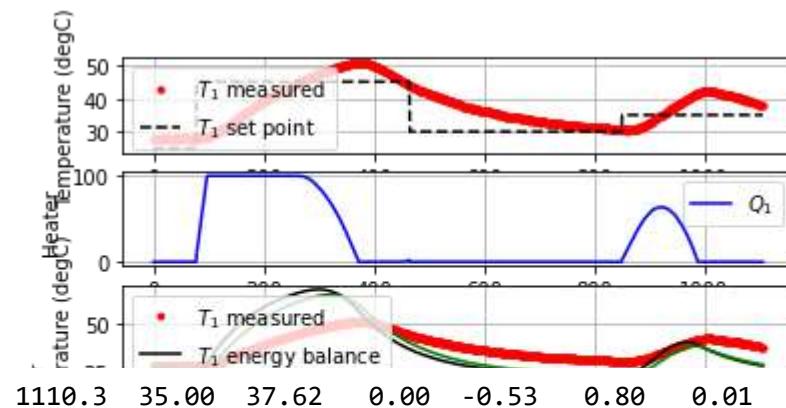
1101.2 35.00 38.09 0.00 -0.62 0.80 -0.00

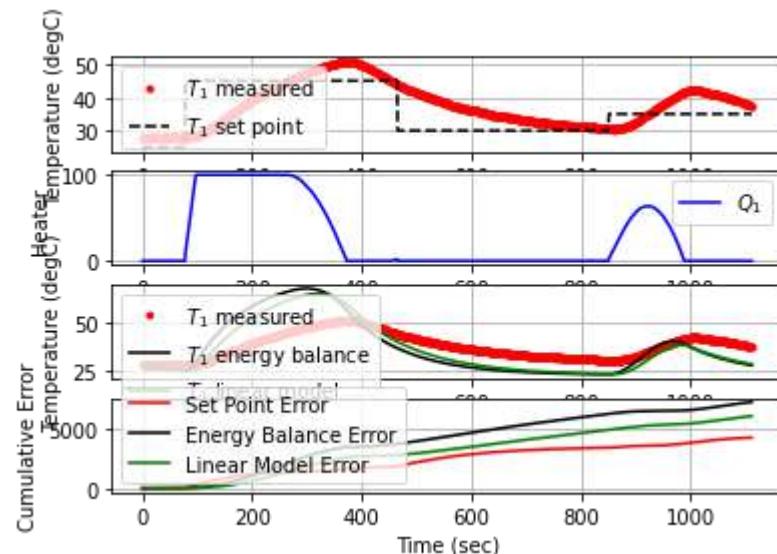
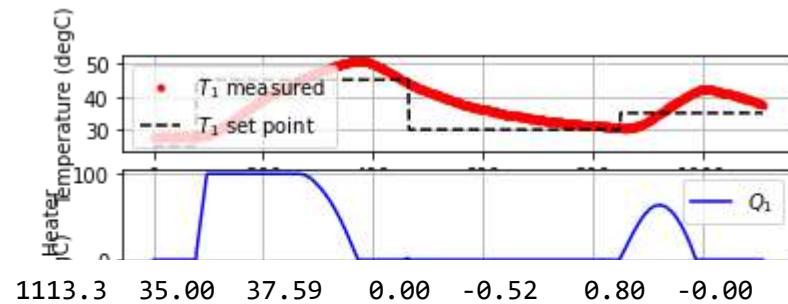


1106.5 35.00 37.84 0.00 -0.57 0.80 0.00

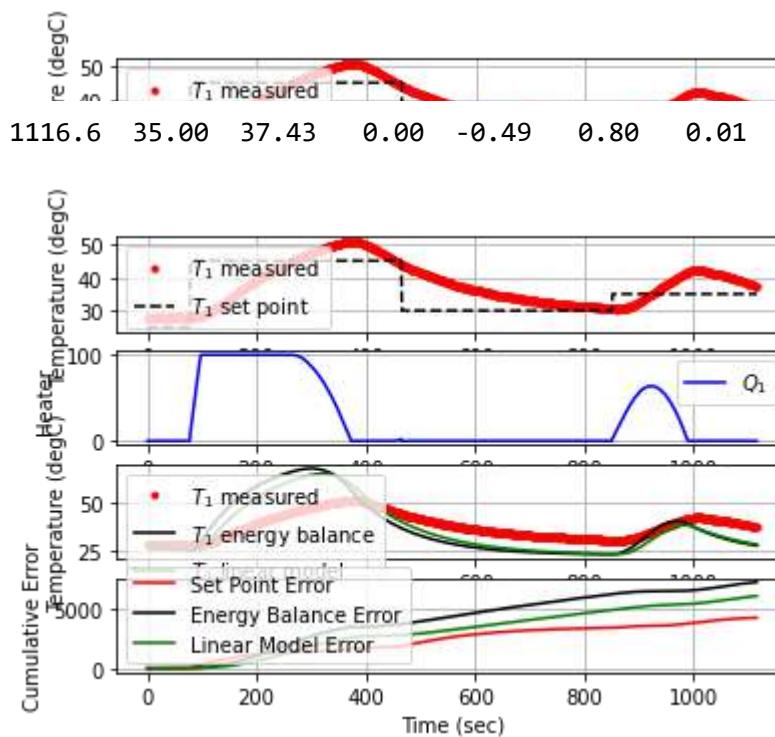


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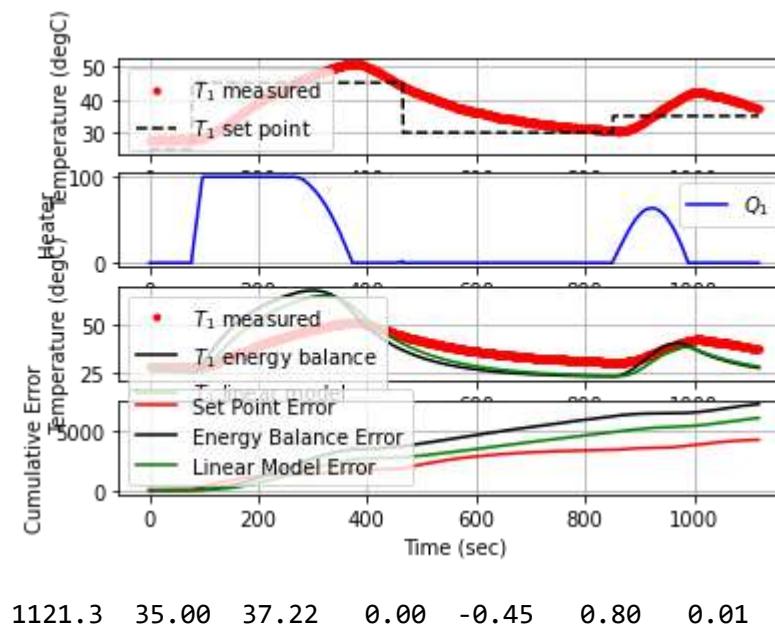
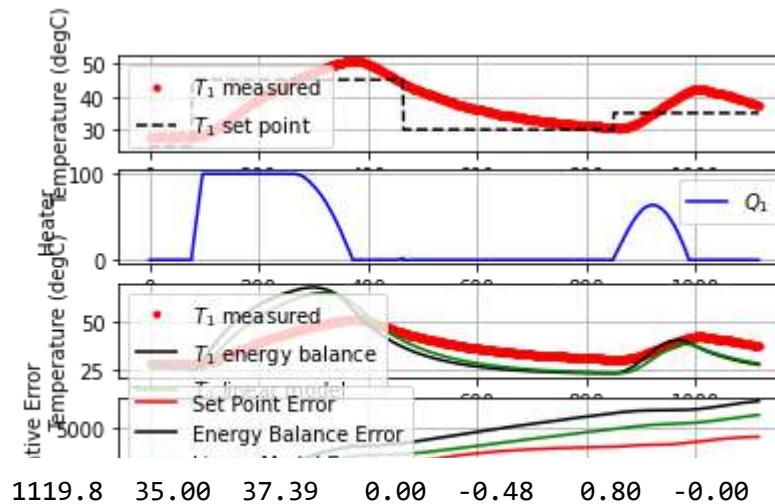


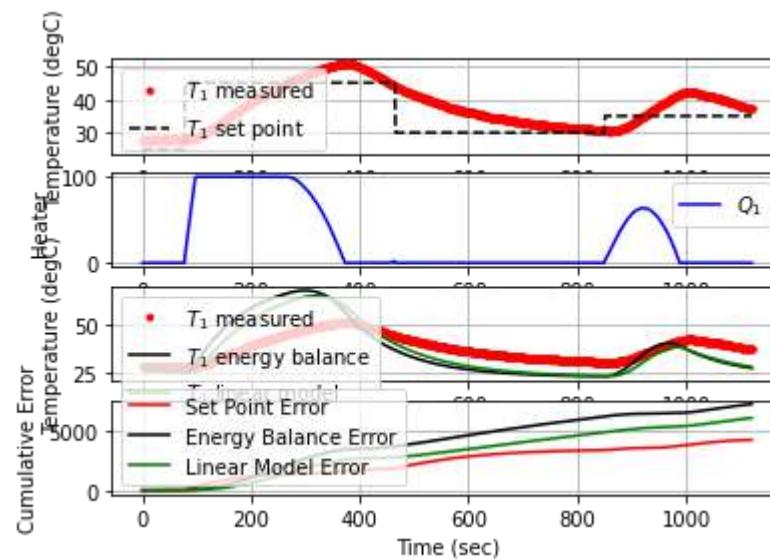
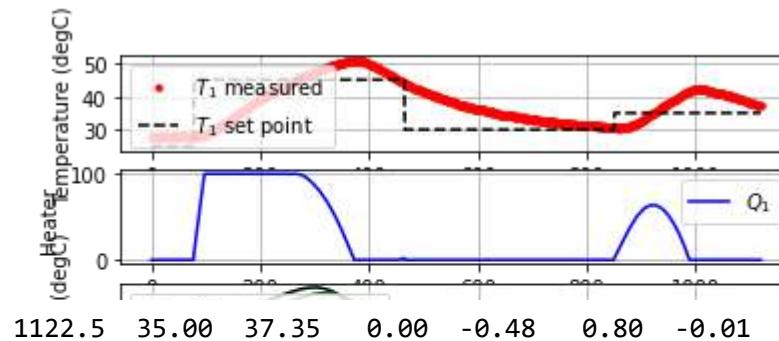


1115.2 35.00 37.59 0.00 -0.52 0.80 -0.00

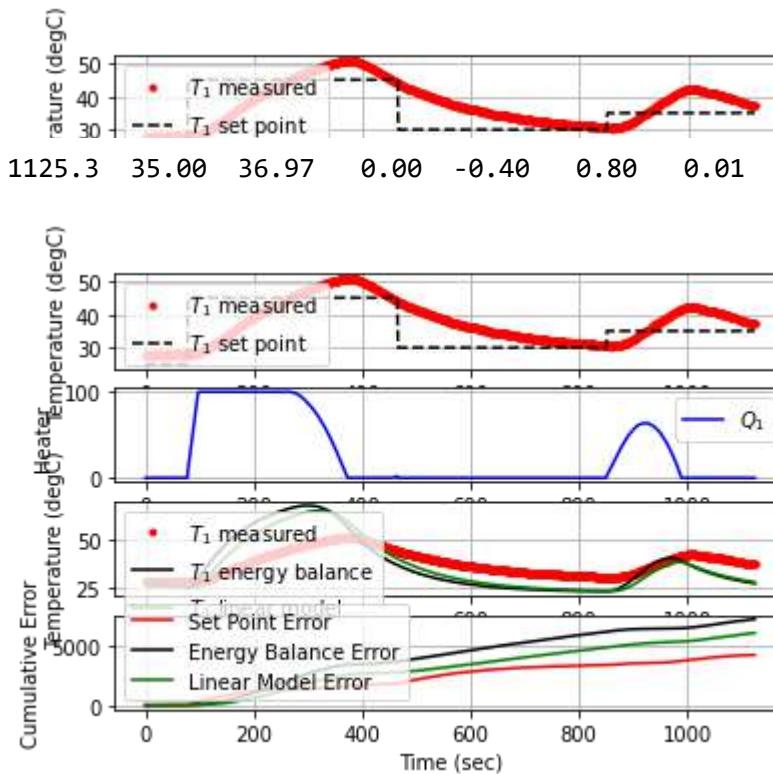


1118.4 35.00 37.38 0.00 -0.48 0.80 0.00

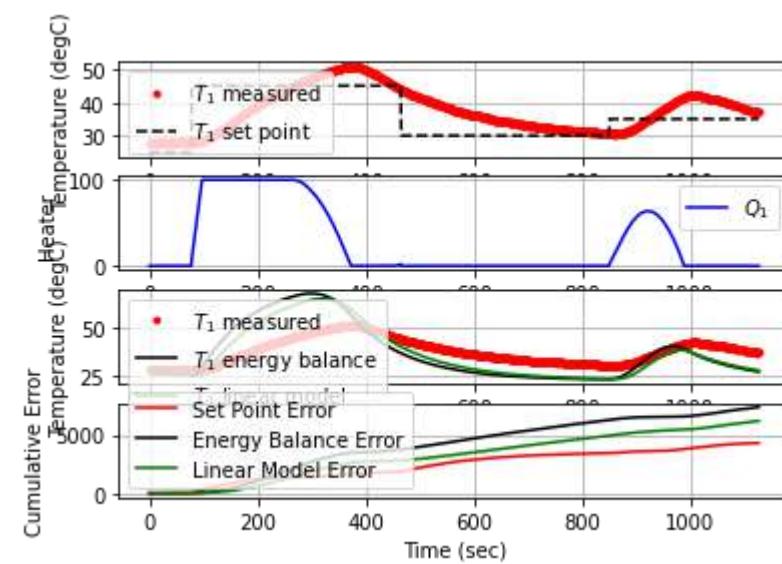
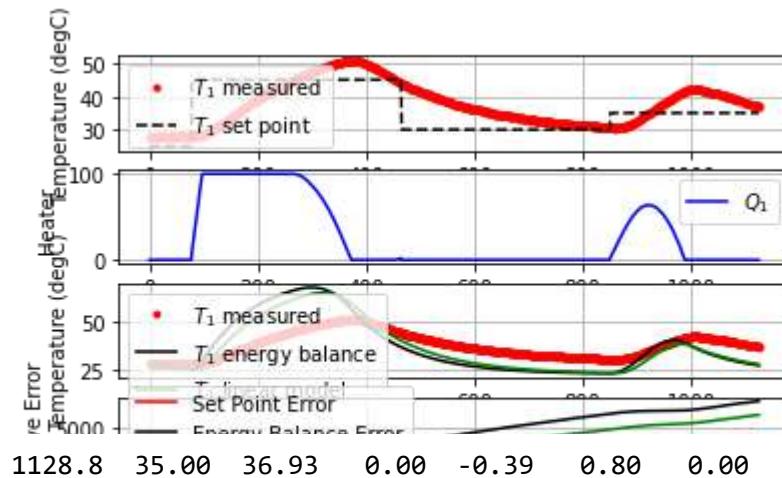




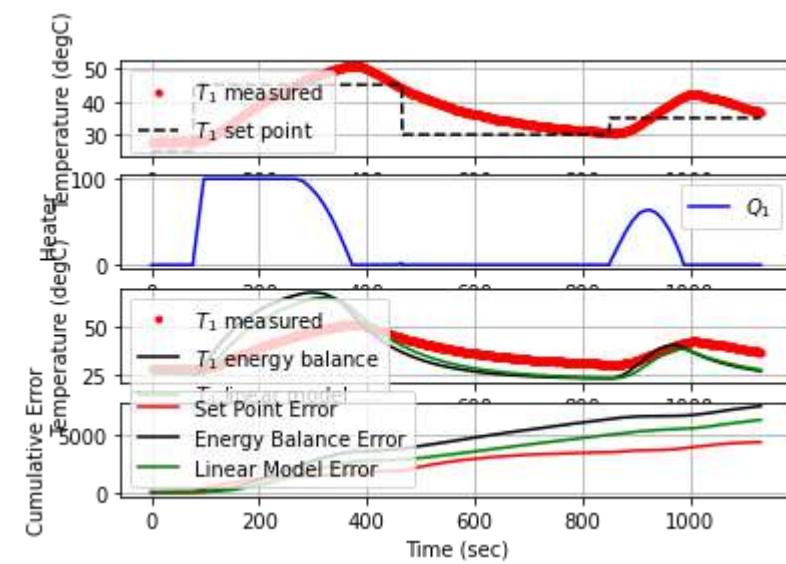
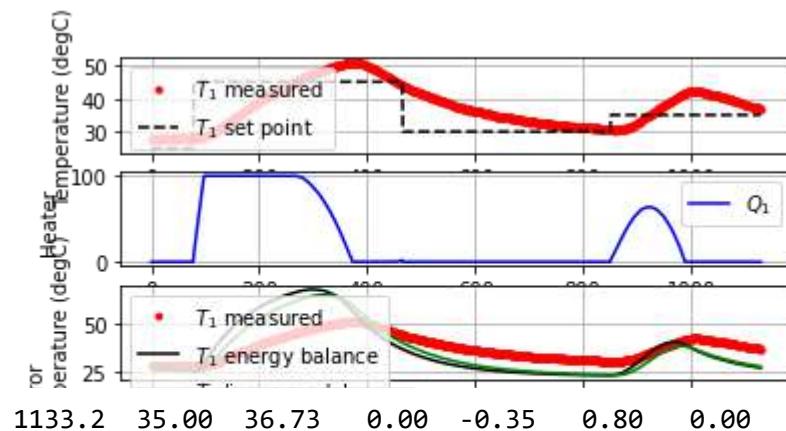
1123.9 35.00 37.24 0.00 -0.45 0.80 0.01



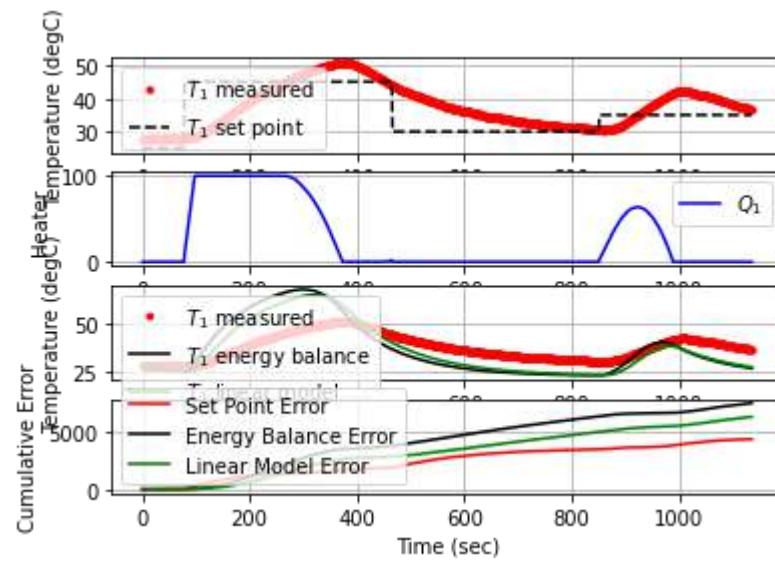
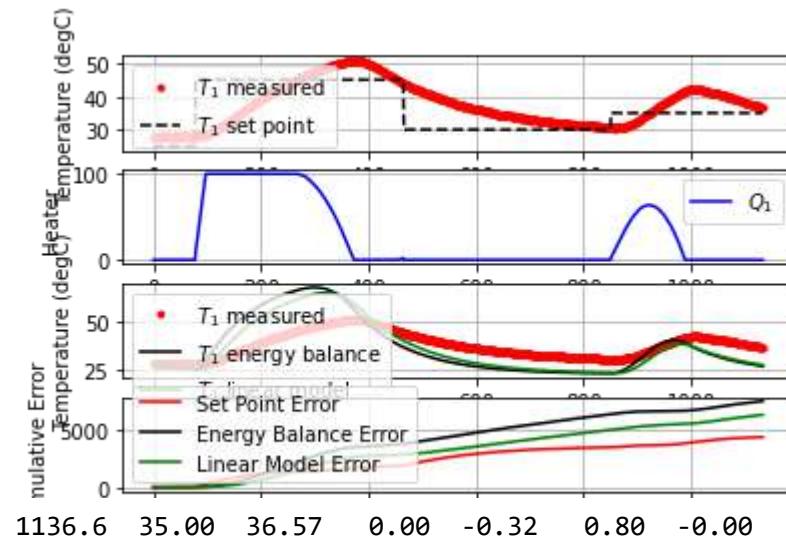
1126.8 35.00 37.06 0.00 -0.42 0.80 -0.00



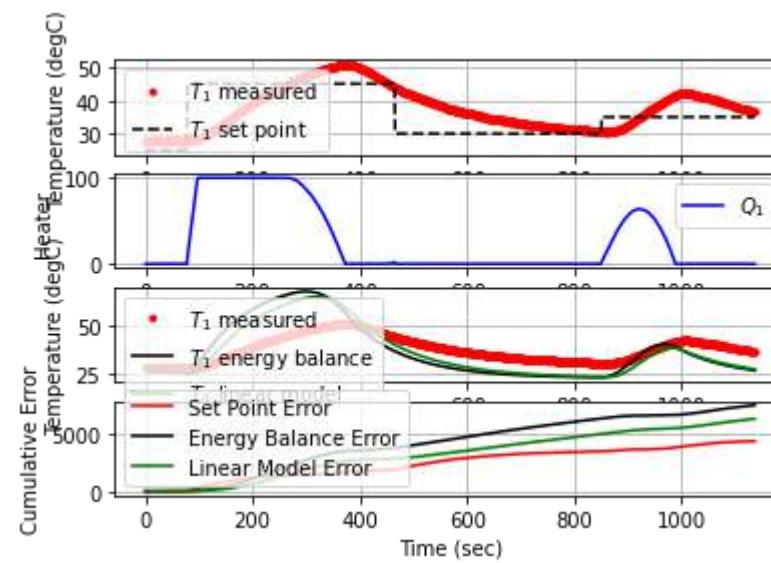
1131.1 35.00 36.85 0.00 -0.38 0.80 0.00



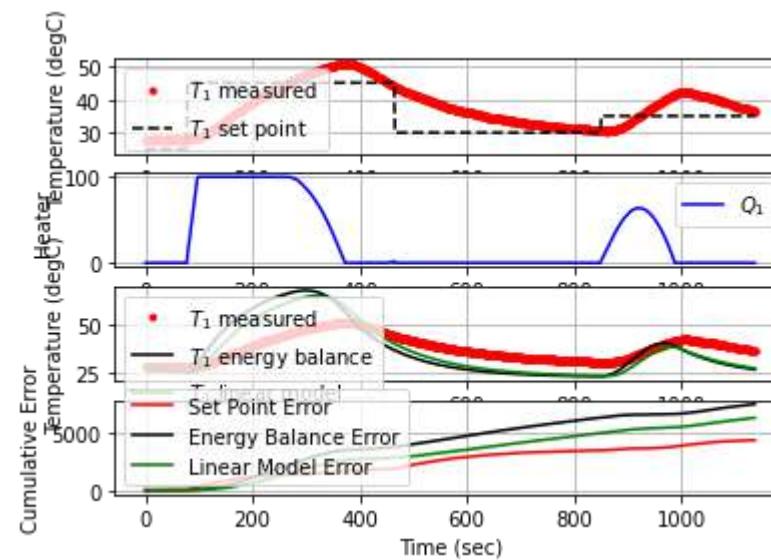
1135.0 35.00 36.56 0.00 -0.32 0.80 0.01

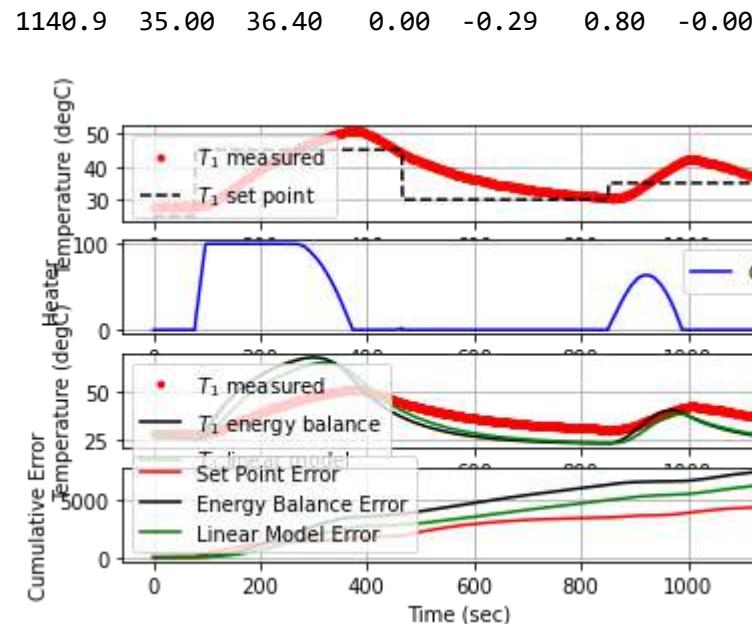


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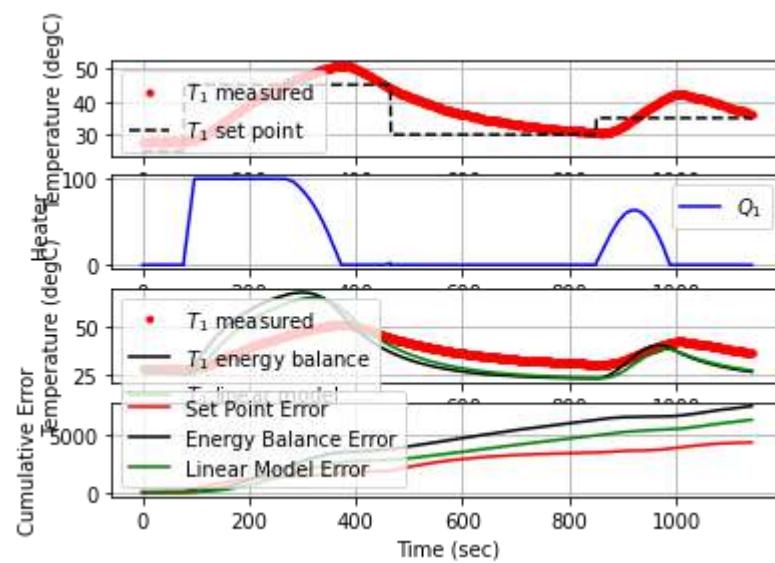
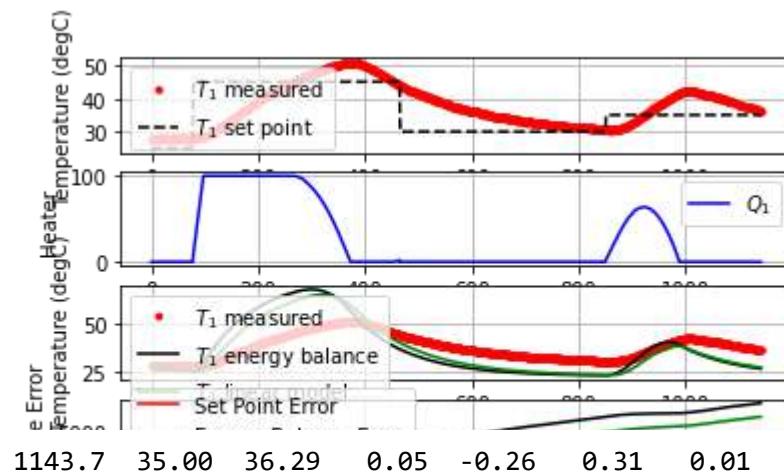


1139.4 35.00 36.39 0.00 -0.28 0.80 0.00

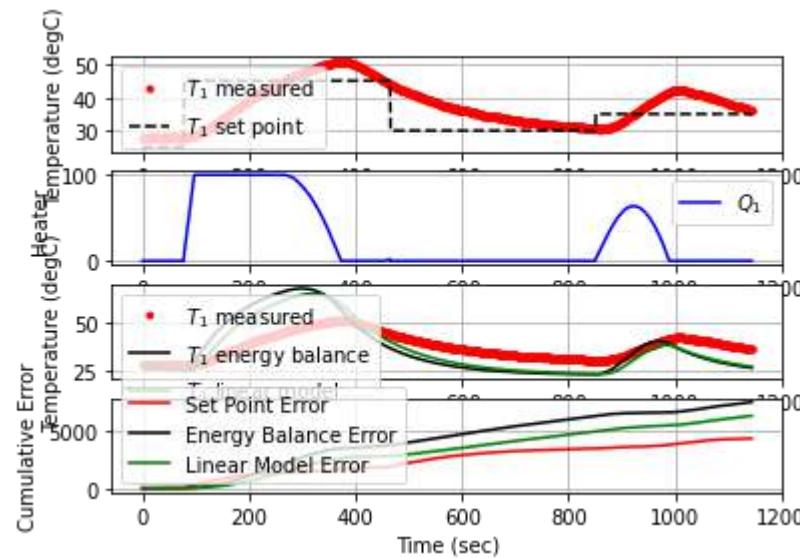




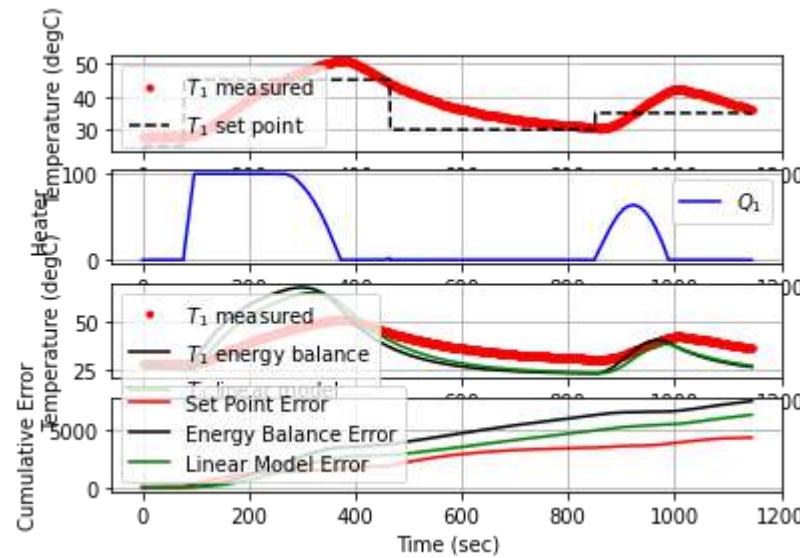
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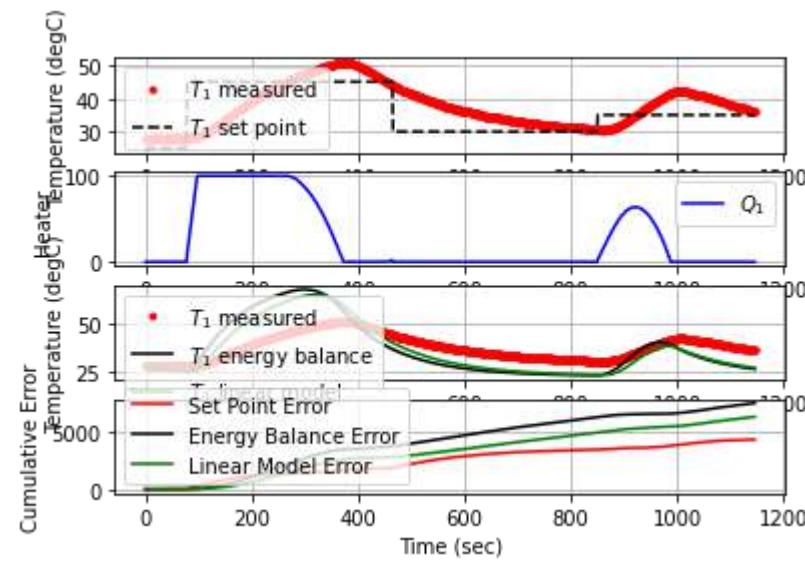
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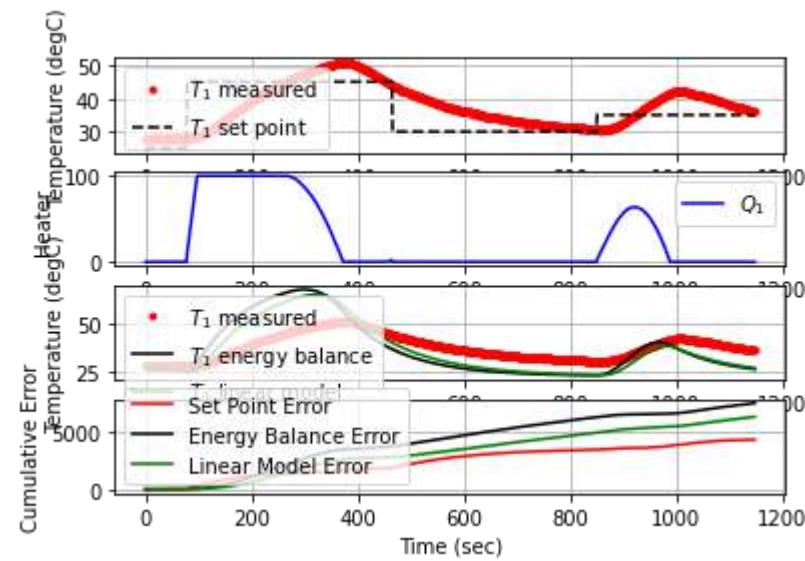
1146.6 35.00 36.29 0.00 -0.26 0.31 -0.00



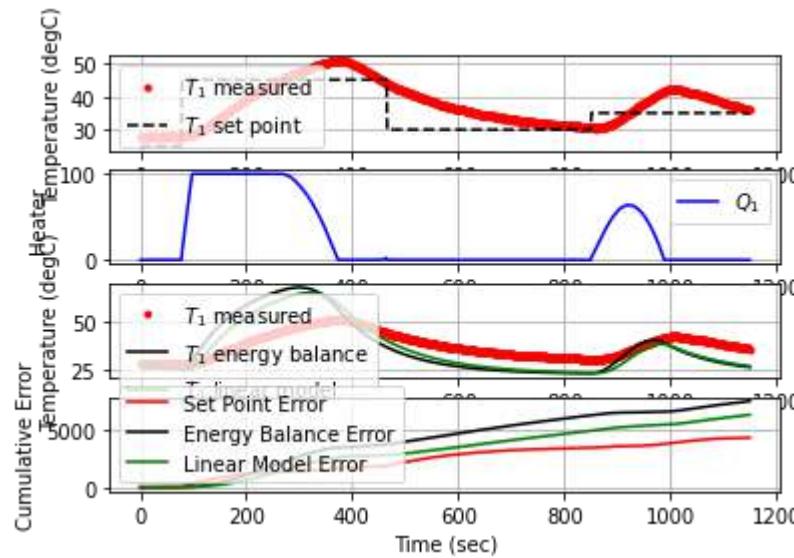
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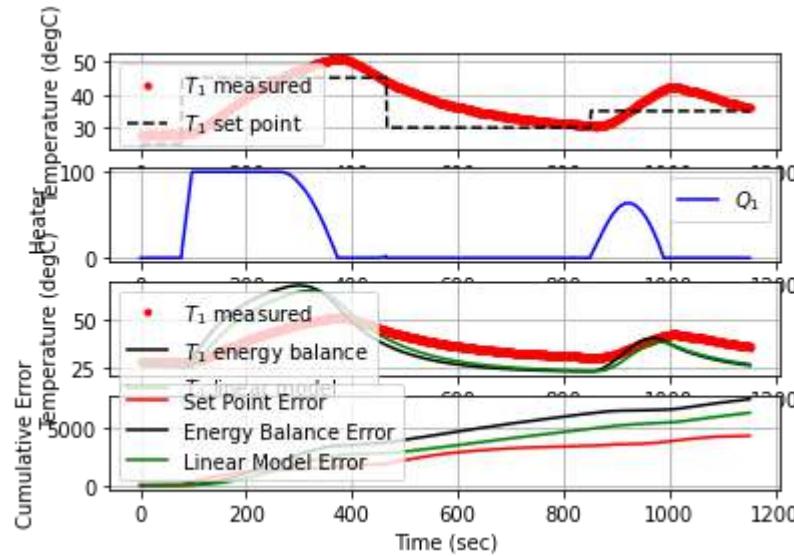
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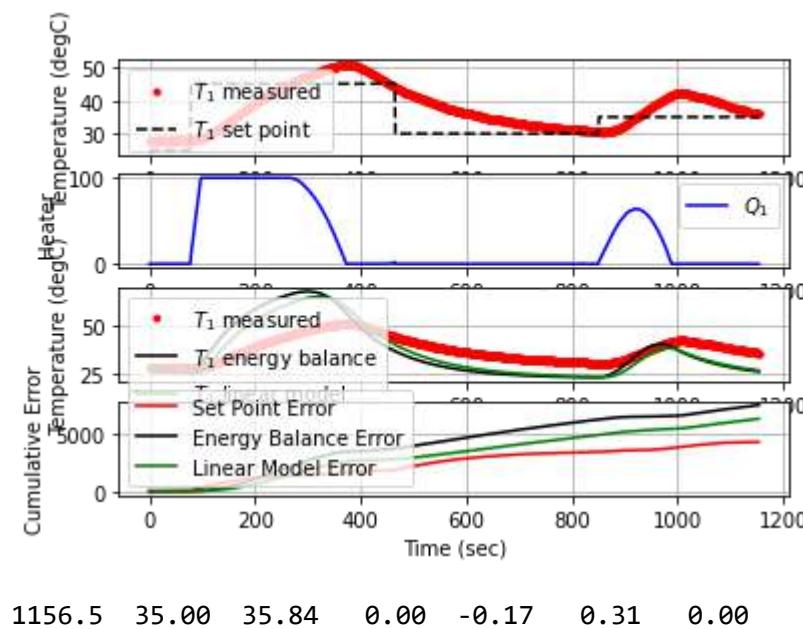
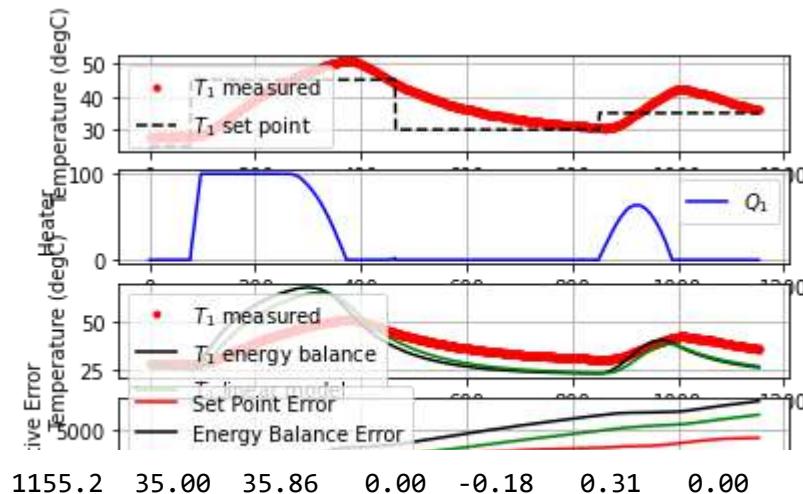
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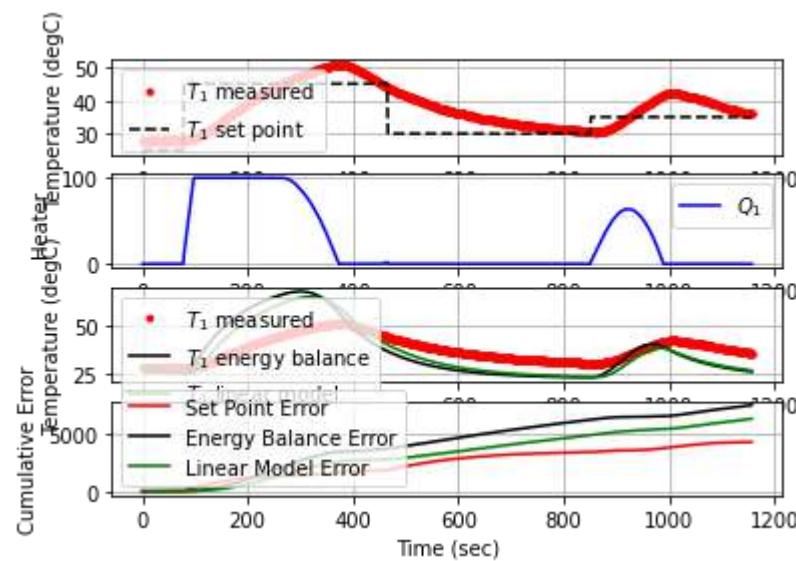
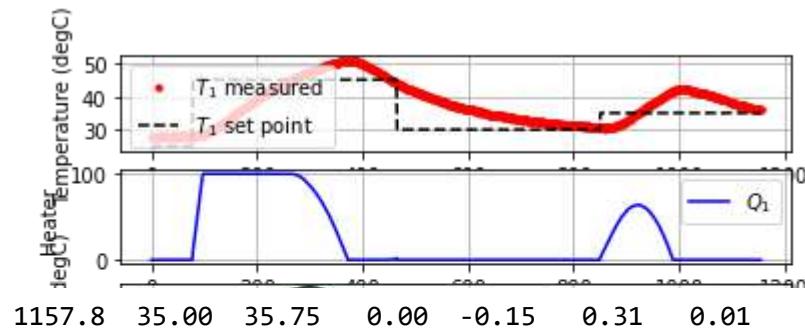


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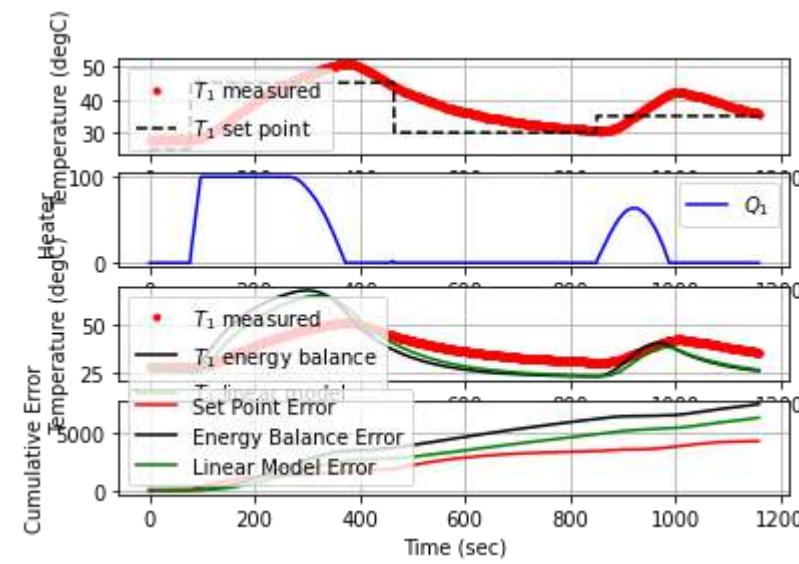
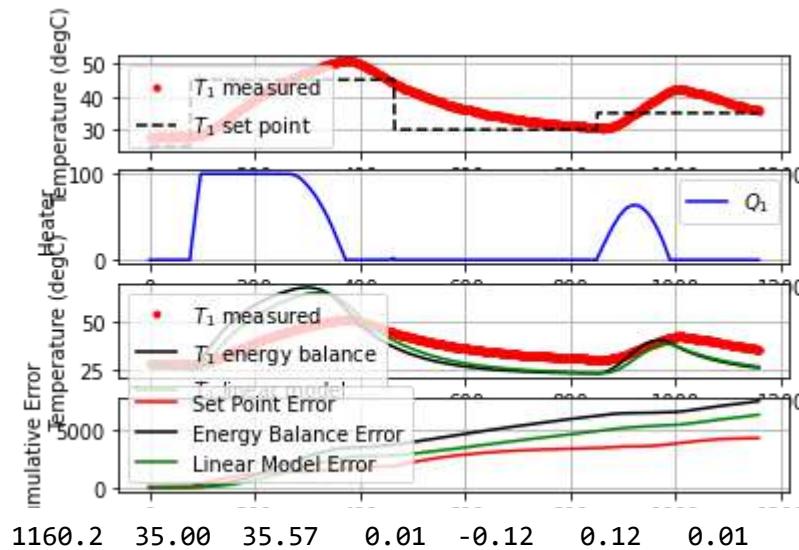


1153.9 35.00 35.94 0.00 -0.19 0.31 -0.00

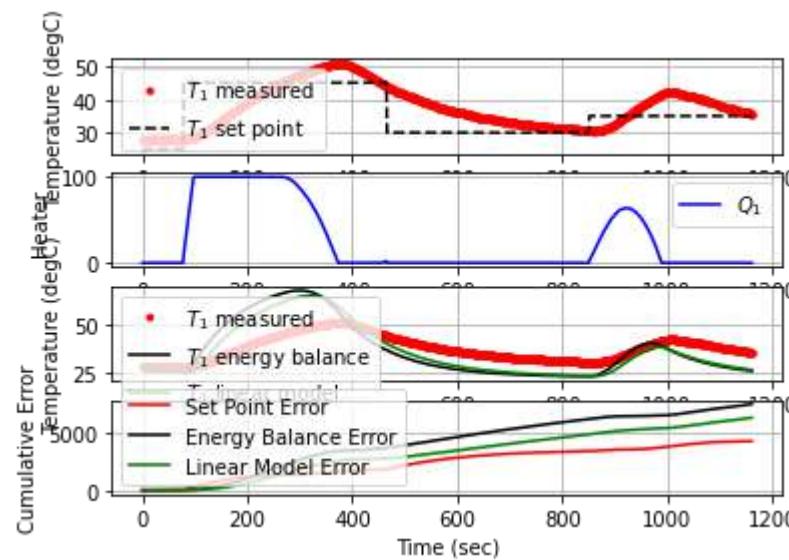




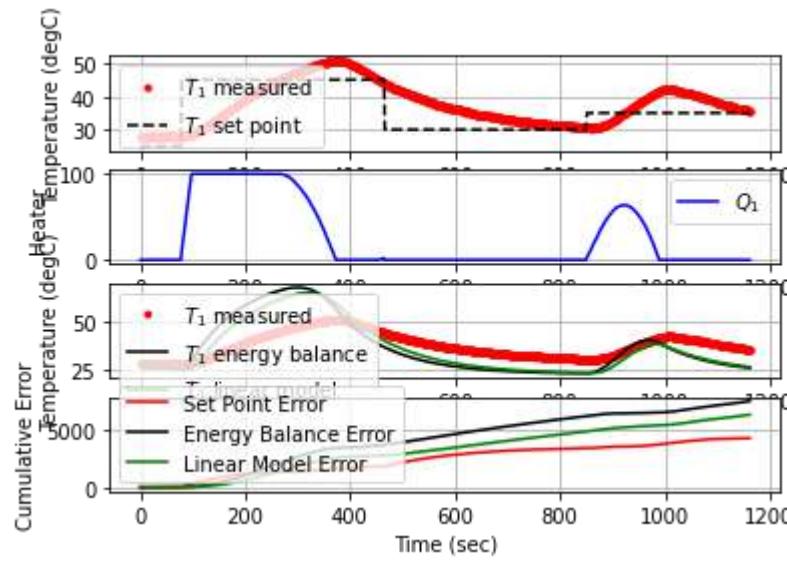
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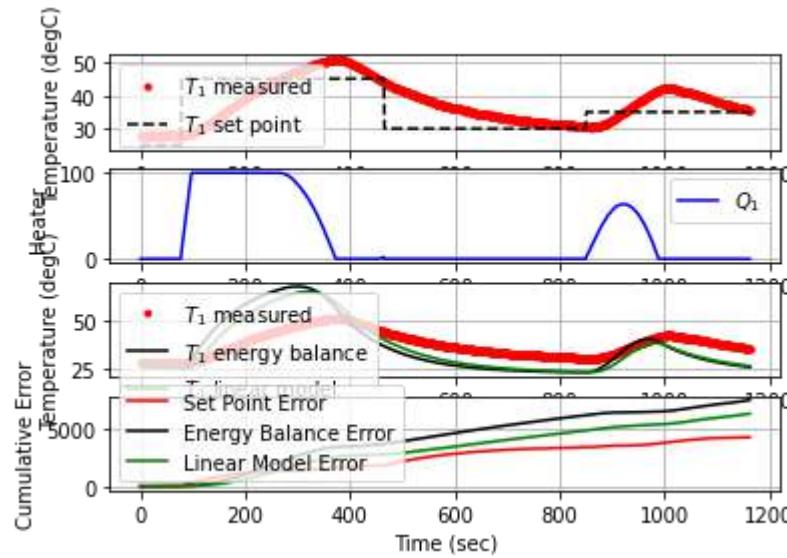
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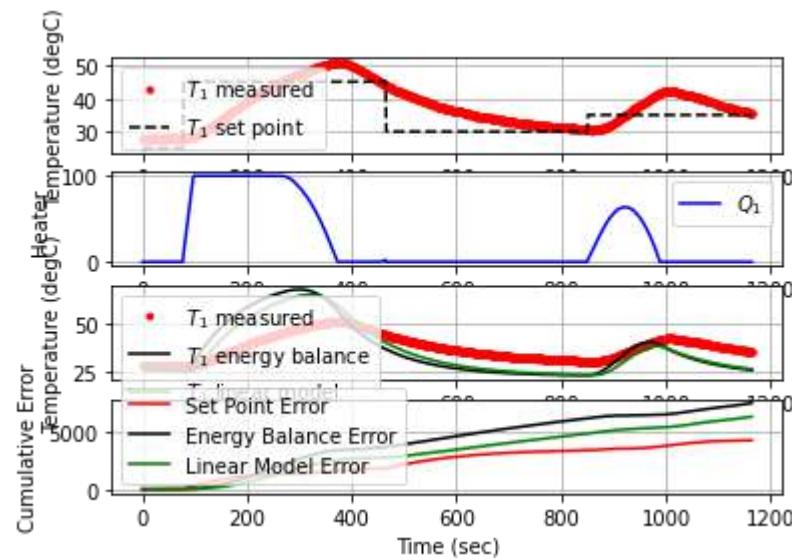
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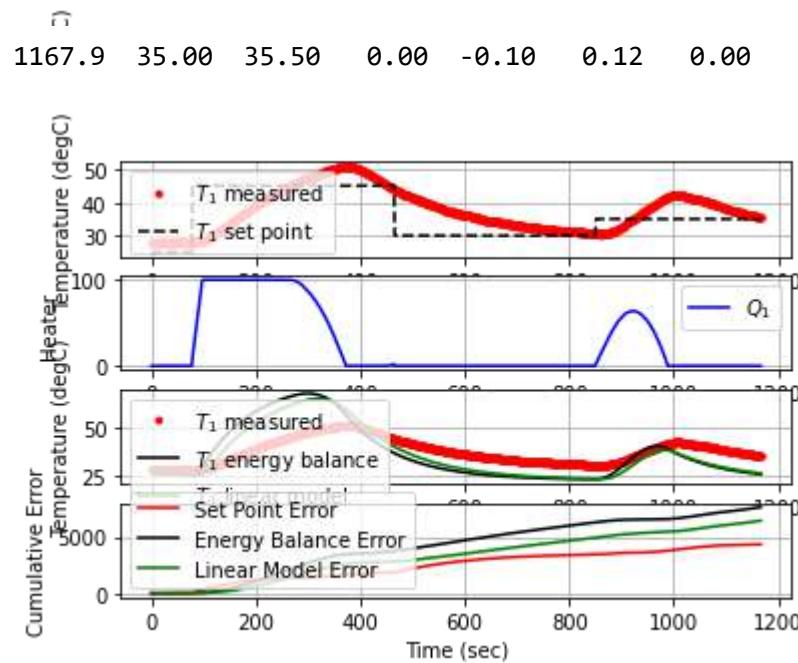
1164.1 35.00 35.58 0.00 -0.12 0.12 0.00



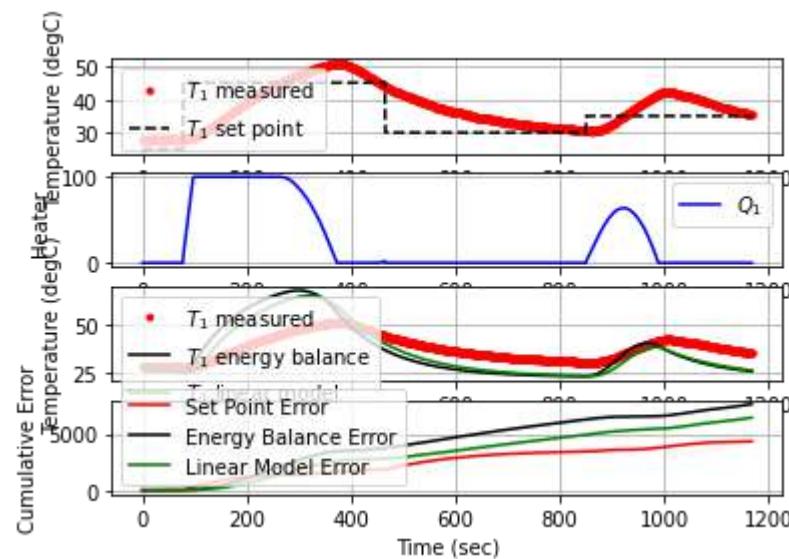
1165.3 35.00 35.54 0.00 -0.11 0.12 0.00



1166.6 35.00 35.51 0.00 -0.11 0.12 0.00



1169.2 35.00 35.42 0.00 -0.09 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 []: