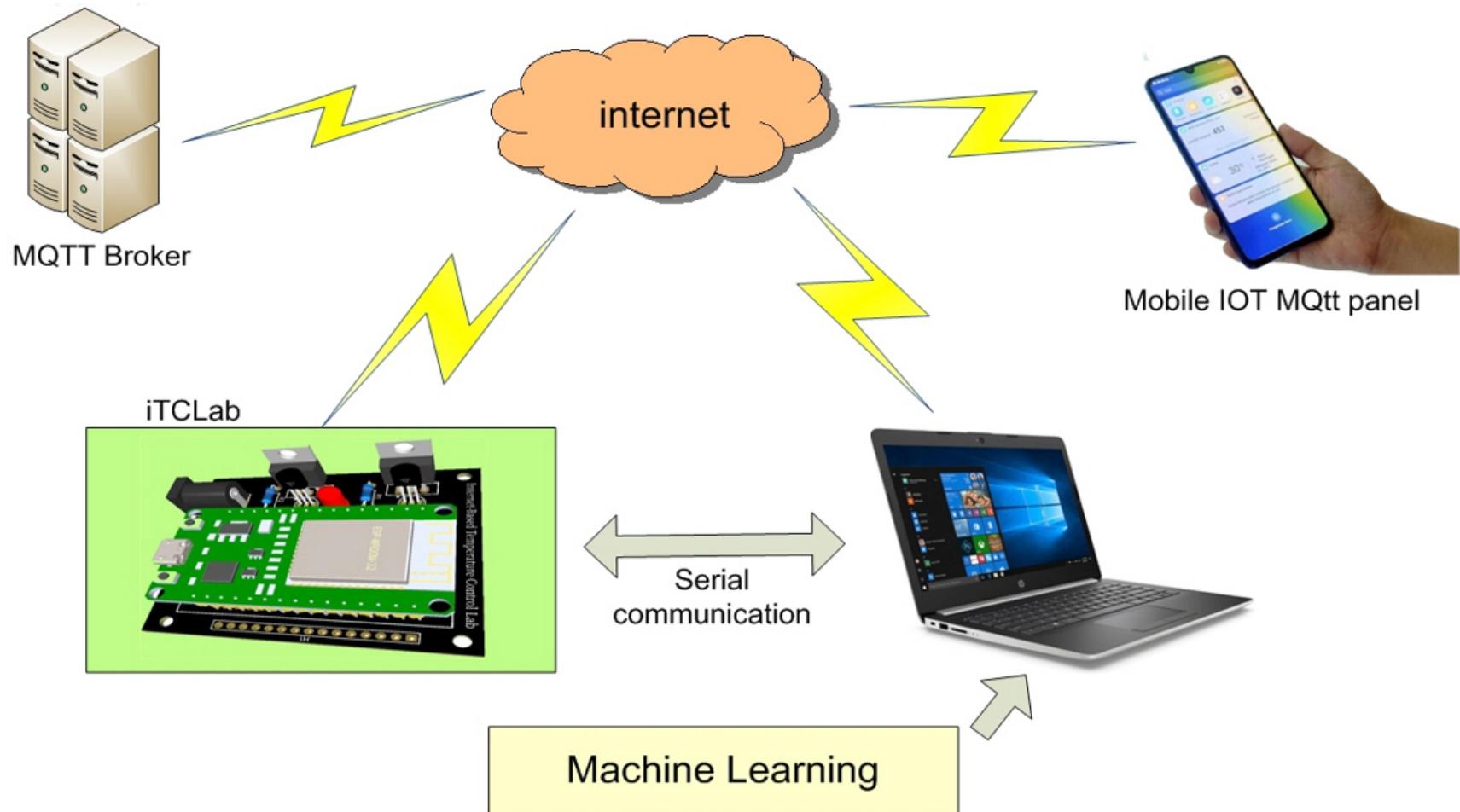


# Penalaan Parameter PID Menggunakan Deep Learning pada Kit iTCLab dan Pemantauannya Menggunakan Internet of Things (IoT)

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



Proses penalaan nilai  $K_c$ ,  $T_I$  dan  $T_D$  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
```

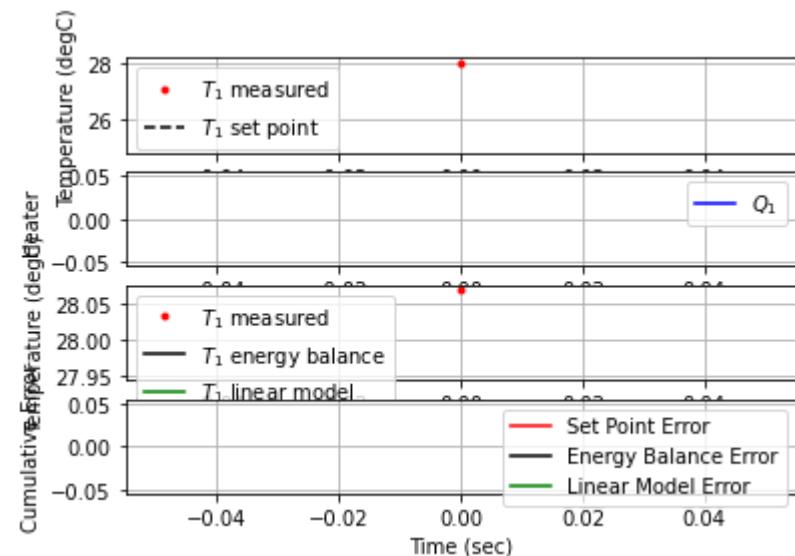
```
a.close()
```

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

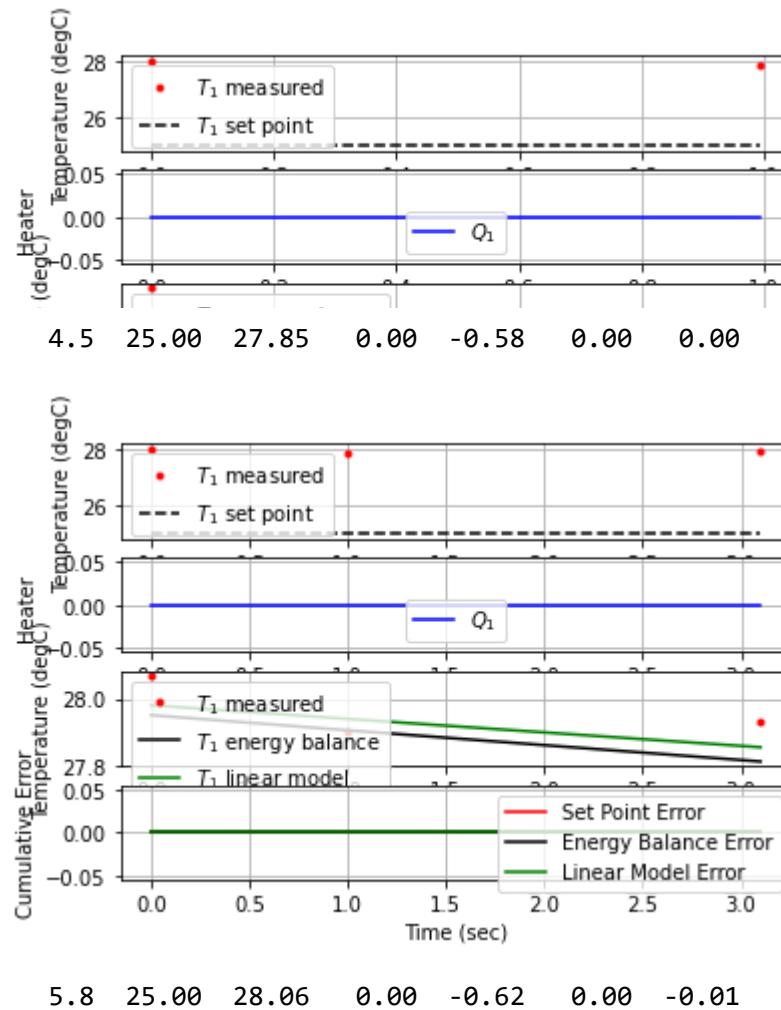
Time	SP	PV	Q1	=	P	+	I	+	D
0.0	25.00	28.07	0.00		0.00		0.00		0.00

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

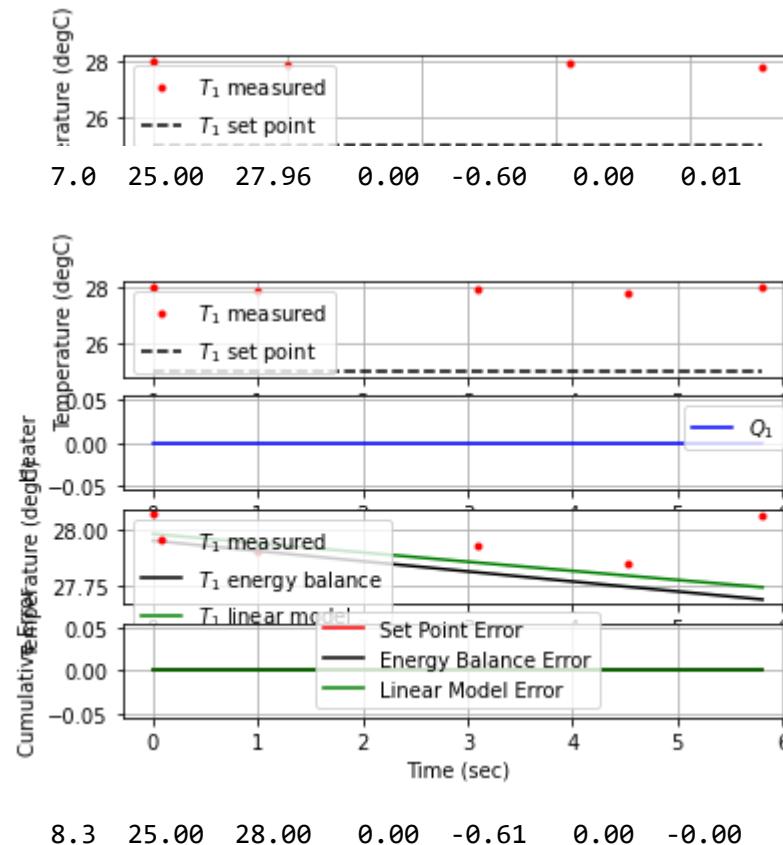
1.0	25.00	27.90	0.00	-0.59	0.00	0.01
-----	-------	-------	------	-------	------	------



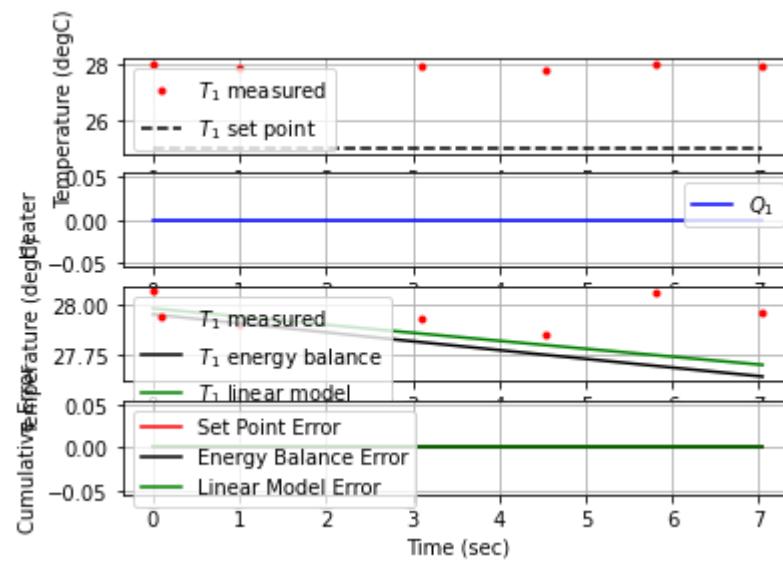
3.1	25.00	27.93	0.00	-0.59	0.00	-0.00
-----	-------	-------	------	-------	------	-------



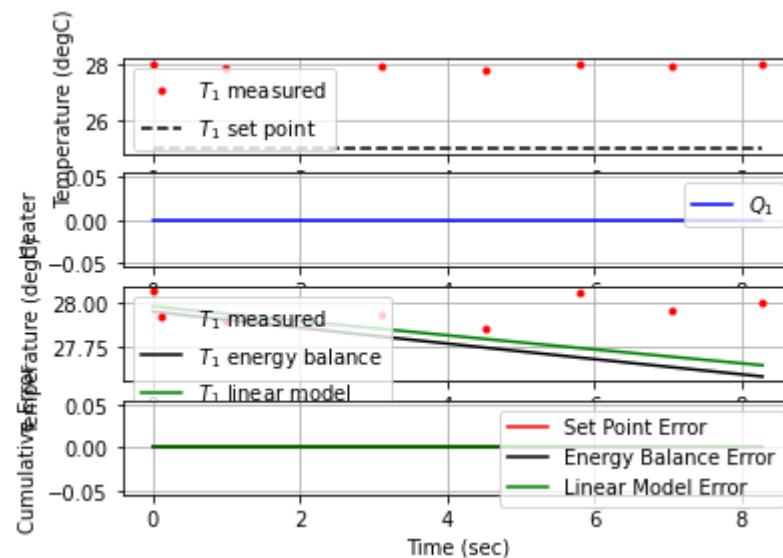
5.8 25.00 28.06 0.00 -0.62 0.00 -0.01



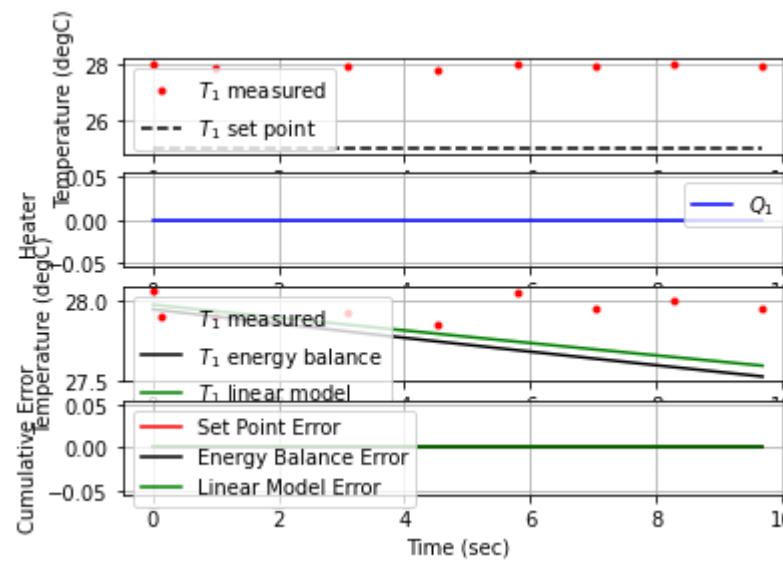
8.3 25.00 28.00 0.00 -0.61 0.00 -0.00



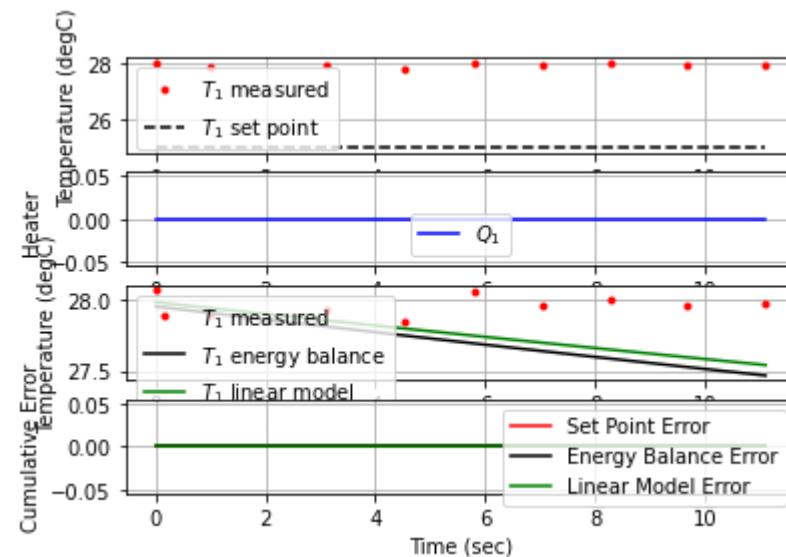
9.7 25.00 27.96 0.00 -0.60 0.00 0.00



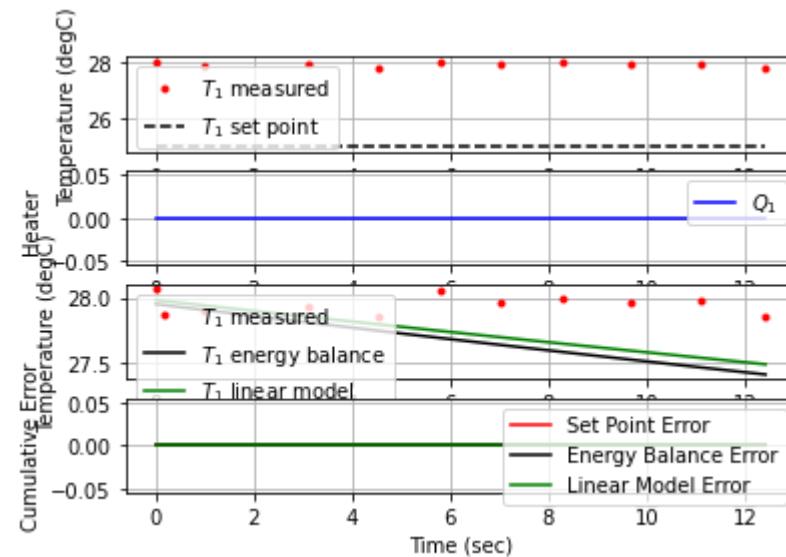
11.1 25.00 27.97 0.00 -0.60 0.00 -0.00



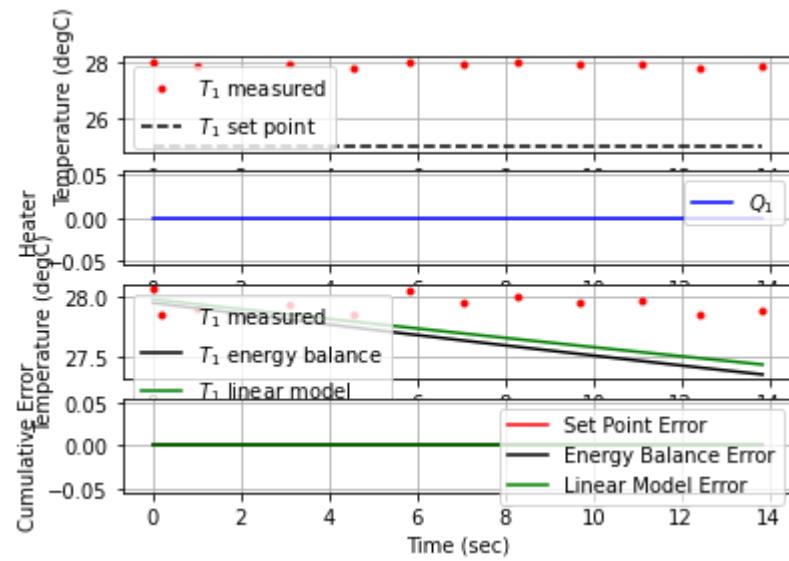
12.4 25.00 27.85 0.00 -0.58 0.00 0.01



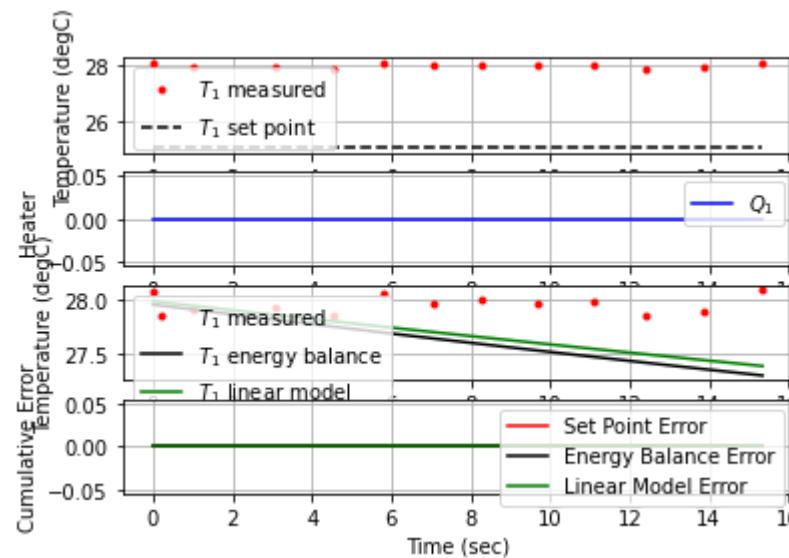
13.8 25.00 27.89 0.00 -0.58 0.00 -0.00

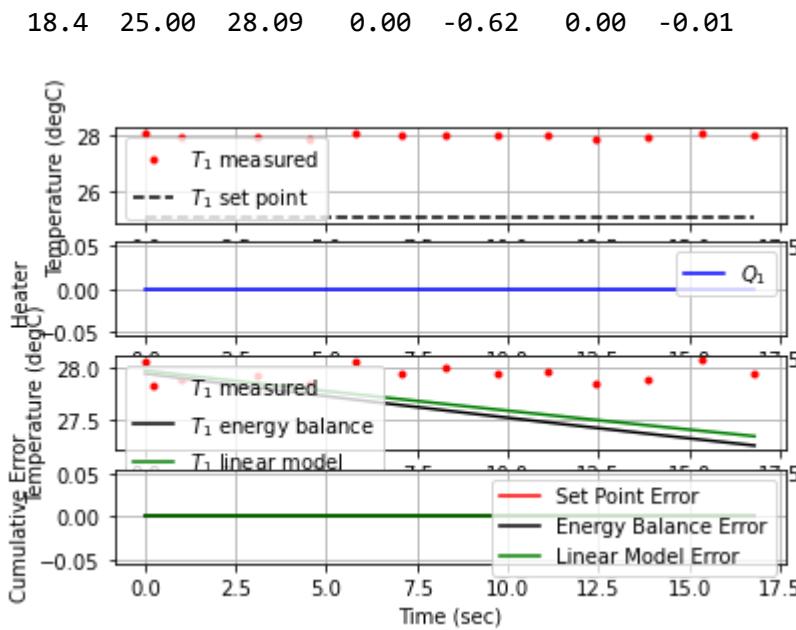


15.3 25.00 28.09 0.00 -0.62 0.00 -0.01

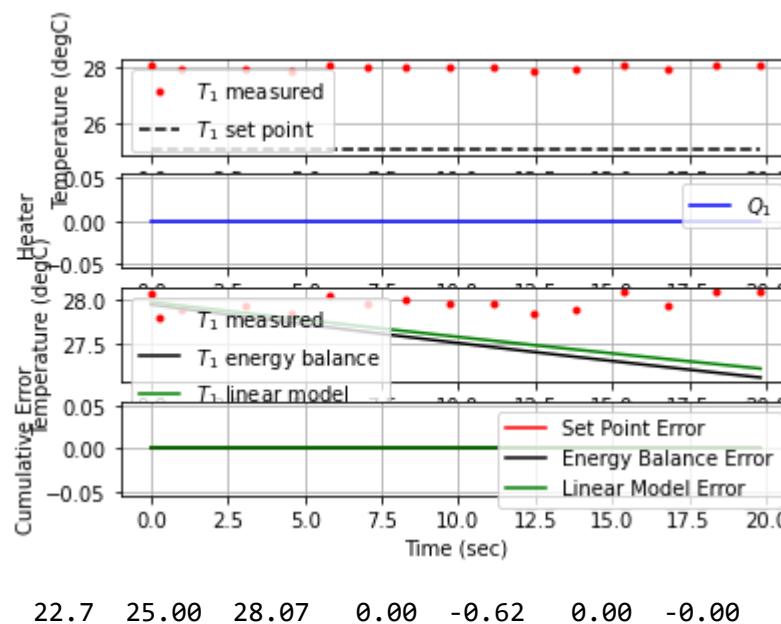
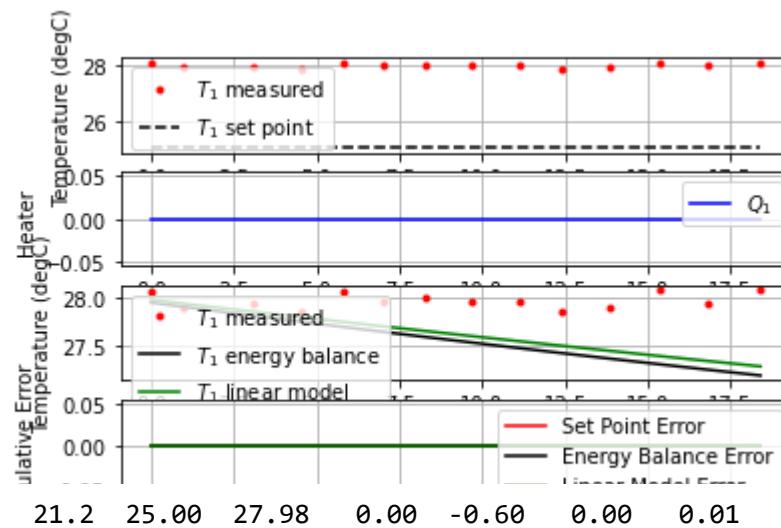


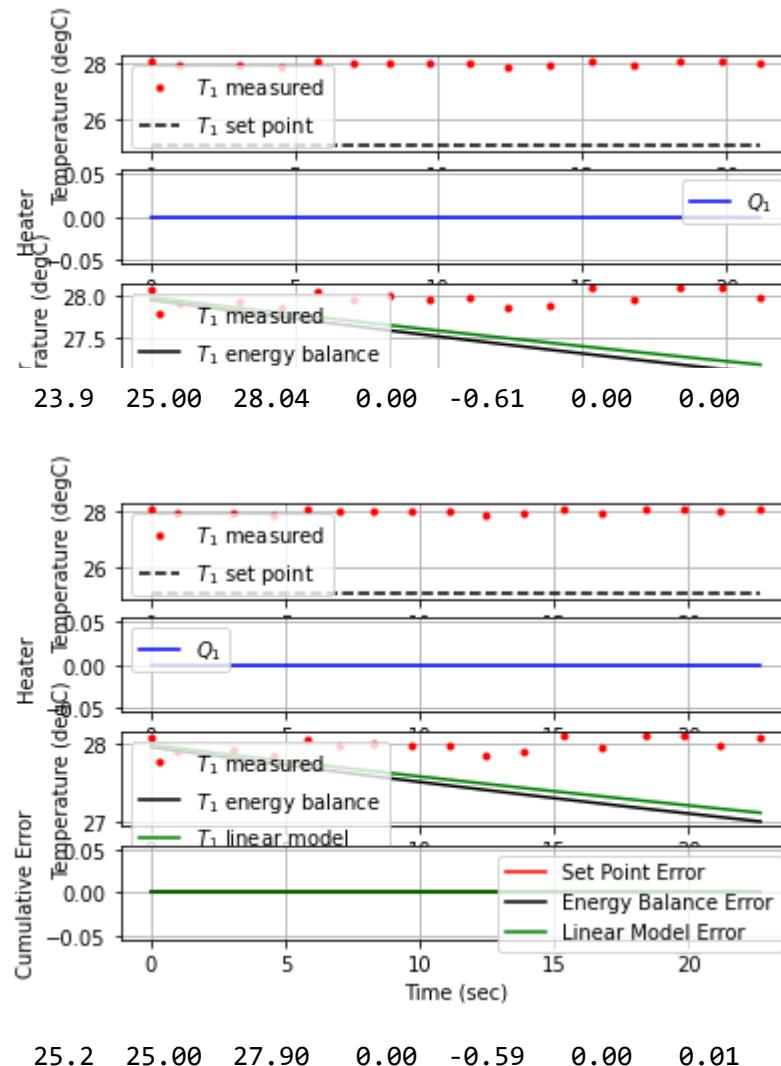
16.8 25.00 27.95 0.00 -0.60 0.00 0.01

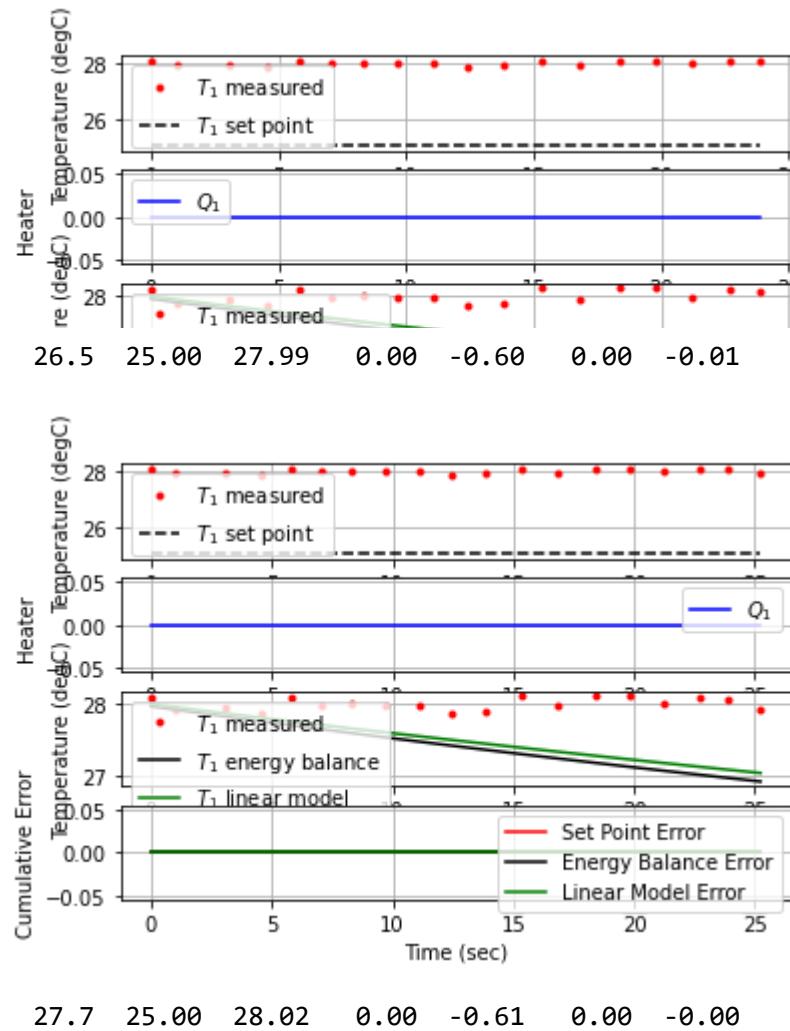


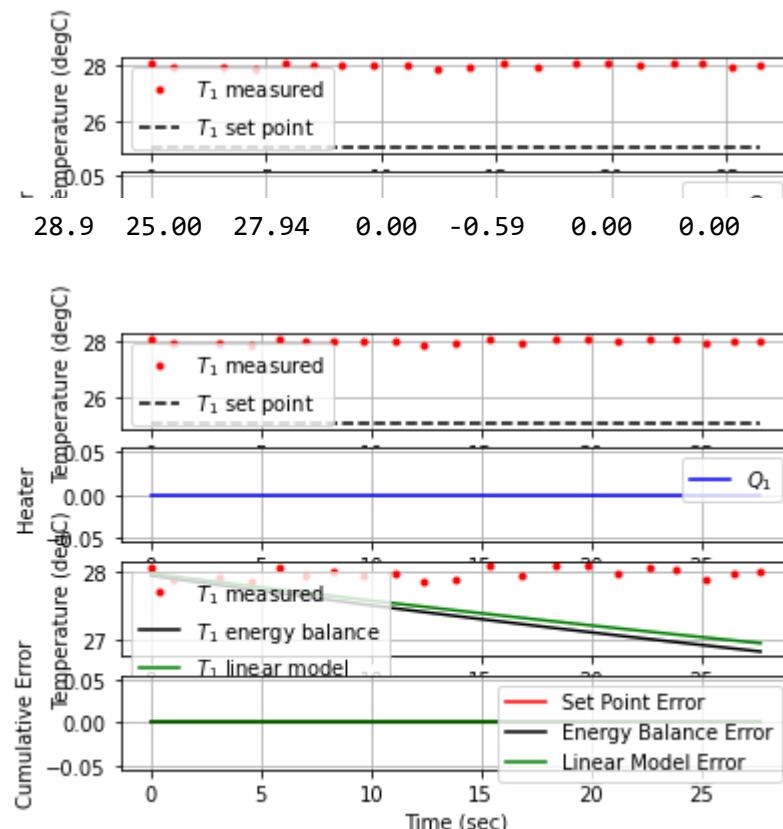


19.8 25.00 28.10 0.00 -0.63 0.00 -0.00

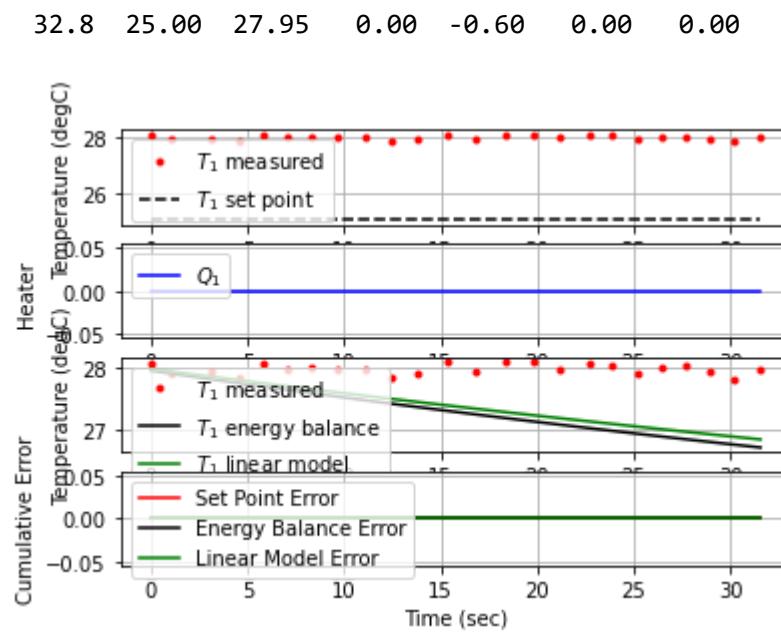
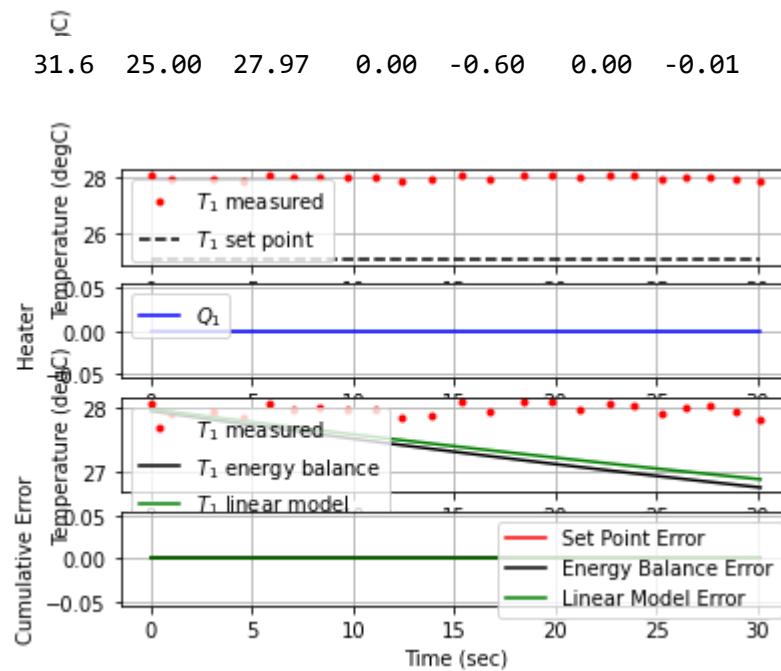




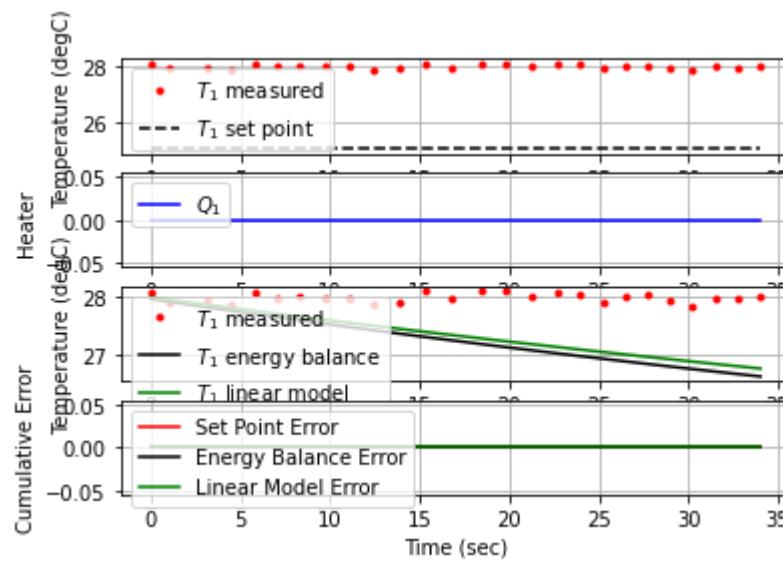
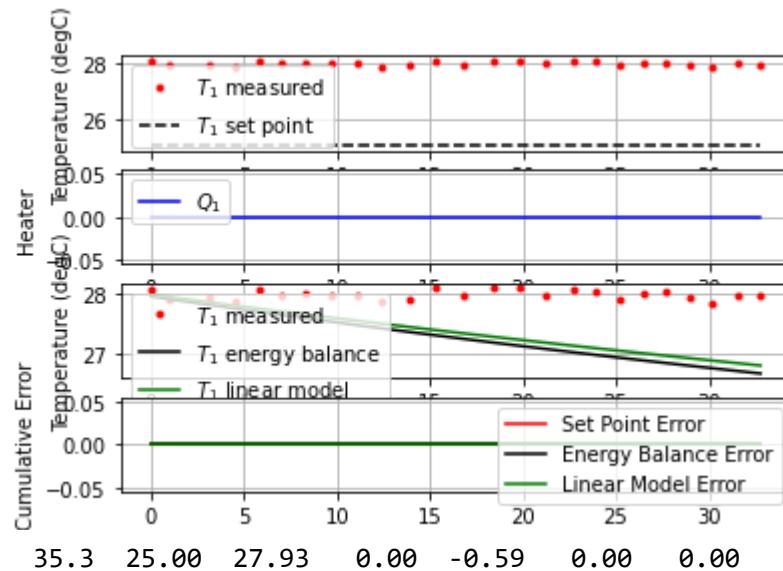




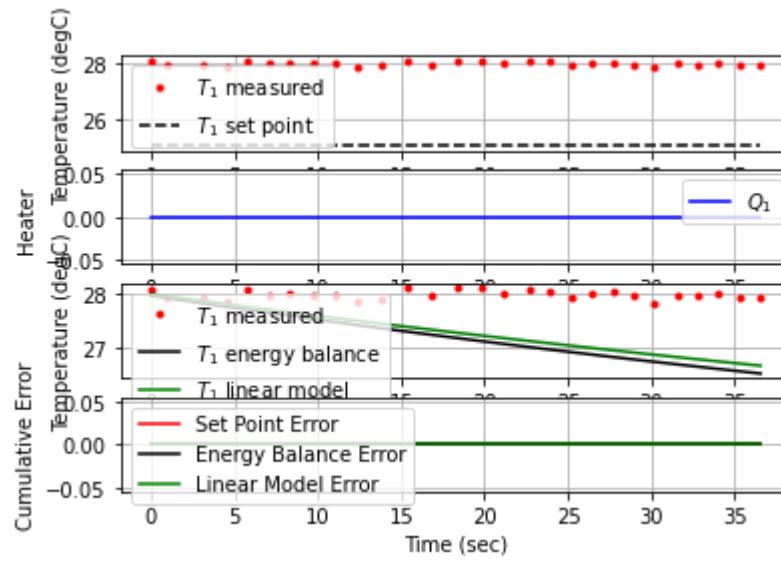
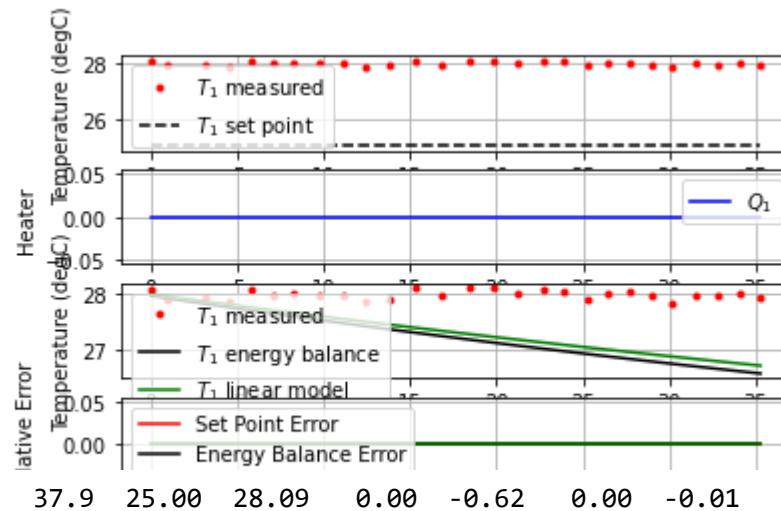
30.2 25.00 27.82 0.00 -0.57 0.00 0.01



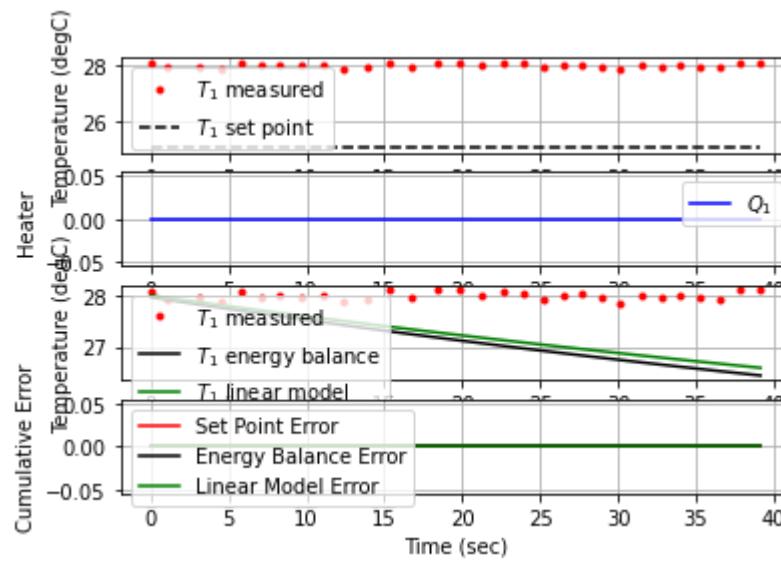
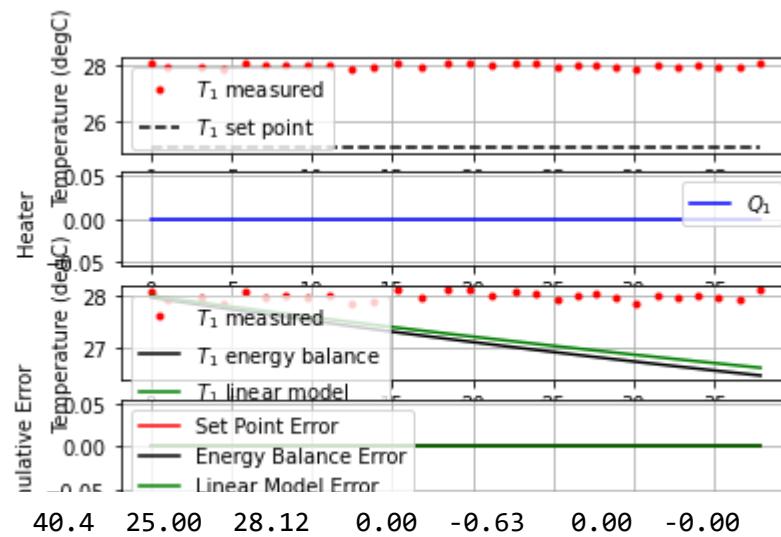
34.0 25.00 27.99 0.00 -0.60 0.00 -0.00



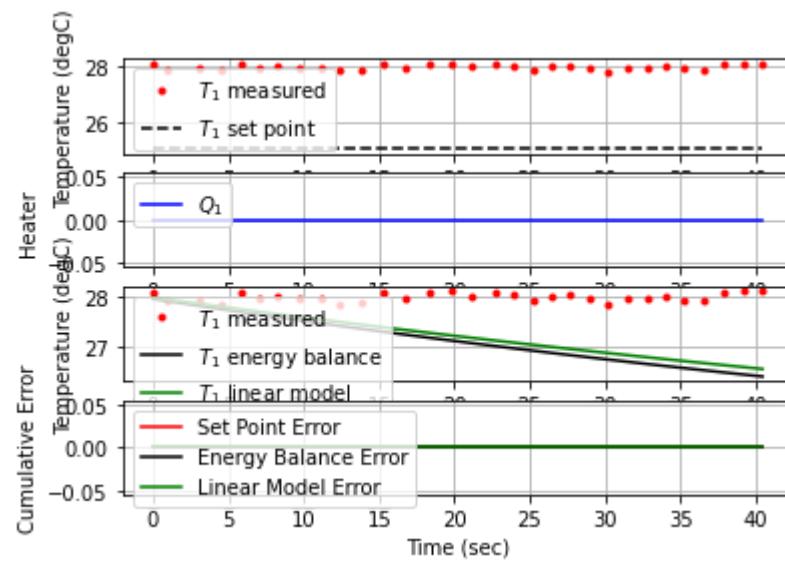
36.5 25.00 27.90 0.00 -0.59 0.00 0.00



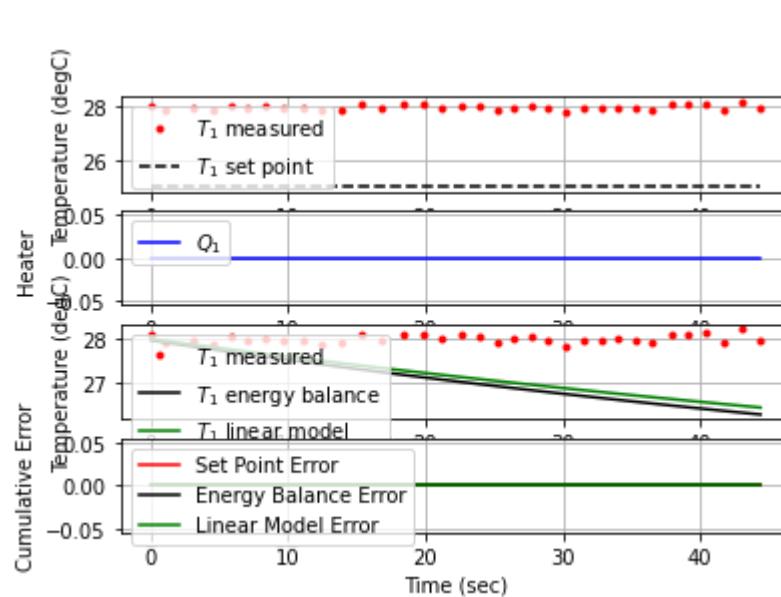
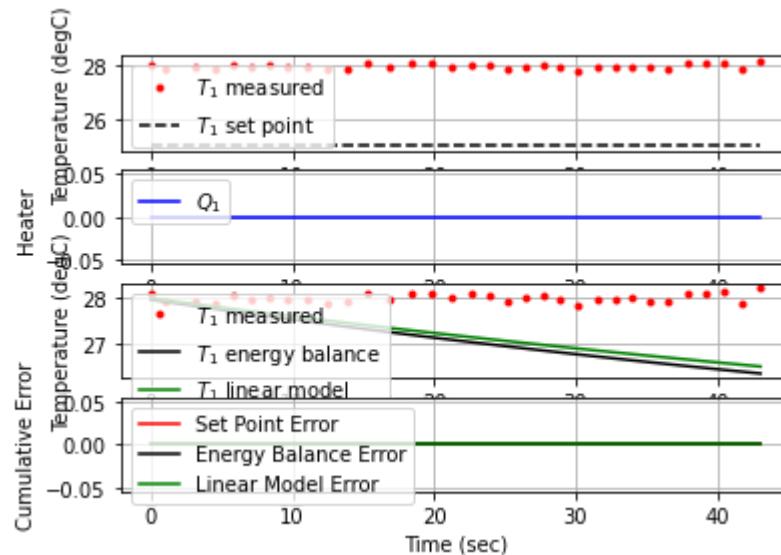
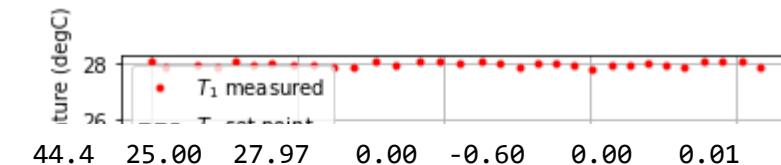
39.2 25.00 28.10 0.00 -0.63 0.00 -0.00



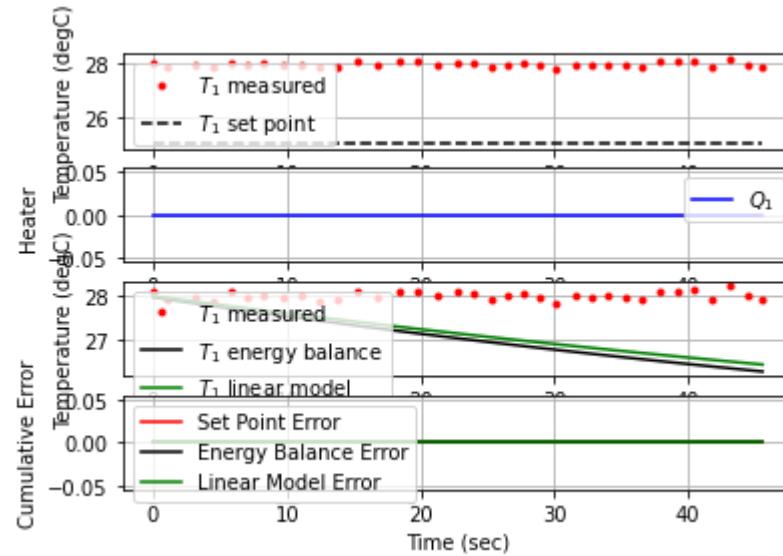
41.7 25.00 27.88 0.00 -0.58 0.00 0.01



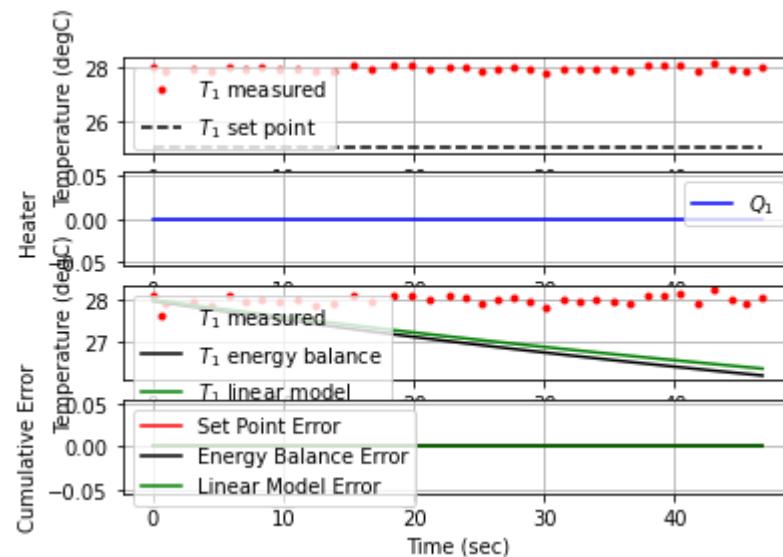
43.1 25.00 28.22 0.00 -0.65 0.00 -0.02



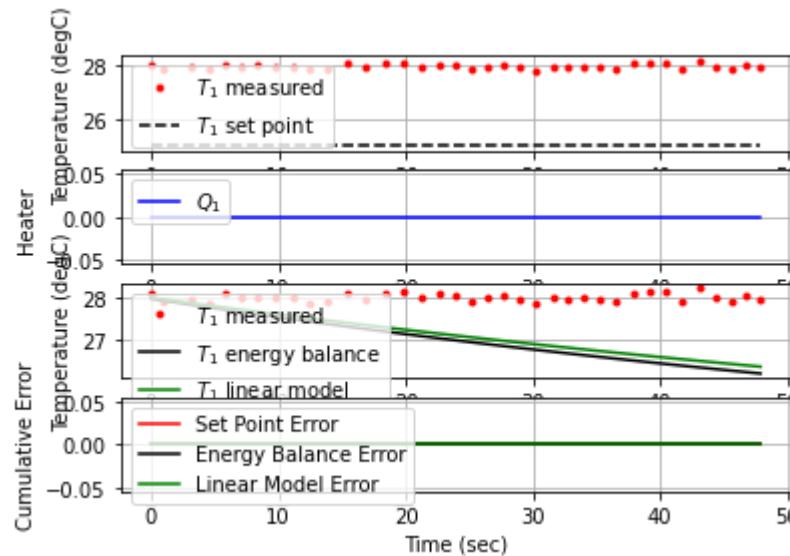
46.7 25.00 28.05 0.00 -0.62 0.00 -0.01



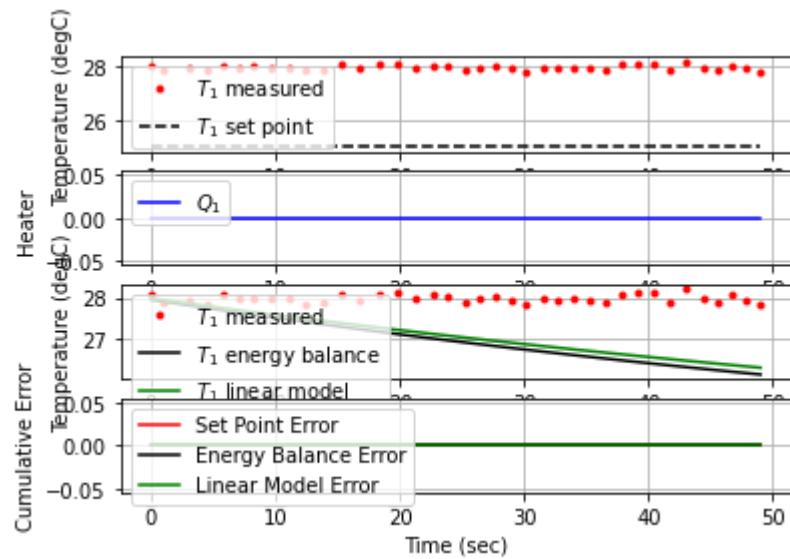
47.9 25.00 27.95 0.00 -0.60 0.00 0.01



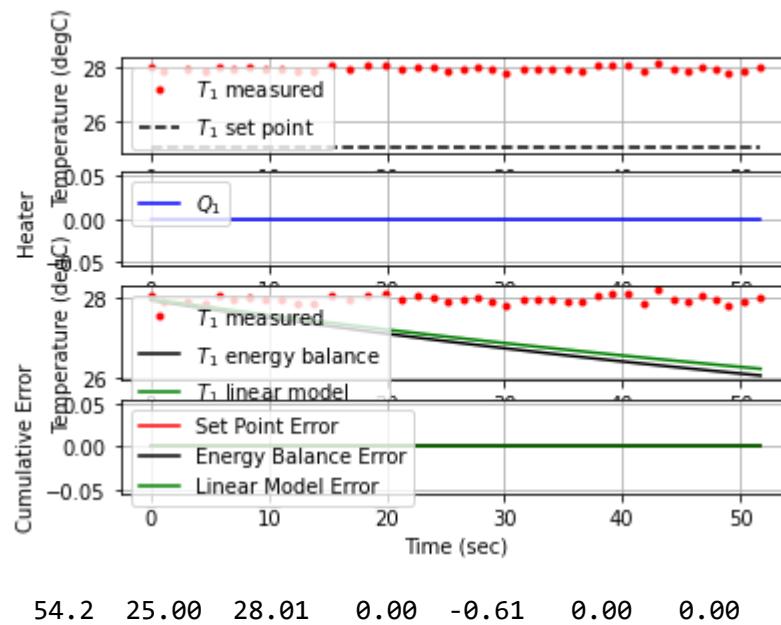
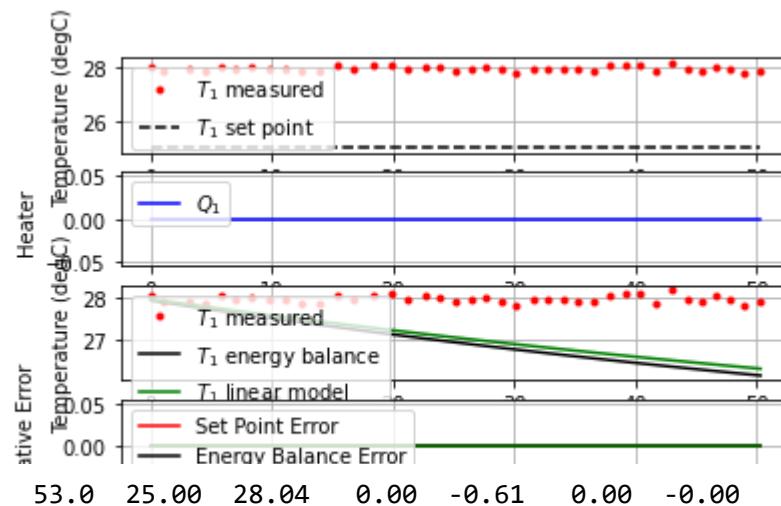
49.0 25.00 27.84 0.00 -0.57 0.00 0.01

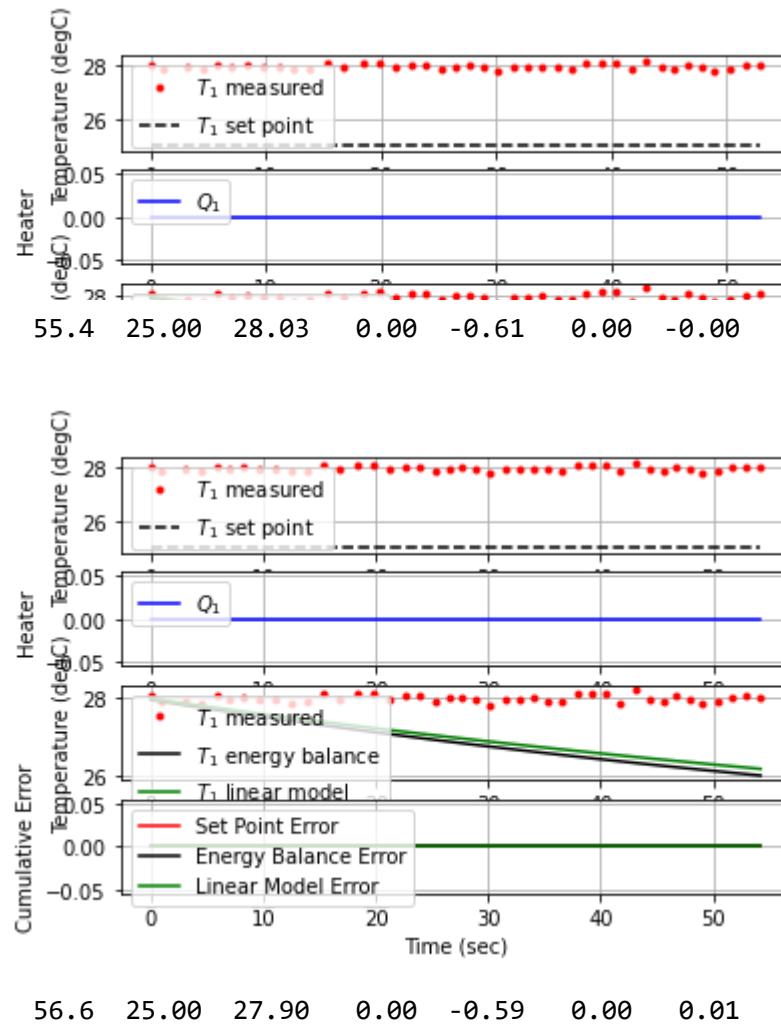


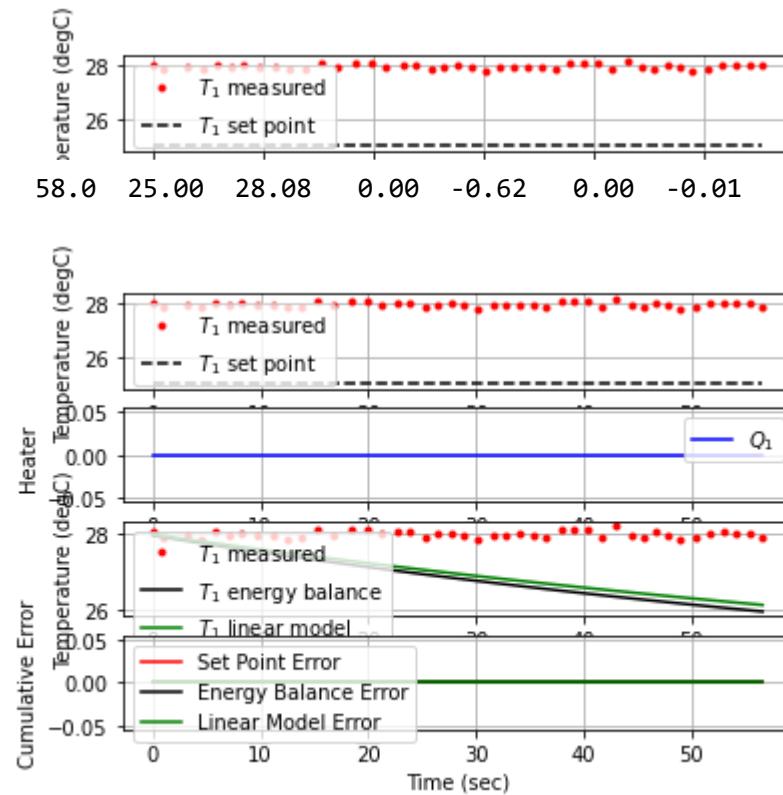
50.4 25.00 27.90 0.00 -0.59 0.00 -0.00



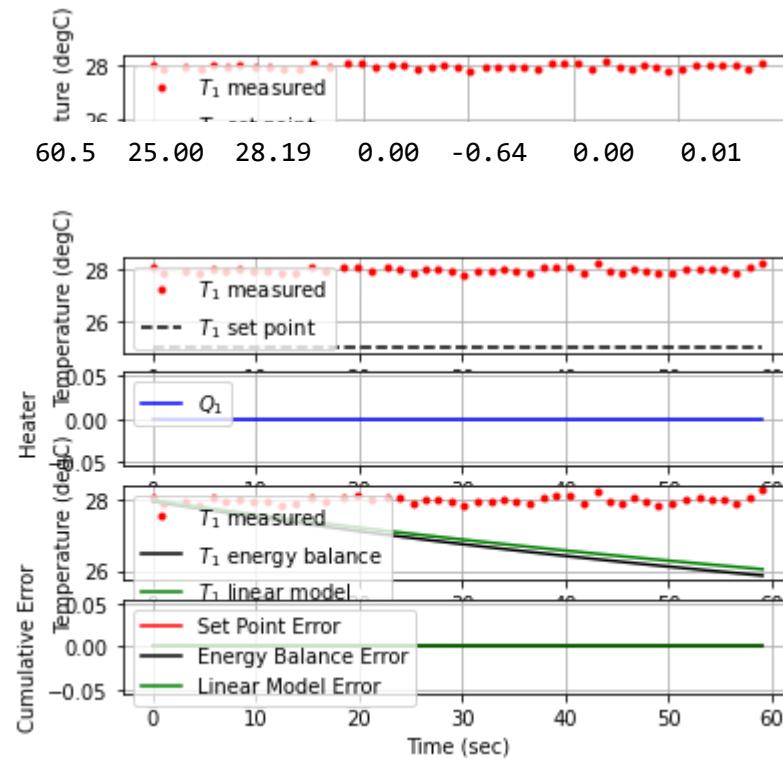
51.7 25.00 28.01 0.00 -0.61 0.00 -0.01



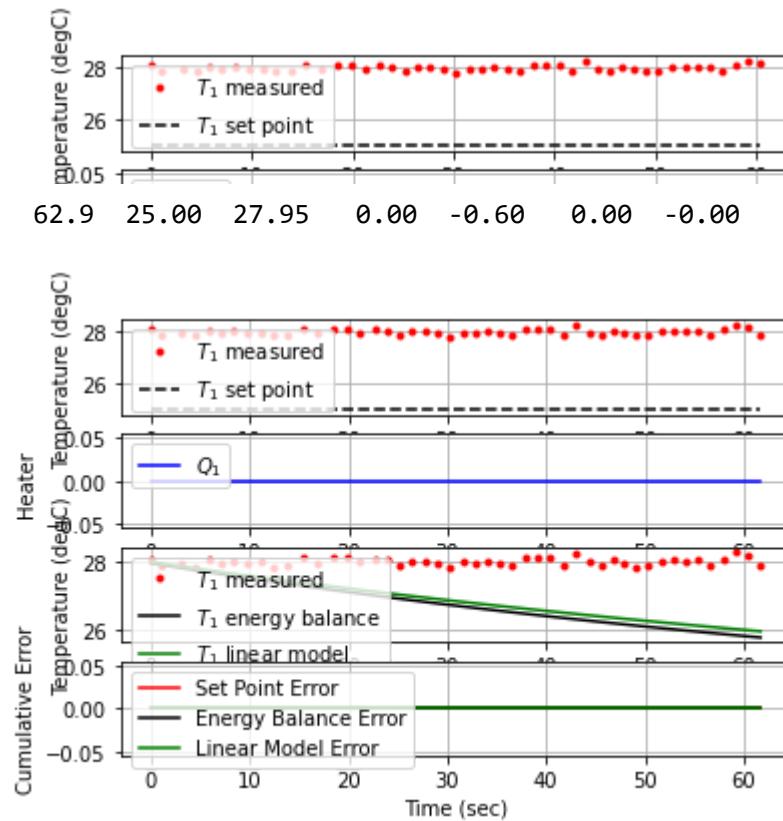




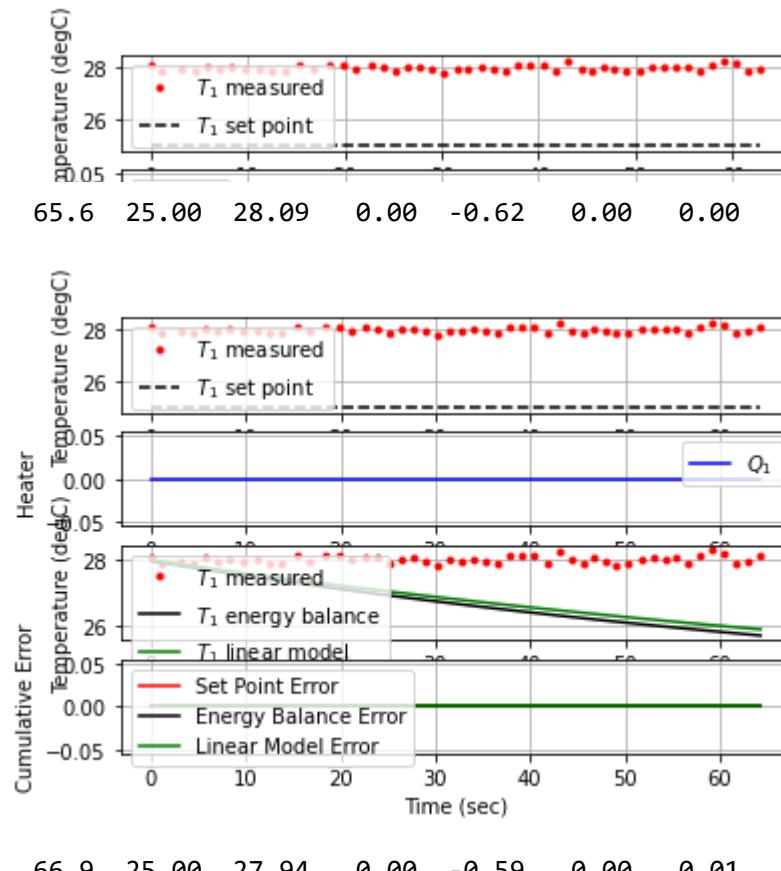
59.1 25.00 28.29 0.00 -0.66 0.00 -0.01



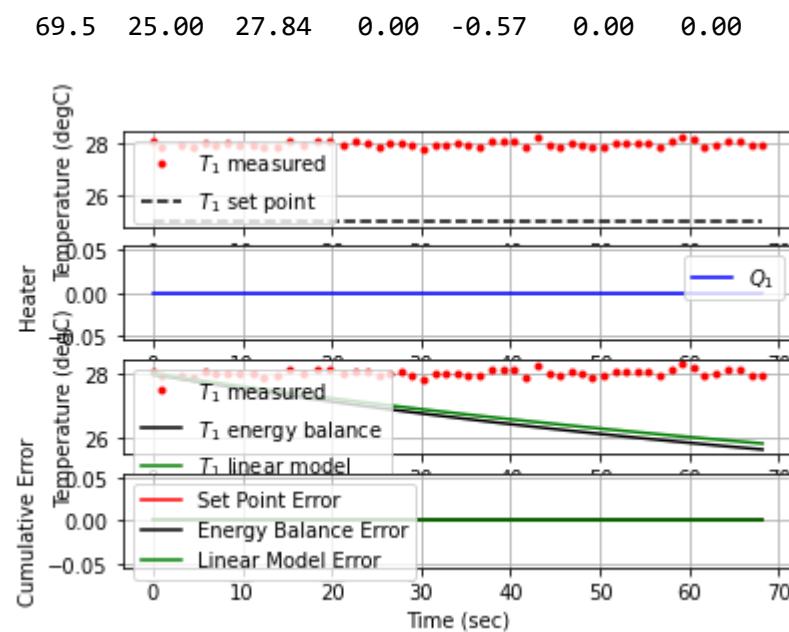
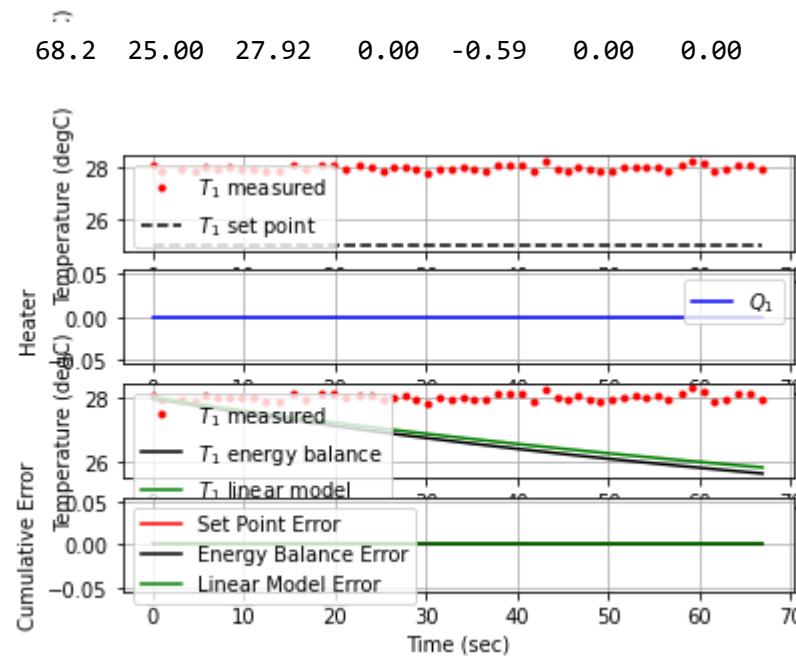
61.7 25.00 27.89 0.00 -0.58 0.00 0.02

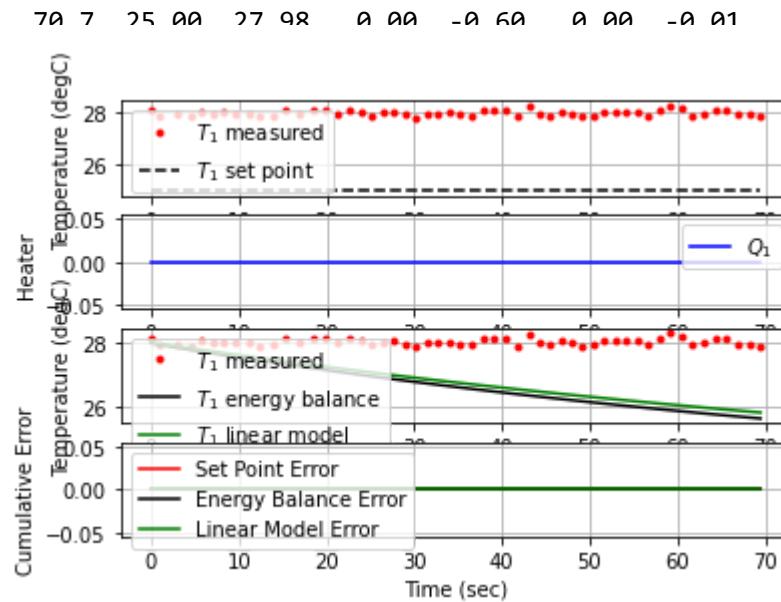


64.3 25.00 28.10 0.00 -0.63 0.00 -0.01

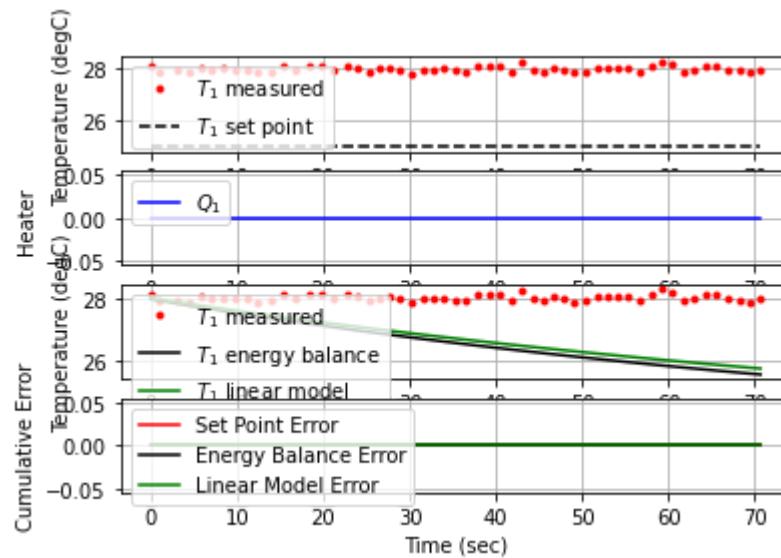


66.9 25.00 27.94 0.00 -0.59 0.00 0.01

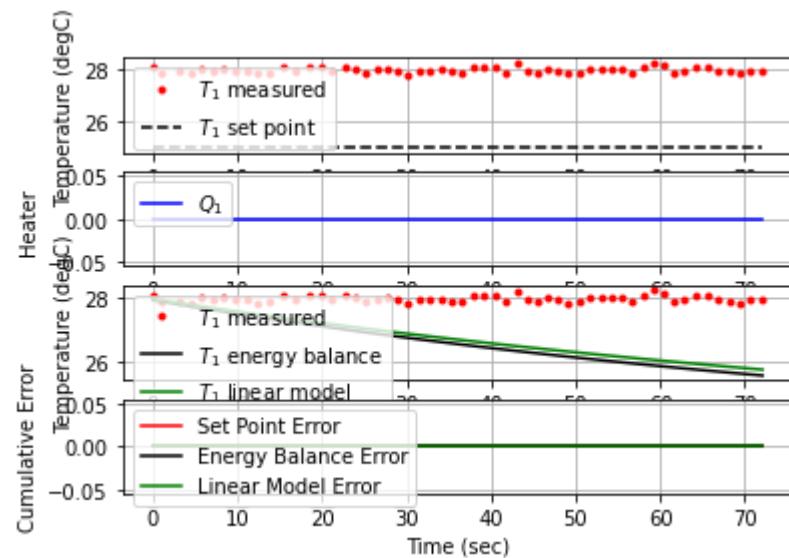




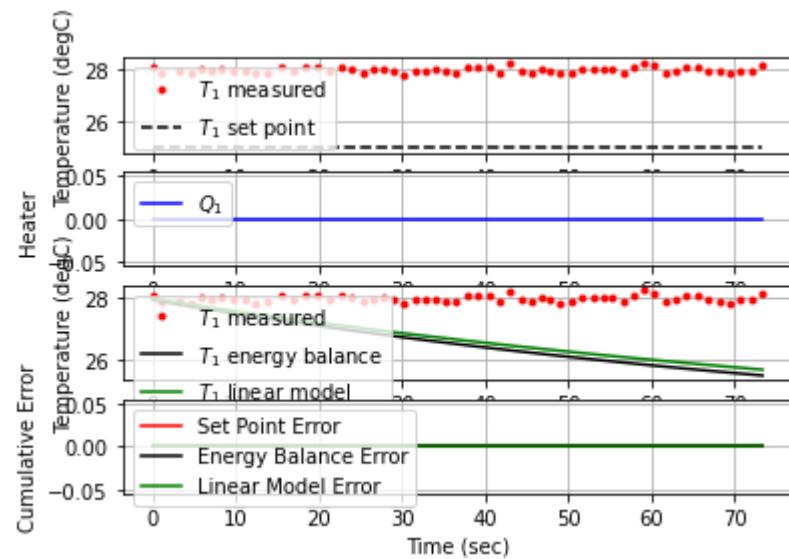
72.1 25.00 27.95 0.00 -0.60 0.00 0.00



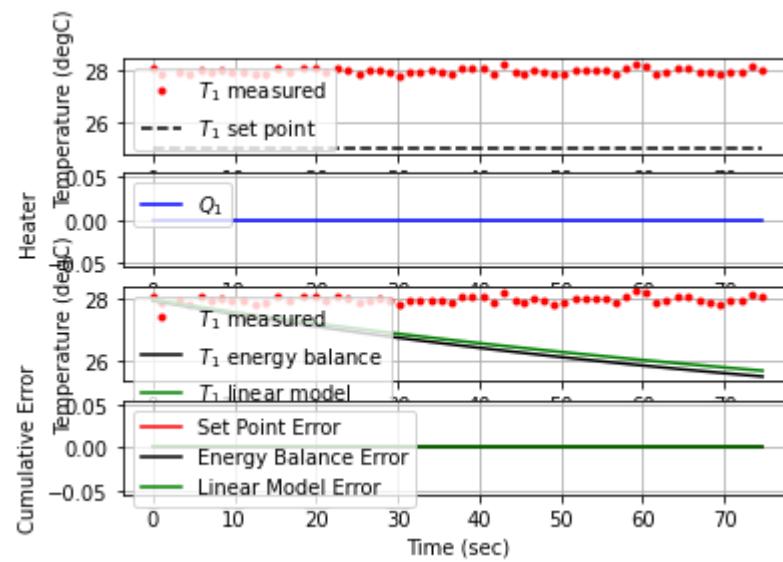
73.4 25.00 28.14 0.00 -0.63 0.00 -0.01



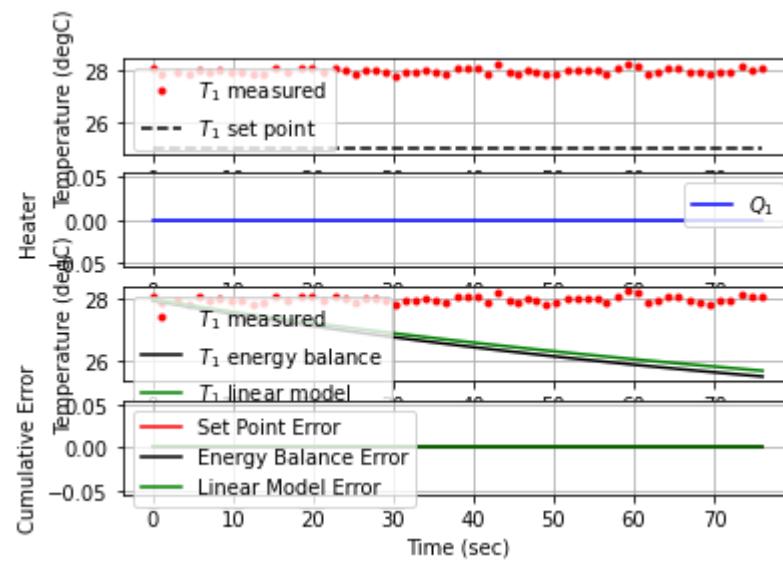
74.7 25.00 28.06 0.00 -0.62 0.00 0.00



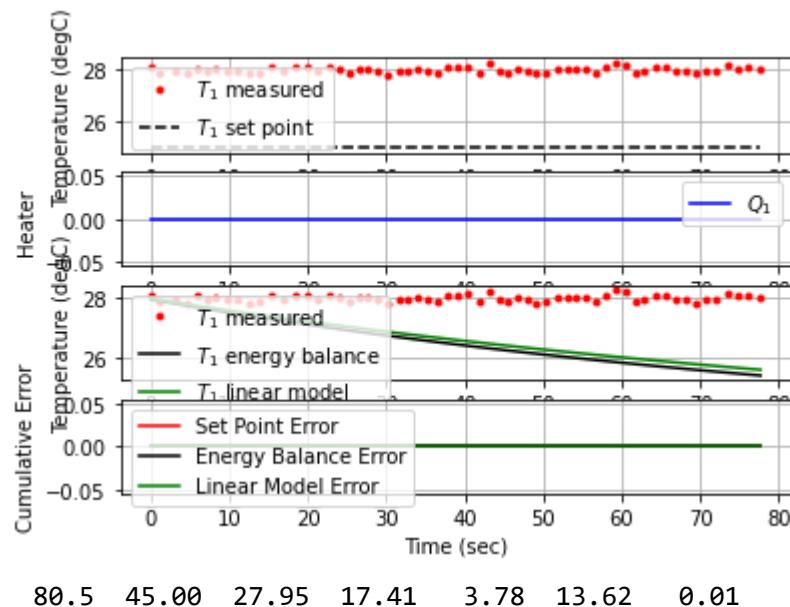
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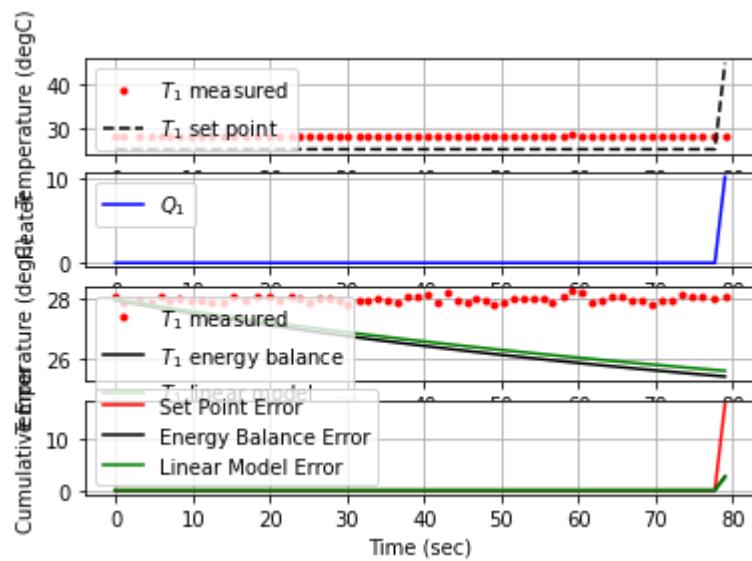
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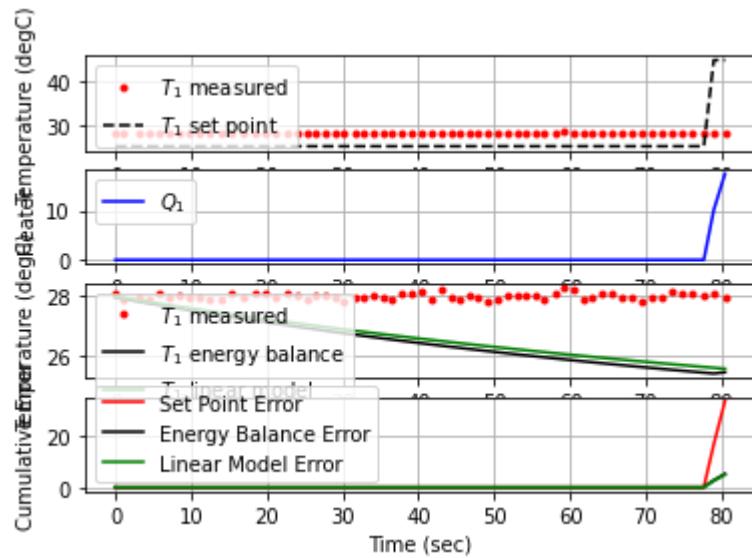
79.0 45.00 28.10 10.11 3.74 6.37 -0.01



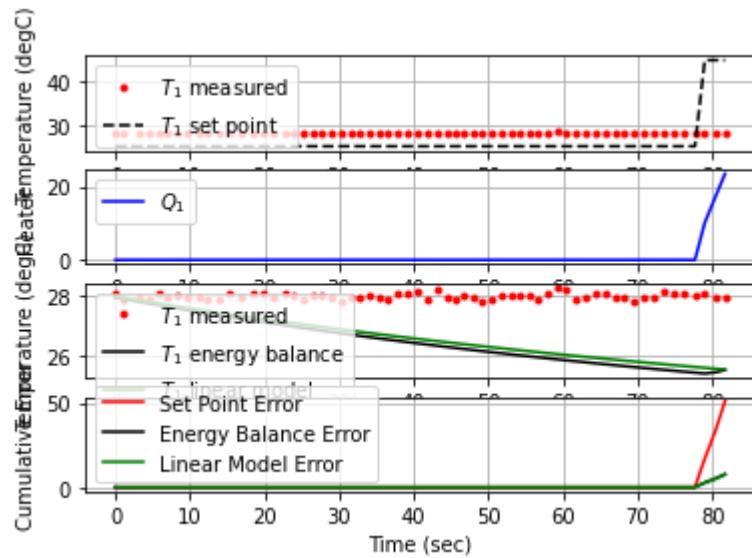
80.5 45.00 27.95 17.41 3.78 13.62 0.01



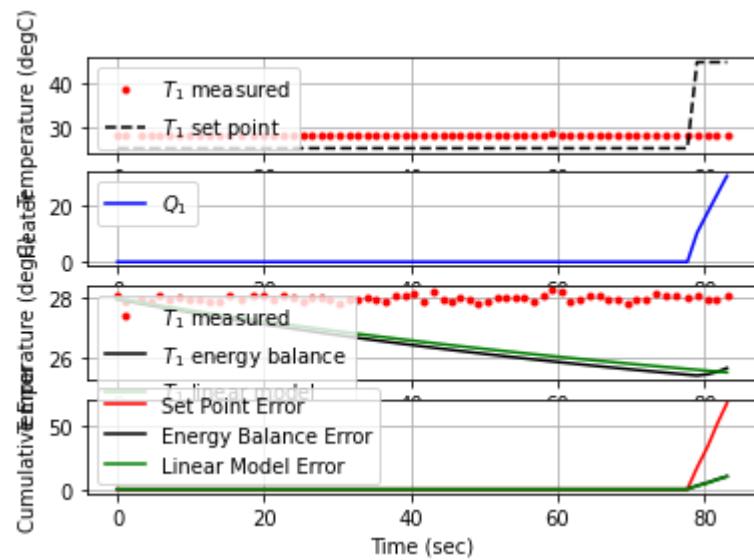
81.7 45.00 27.97 23.42 3.77 19.65 -0.00



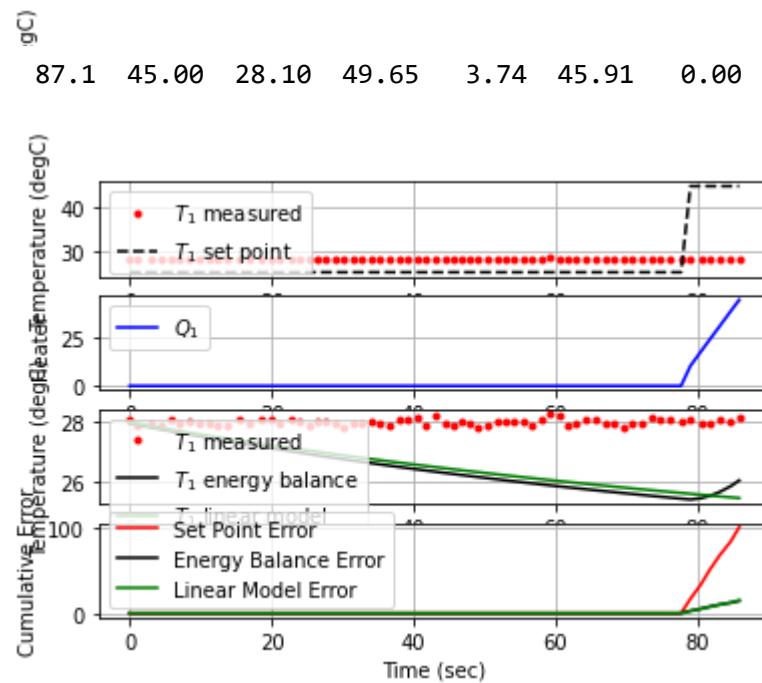
83.1 45.00 28.08 30.07 3.75 26.33 -0.01



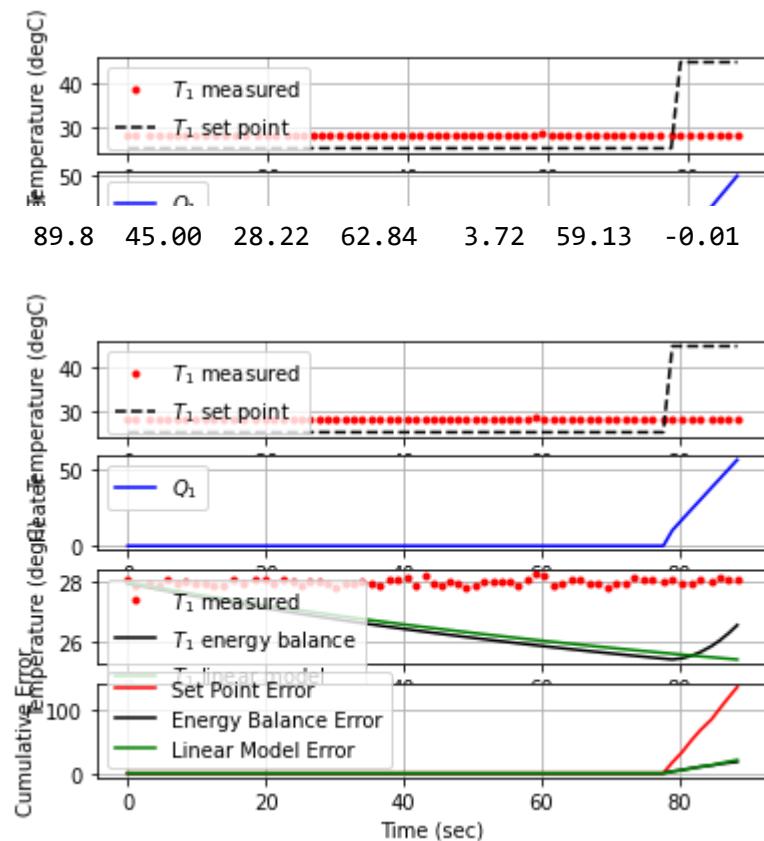
84.7 45.00 28.05 37.93 3.75 34.17 0.00



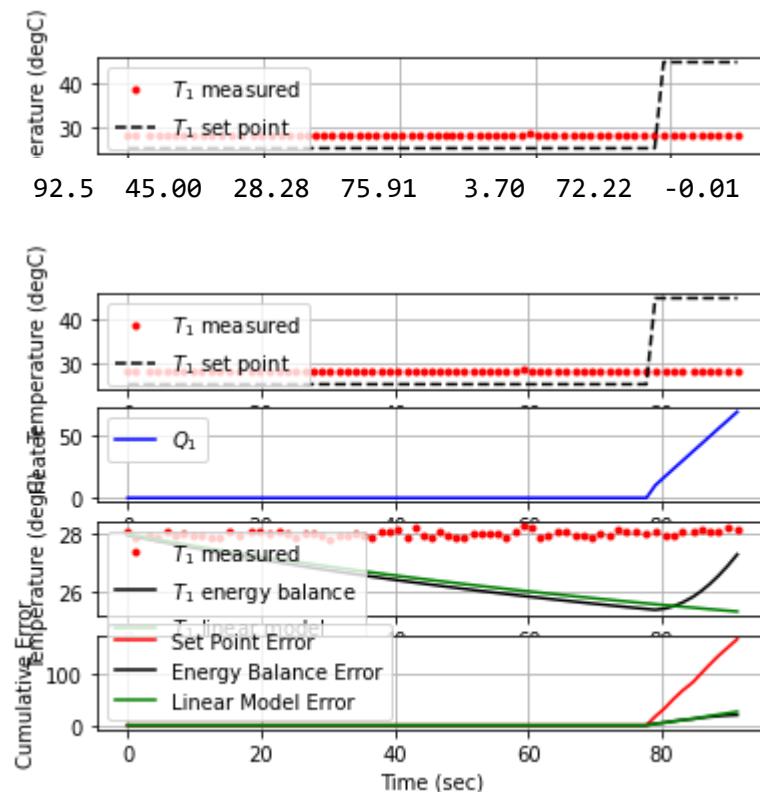
85.9 45.00 28.16 43.63 3.73 39.91 -0.01



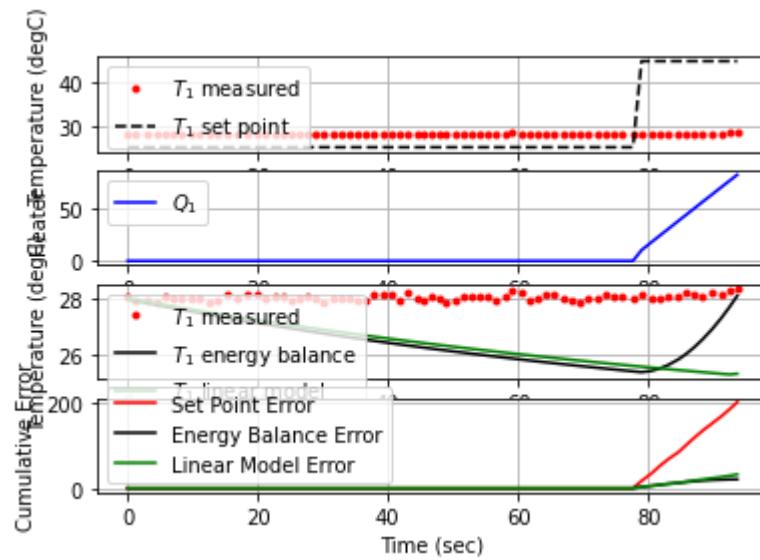
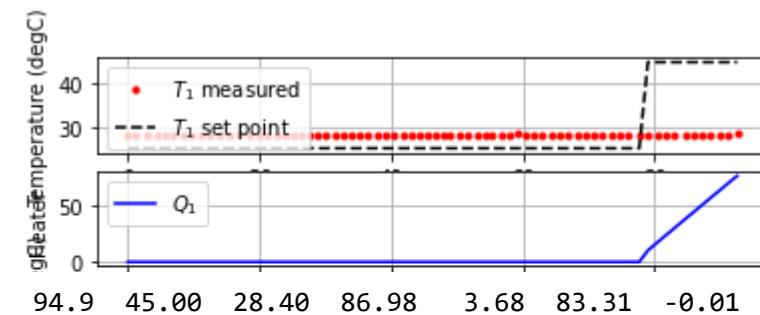
88.4 45.00 28.07 55.95 3.75 52.20 0.00



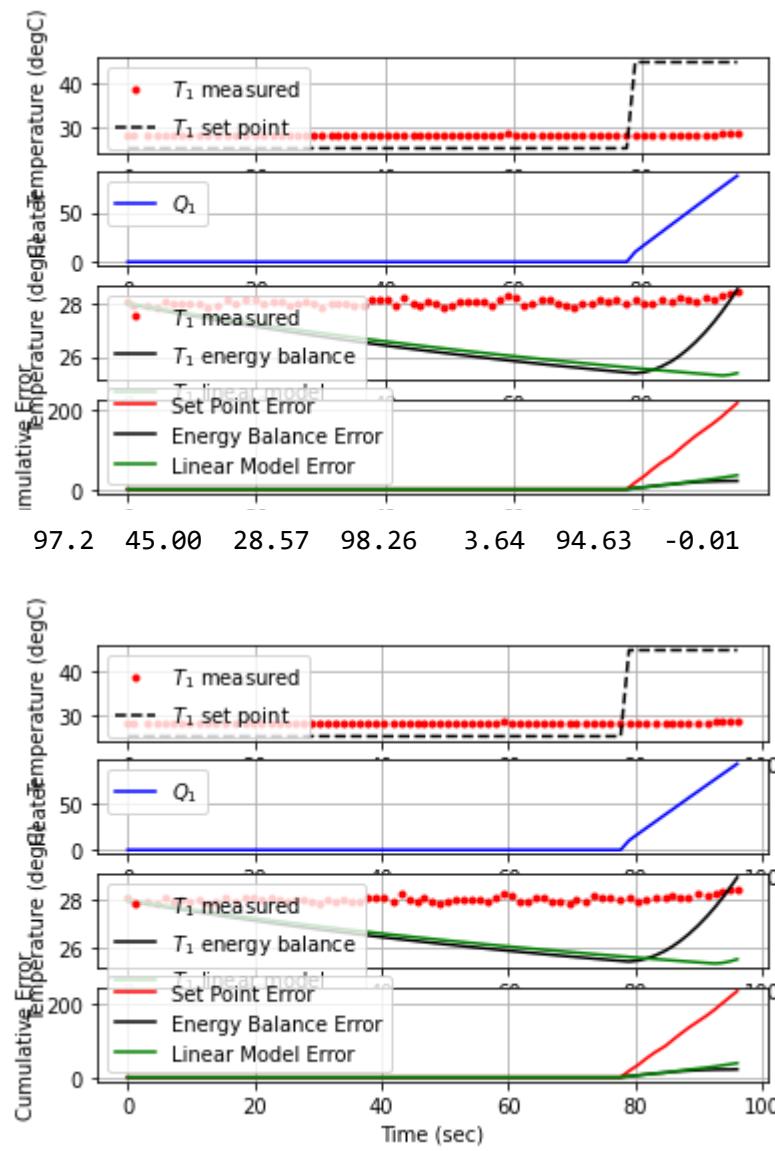
91.3 45.00 28.15 69.81 3.73 66.08 0.00



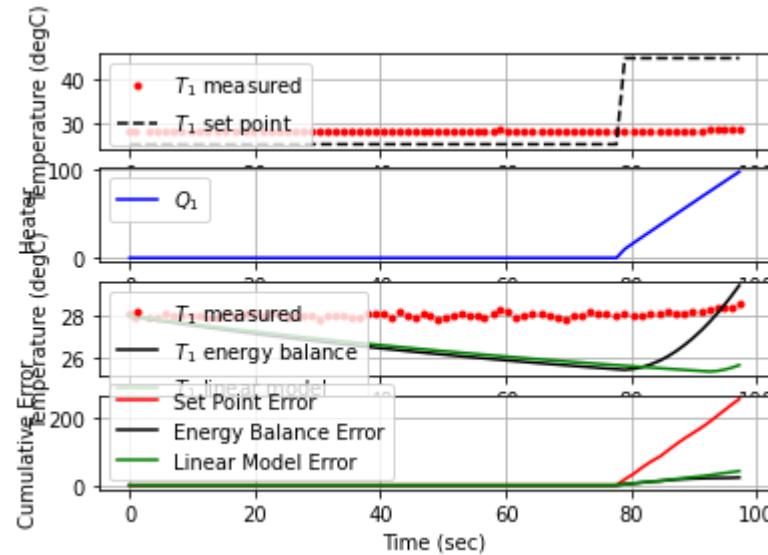
93.7 45.00 28.33 81.42 3.69 77.73 -0.00



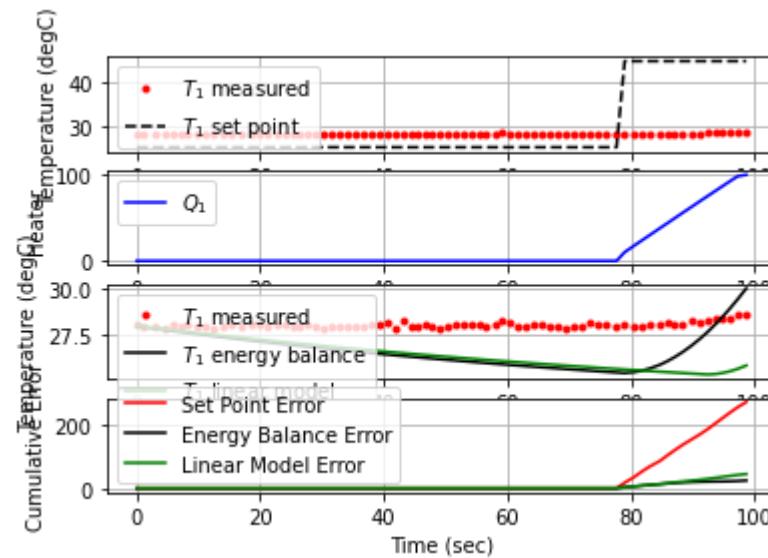
96.0 45.00 28.39 92.57 3.68 88.89 0.00



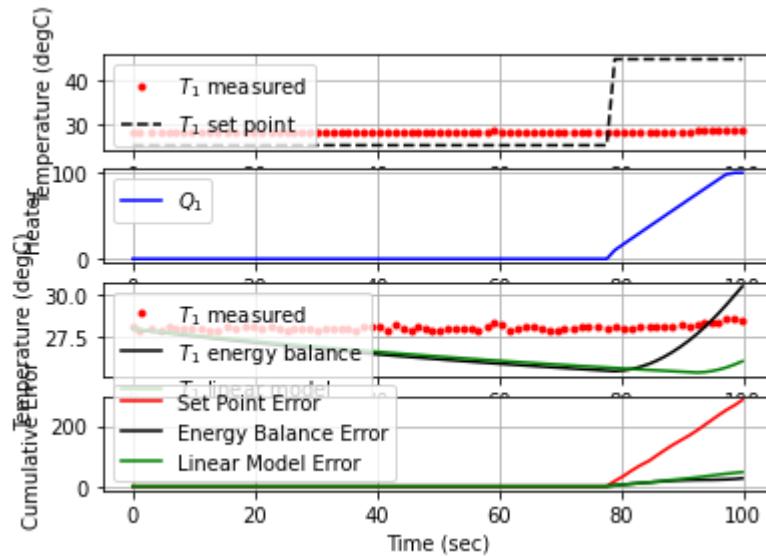
98.7 45.00 28.55 100.00 3.64 94.63 0.00



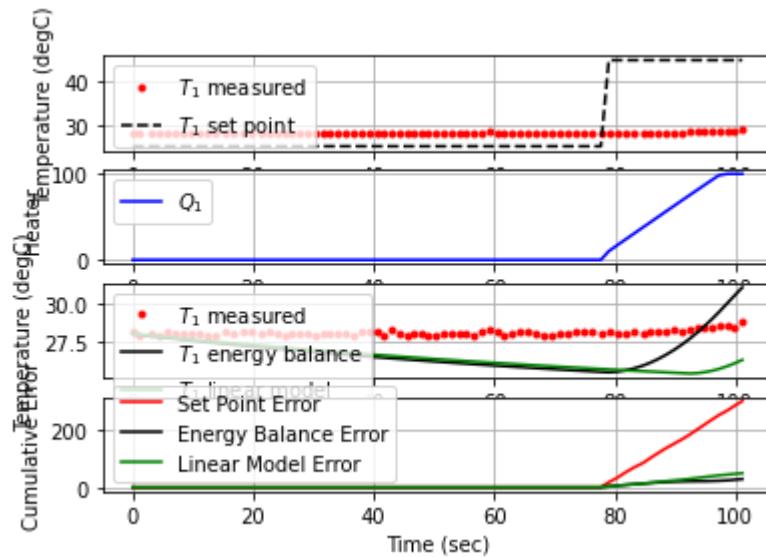
99.9 45.00 28.44 100.00 3.67 94.63 0.01



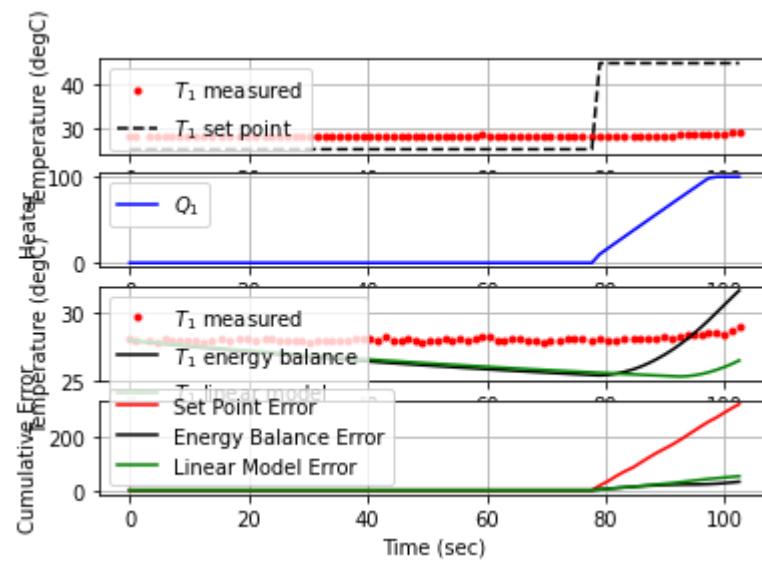
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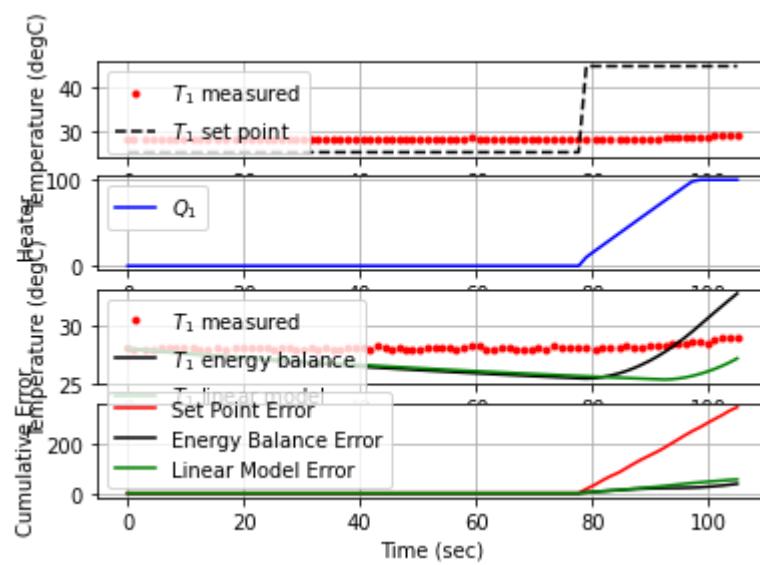
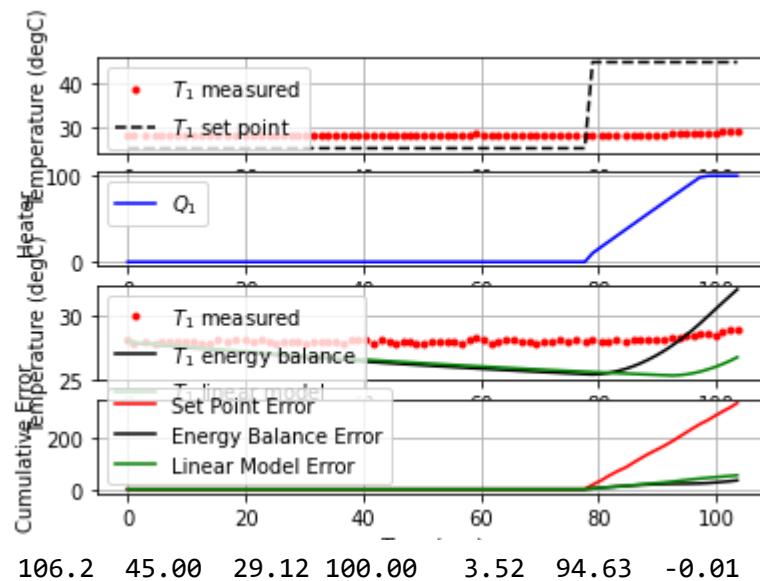
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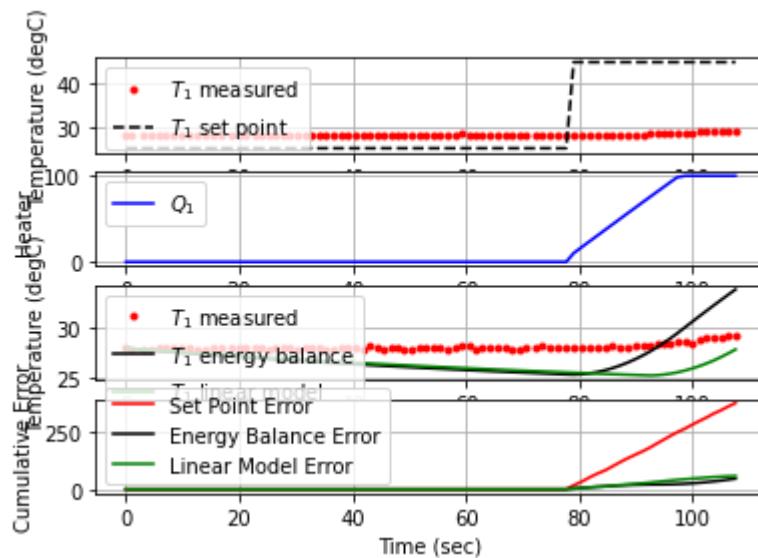
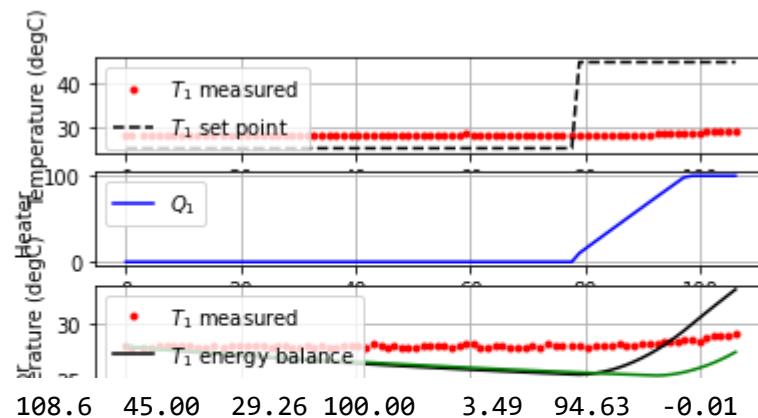


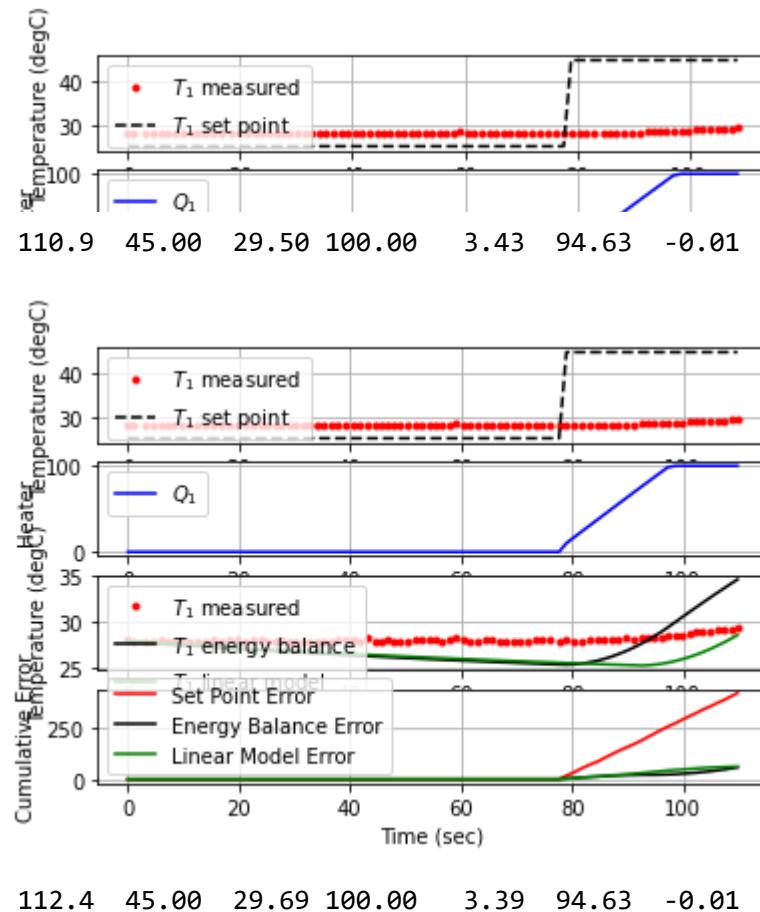
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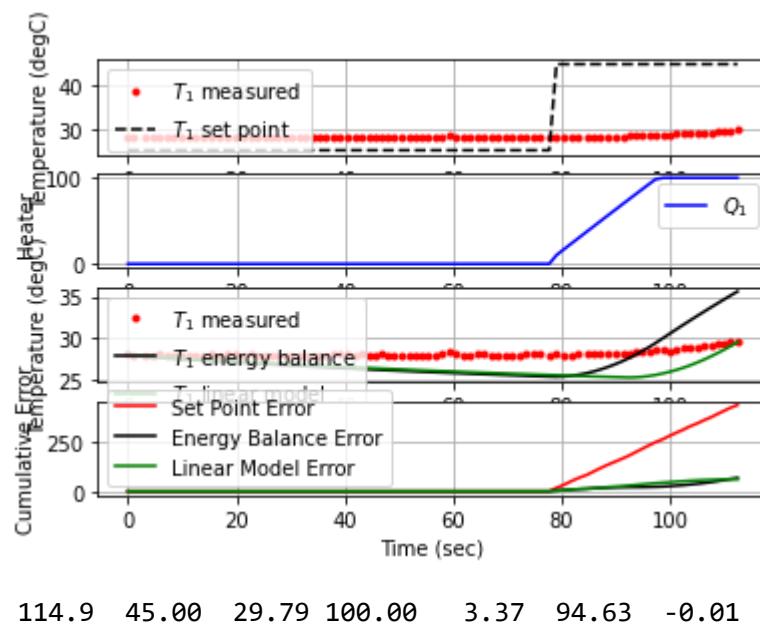
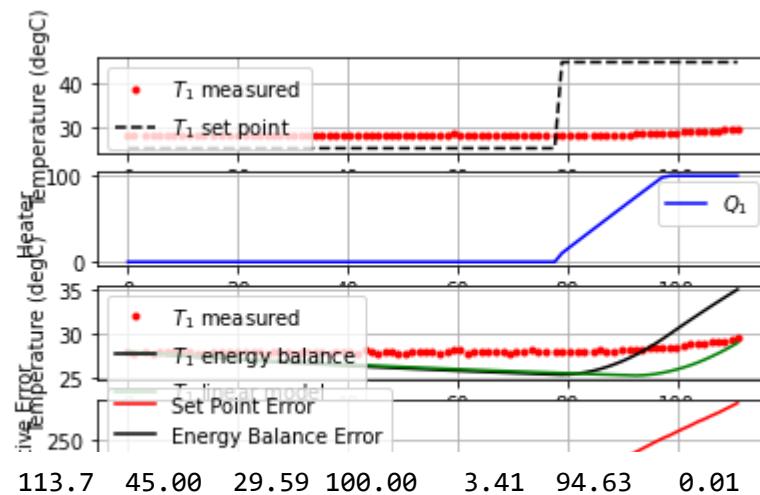


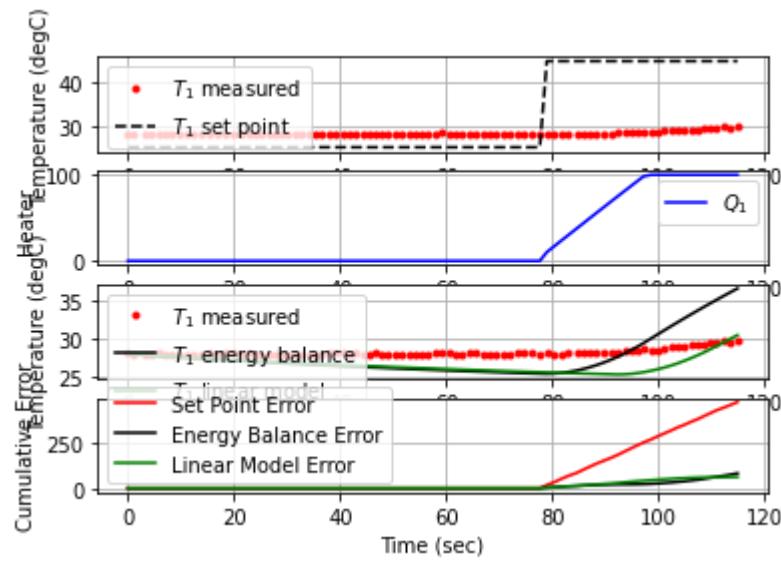
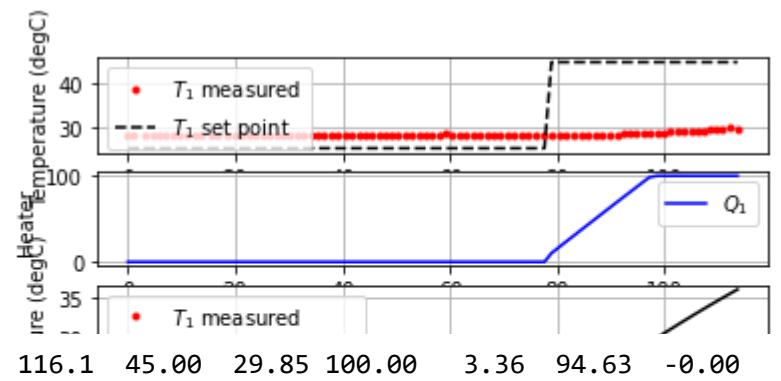
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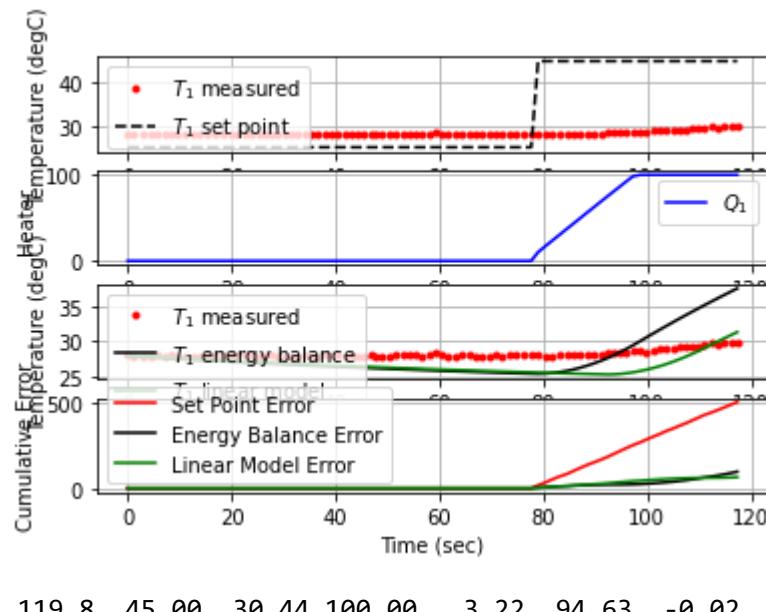
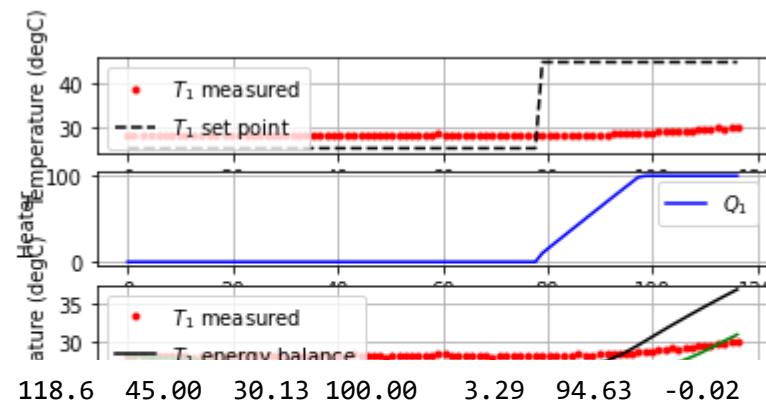


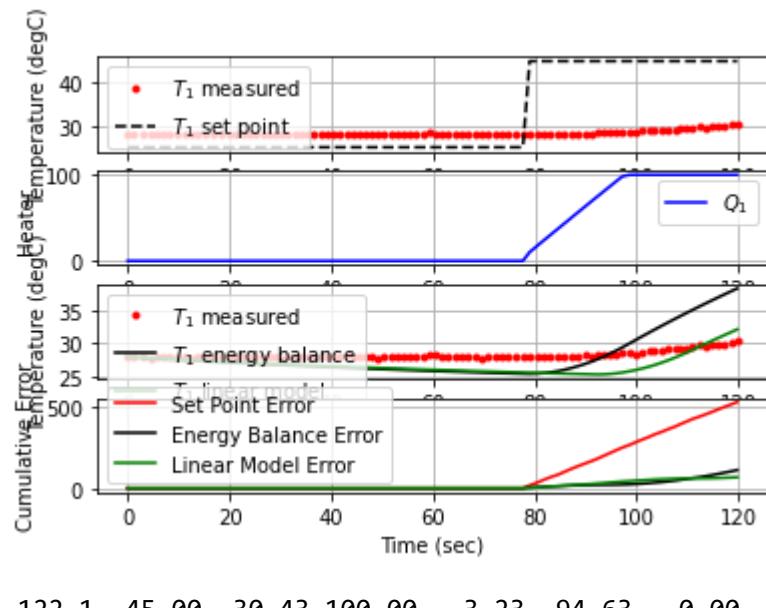
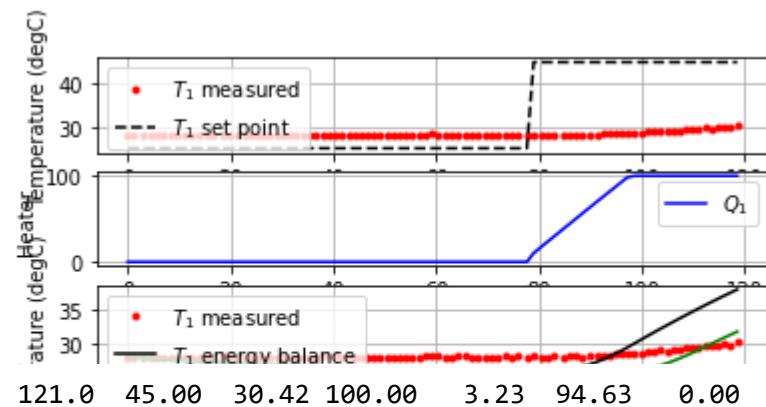


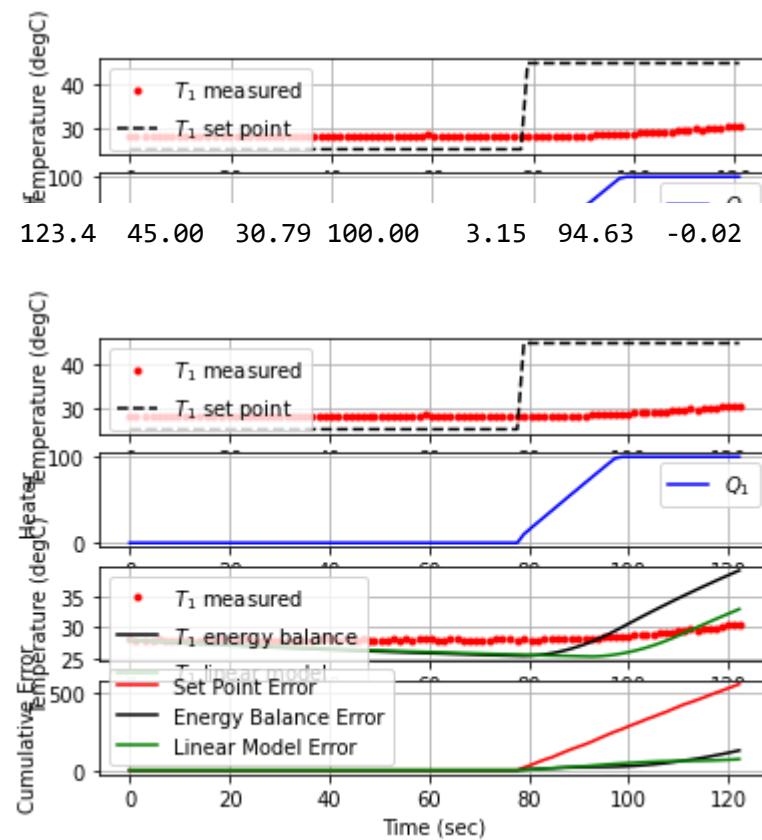




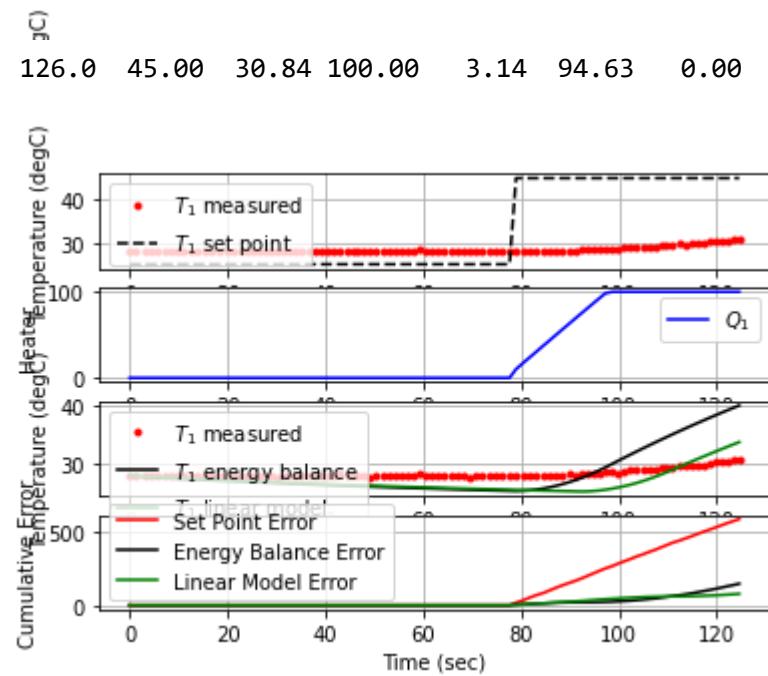




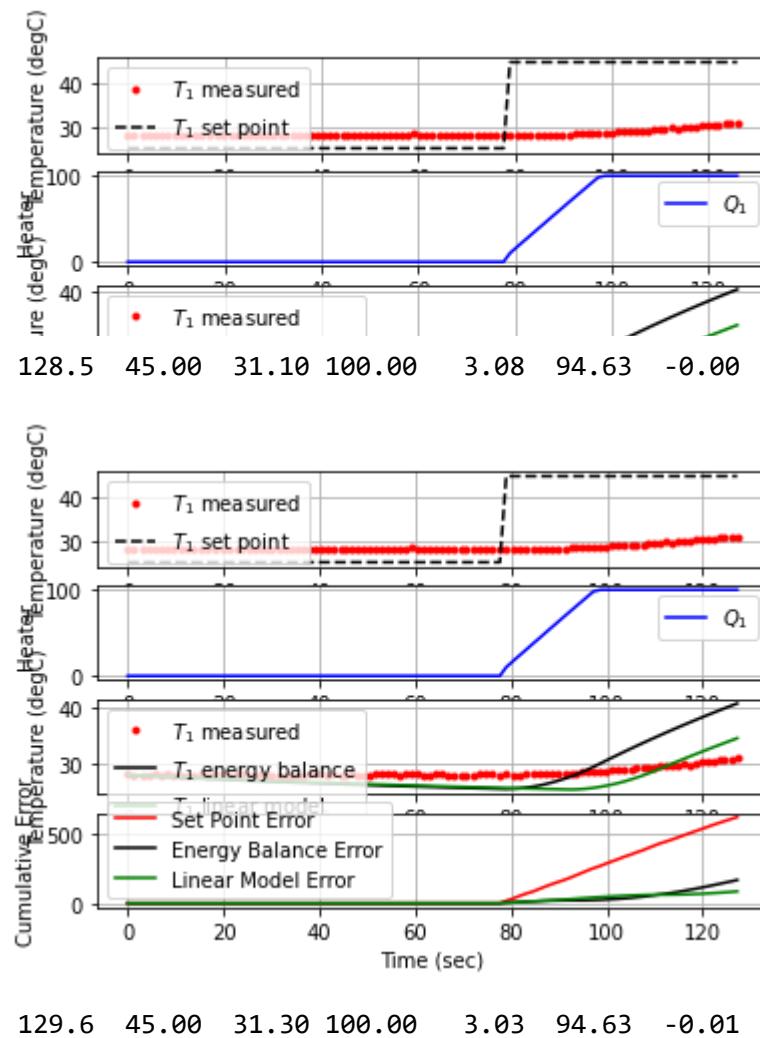


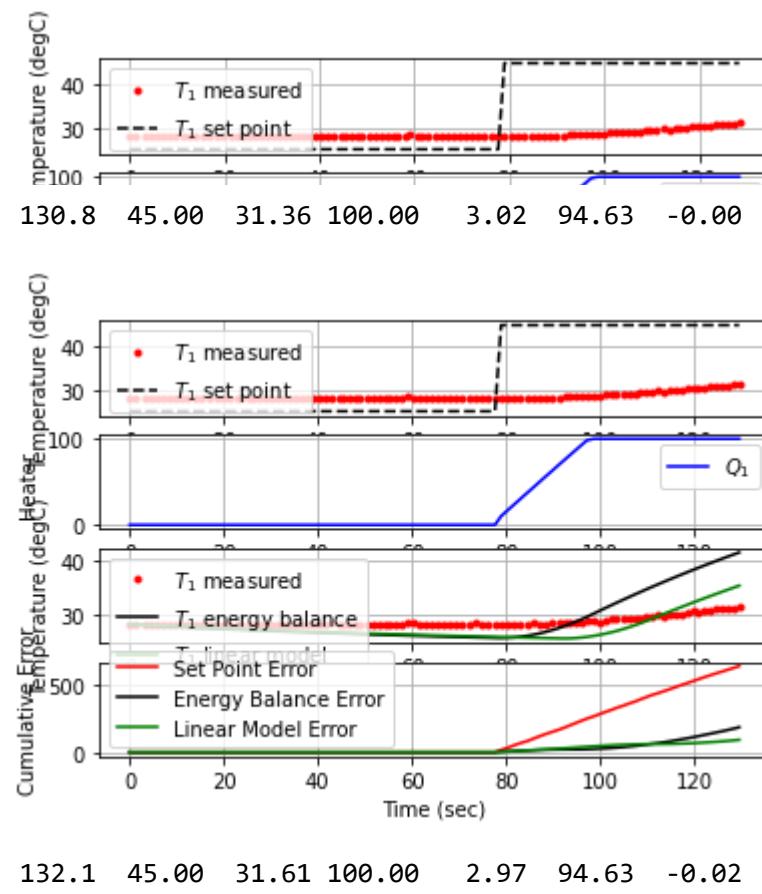


124.6 45.00 30.88 100.00 3.13 94.63 -0.01

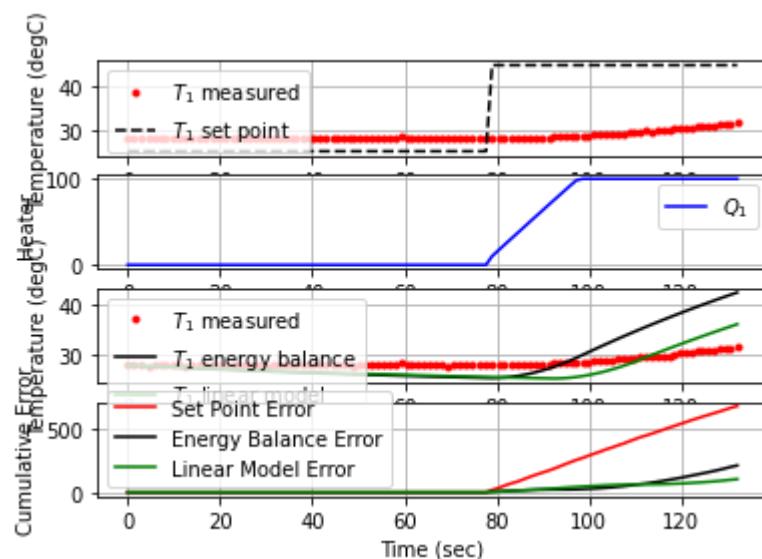


127.2 45.00 31.03 100.00 3.09 94.63 -0.01

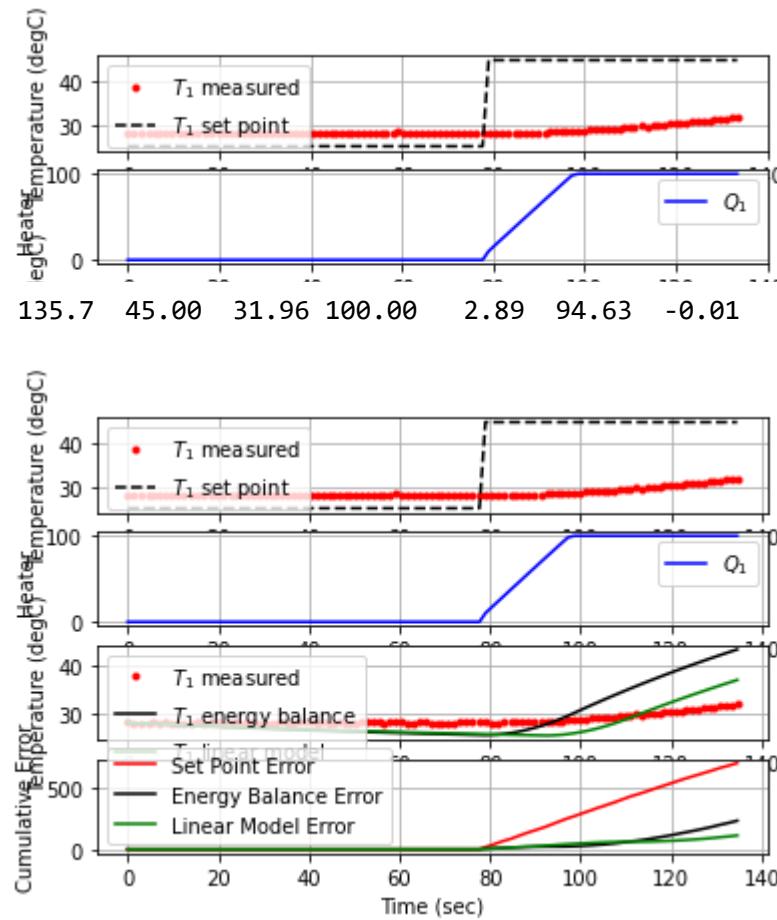




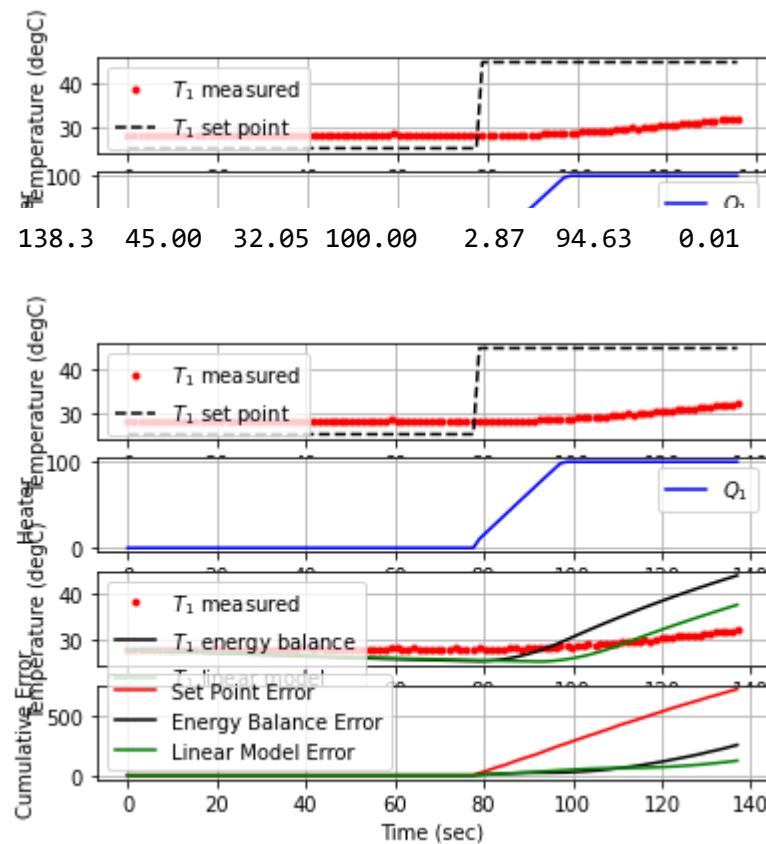
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133.4 45.00 31.70 100.00 2.95 94.63 -0.01
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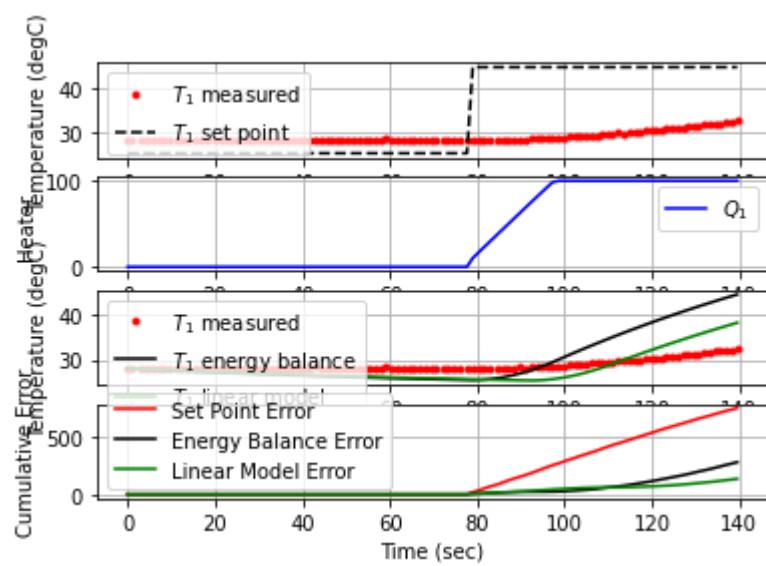
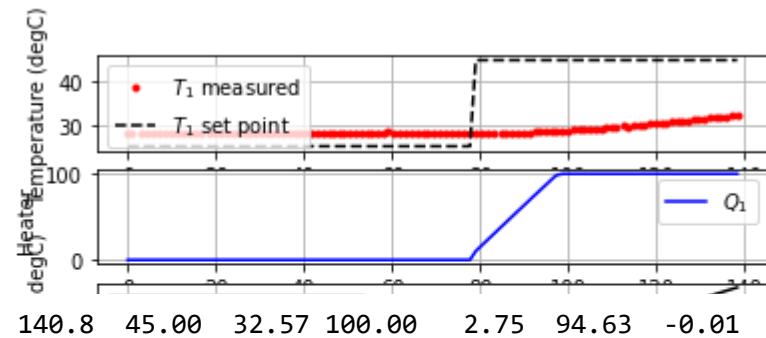
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134.6 45.00 31.88 100.00 2.91 94.63 -0.01
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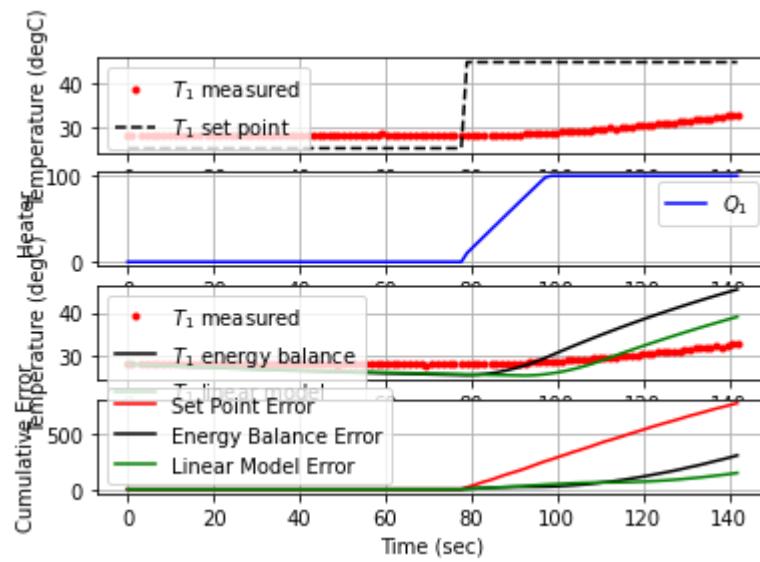
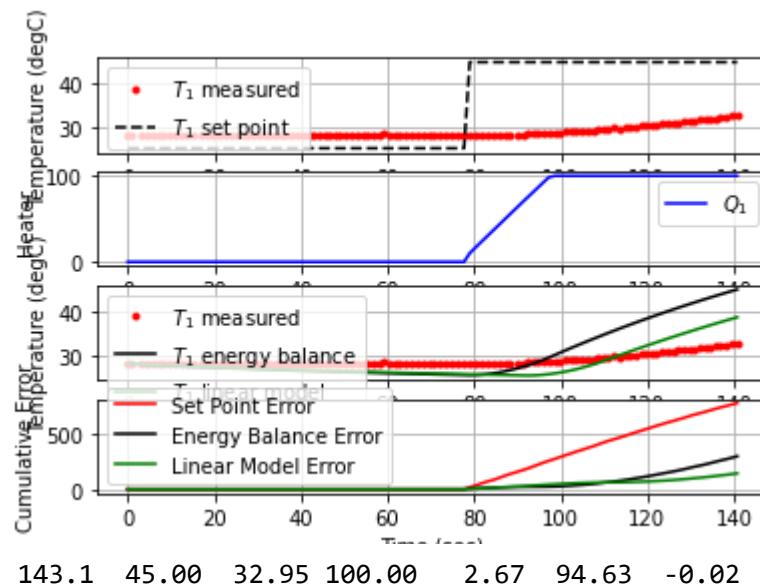
137.0 45.00 32.13 100.00 2.85 94.63 -0.01



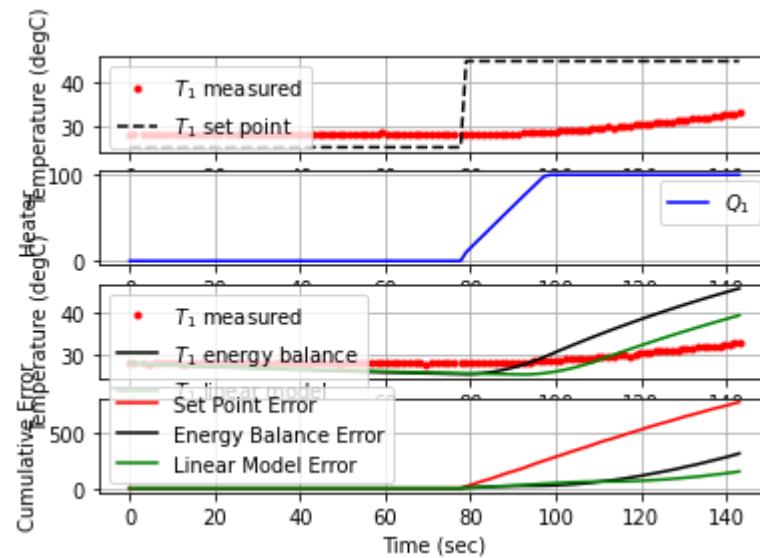
139.5 45.00 32.44 100.00 2.78 94.63 -0.03



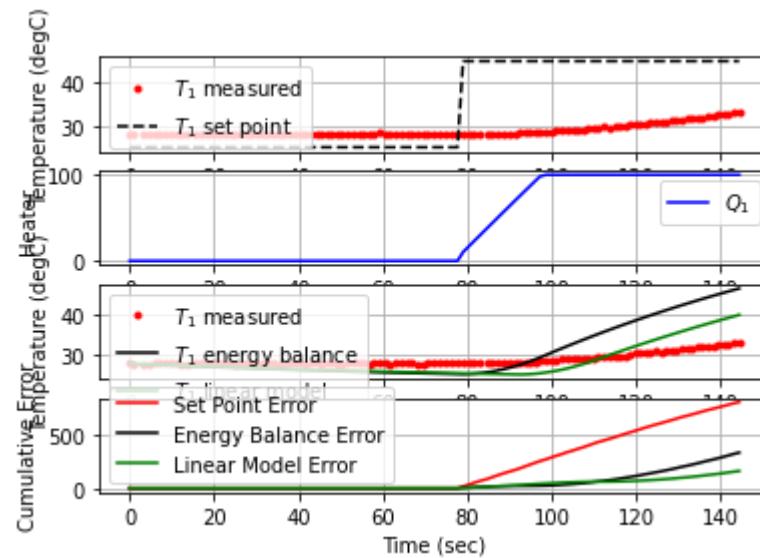
141.9 45.00 32.69 100.00 2.73 94.63 -0.01

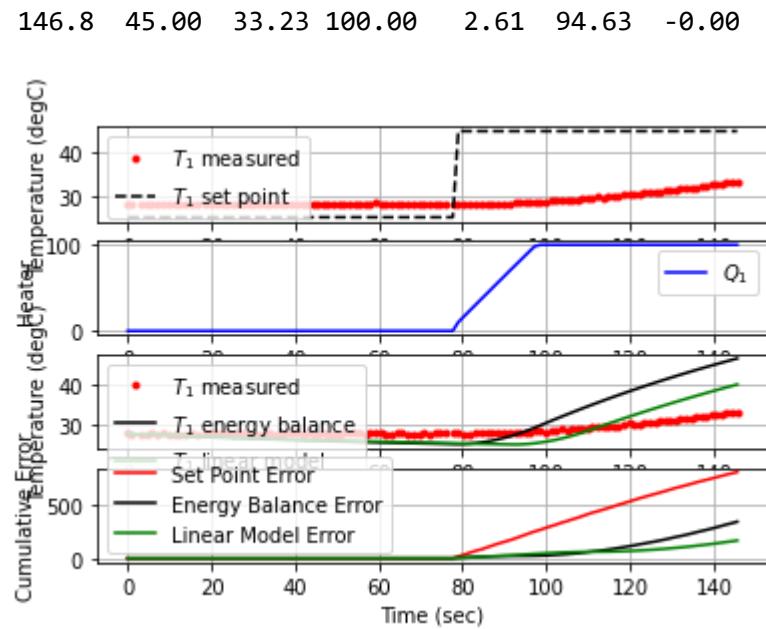


144.4 45.00 32.92 100.00 2.68 94.63 0.00

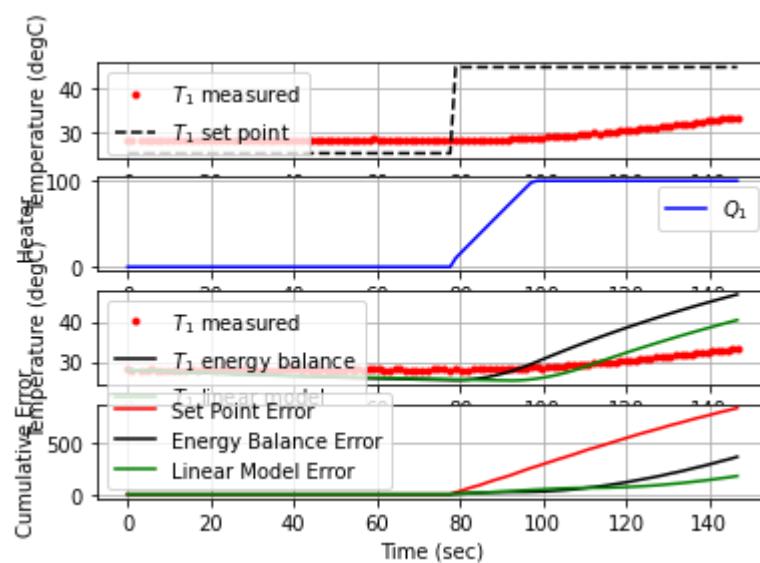


145.6 45.00 33.17 100.00 2.62 94.63 -0.02

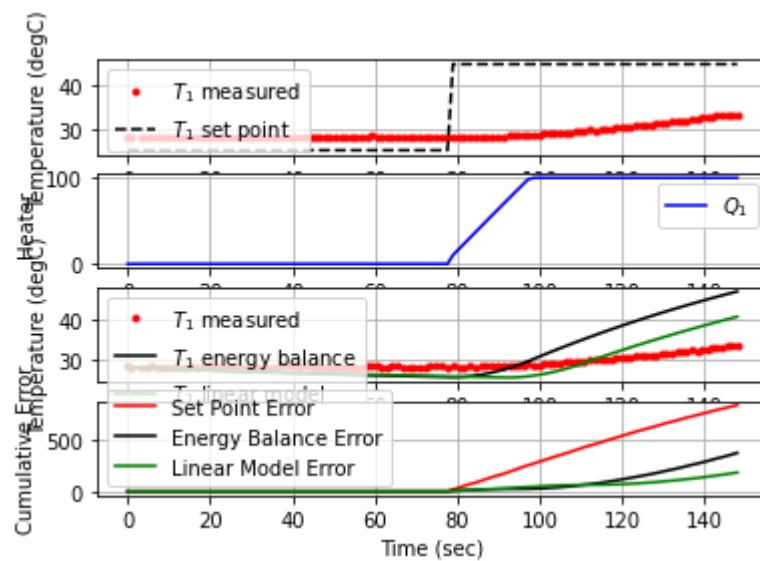




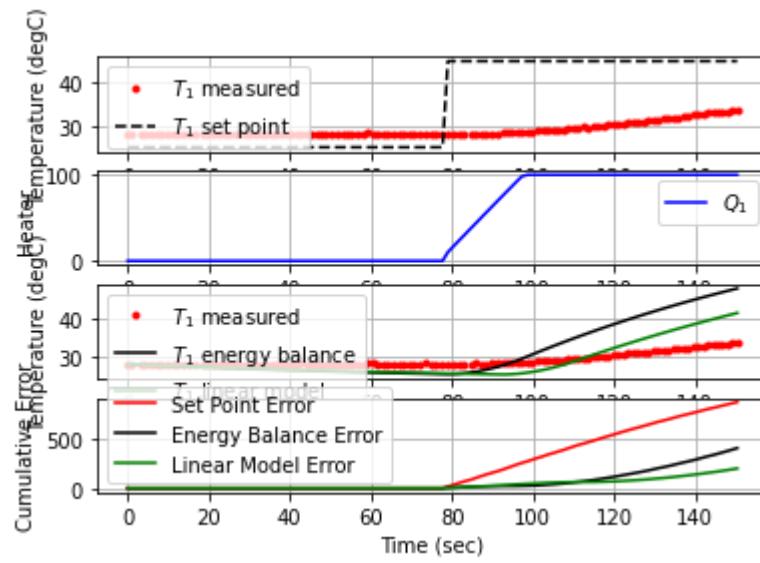
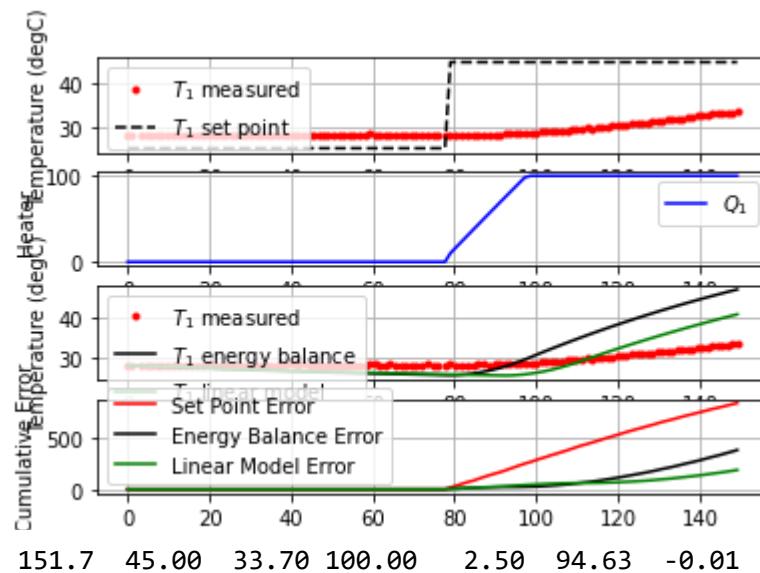
148.0 45.00 33.30 100.00 2.59 94.63 -0.00

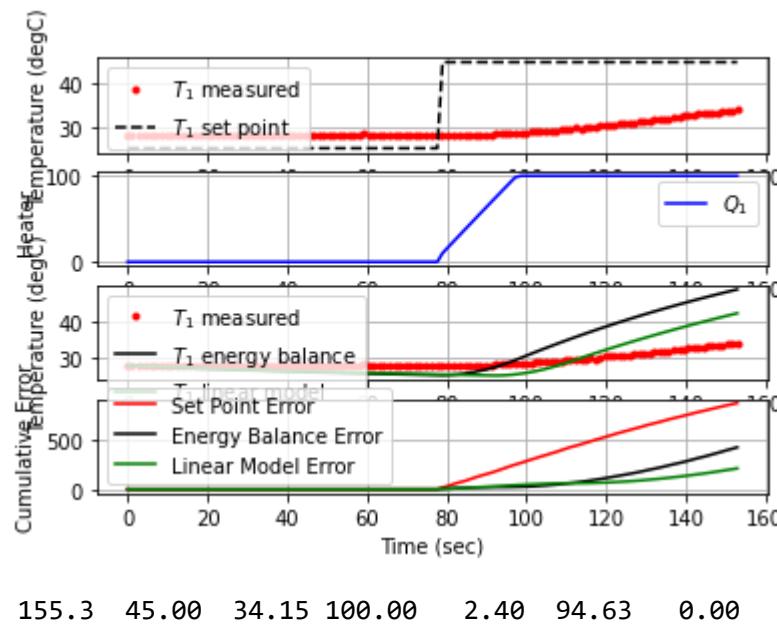
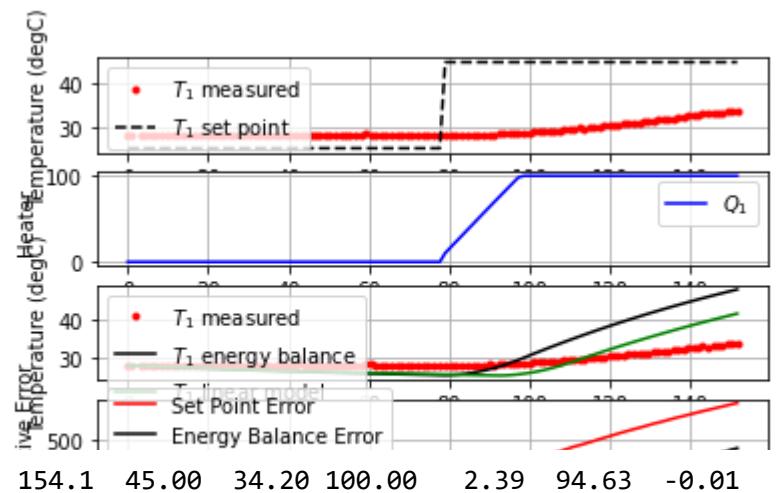


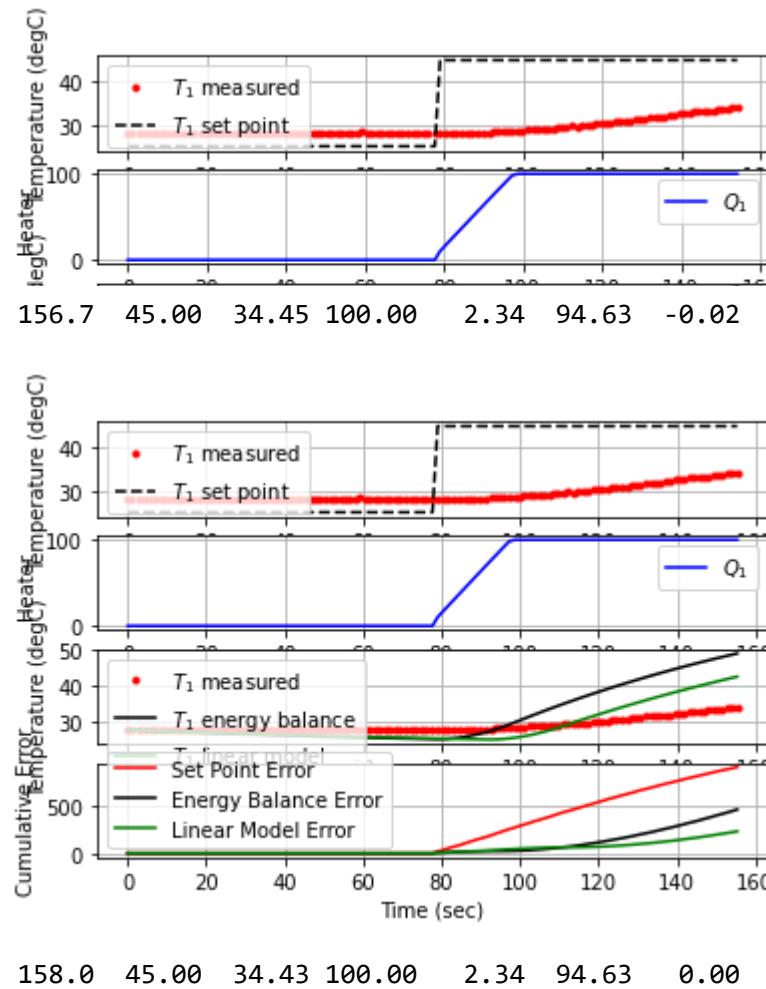
149.2 45.00 33.54 100.00 2.54 94.63 -0.02

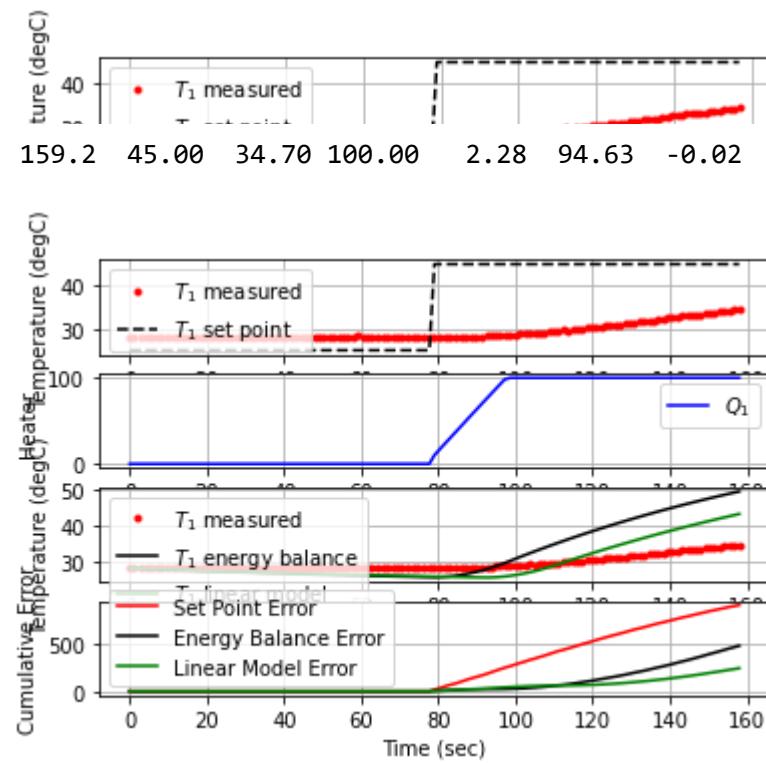


150.4 45.00 33.62 100.00 2.52 94.63 -0.01

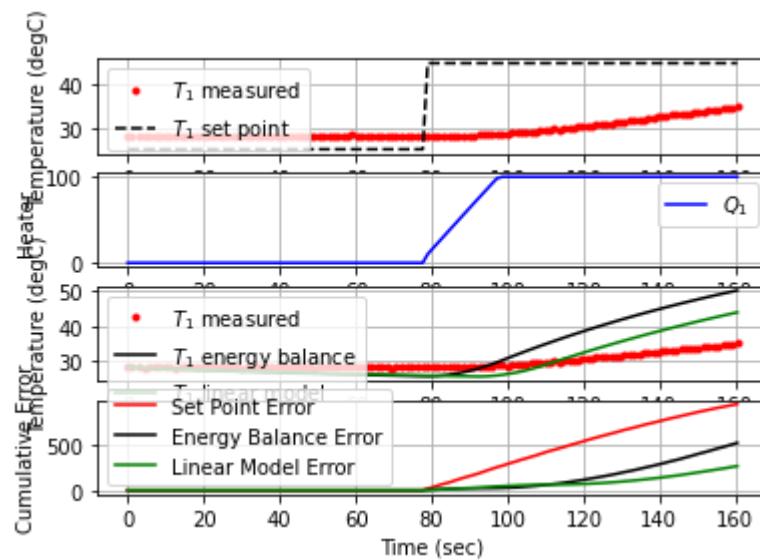
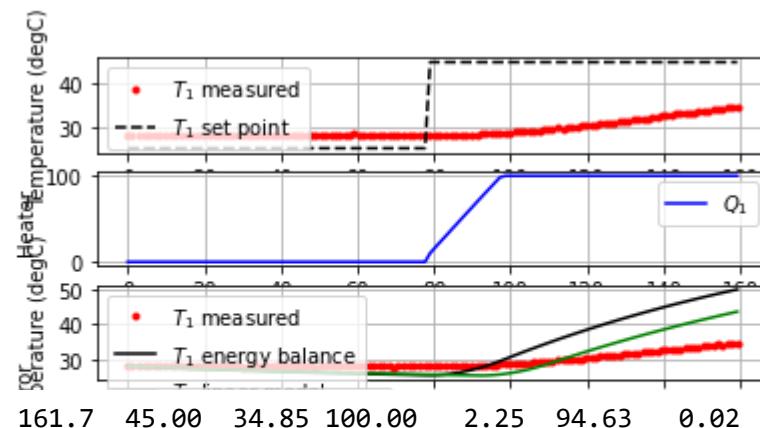


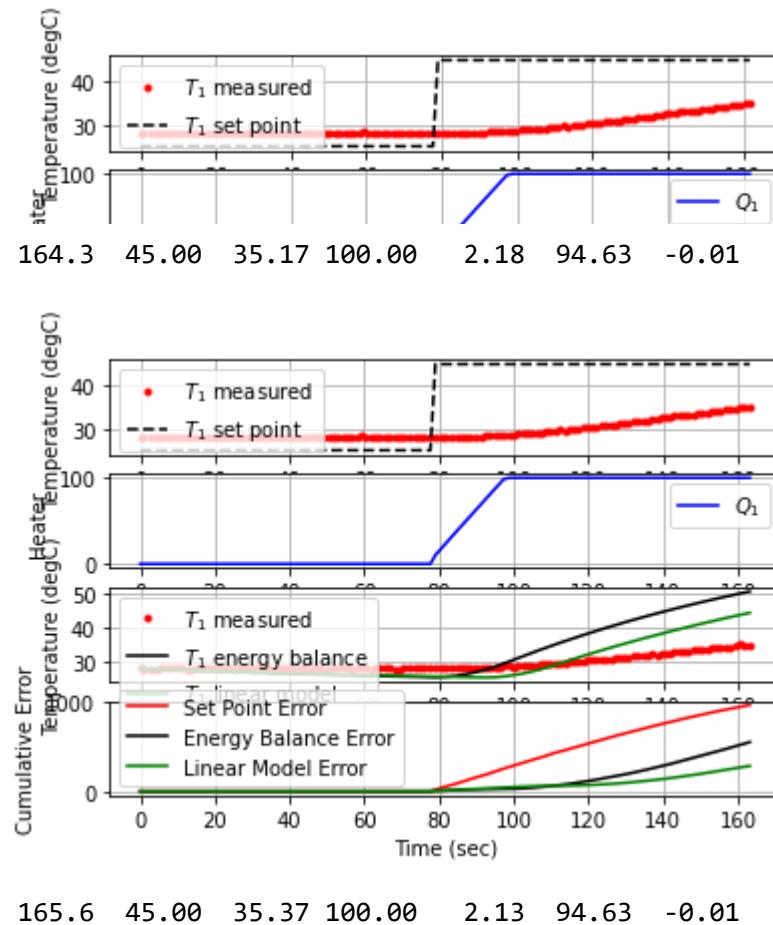


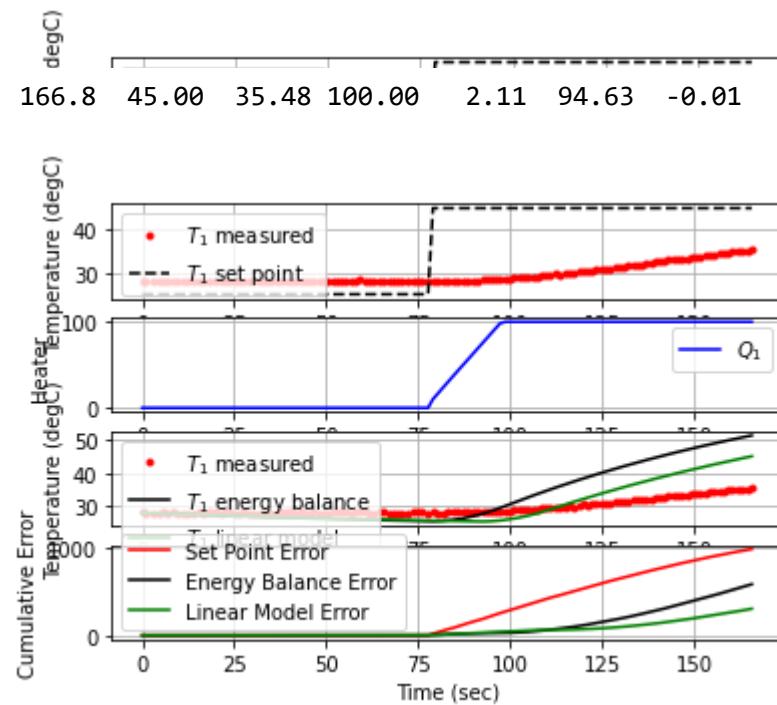




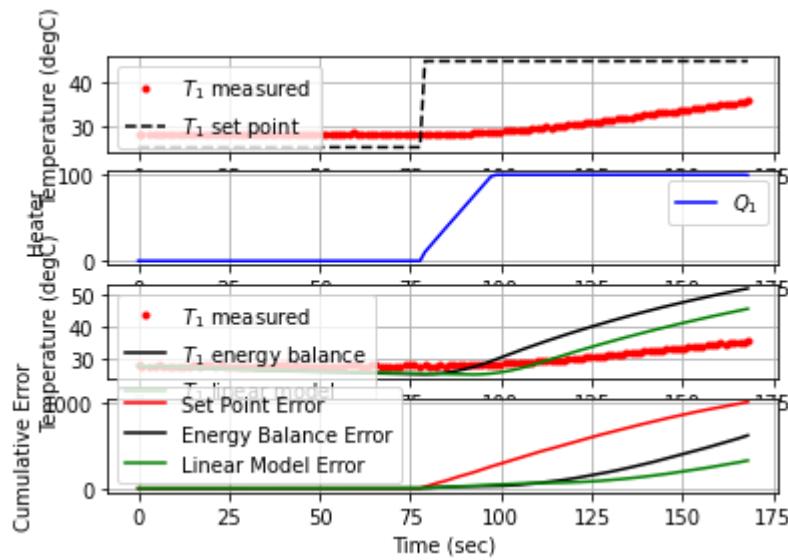
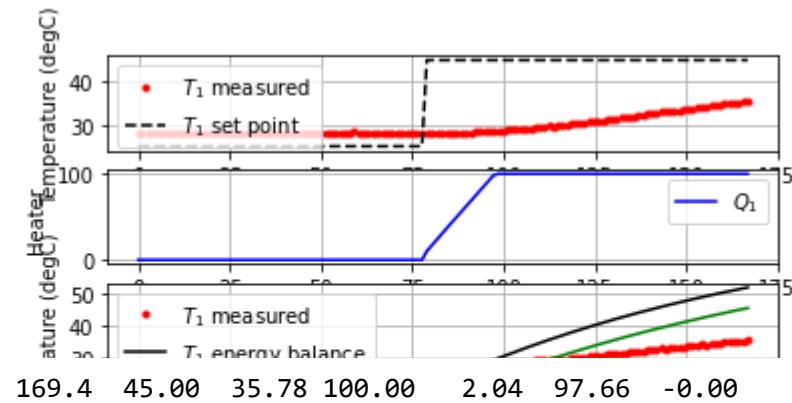
160.5 45.00 35.09 100.00 2.19 94.63 -0.03

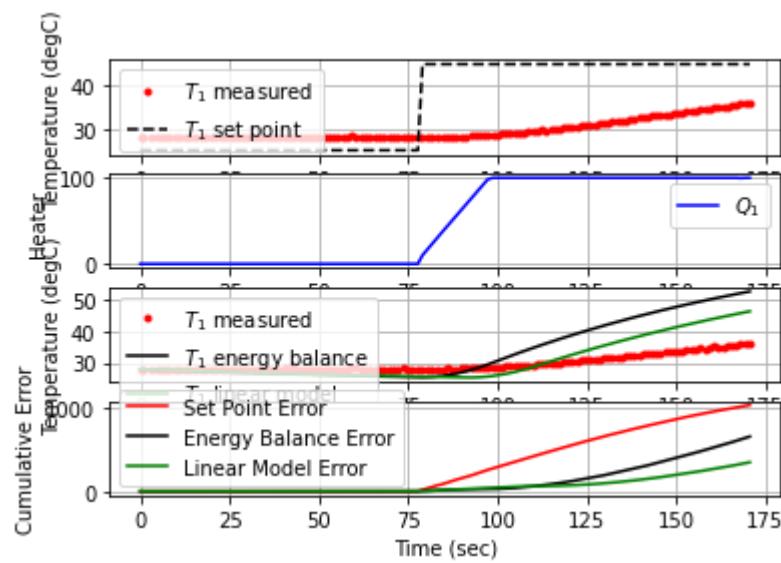
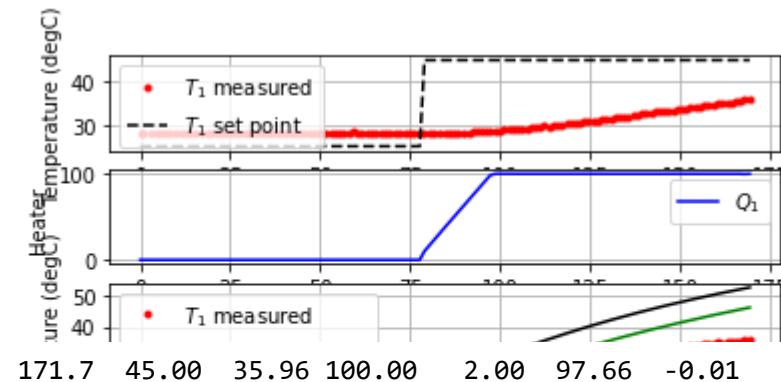


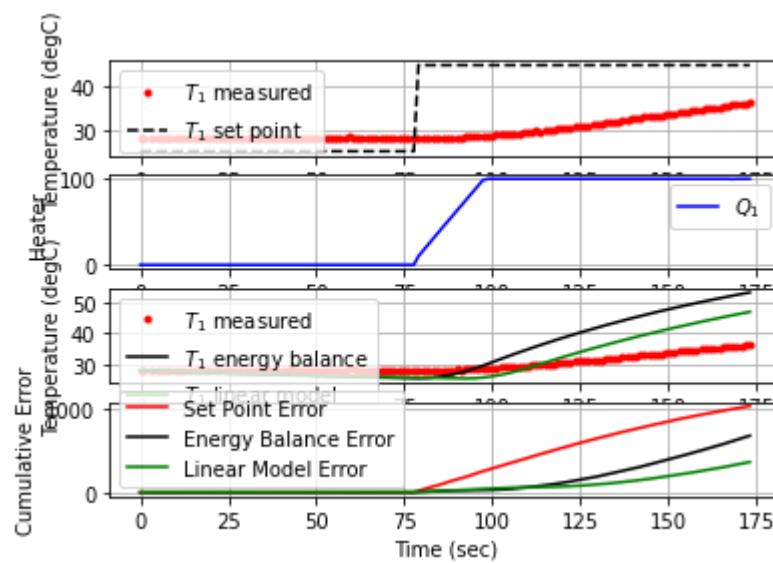
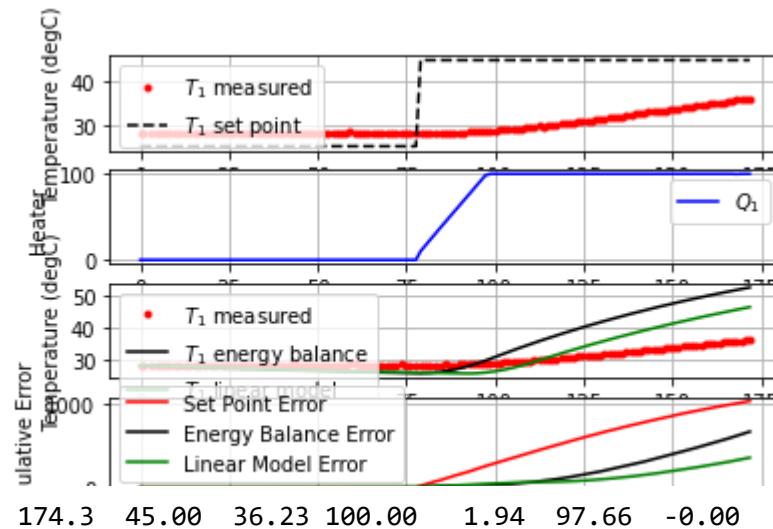




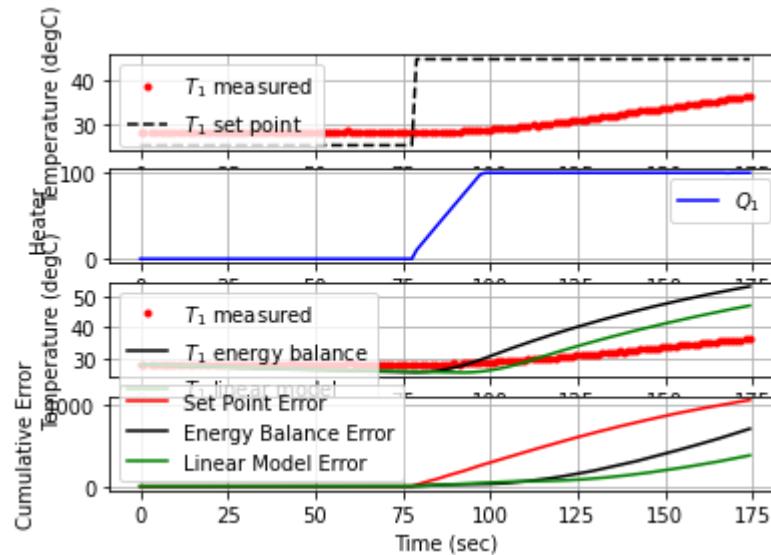
168.0 45.00 35.75 99.69 2.05 97.66 -0.02



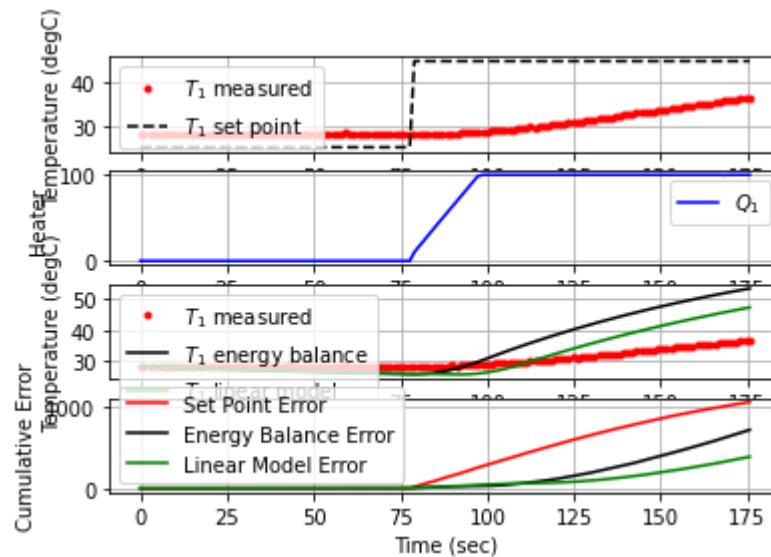


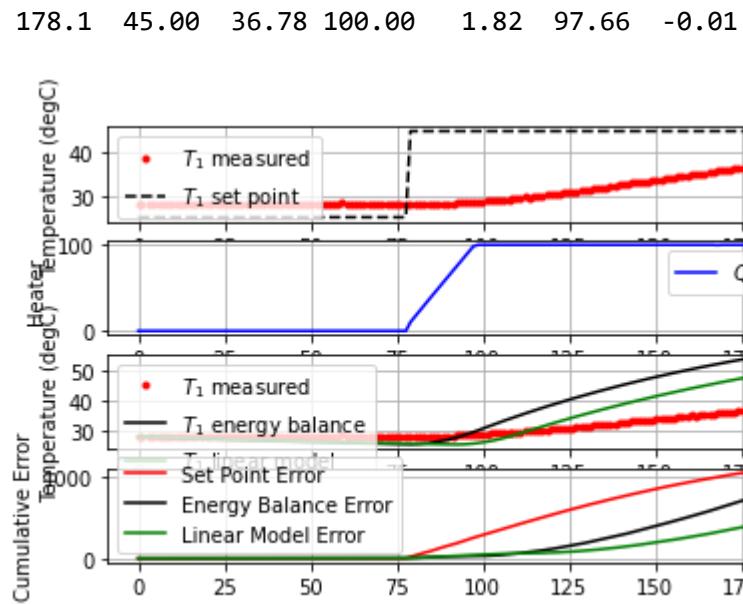


175.6 45.00 36.51 100.00 1.88 97.66 -0.02

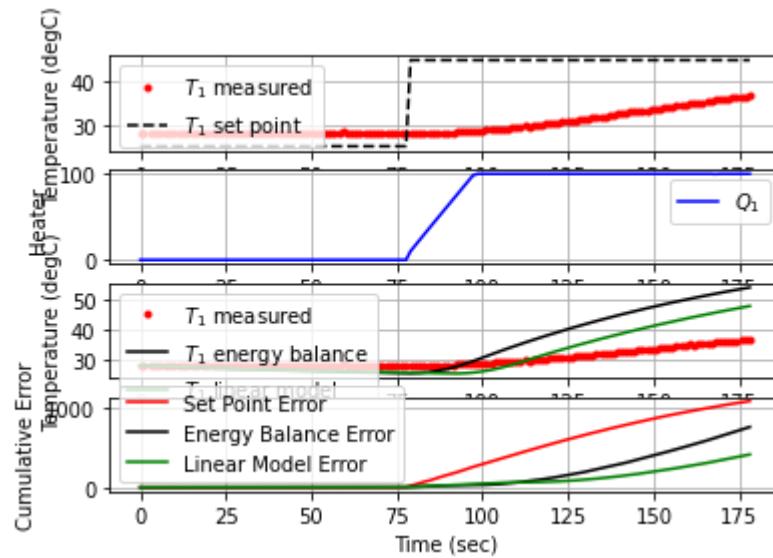


176.9 45.00 36.57 100.00 1.87 97.66 -0.00

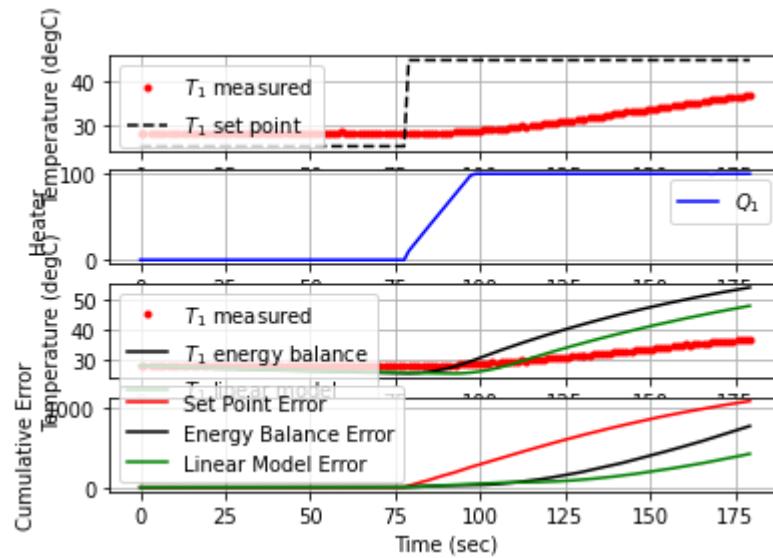




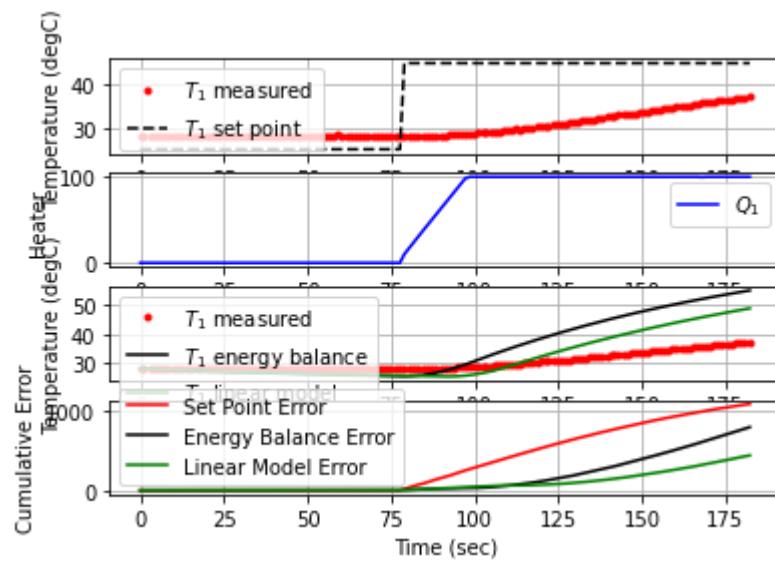
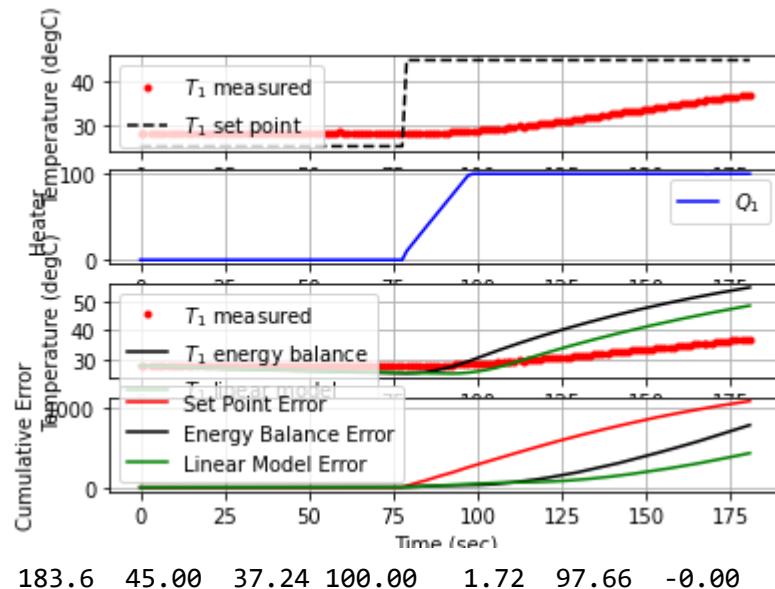
179.3 45.00 36.77 100.00 1.82 97.66 0.00



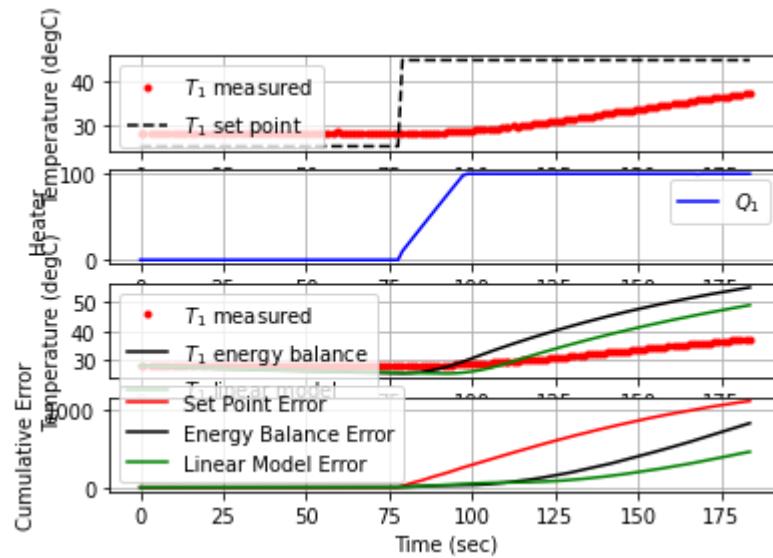
180.7 45.00 36.85 100.00 1.81 97.66 -0.01



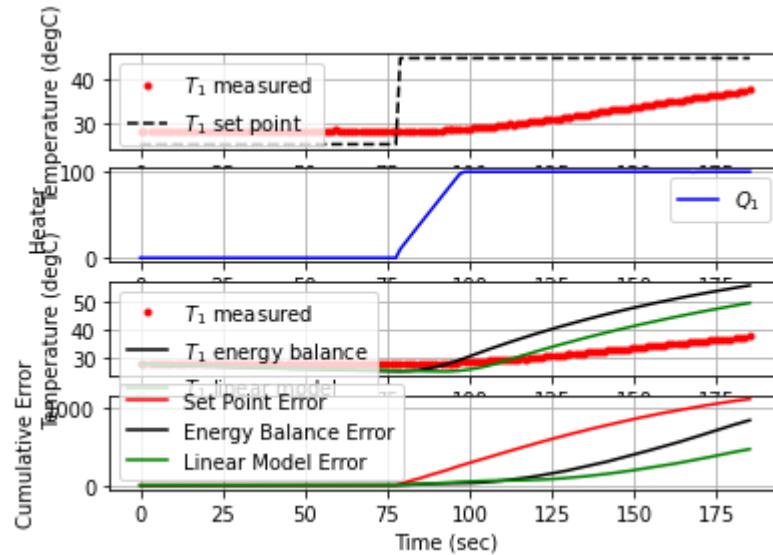
182.3 45.00 37.21 100.00 1.73 97.66 -0.02



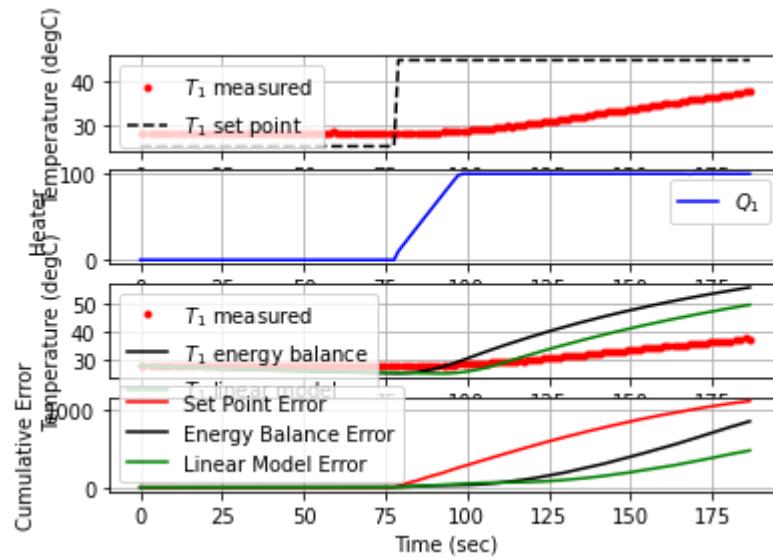
185.2	45.00	37.72	100.00	1.61	97.66	-0.03
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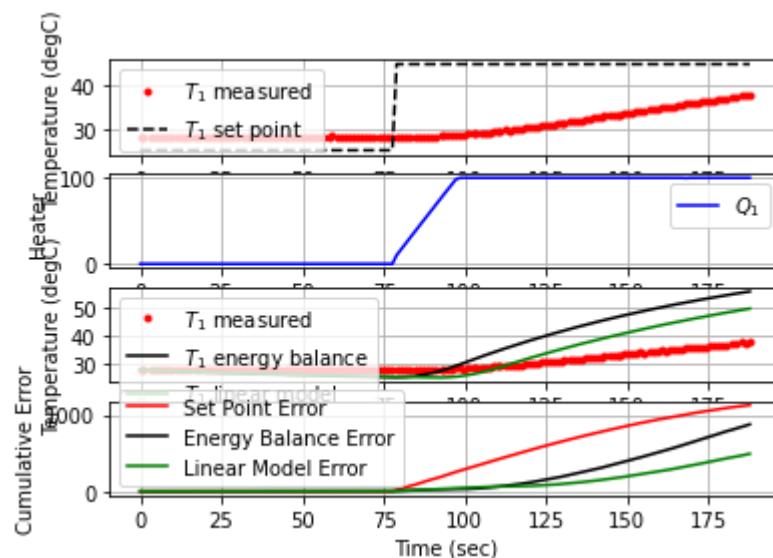
186.5 45.00 37.58 100.00 1.64 97.66 0.01



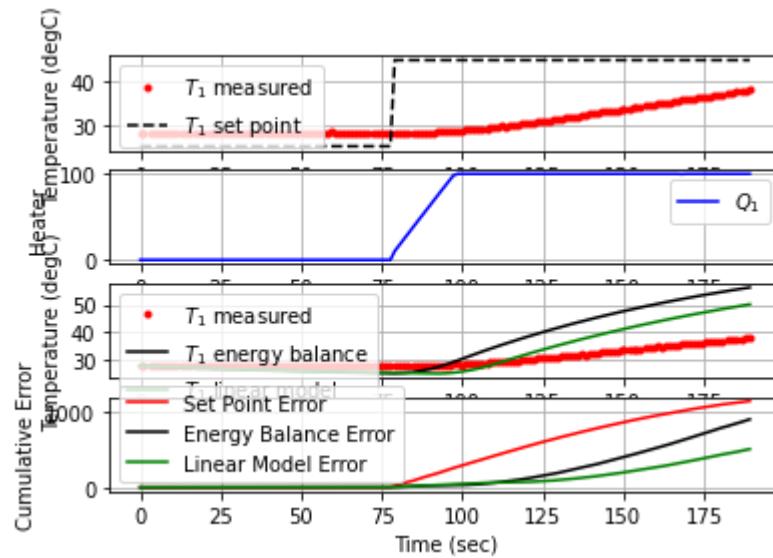
187.8 45.00 37.89 100.00 1.57 97.66 -0.02



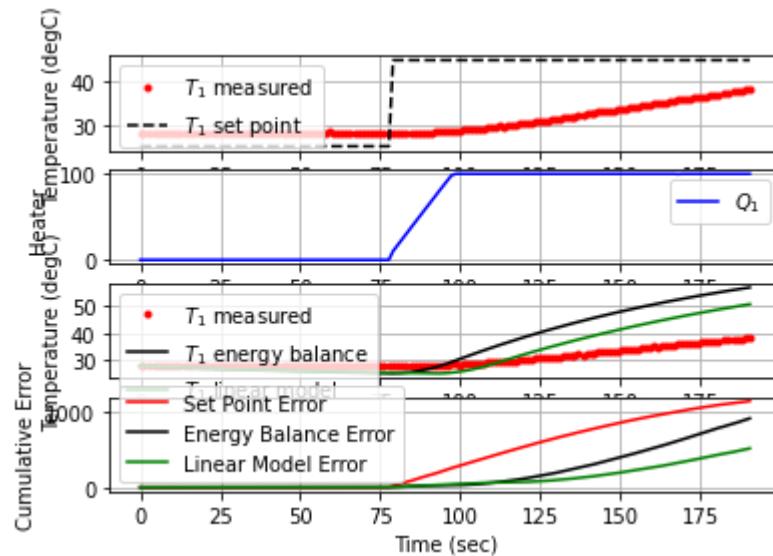
189.2 45.00 38.12 100.00 1.52 97.66 -0.01



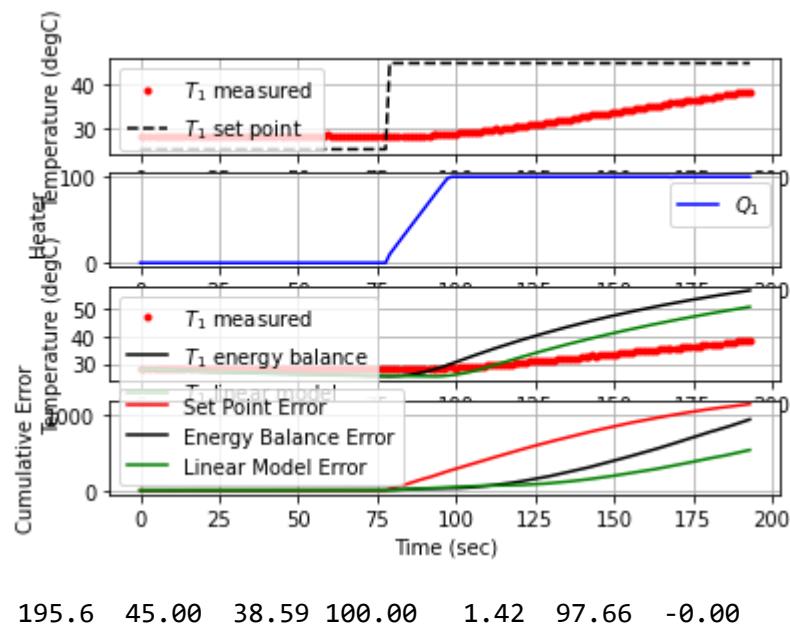
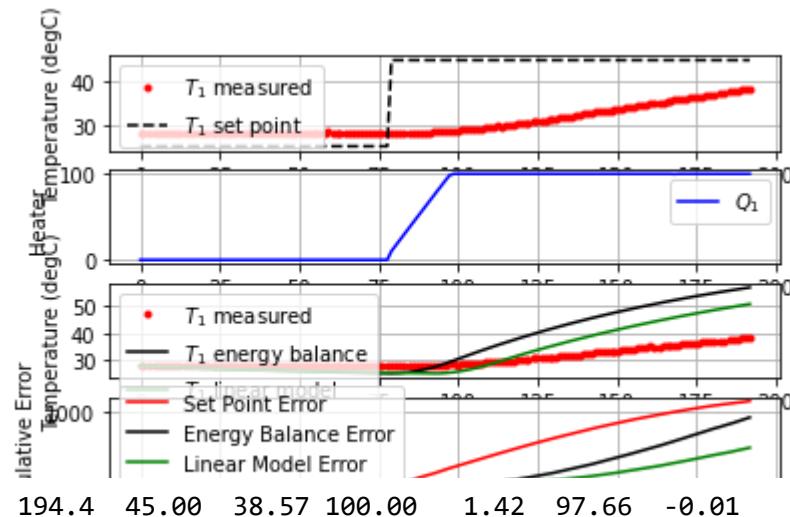
190.4 45.00 38.08 100.00 1.53 97.66 0.00

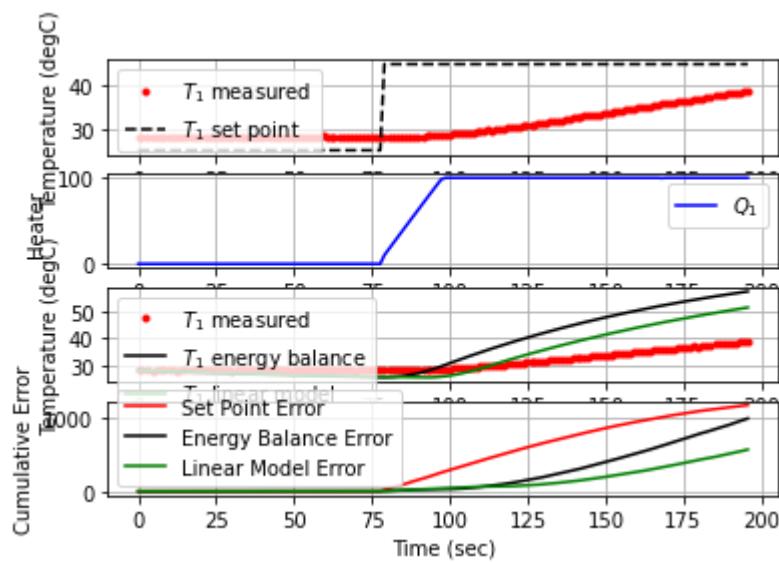
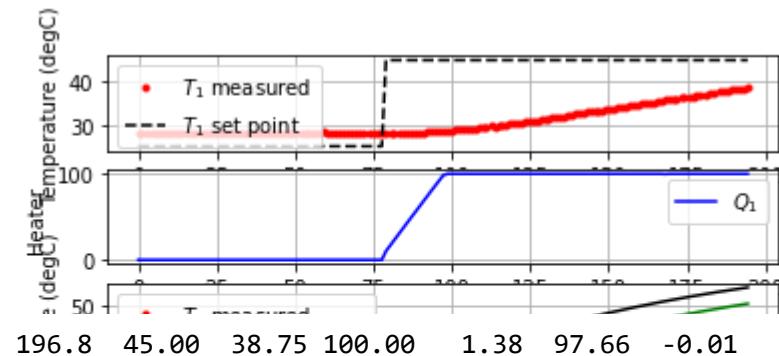


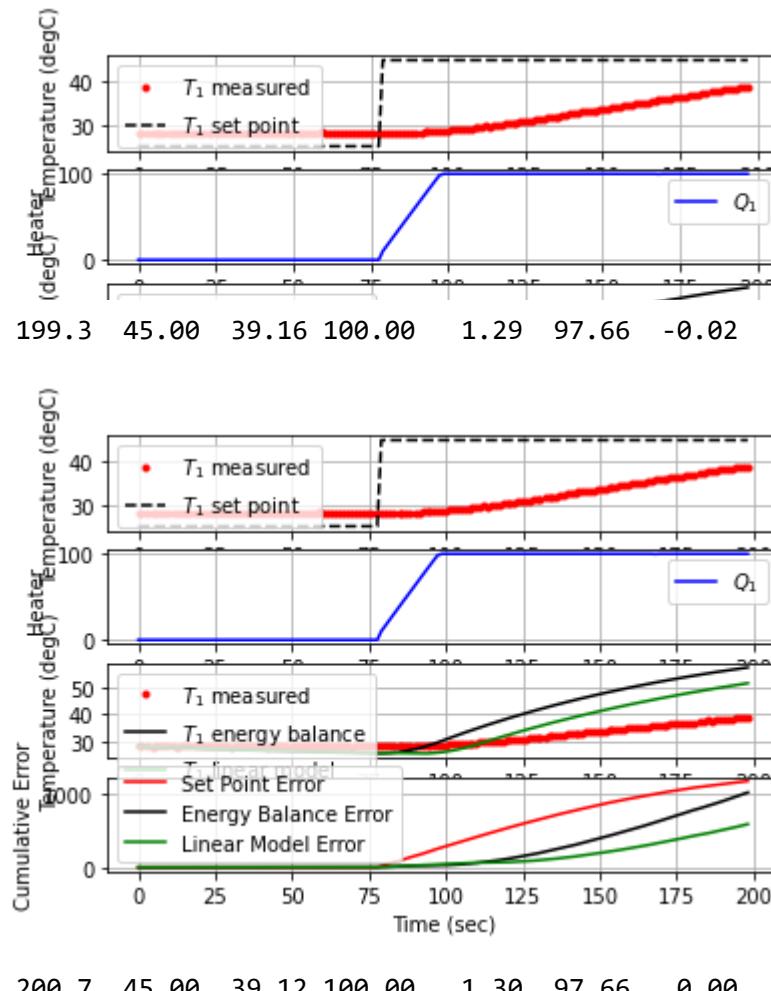
191.7 45.00 38.25 100.00 1.49 97.66 -0.01

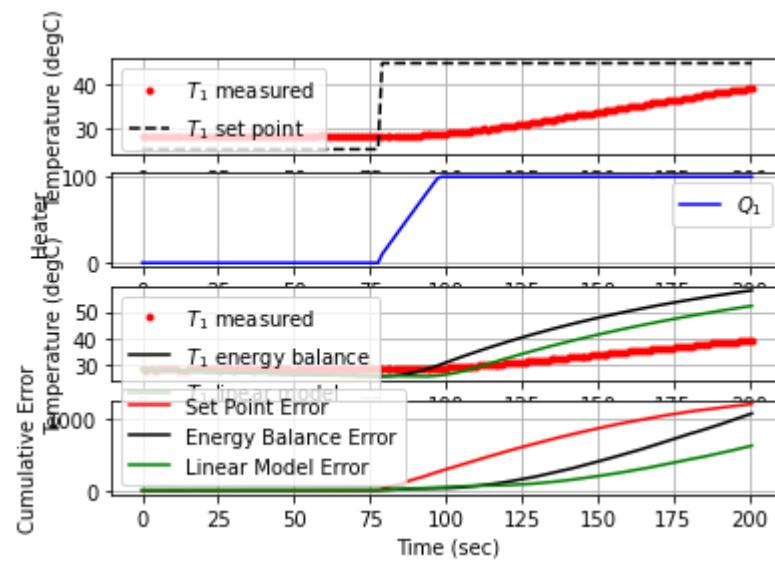
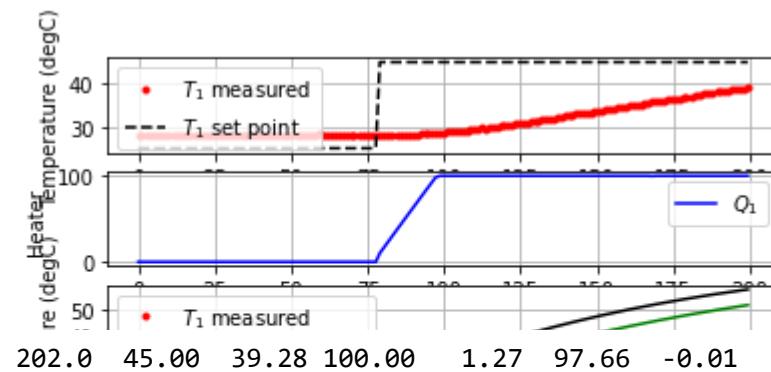


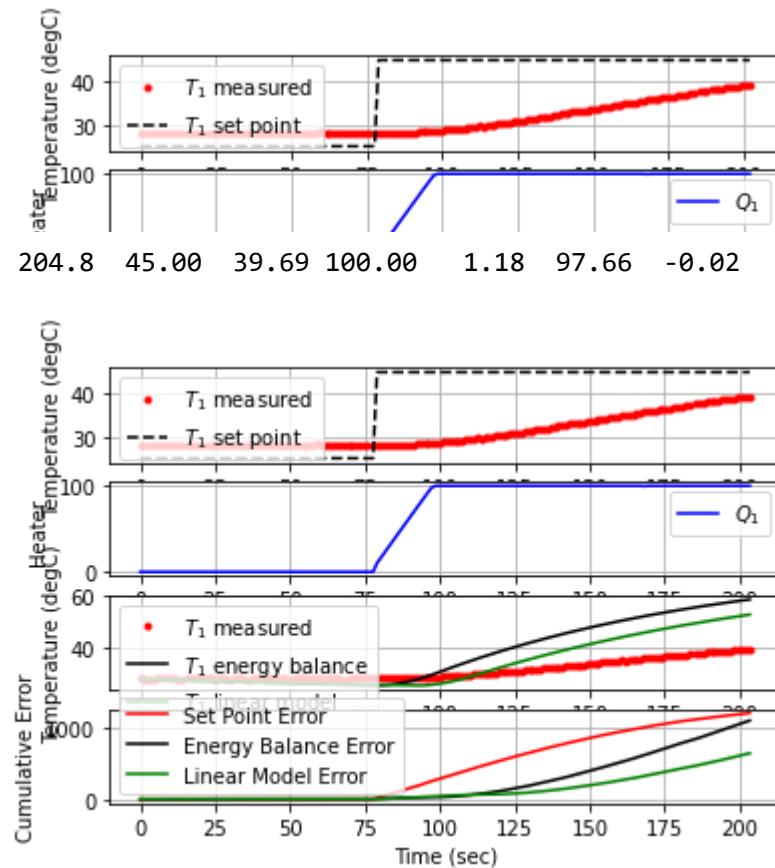
193.0 45.00 38.38 100.00 1.47 97.66 -0.01



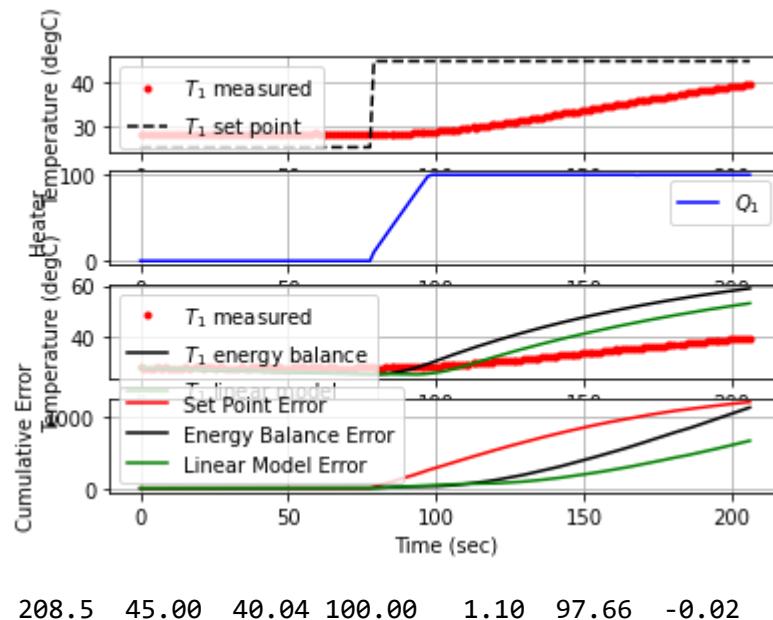
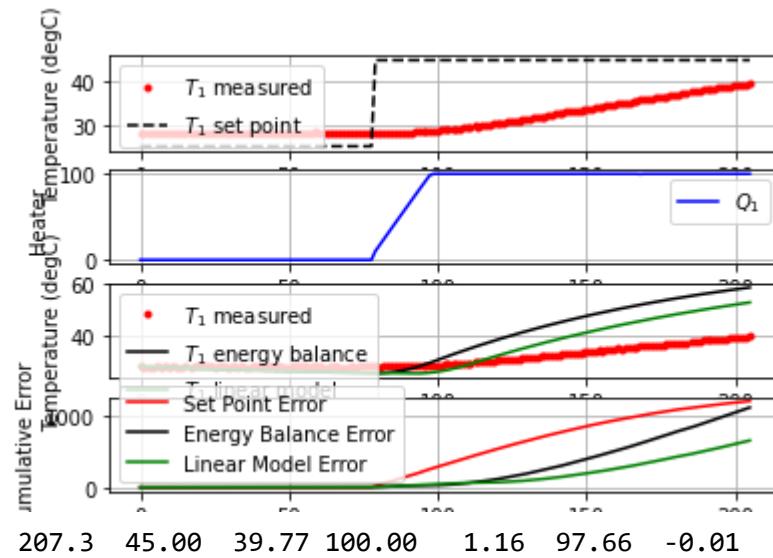


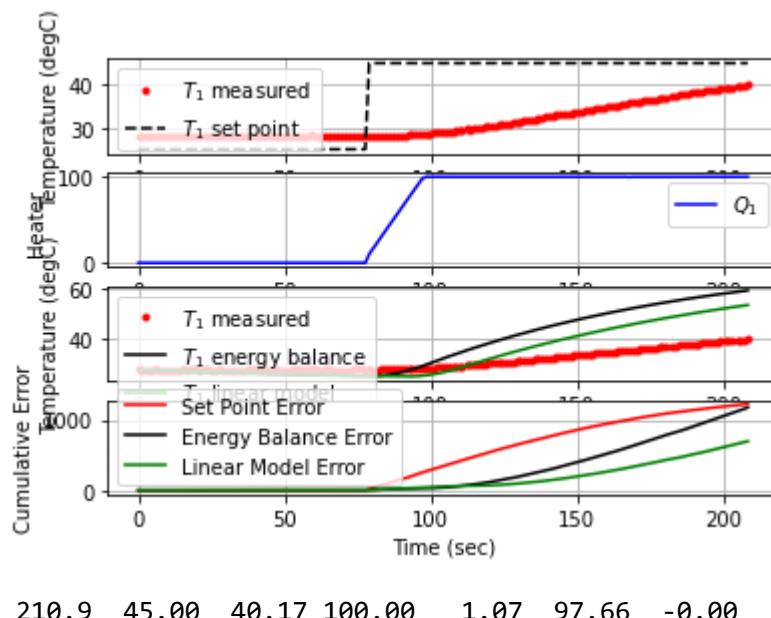
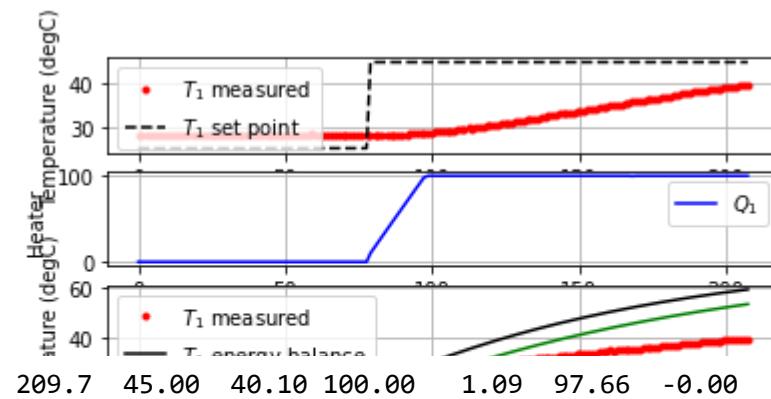


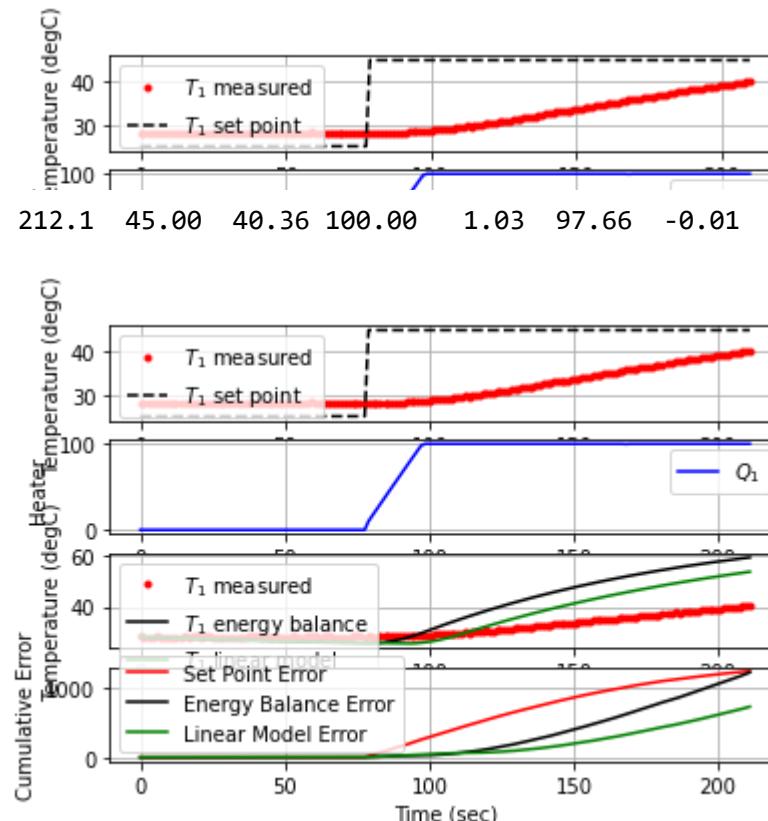




206.1 45.00 39.67 100.00 1.18 97.66 0.00



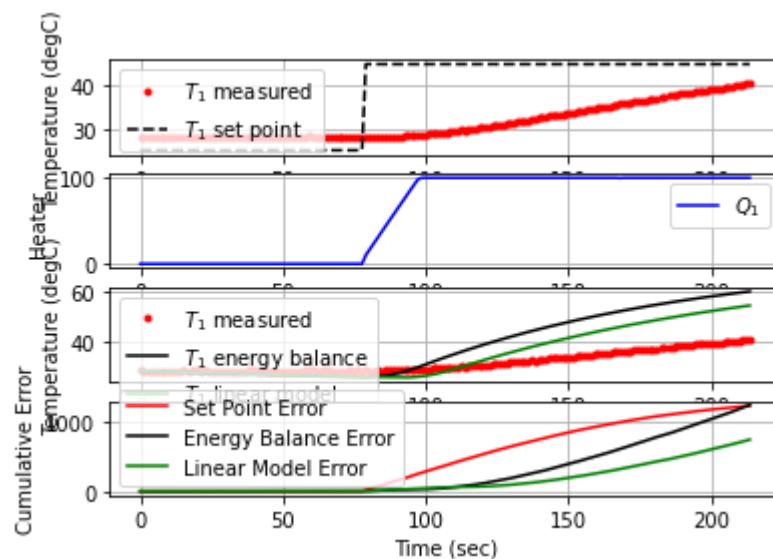




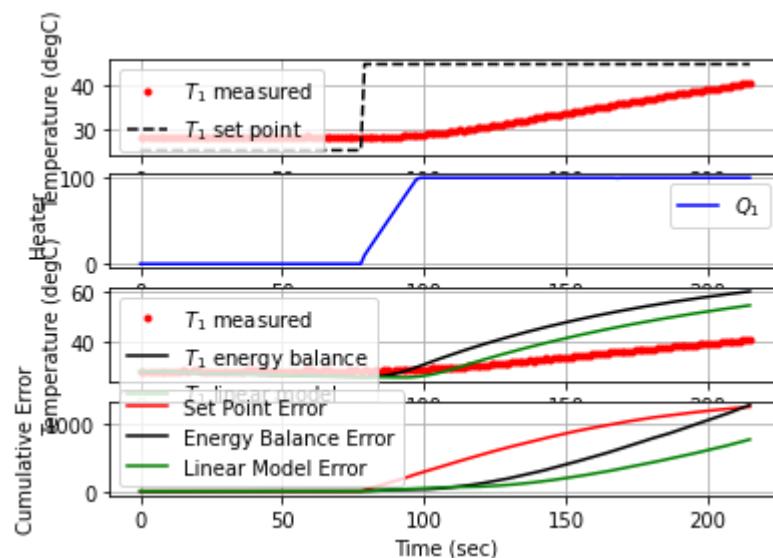
213.4 45.00 40.44 100.00 1.01 97.66 -0.01

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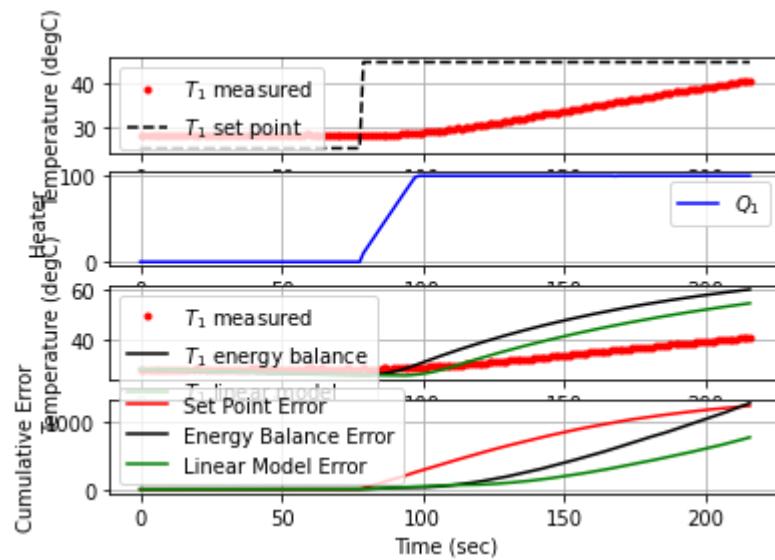
214.6 45.00 40.67 100.00 0.96 97.66 -0.02



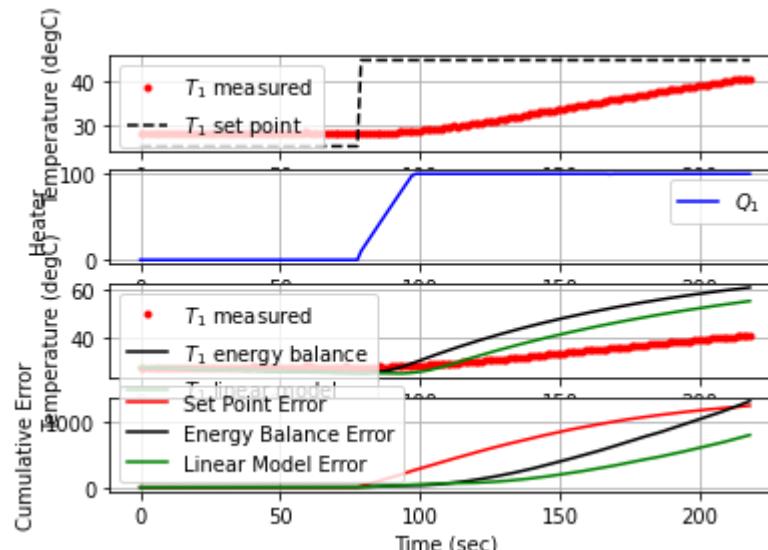
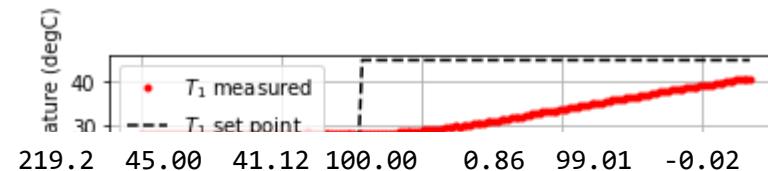
215.7 45.00 40.59 100.00 0.98 97.66 0.01



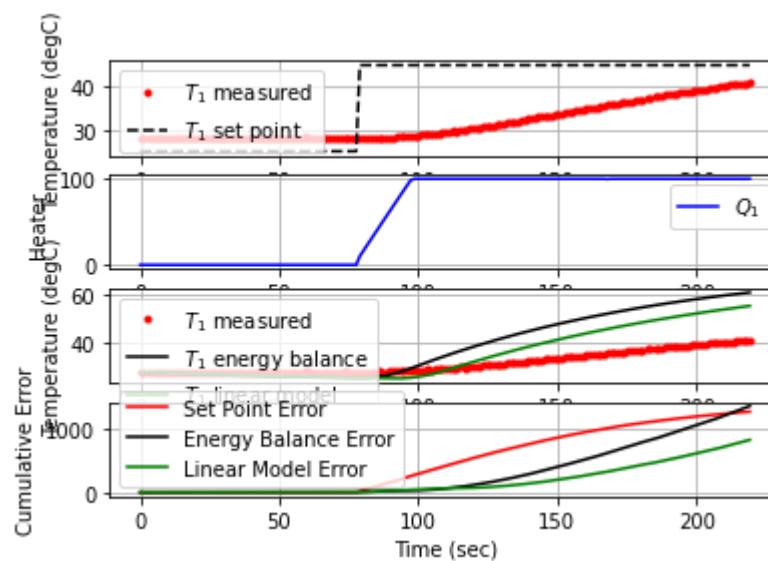
216.9 45.00 40.75 100.00 0.94 97.66 -0.01



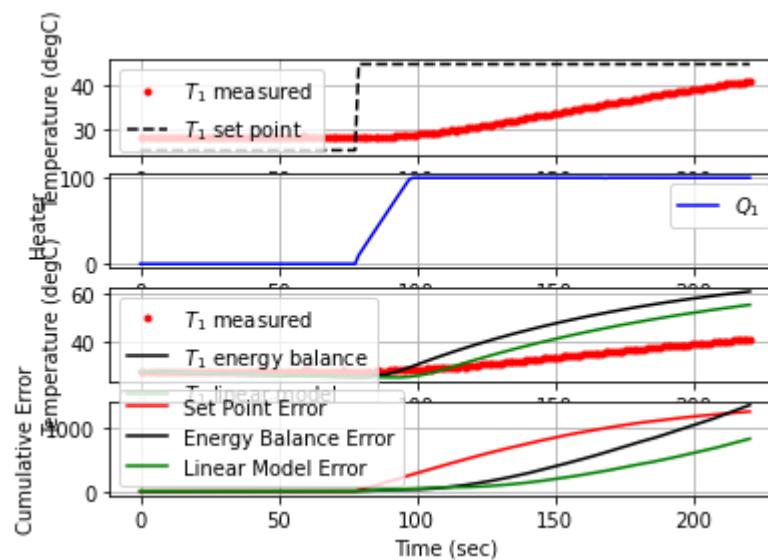
218.0 45.00 40.77 99.94 0.94 99.01 -0.00



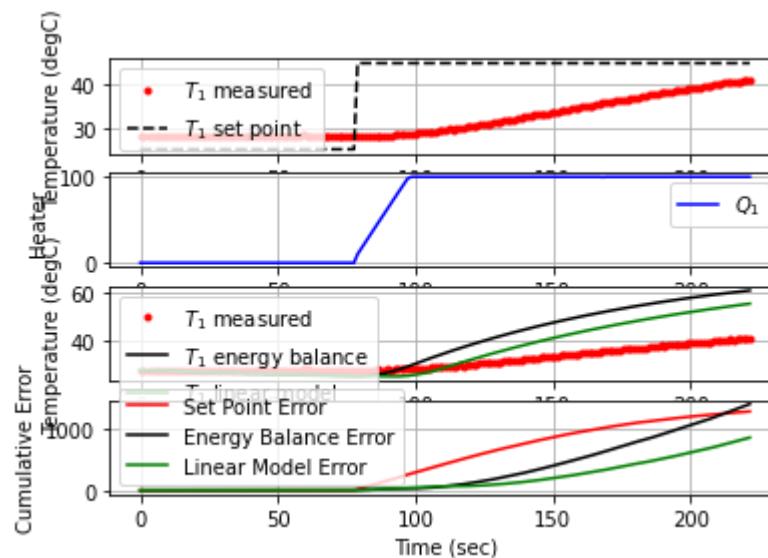
220.3 45.00 41.15 100.00 0.85 99.01 -0.00



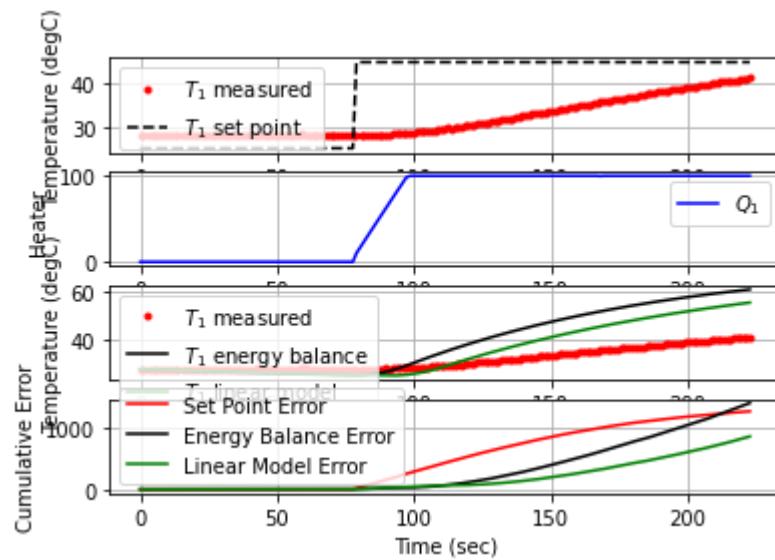
221.5 45.00 41.14 100.00 0.85 99.01 0.00



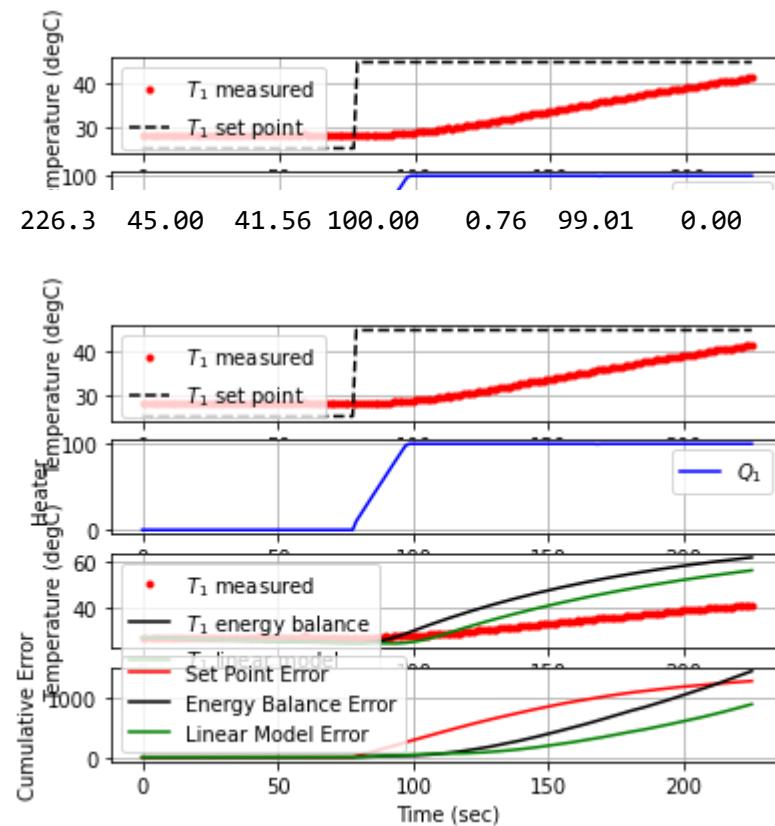
222.7 45.00 41.36 100.00 0.81 99.01 -0.02



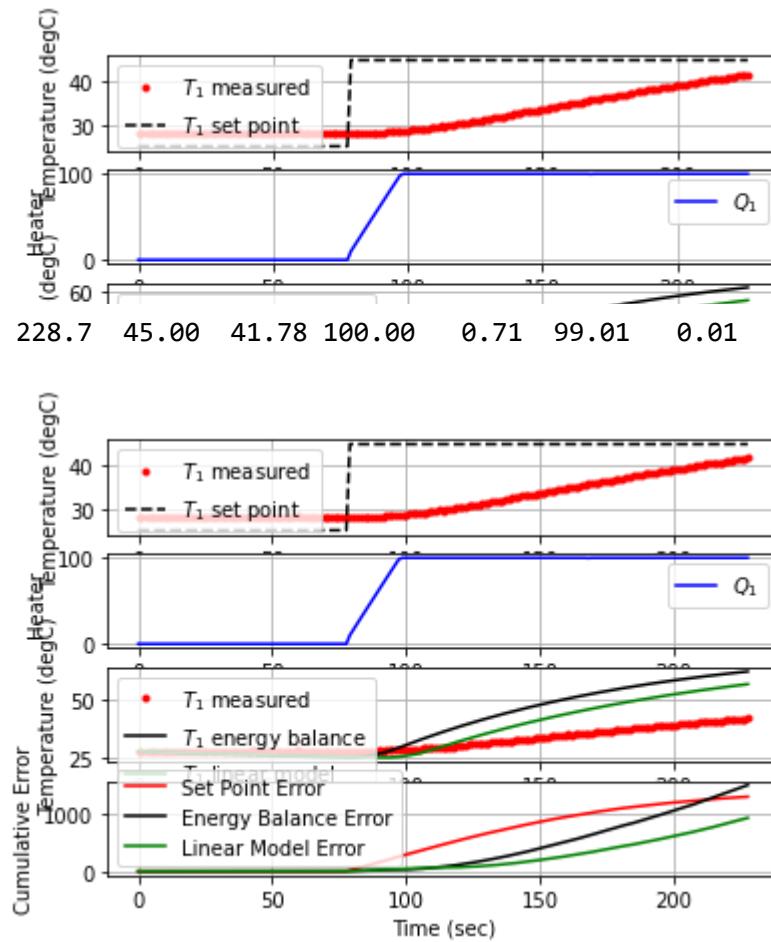
223.8 45.00 41.55 100.00 0.76 99.01 -0.01



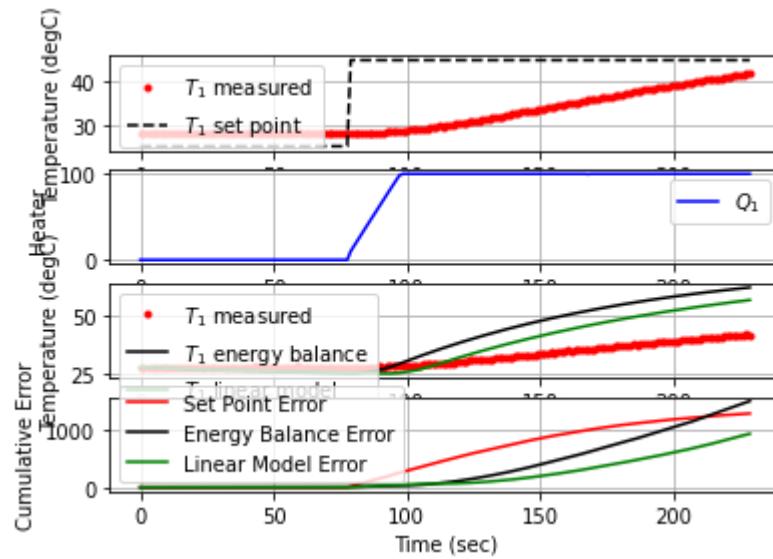
225.0 45.00 41.61 100.00 0.75 99.01 -0.00



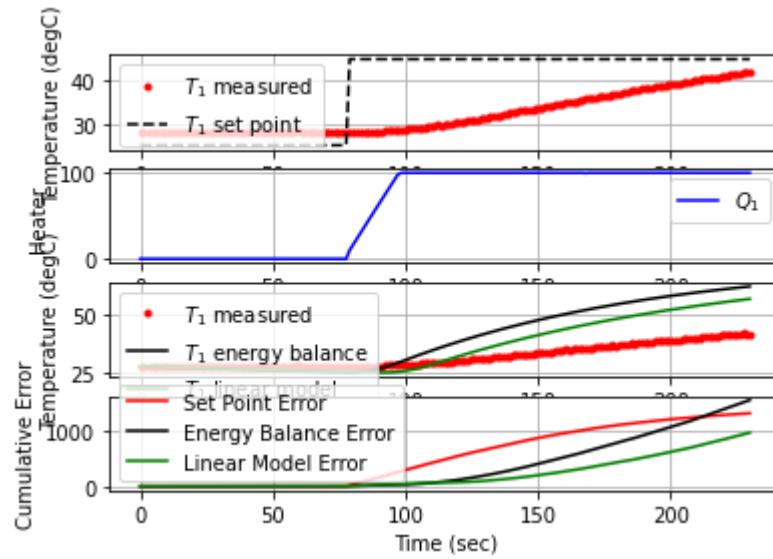
227.5 45.00 41.91 100.00 0.68 99.01 -0.03



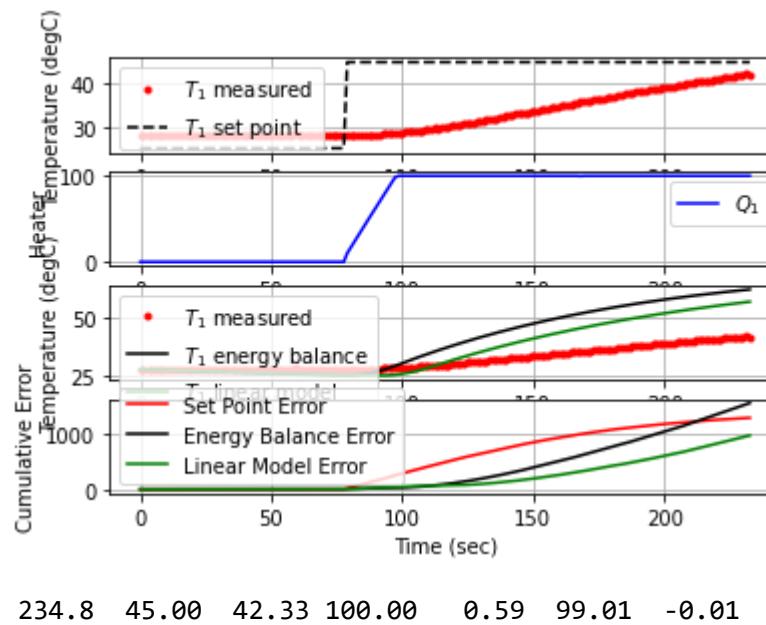
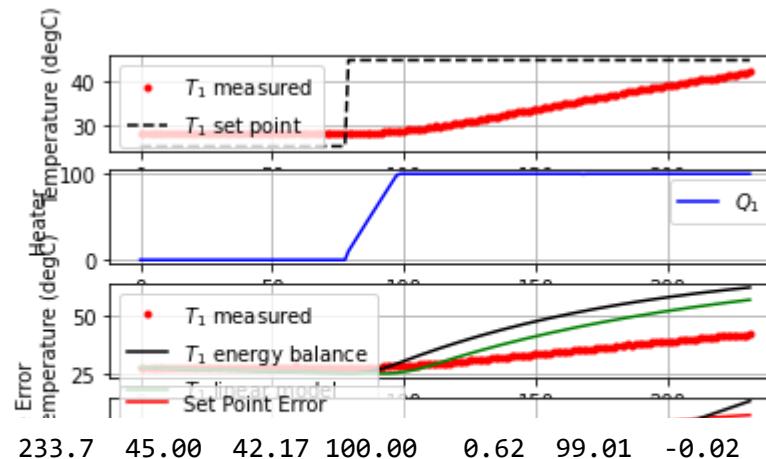
229.9 45.00 41.80 100.00 0.71 99.01 -0.00

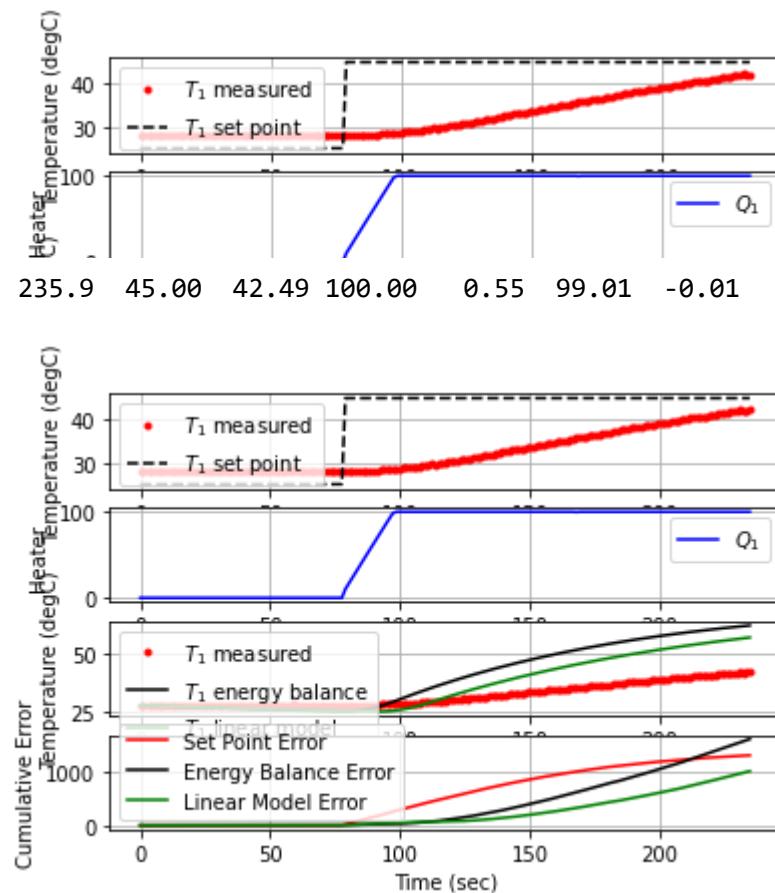


231.2 45.00 42.23 100.00 0.61 99.01 -0.03

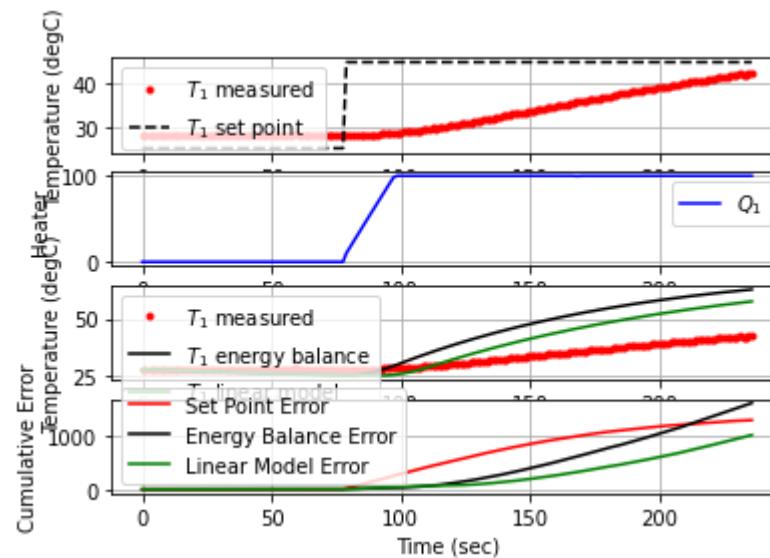


232.6 45.00 41.92 100.00 0.68 99.01 0.02

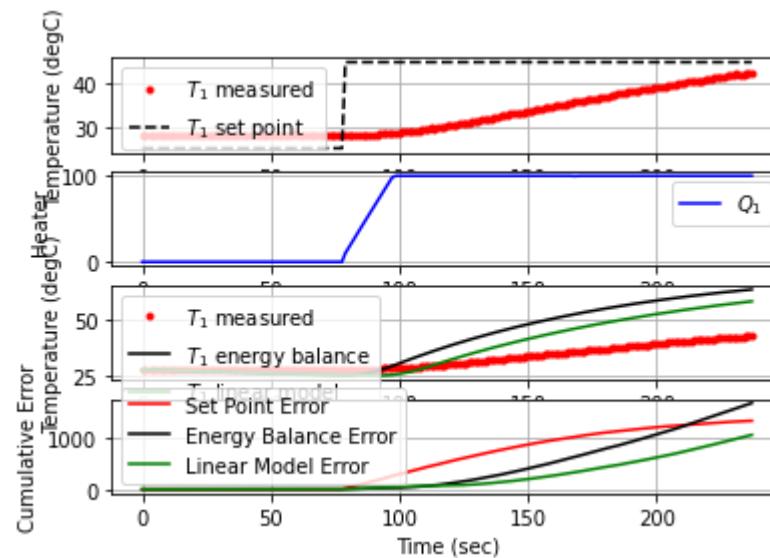




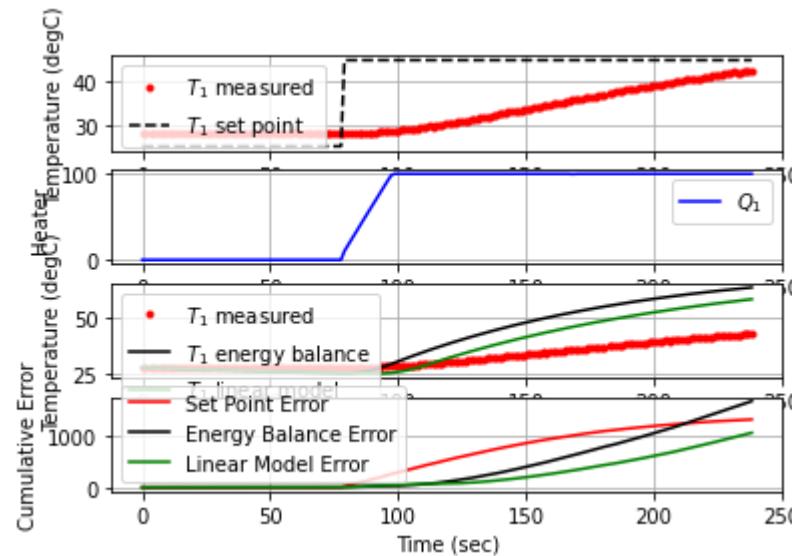
237.1 45.00 42.39 100.00 0.58 99.01 0.01



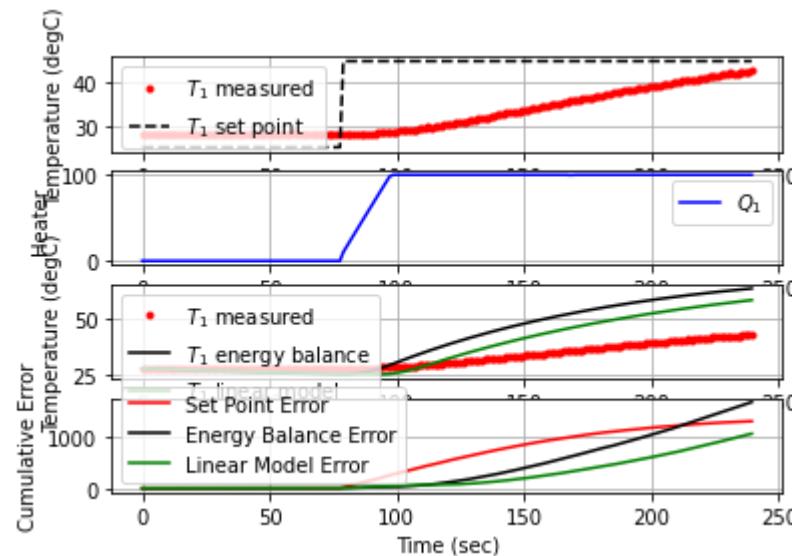
238.2 45.00 42.46 100.00 0.56 99.01 -0.01



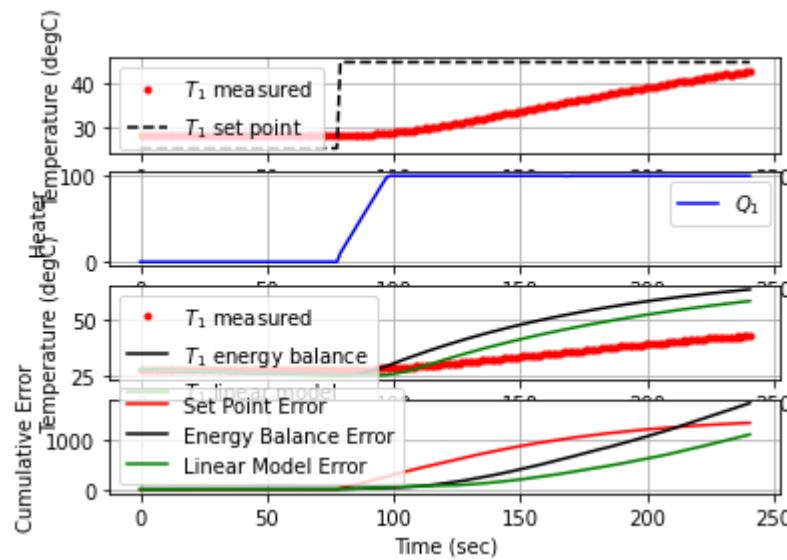
239.5 45.00 42.73 100.00 0.50 99.01 -0.02



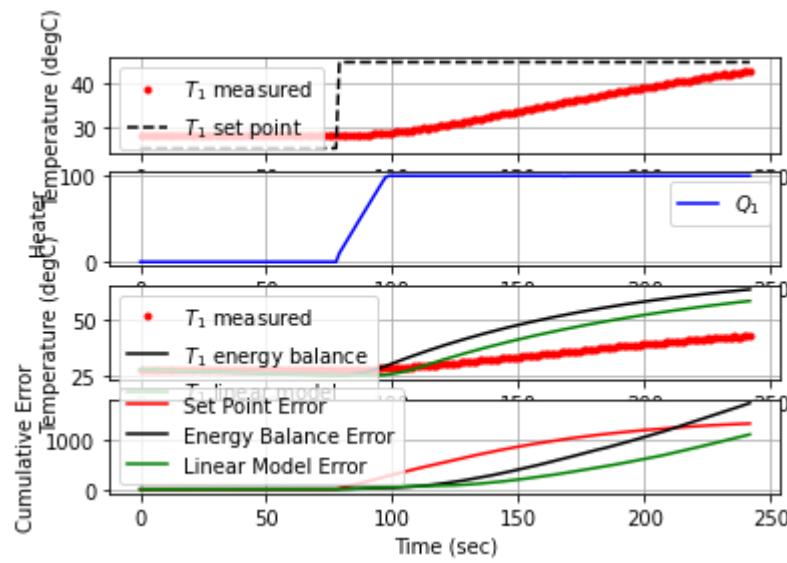
240.6 45.00 42.85 100.00 0.47 99.01 -0.01



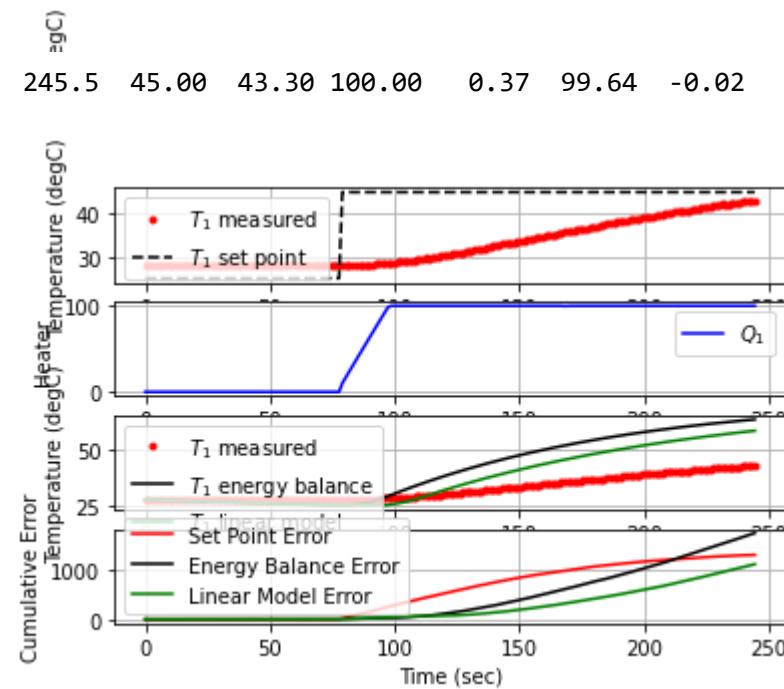
241.8 45.00 42.93 100.00 0.46 99.01 -0.01



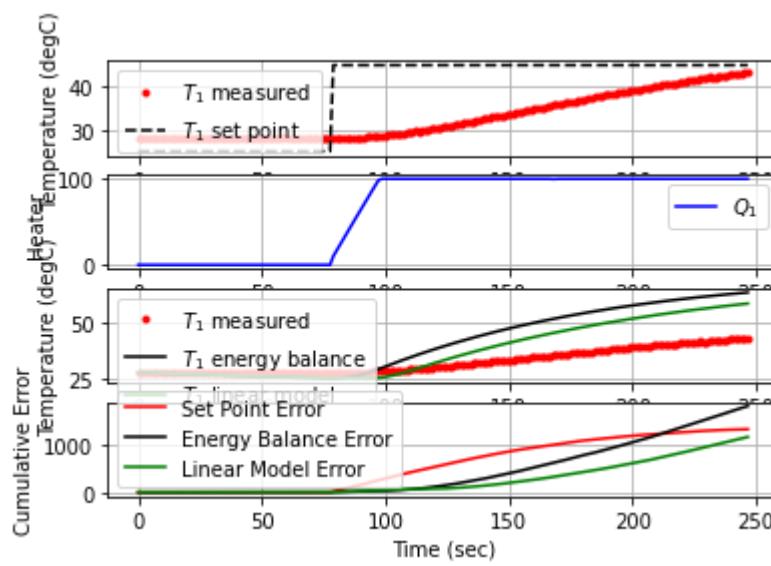
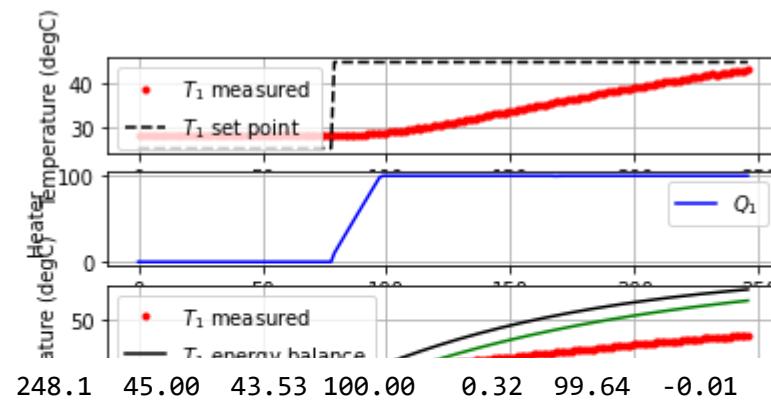
243.0 45.00 42.97 100.00 0.45 99.01 -0.00



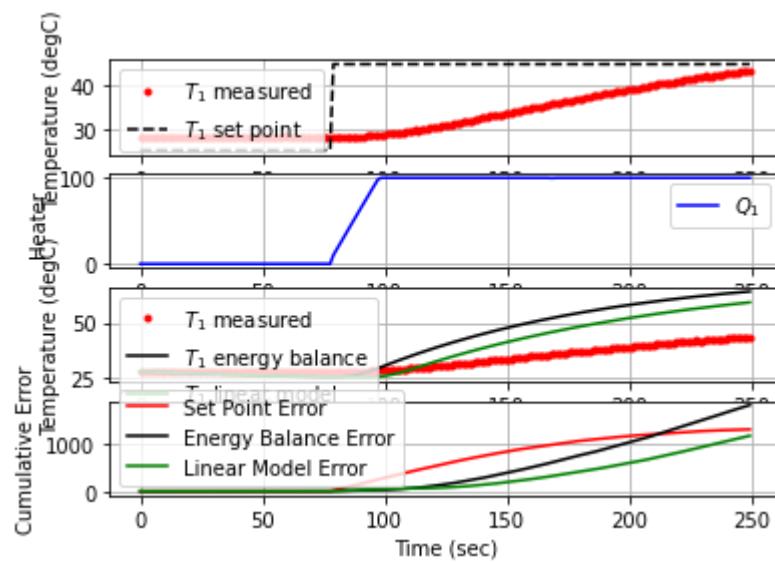
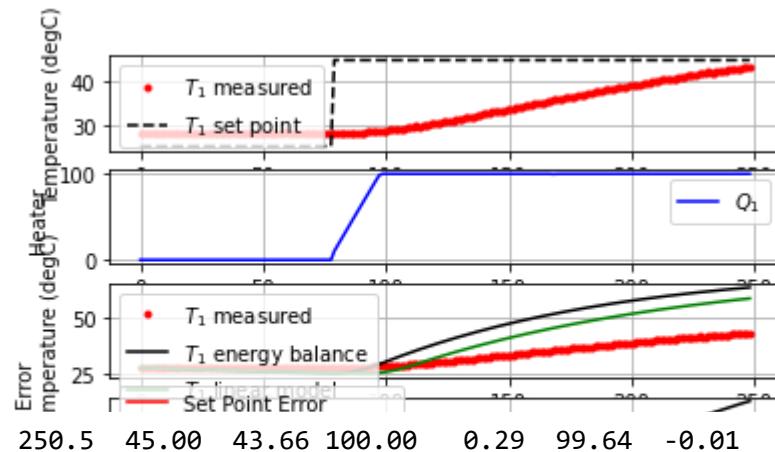
244.2 45.00 43.01 100.00 0.44 99.01 -0.00



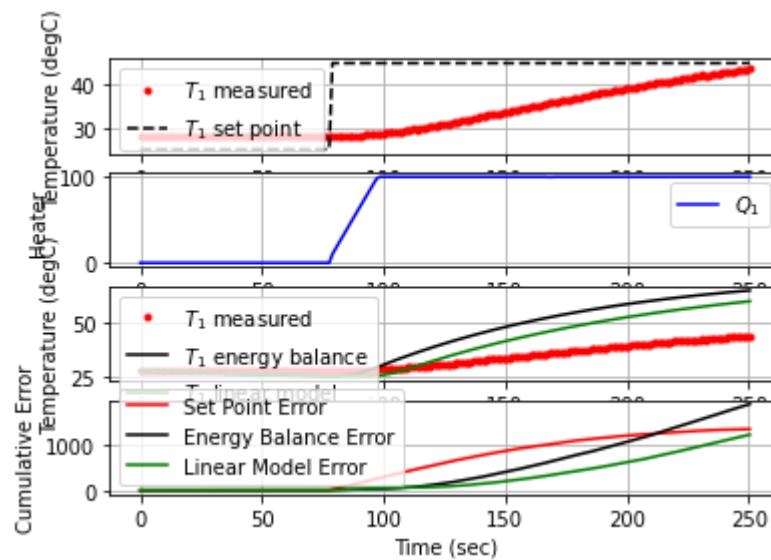
246.8 45.00 43.41 100.00 0.35 99.64 -0.01



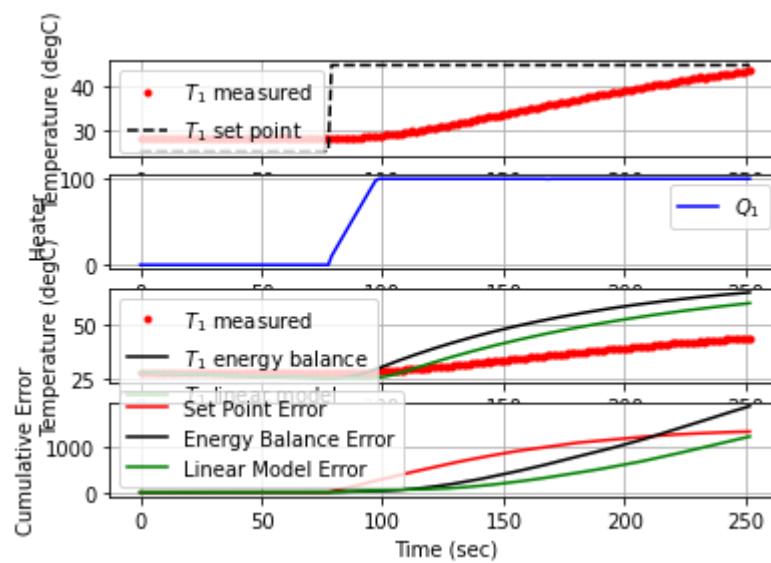
249.3 45.00 43.51 100.00 0.33 99.64 0.00

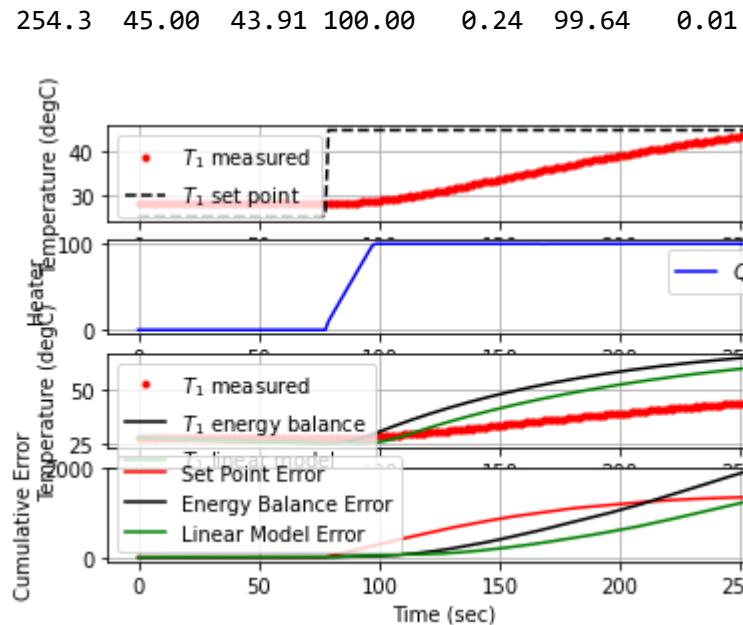


251.7 45.00 43.69 100.00 0.29 99.64 -0.00

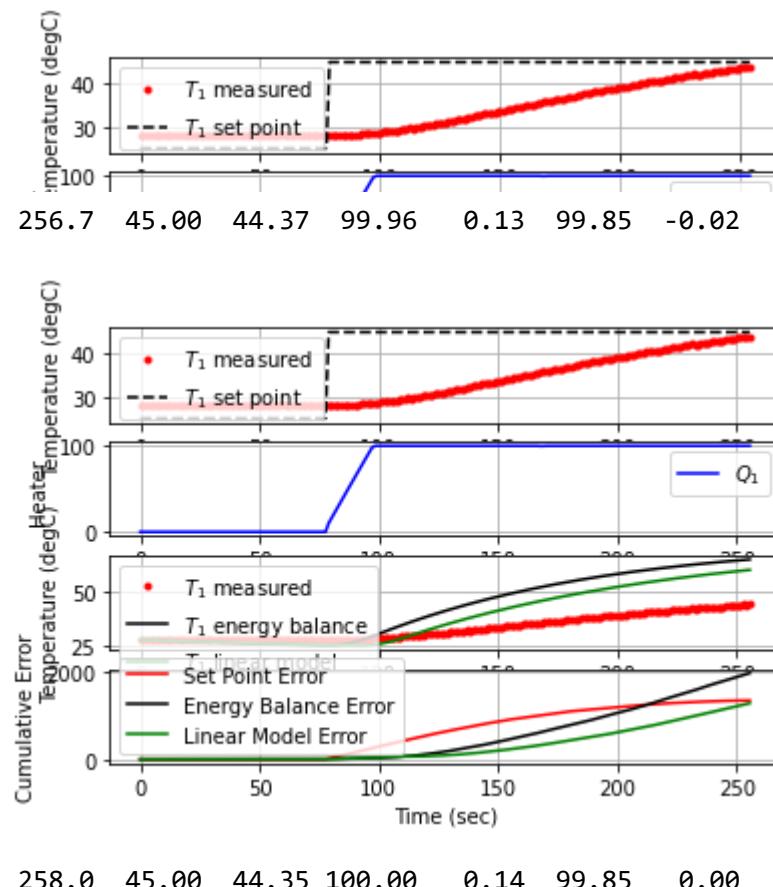


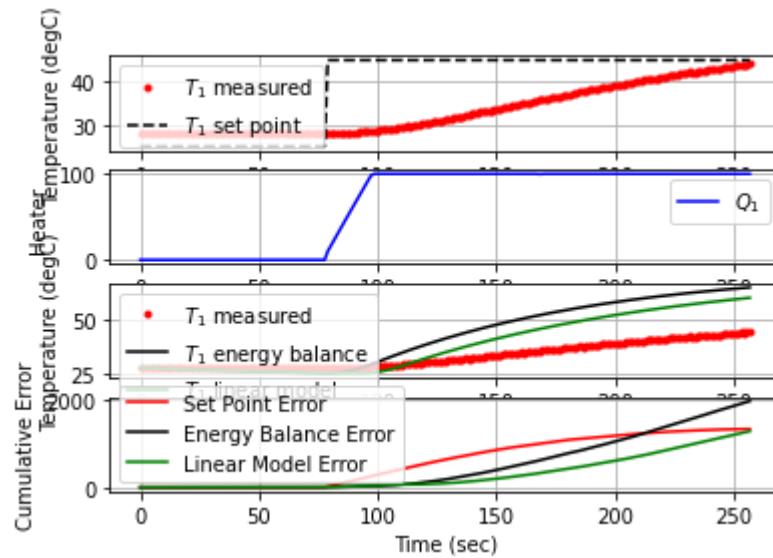
253.1 45.00 44.03 100.00 0.21 99.64 -0.02



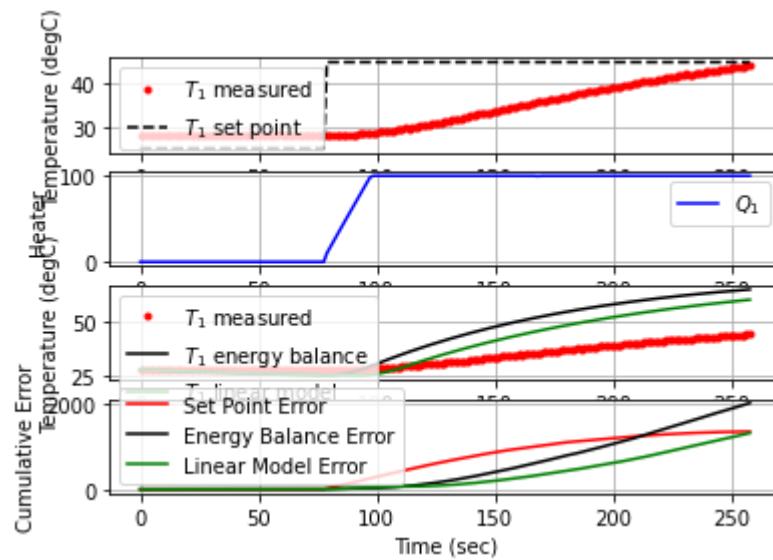


255.5 45.00 44.03 100.00 0.21 99.64 -0.01

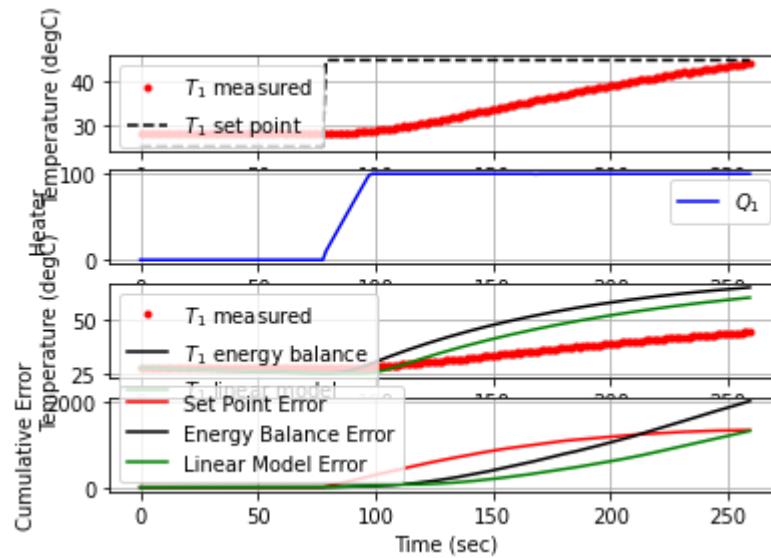




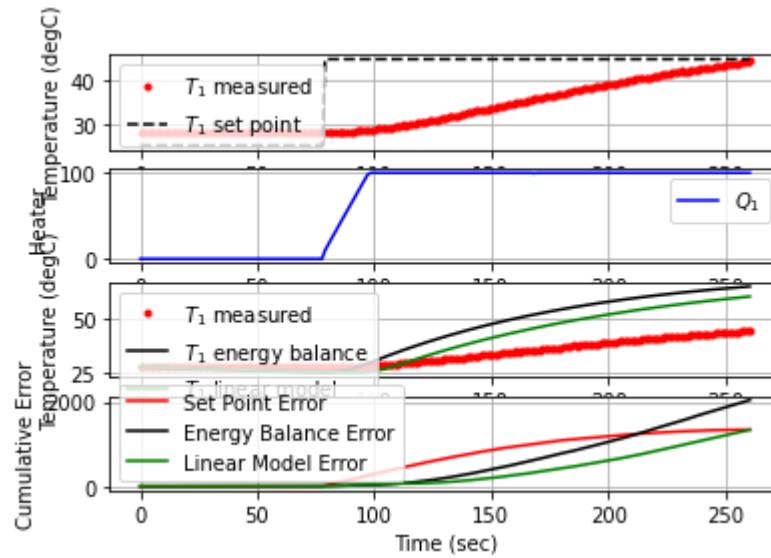
259.2 45.00 44.48 100.00 0.11 99.85 -0.01



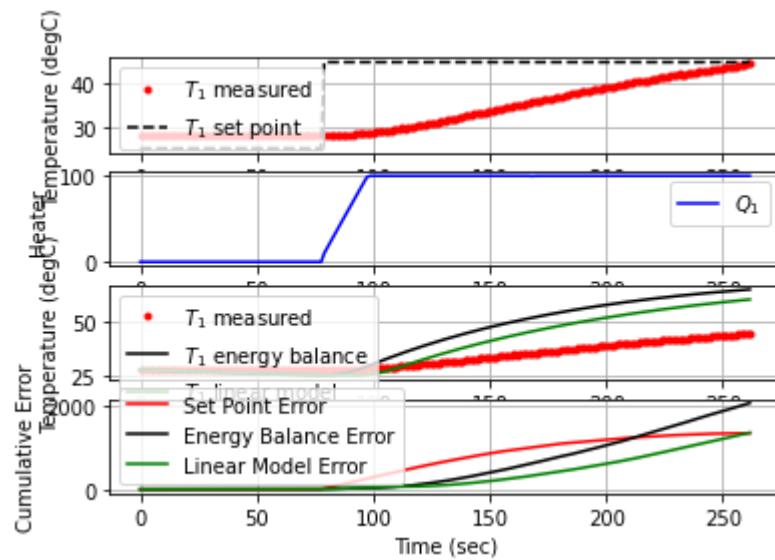
260.4 45.00 44.56 100.00 0.09 99.85 -0.01



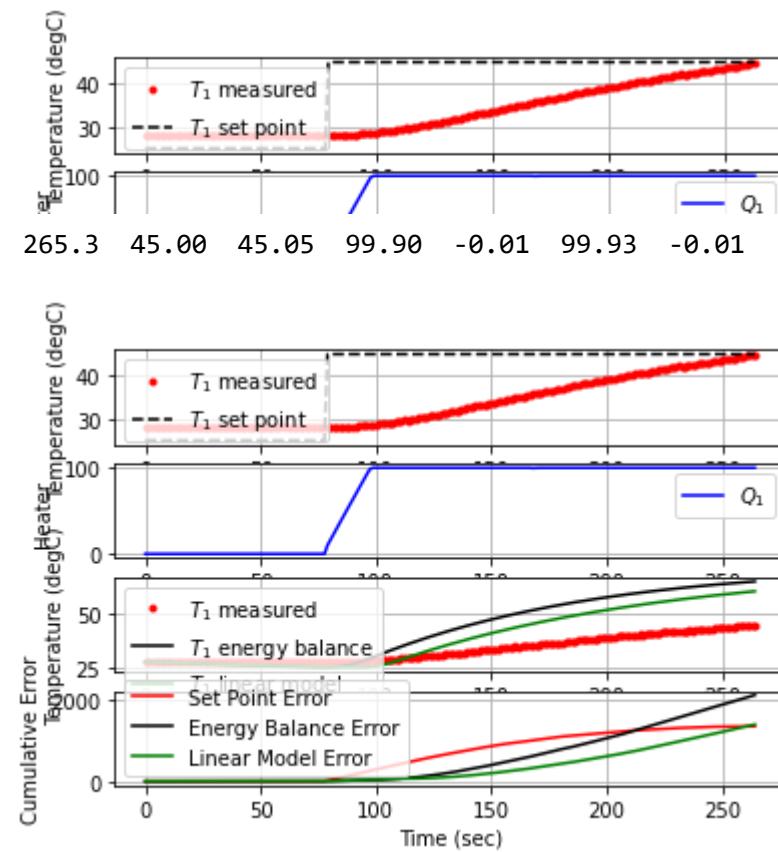
261.6 45.00 44.72 99.99 0.06 99.94 -0.01



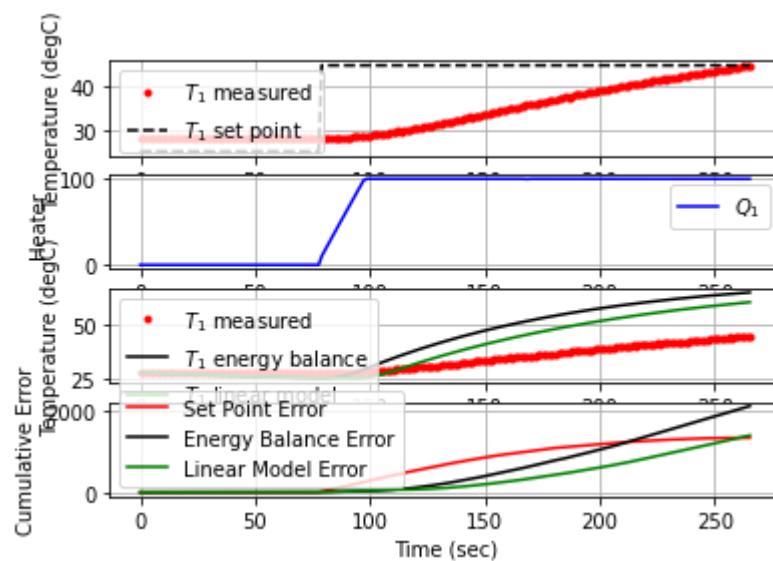
262.9 45.00 44.75 100.00 0.05 99.94 -0.00



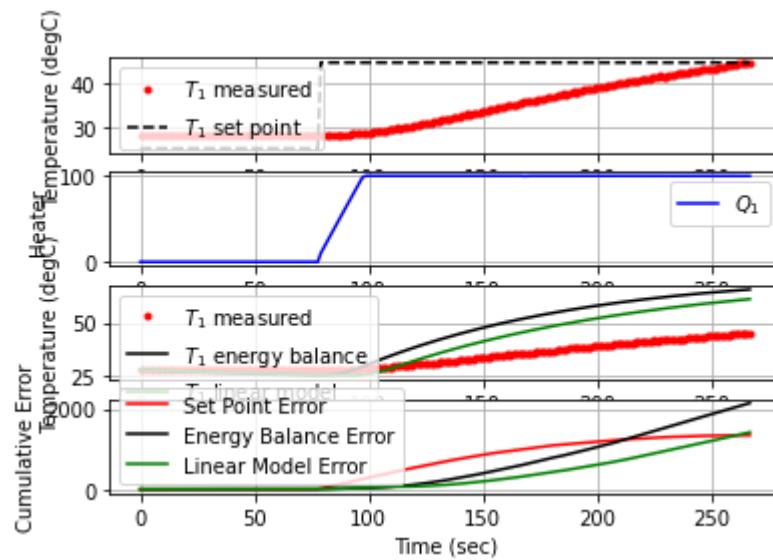
264.1 45.00 44.84 100.00 0.03 99.94 -0.01



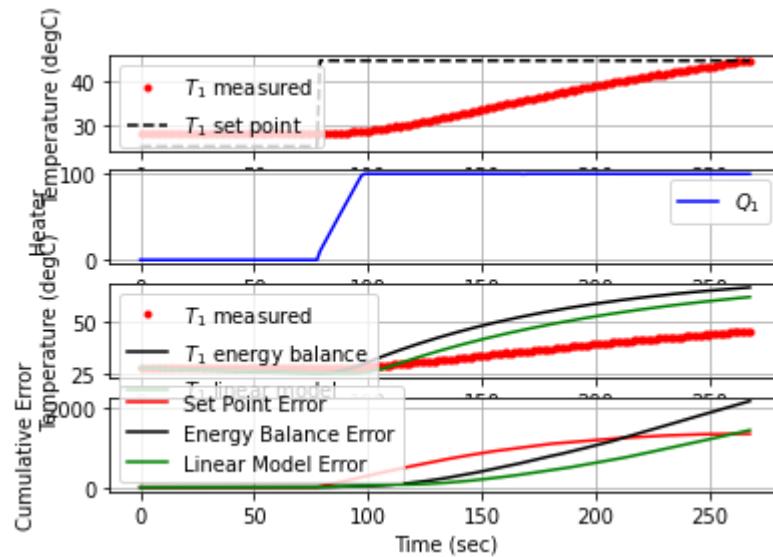
266.6 45.00 45.10 99.87 -0.02 99.89 -0.00



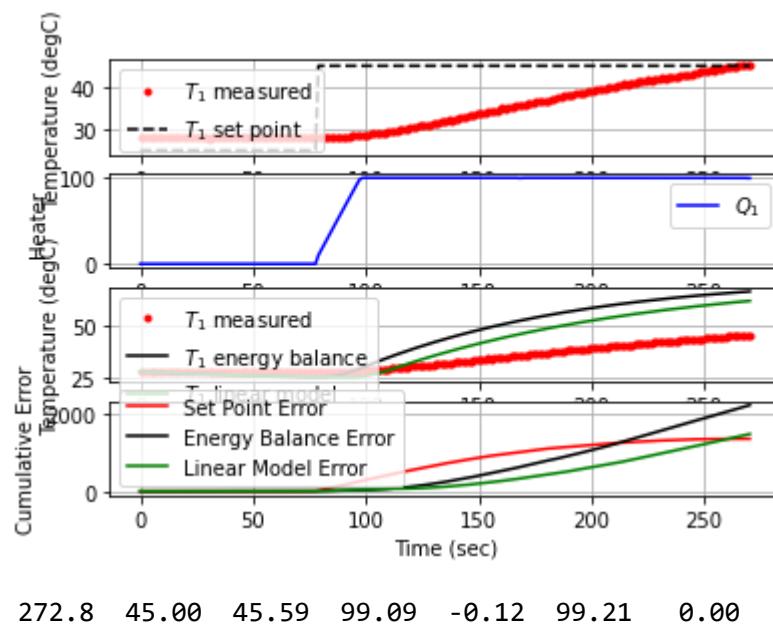
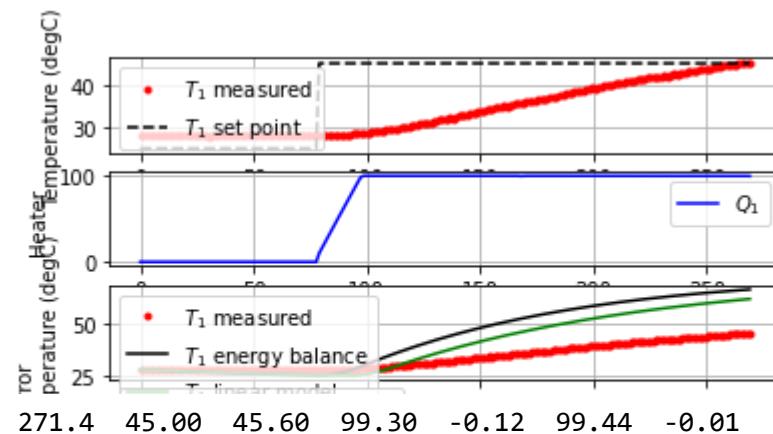
267.8 45.00 45.12 99.83 -0.03 99.85 -0.00

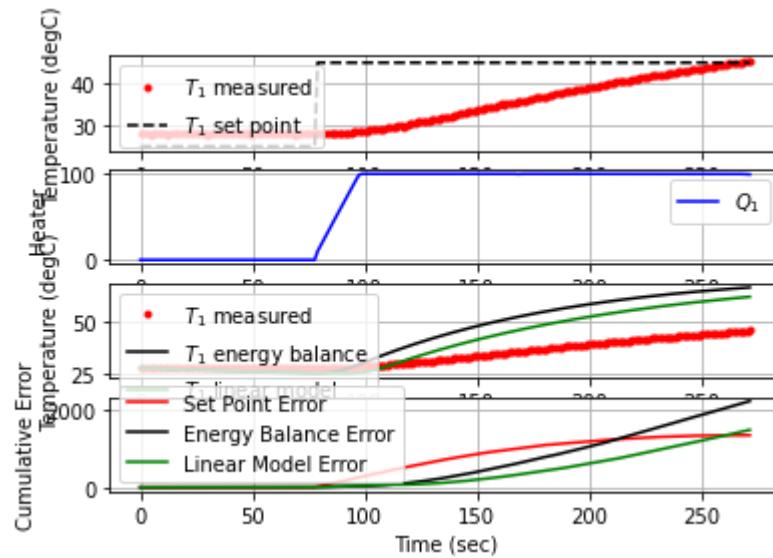


269.0 45.00 45.27 99.70 -0.06 99.76 -0.01

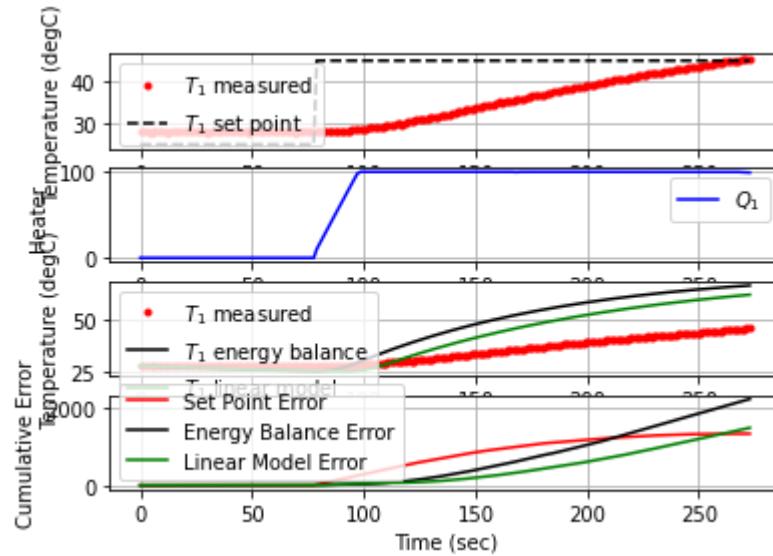


270.2 45.00 45.40 99.55 -0.08 99.64 -0.01

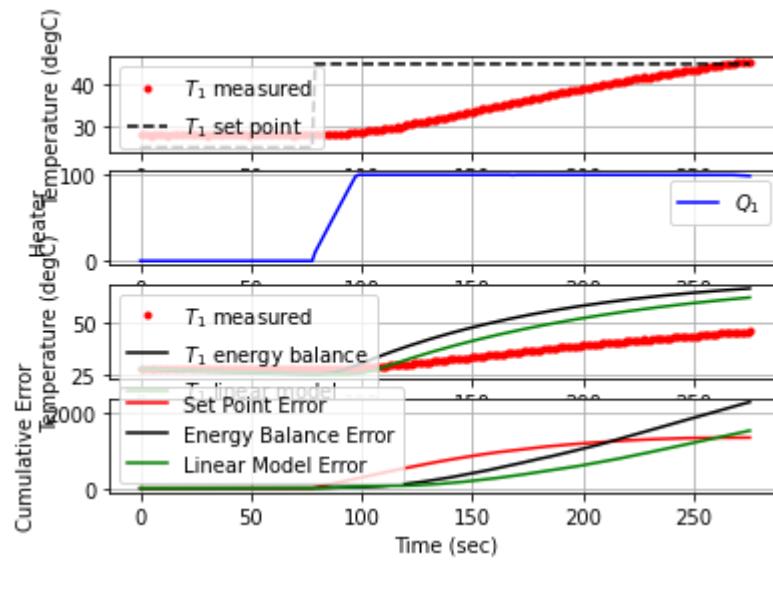
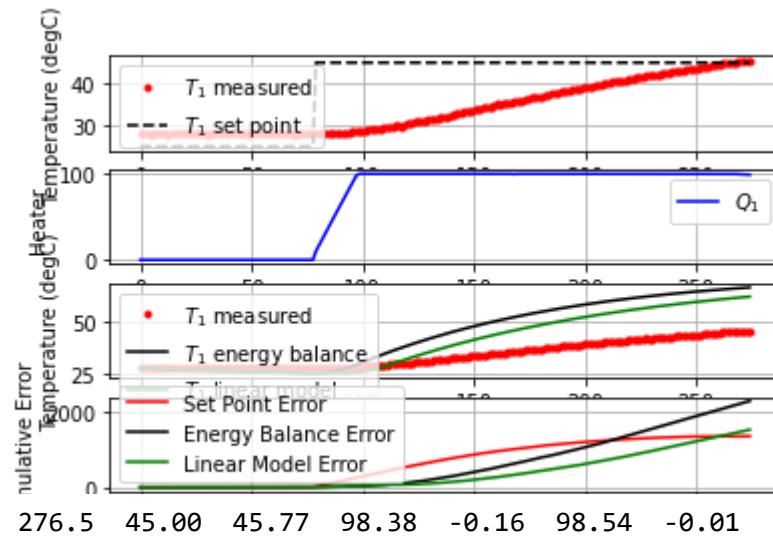


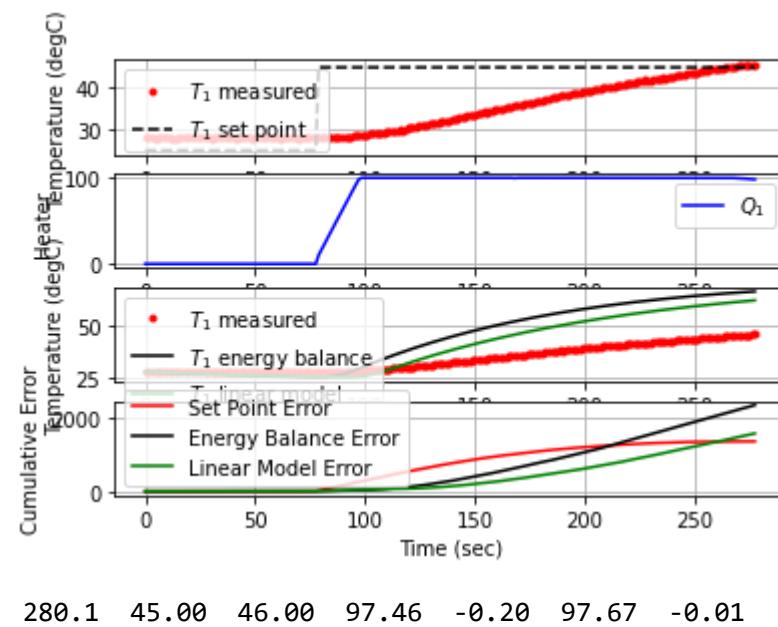
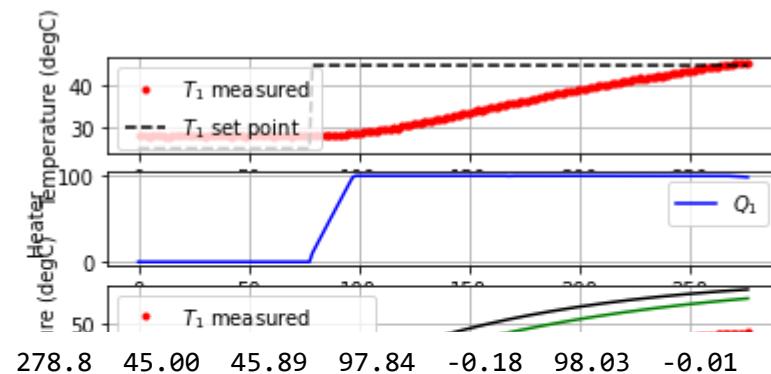


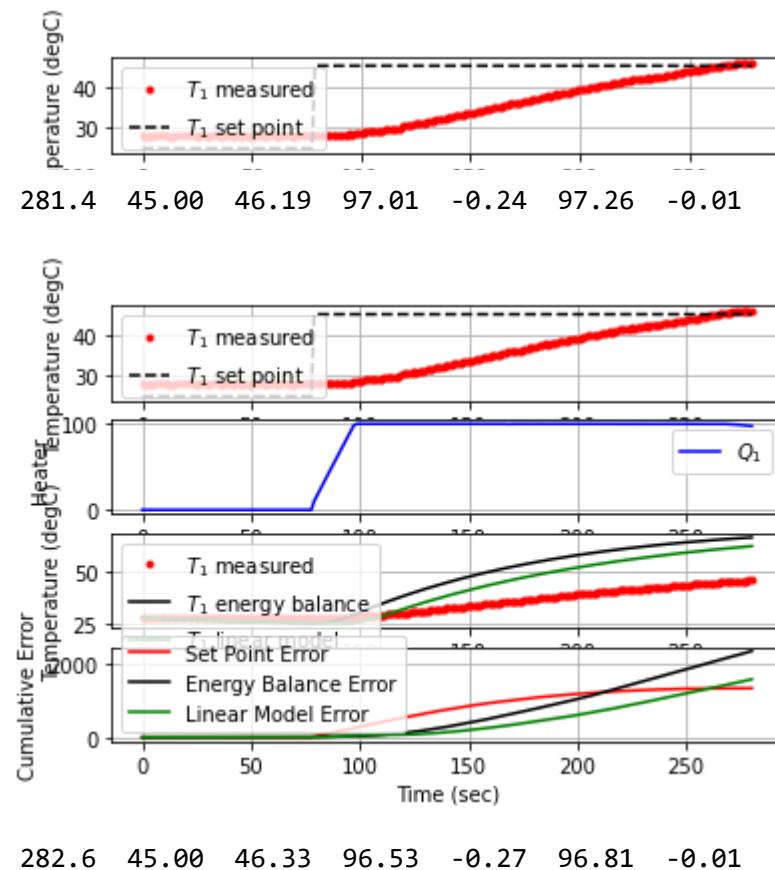
274.1 45.00 45.56 98.90 -0.12 99.02 0.00

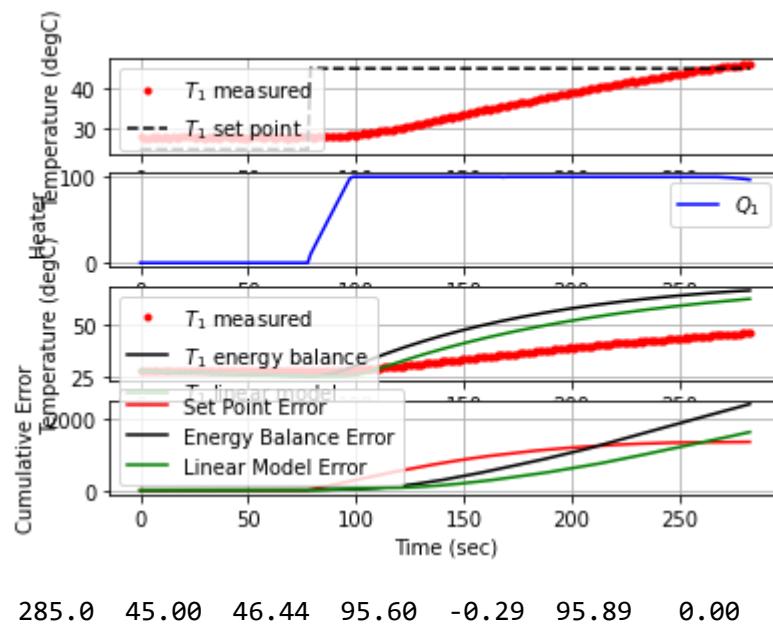
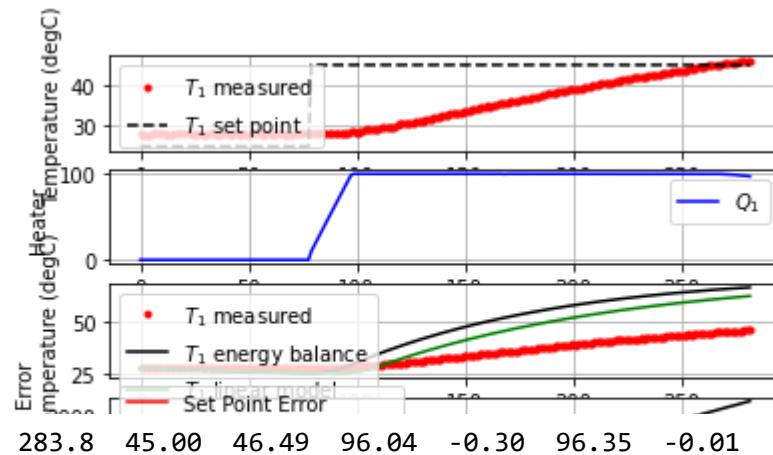


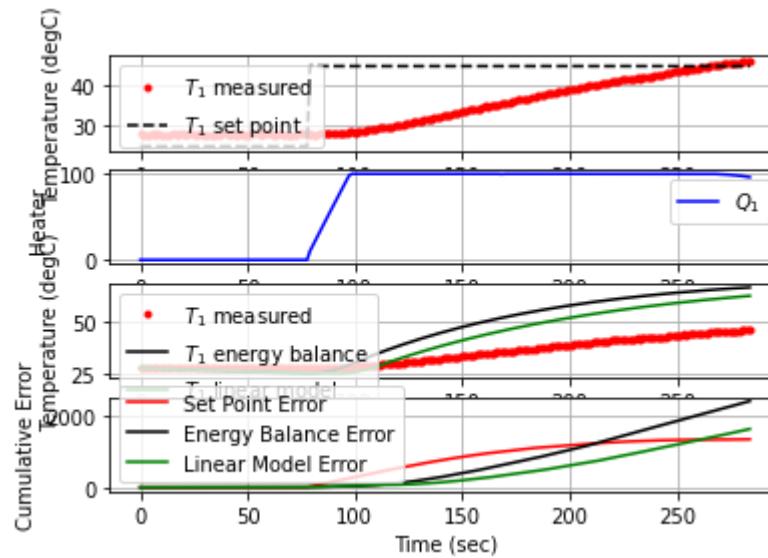
275.3 45.00 45.68 98.65 -0.14 98.79 -0.01



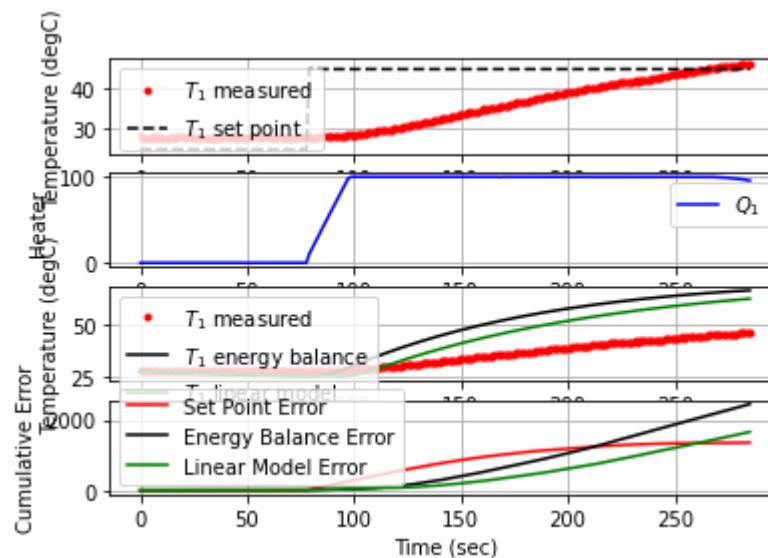




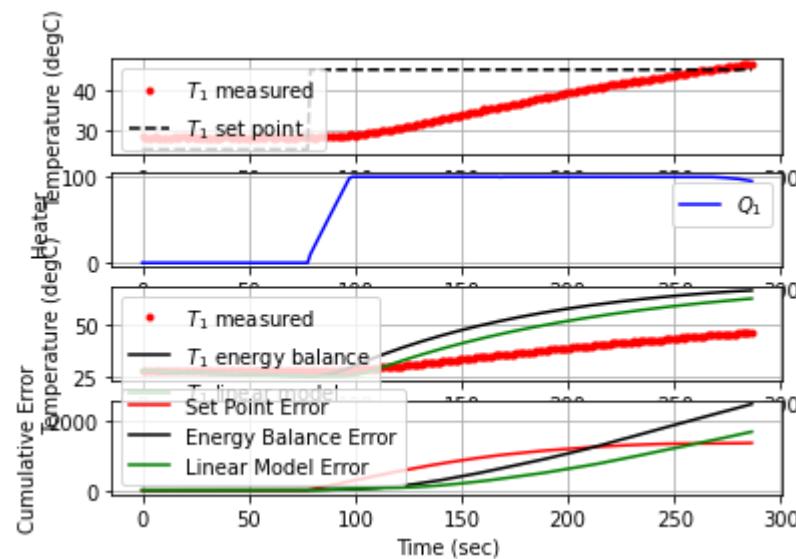




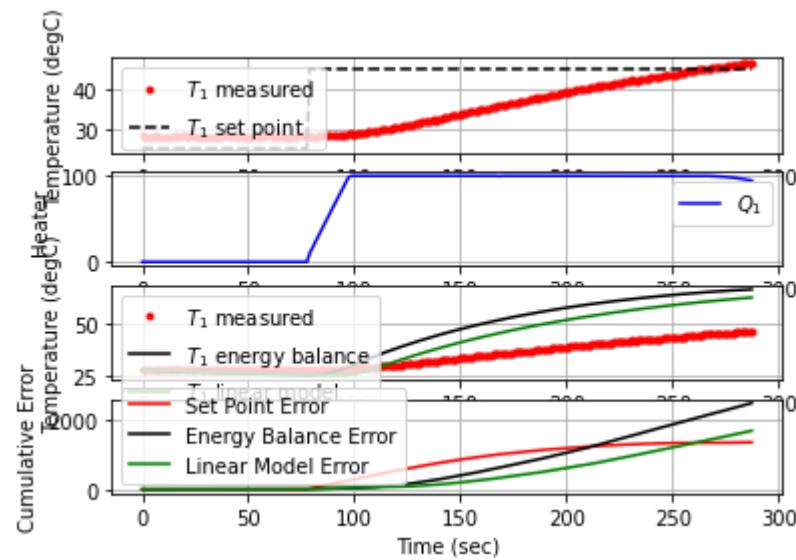
286.3 45.00 46.64 94.95 -0.33 95.30 -0.01



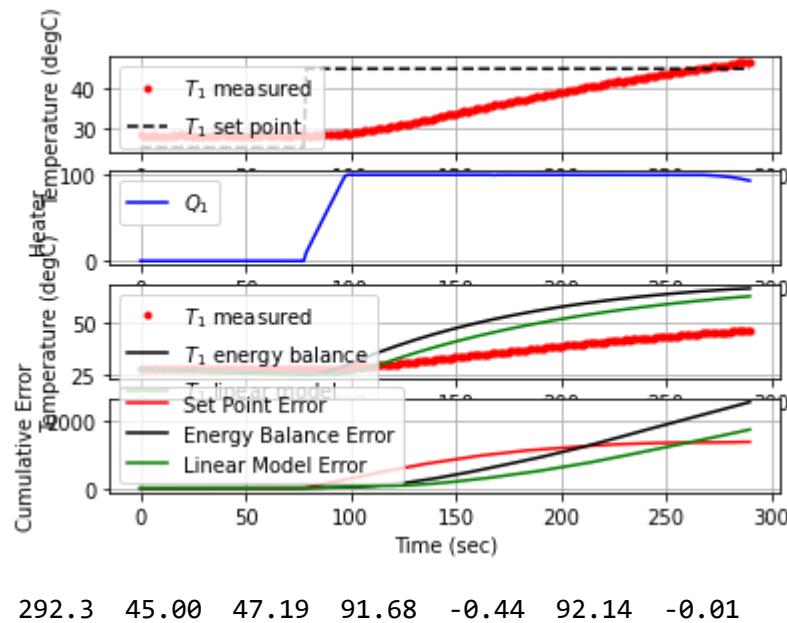
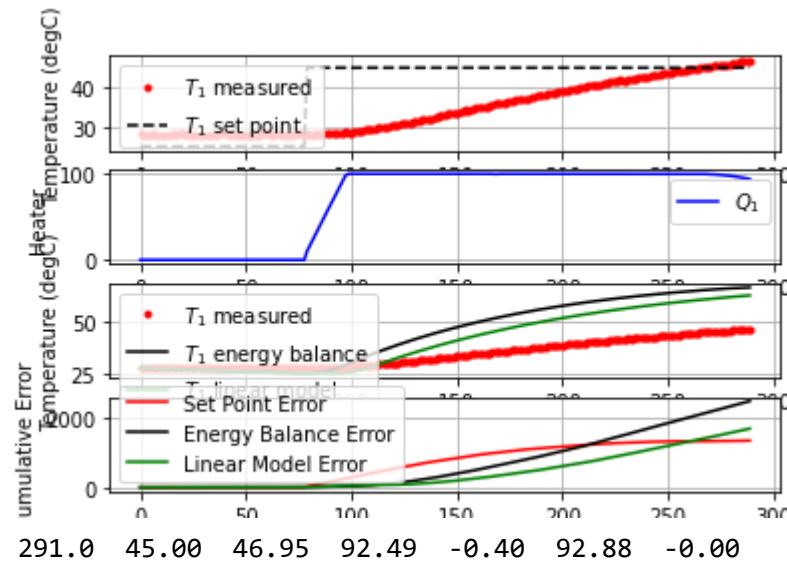
287.4 45.00 46.73 94.40 -0.35 94.76 -0.01

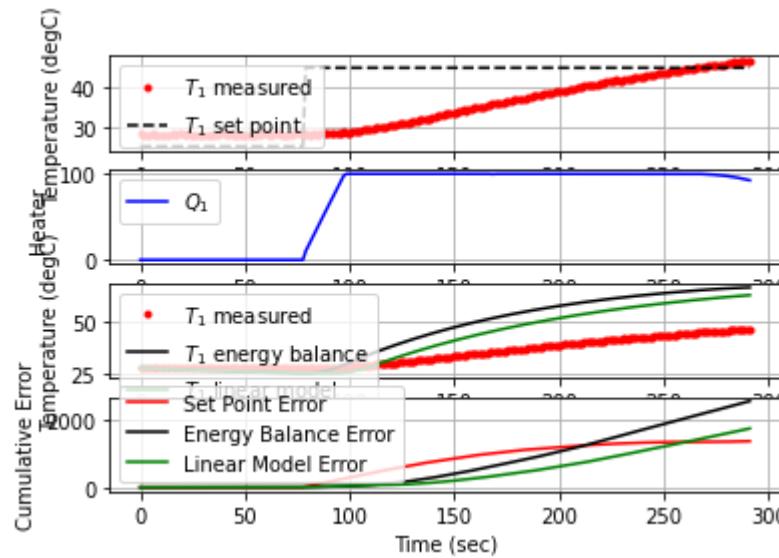


288.6 45.00 46.94 93.74 -0.39 94.14 -0.01

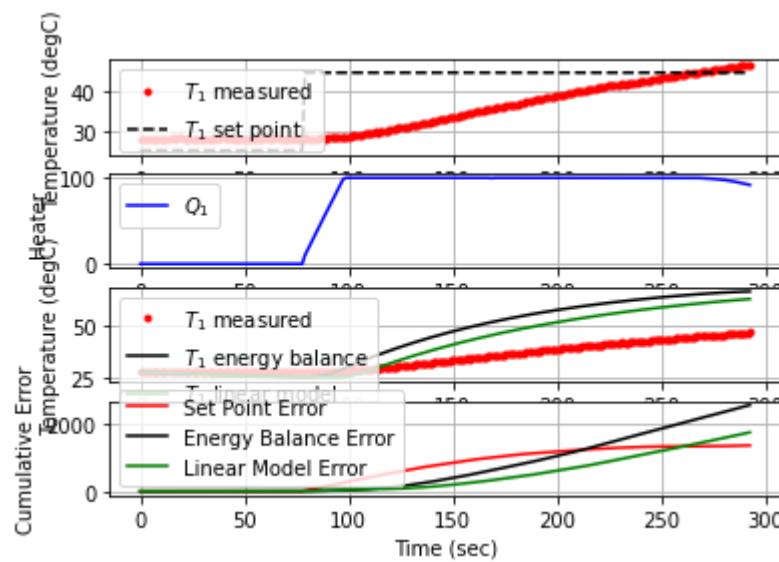


289.8 45.00 46.93 93.14 -0.39 93.53 0.00

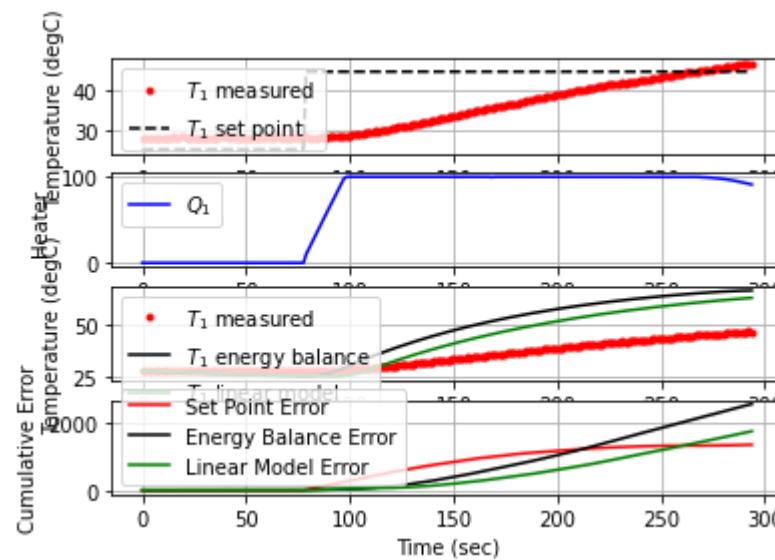




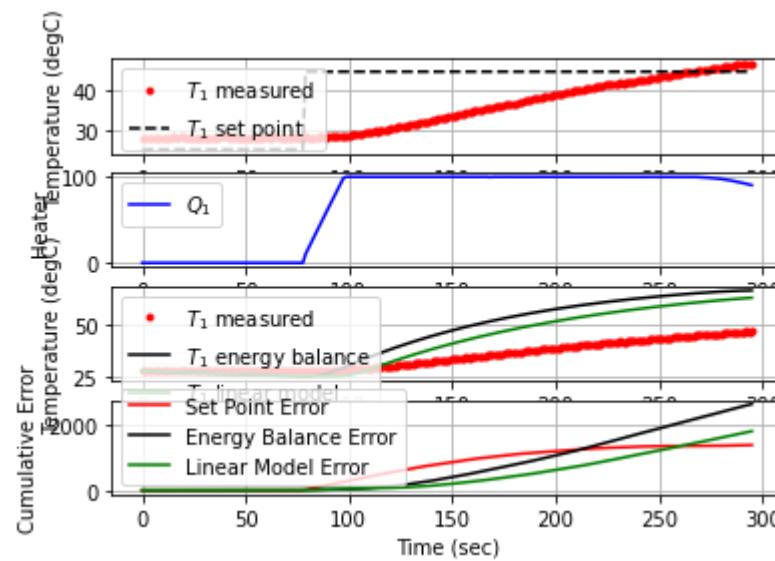
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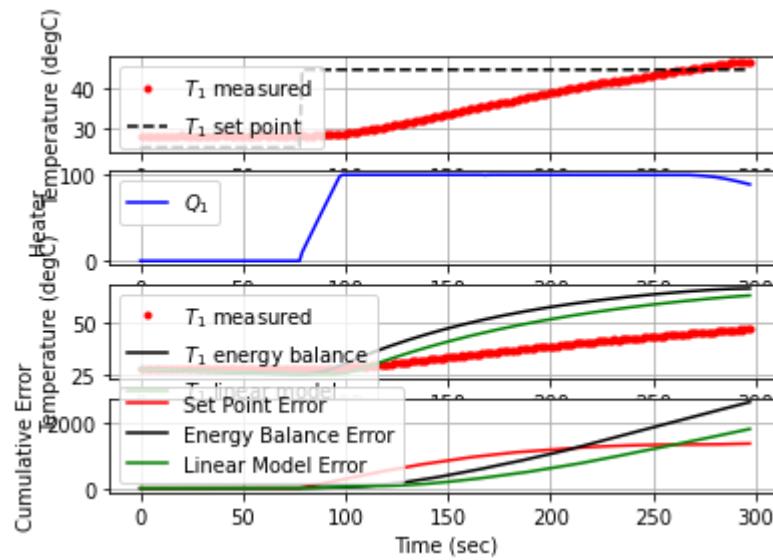
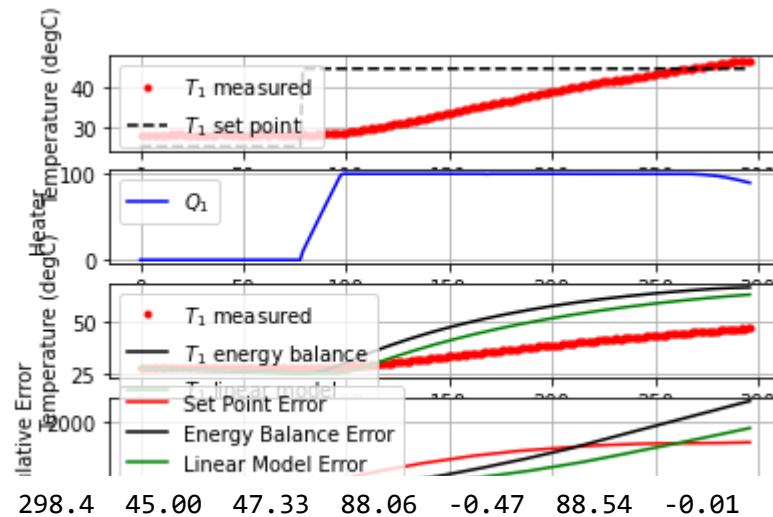
294.8 45.00 47.13 90.27 -0.43 90.71 -0.01

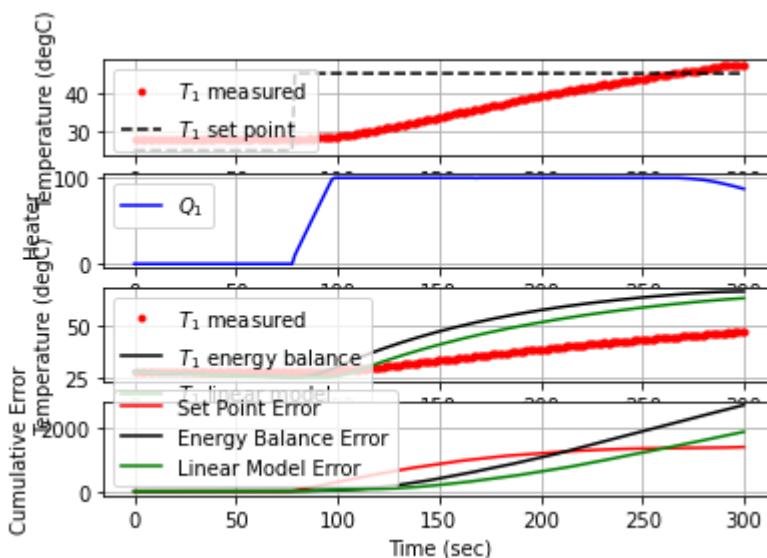
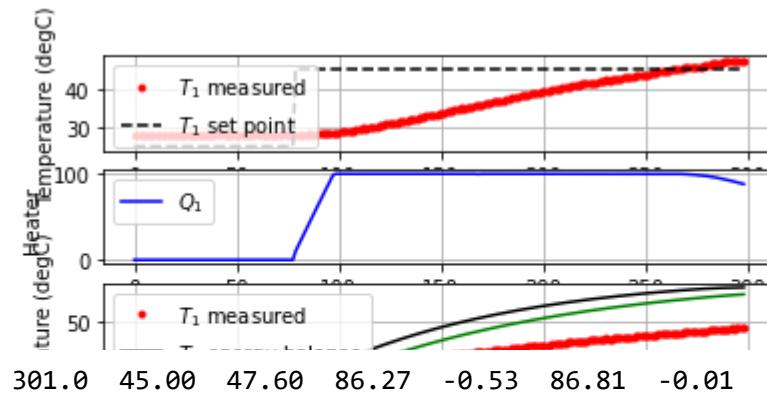


296.0 45.00 47.20 89.56 -0.45 90.01 -0.00

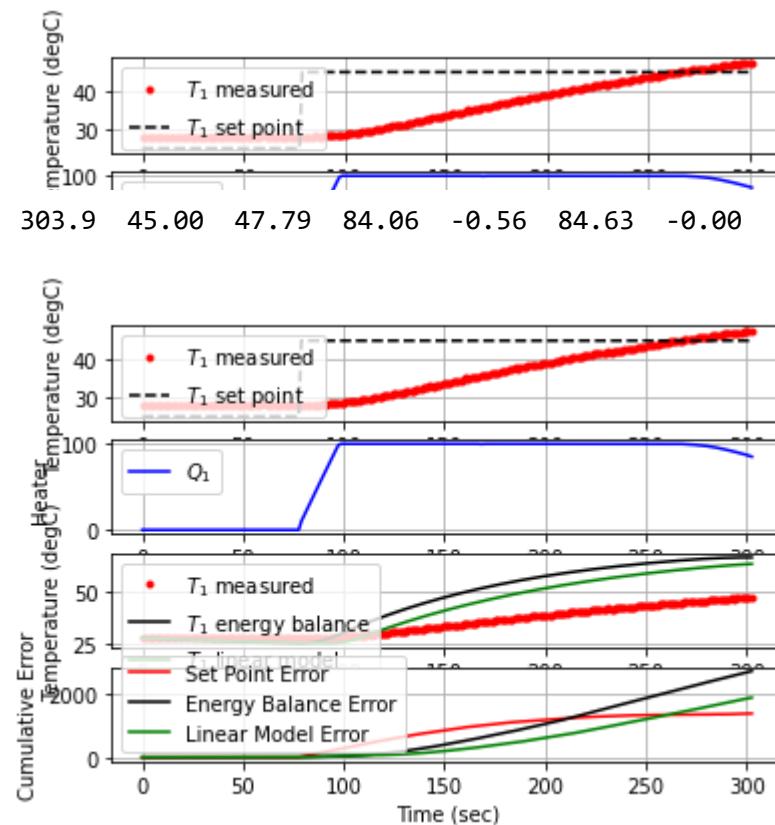


297.2 45.00 47.21 88.83 -0.45 89.27 -0.00



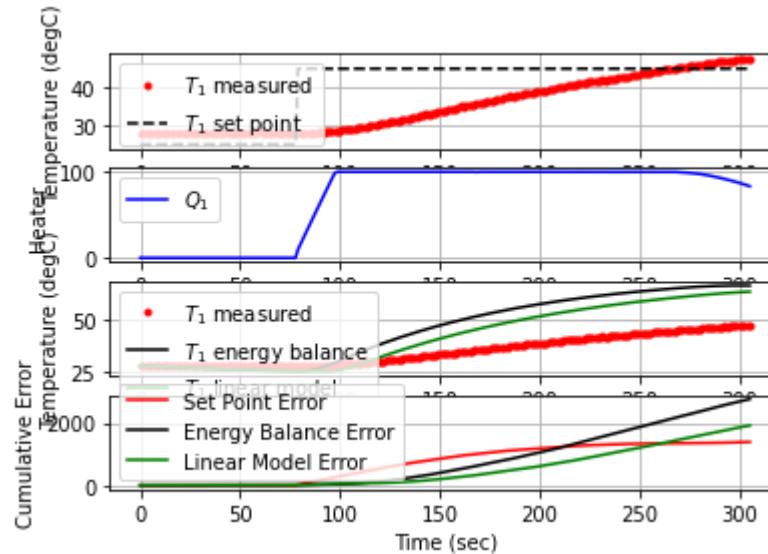


302.5 45.00 47.79 85.07 -0.56 85.64 -0.01

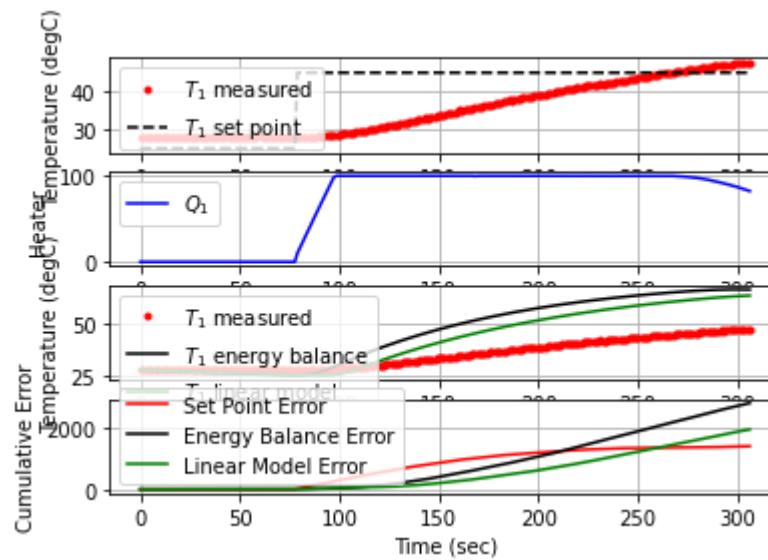


305.0 45.00 47.69 83.24 -0.54 83.78 0.01

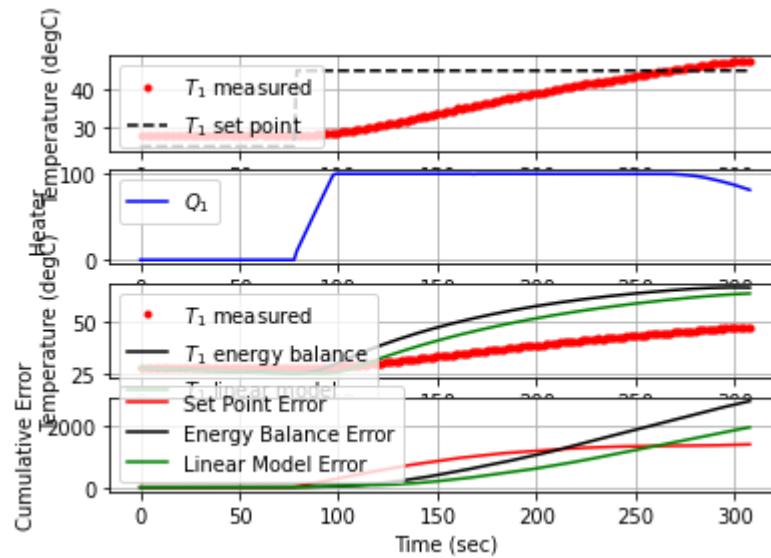
306.3 45.00 47.77 82.24 -0.56 82.81 -0.00



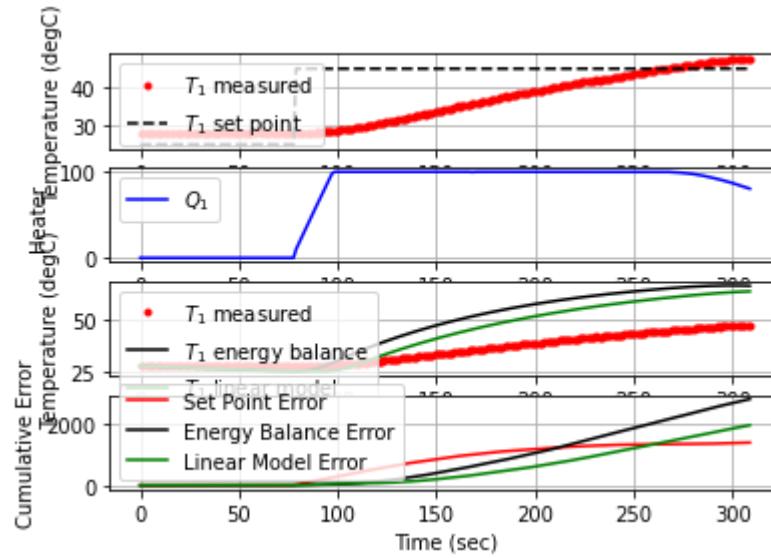
307.7 45.00 47.73 81.28 -0.55 81.83 0.00



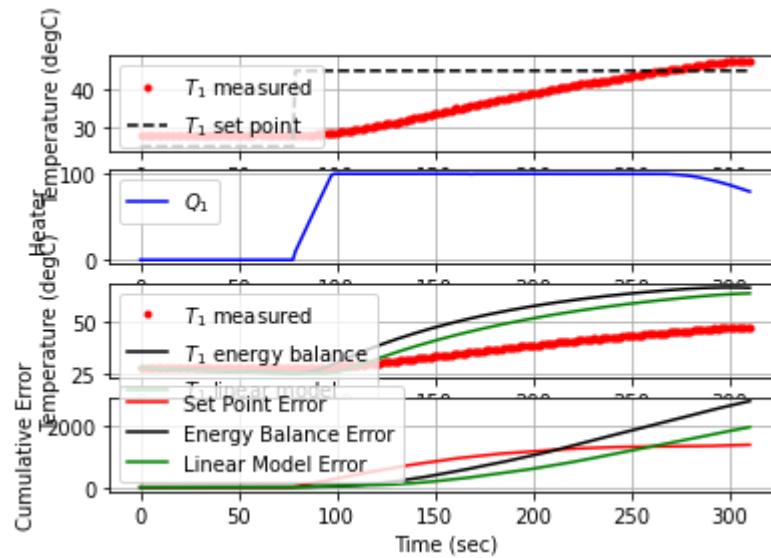
308.9 45.00 47.72 80.37 -0.55 80.92 0.00



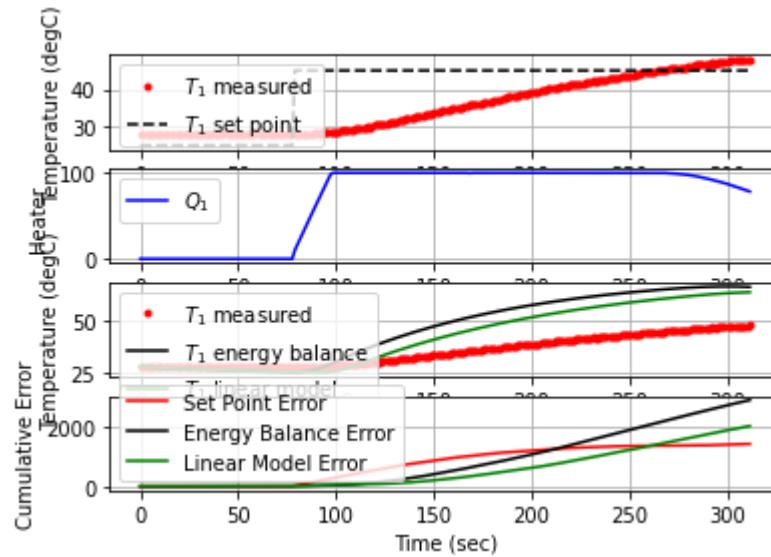
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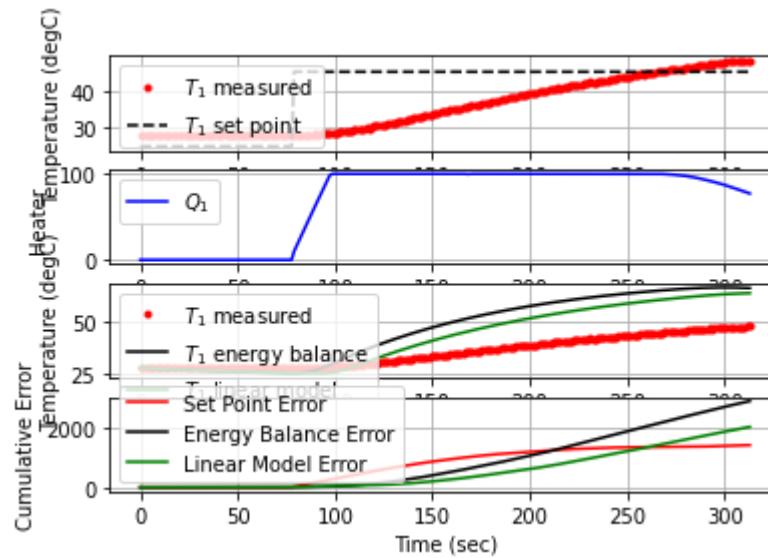
311.4 45.00 48.04 78.28 -0.61 78.91 -0.01



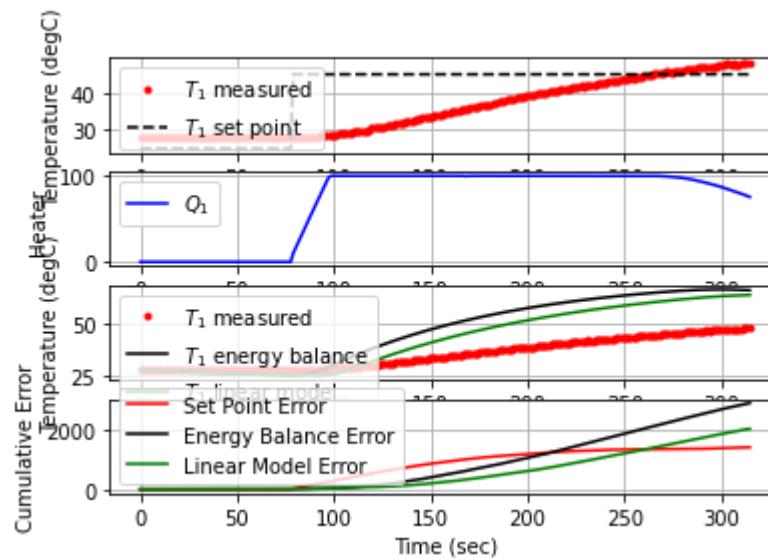
312.8 45.00 48.13 77.08 -0.63 77.72 -0.00



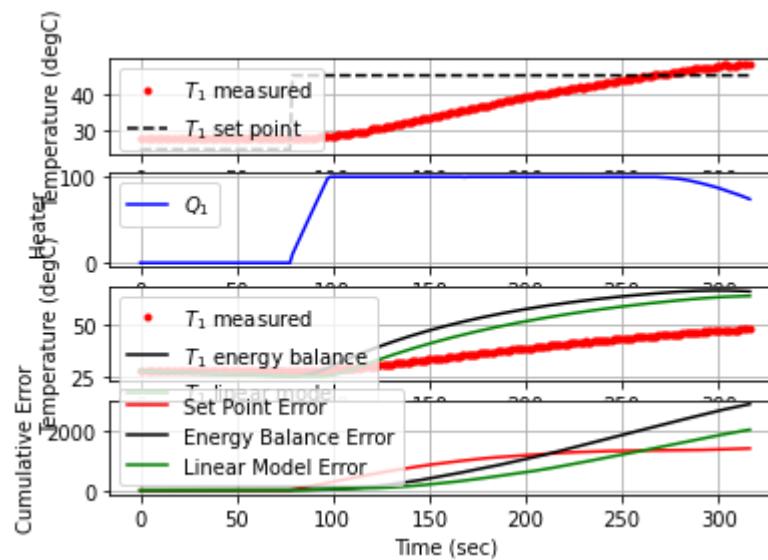
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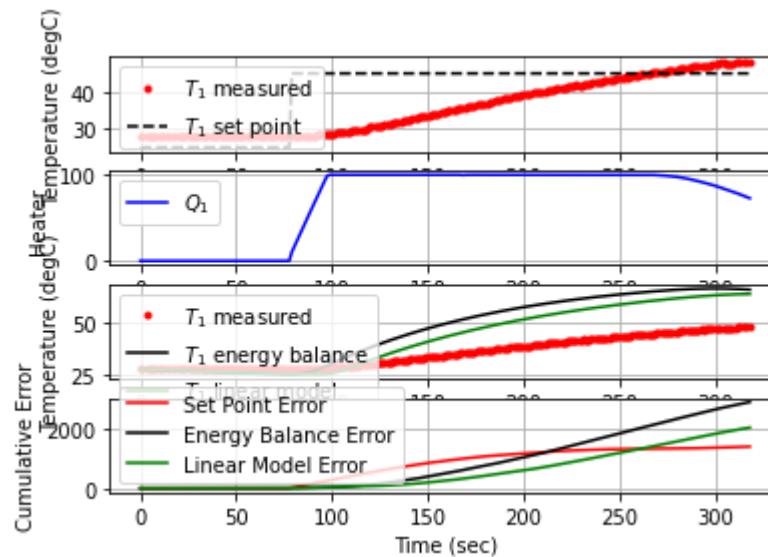
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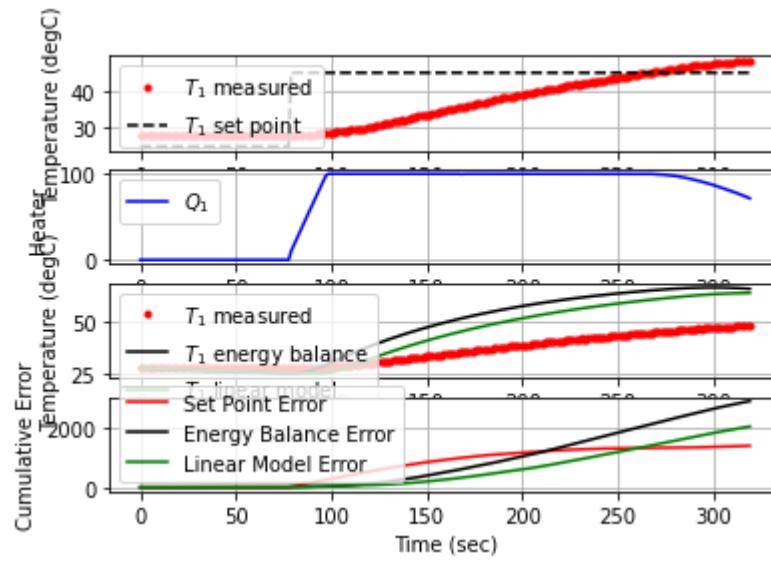
317.7 45.00 48.19 72.76 -0.64 73.40 0.01



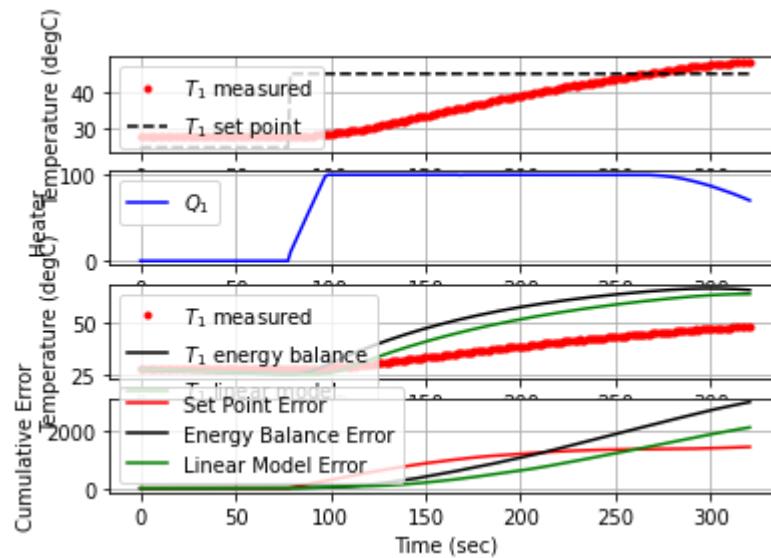
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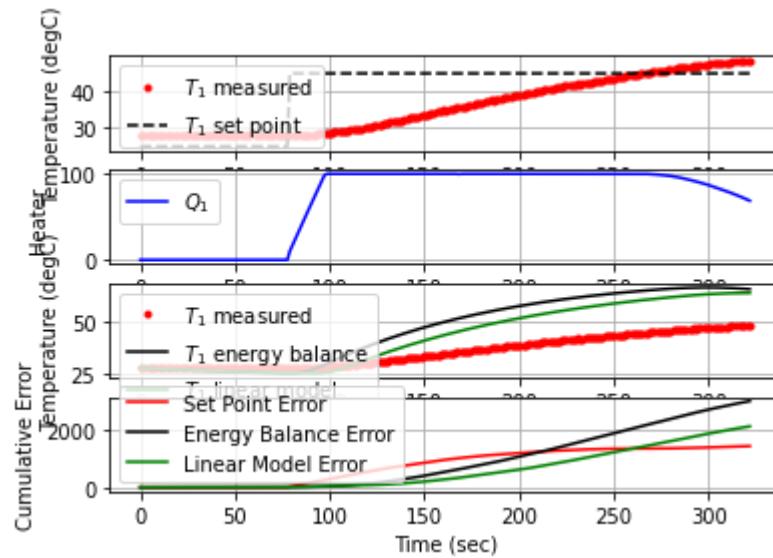
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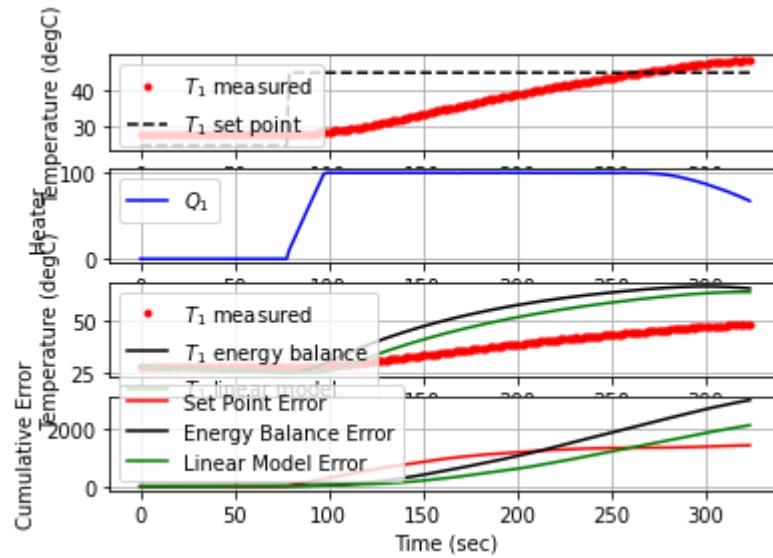
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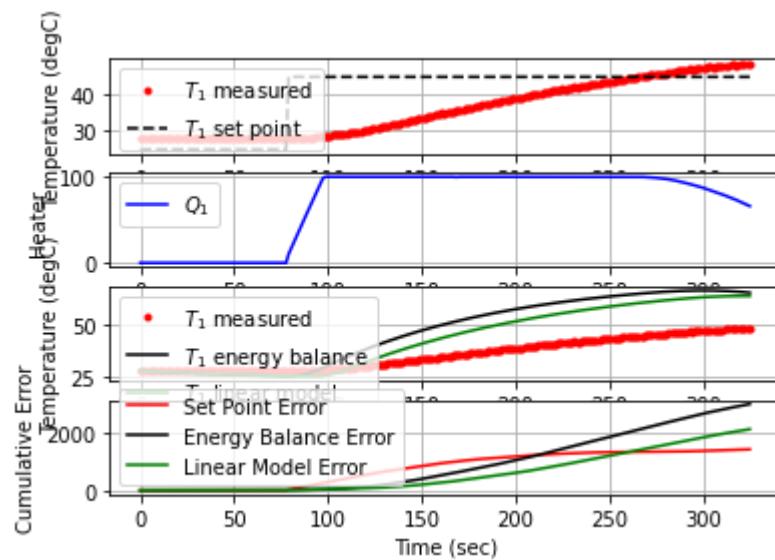
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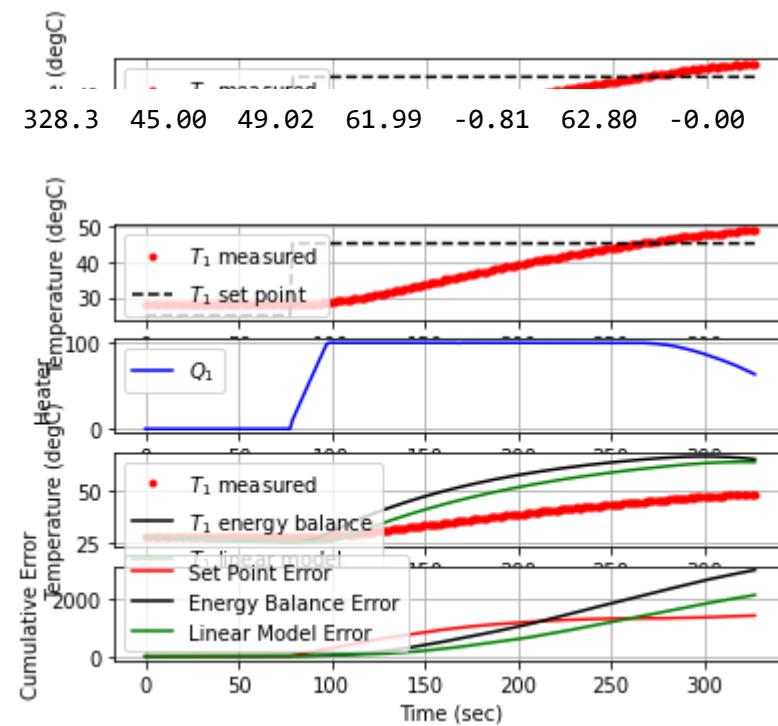
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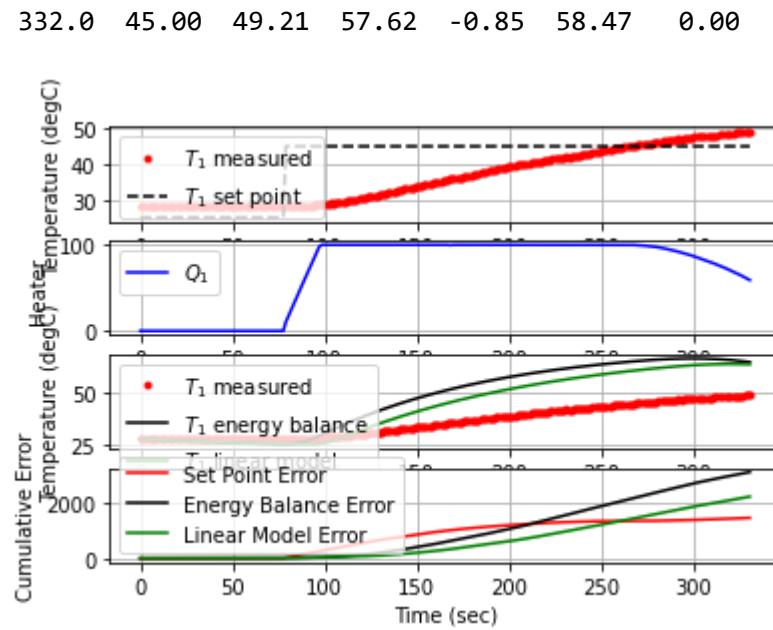
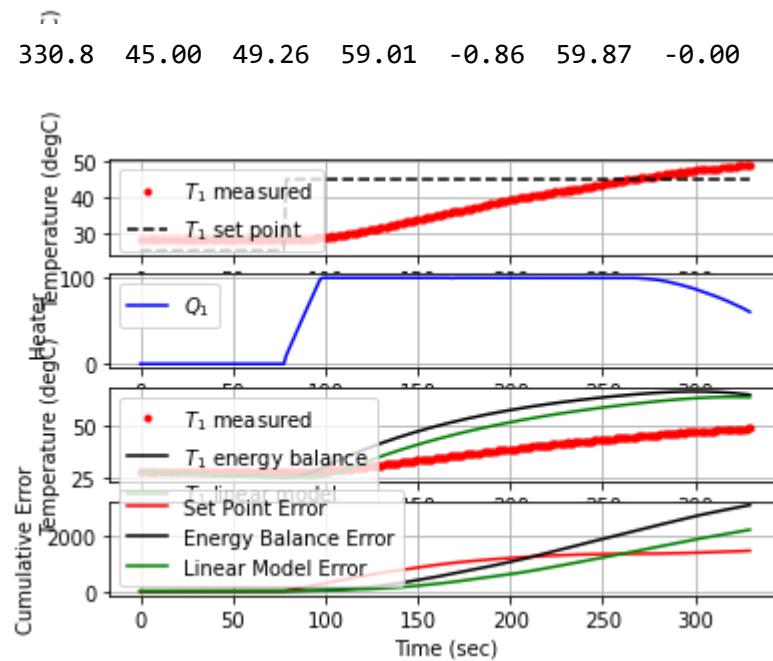
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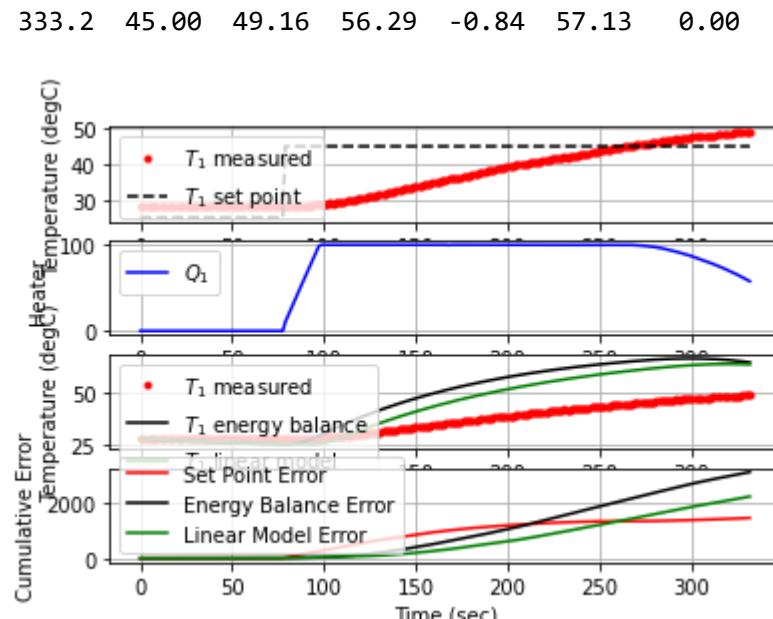


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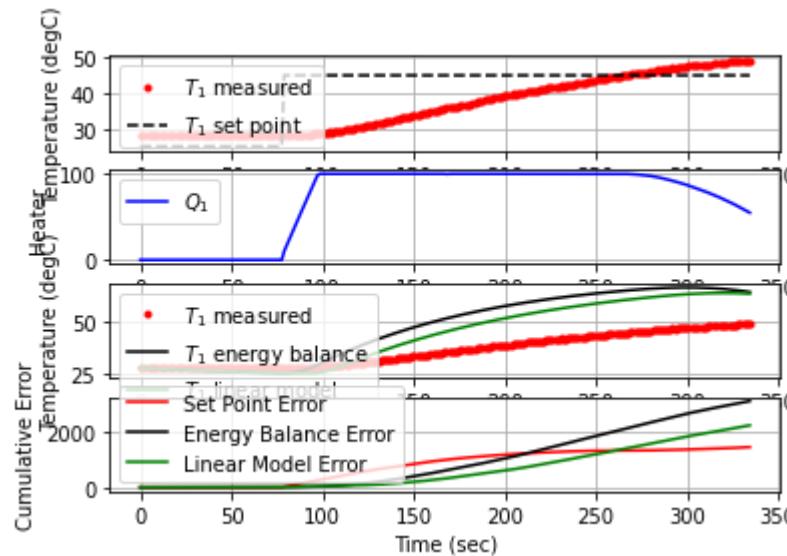
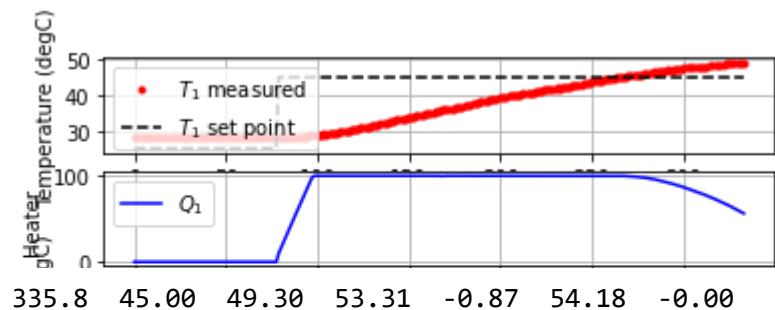


329.6 45.00 49.26 60.42 -0.86 61.29 -0.01

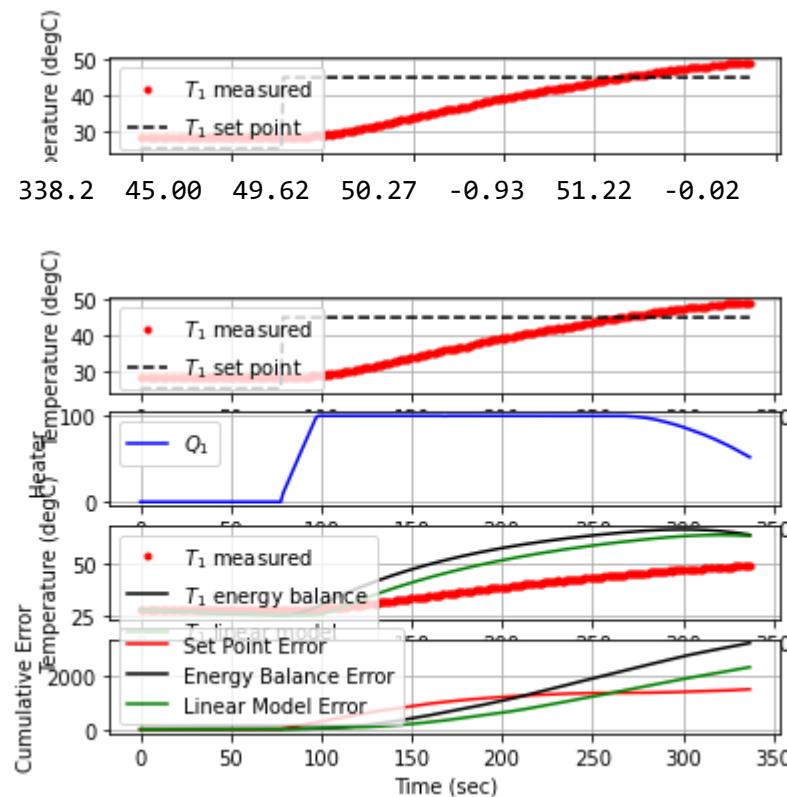




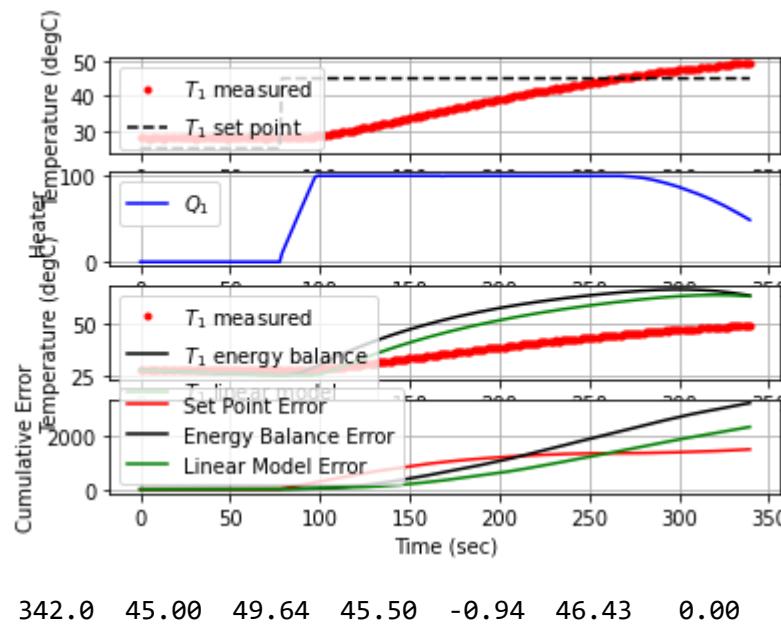
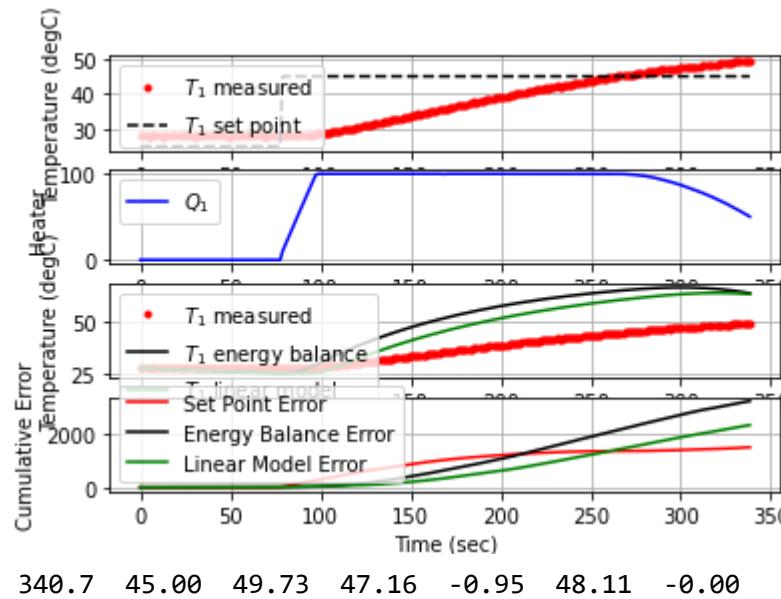
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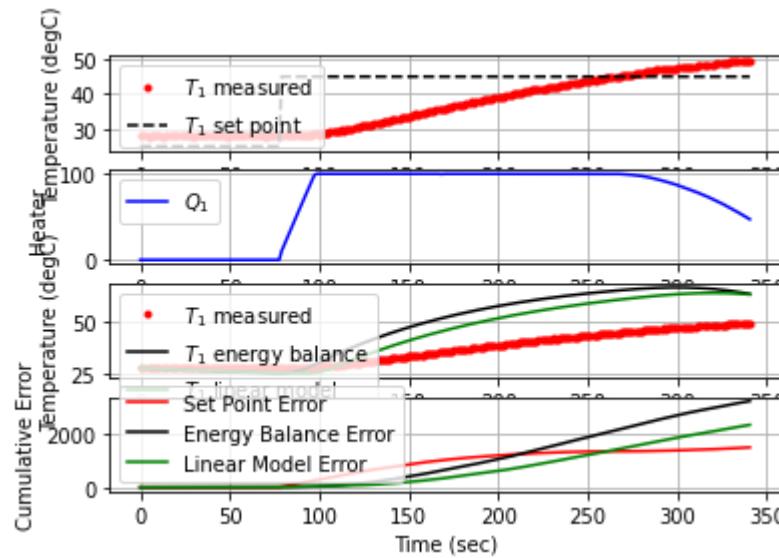


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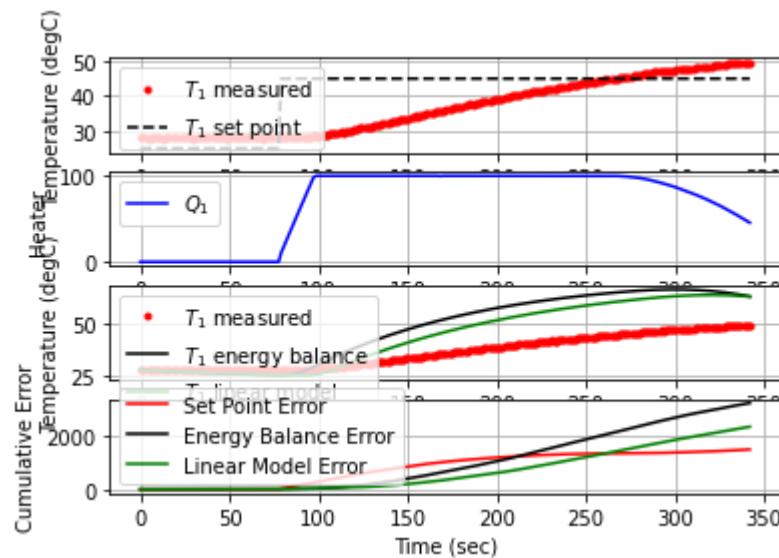


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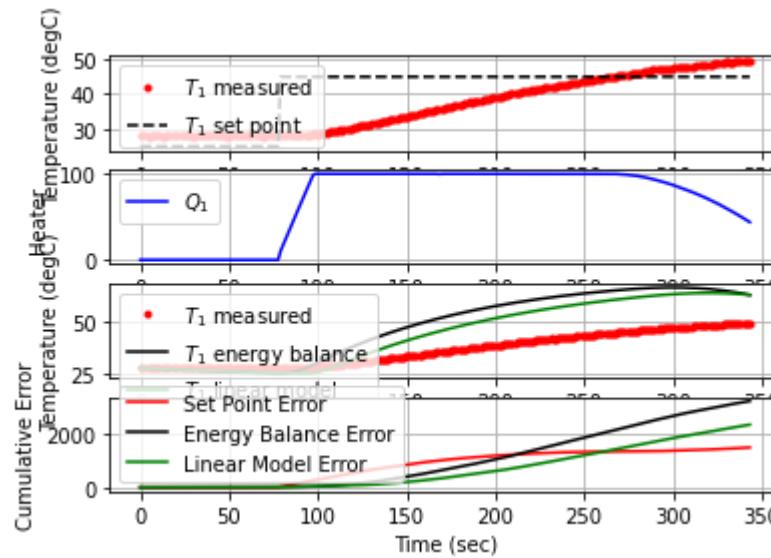




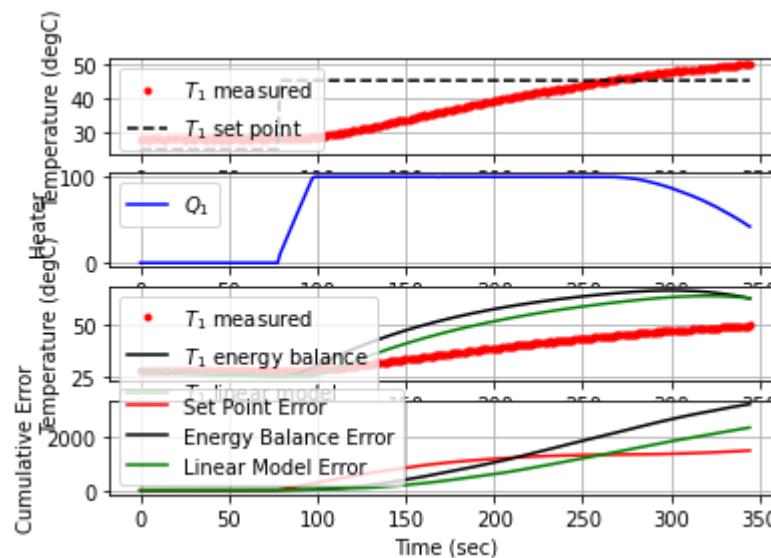
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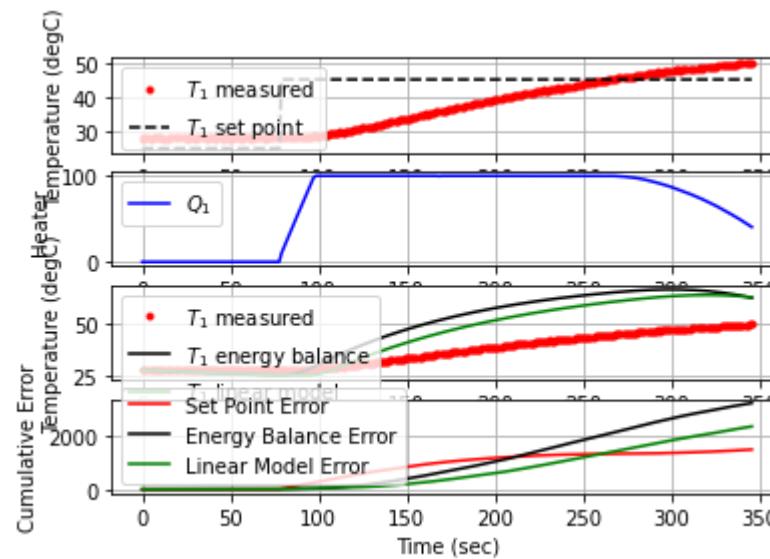
344.5 45.00 50.04 42.10 -1.02 43.13 -0.01



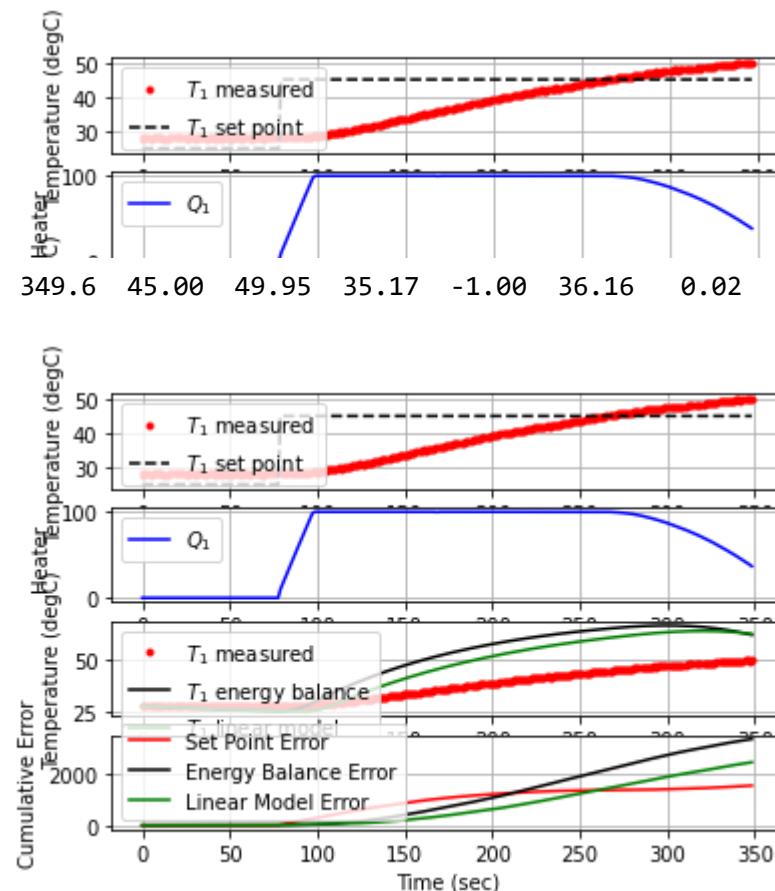
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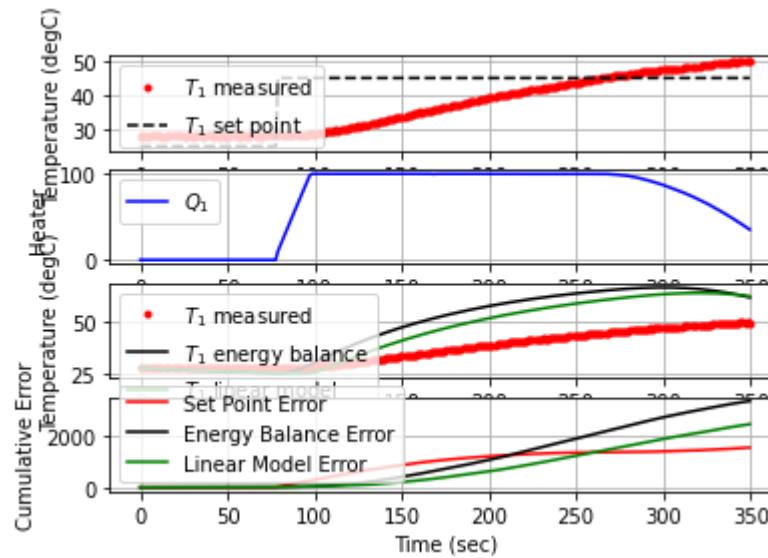
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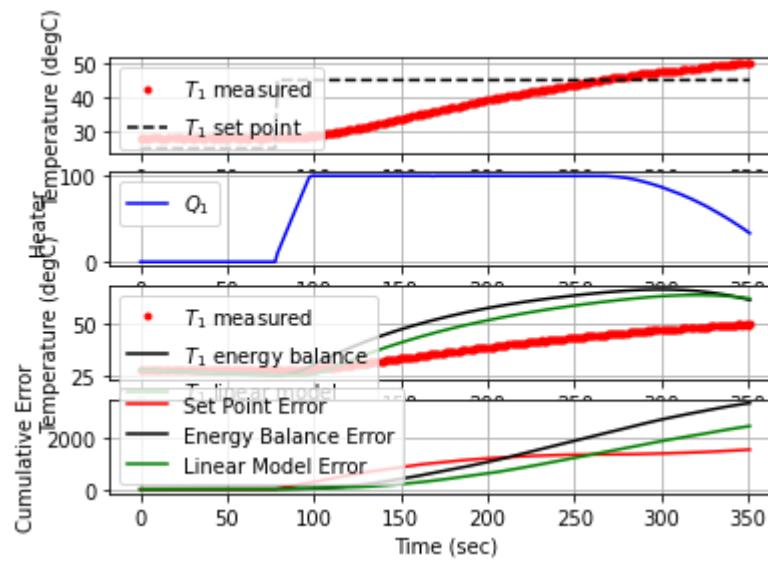
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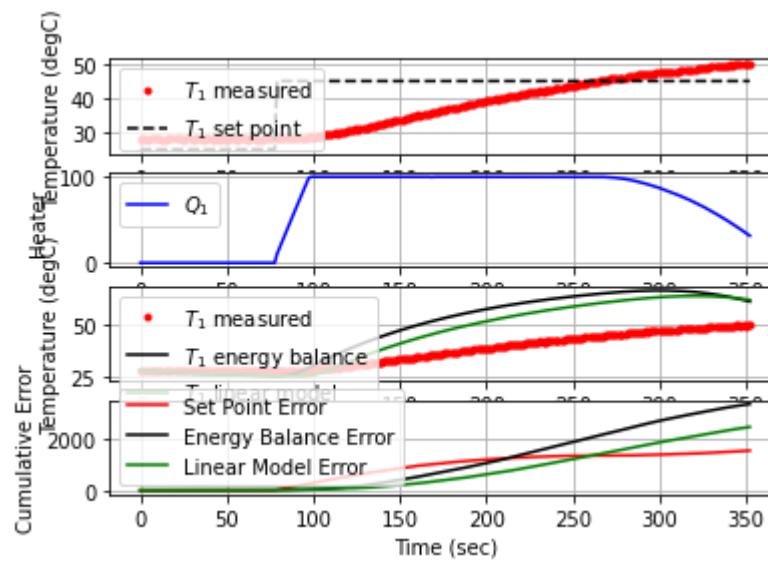
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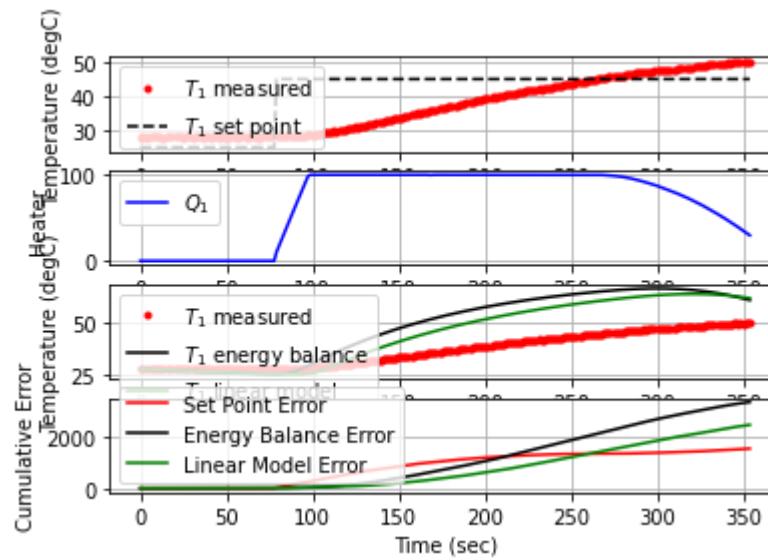
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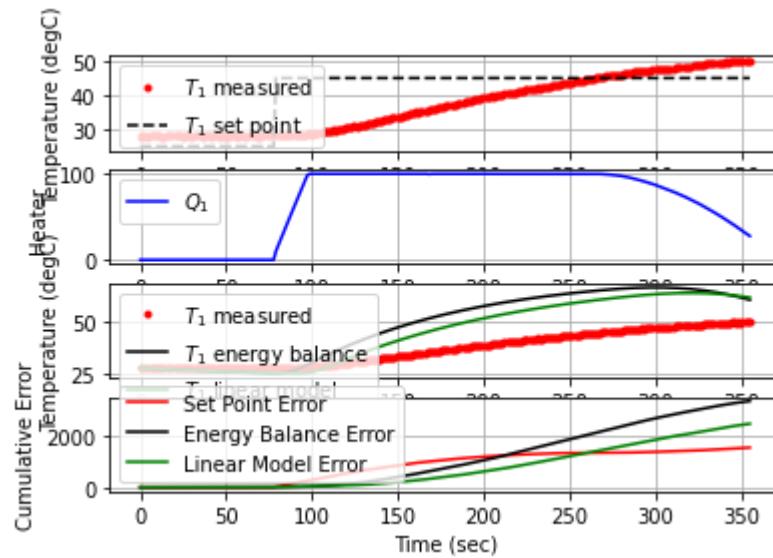
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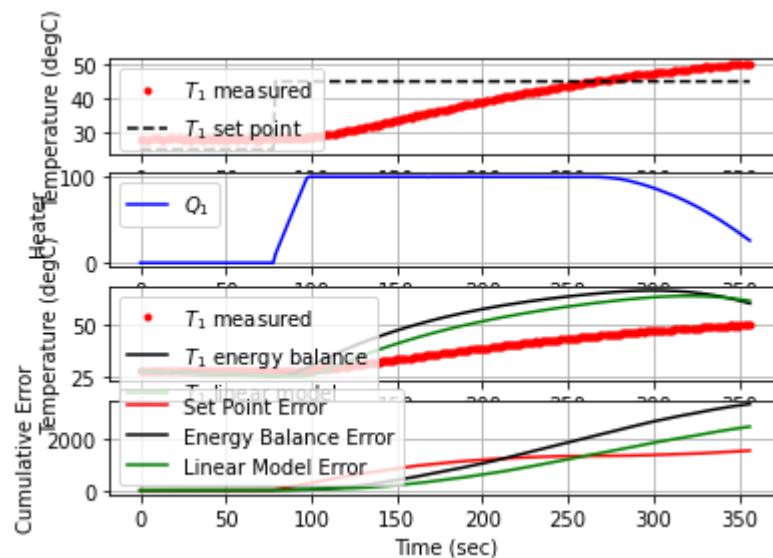
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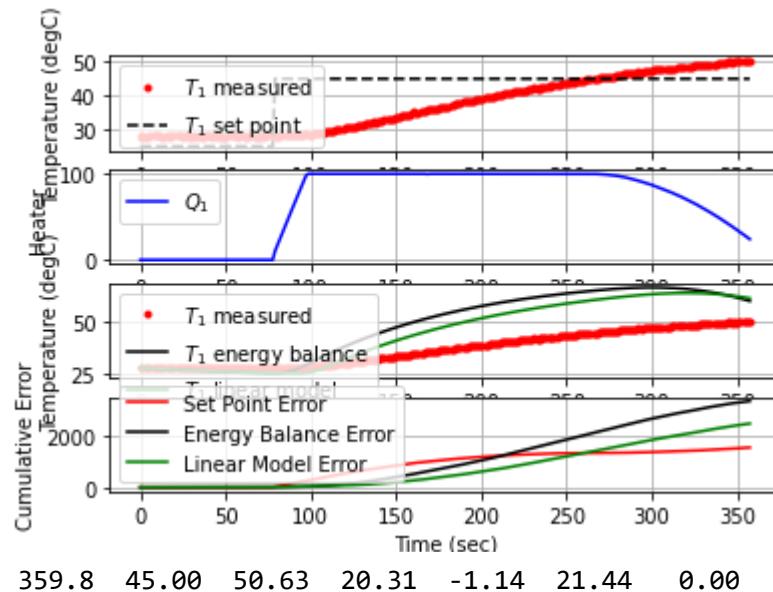
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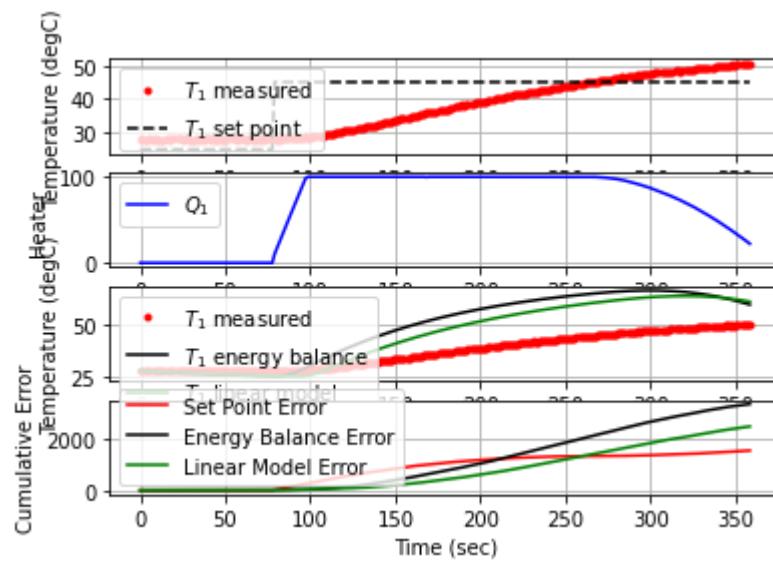
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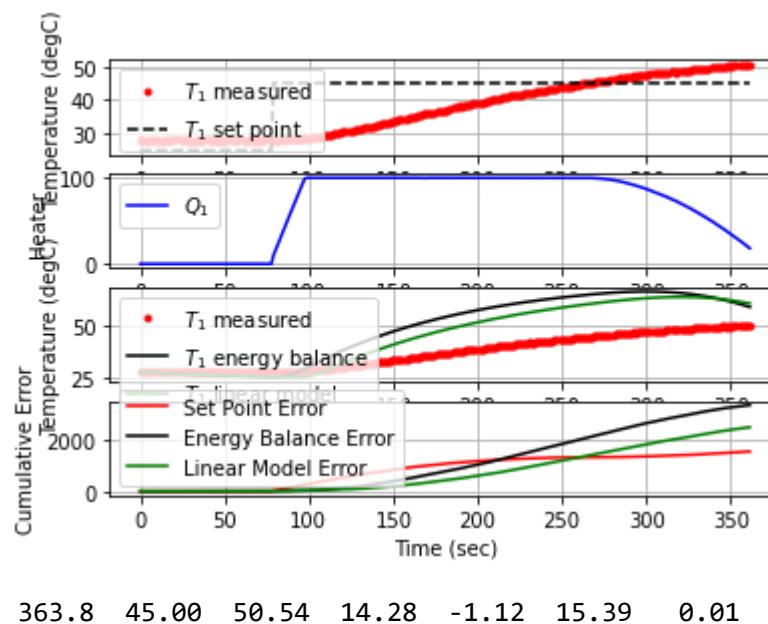
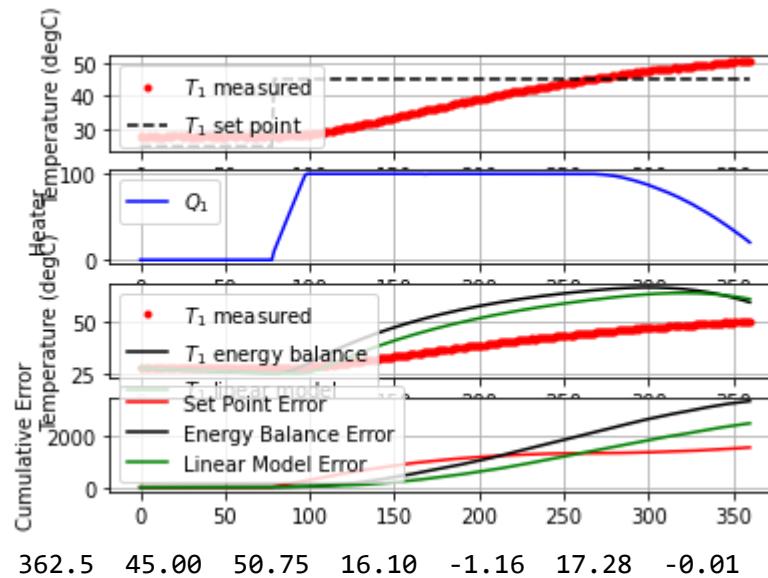
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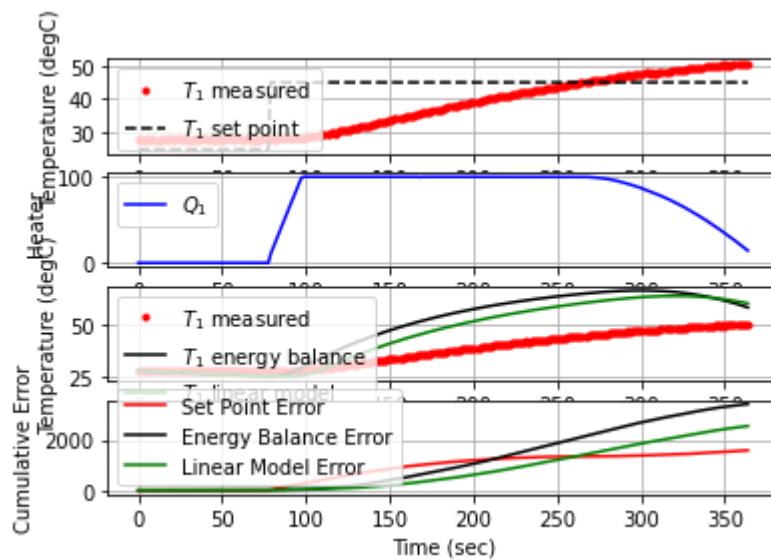
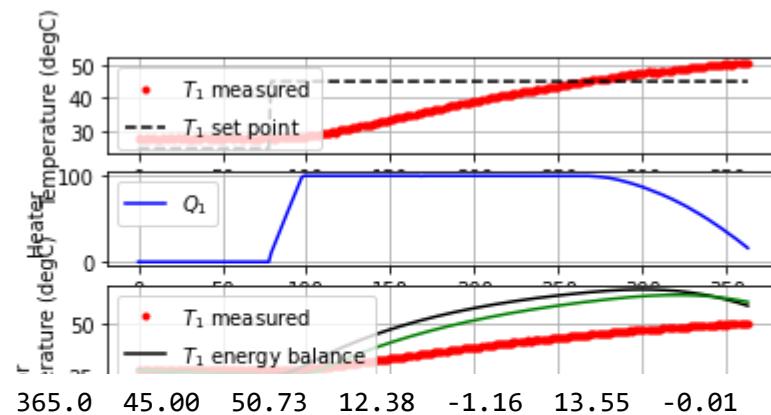


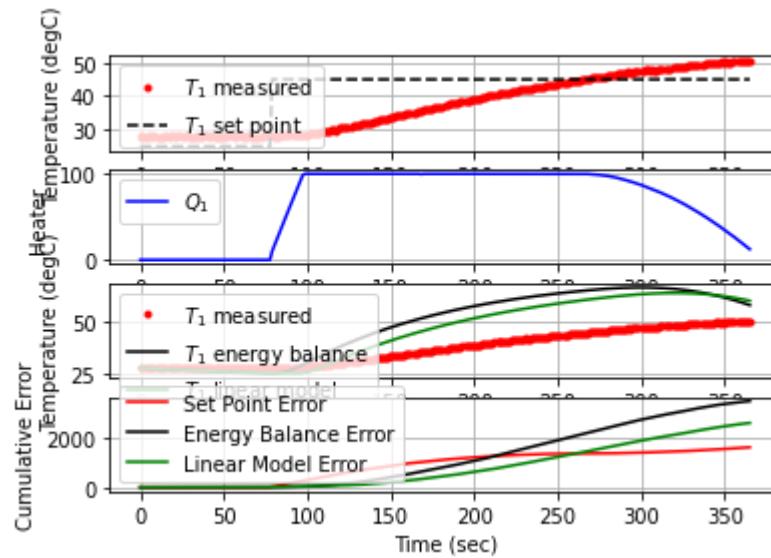
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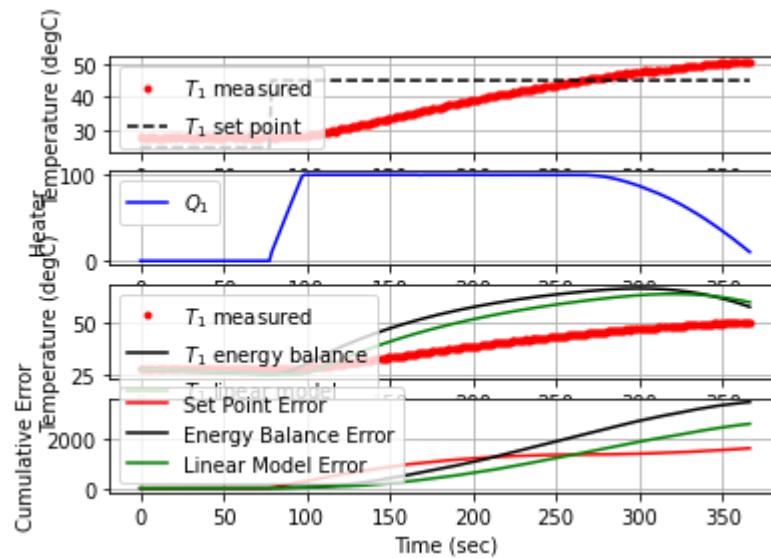
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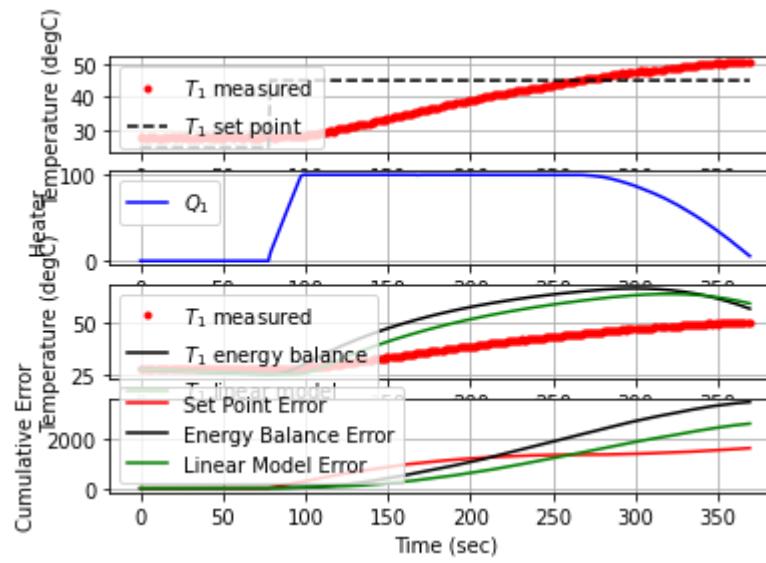
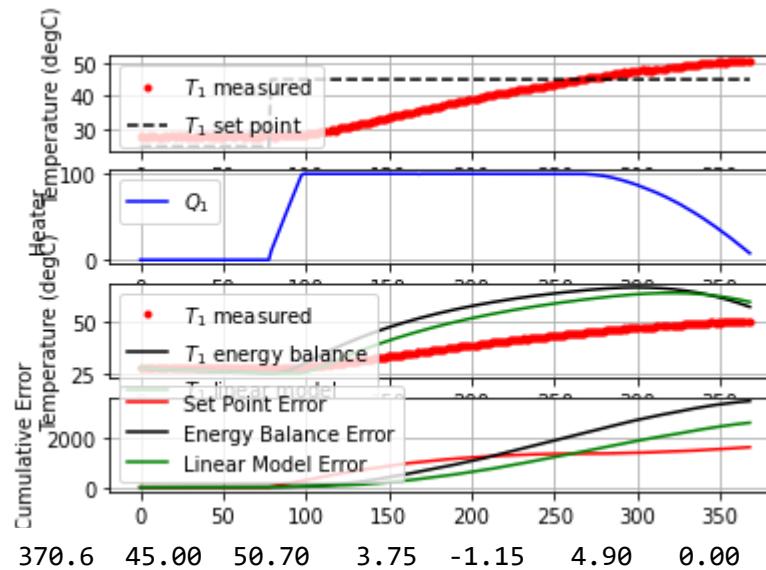




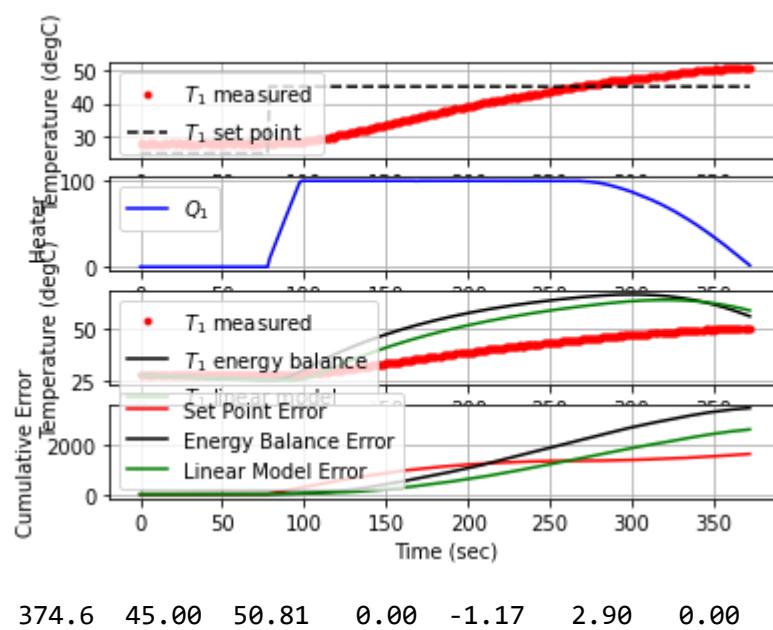
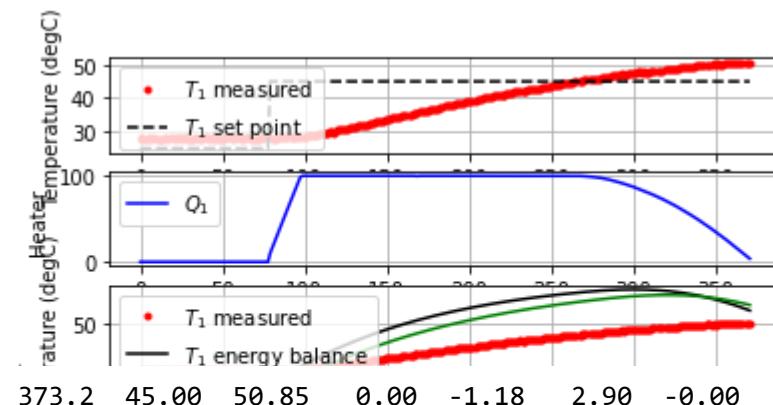
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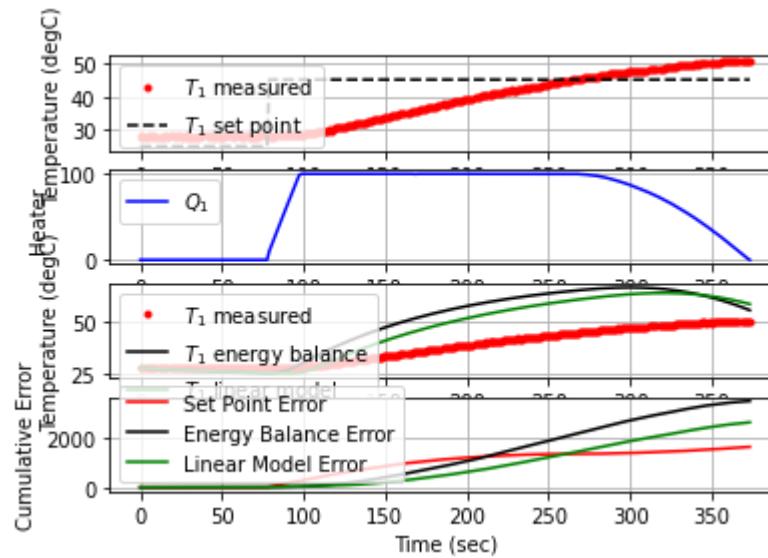


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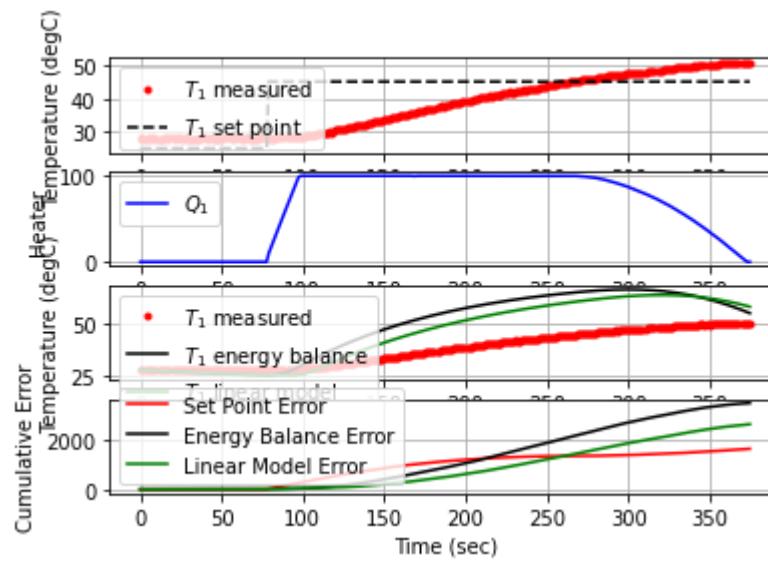


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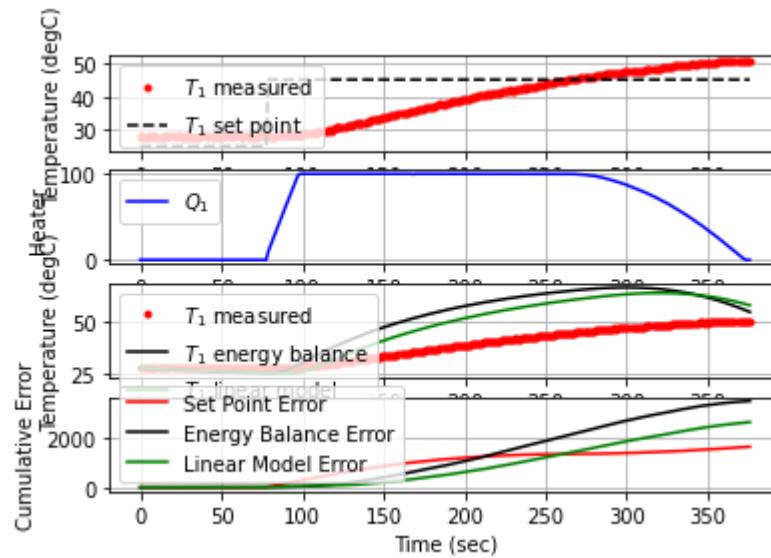




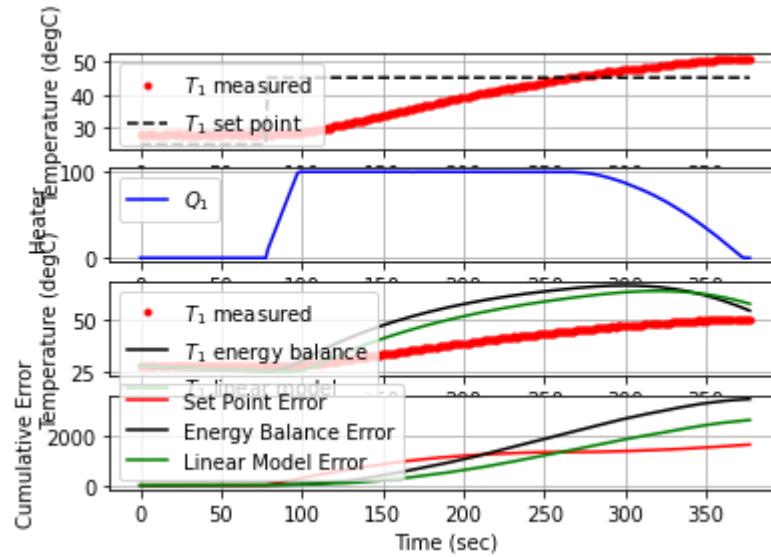
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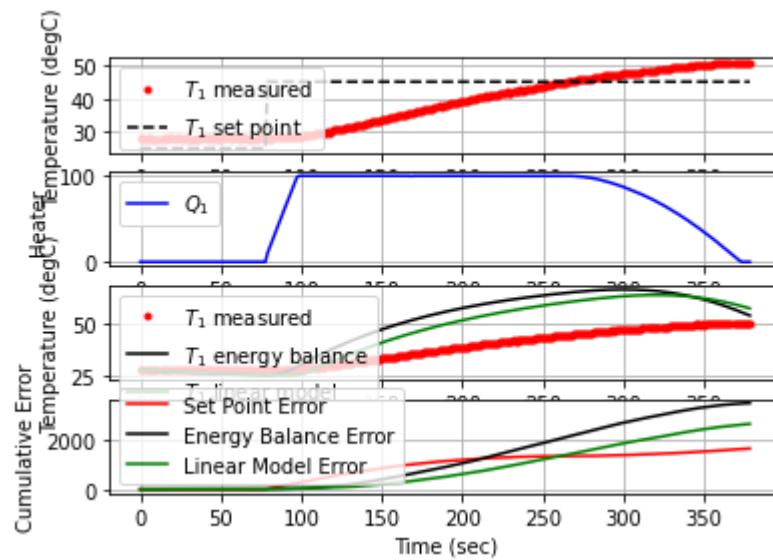
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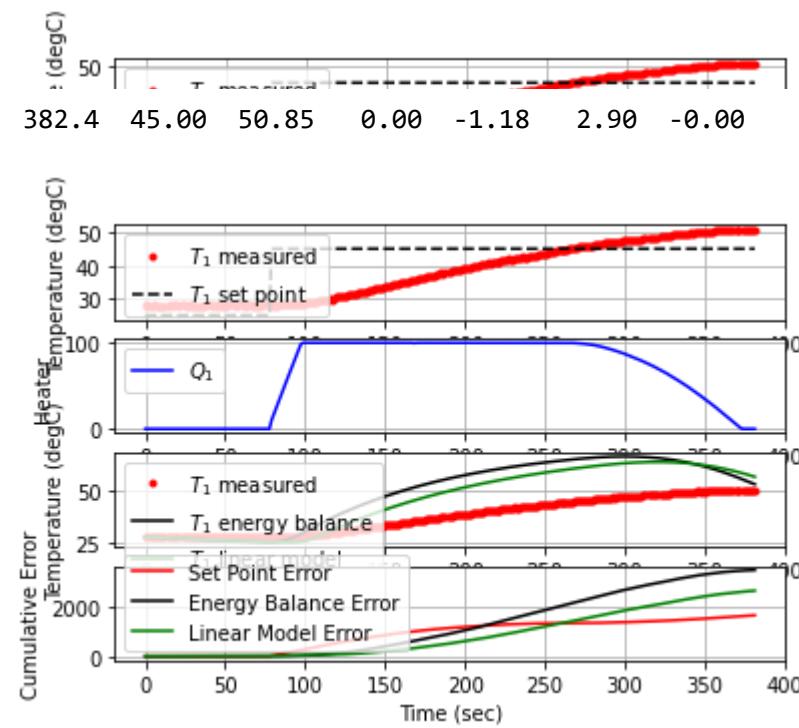
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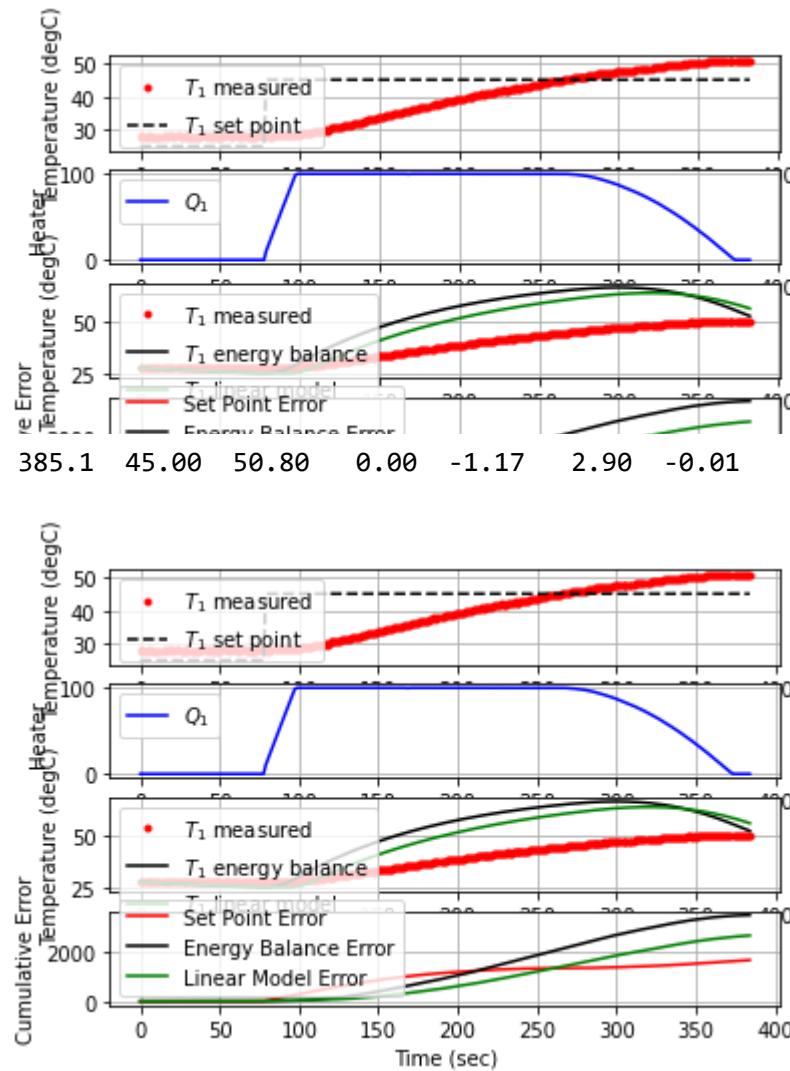
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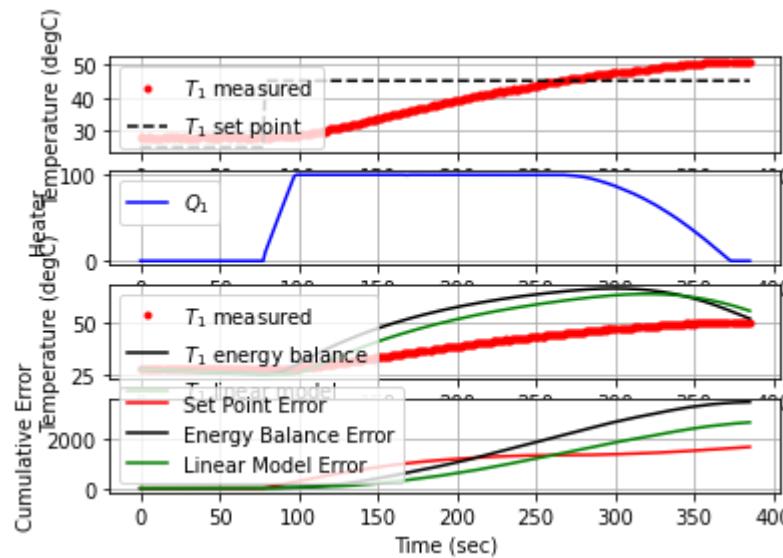
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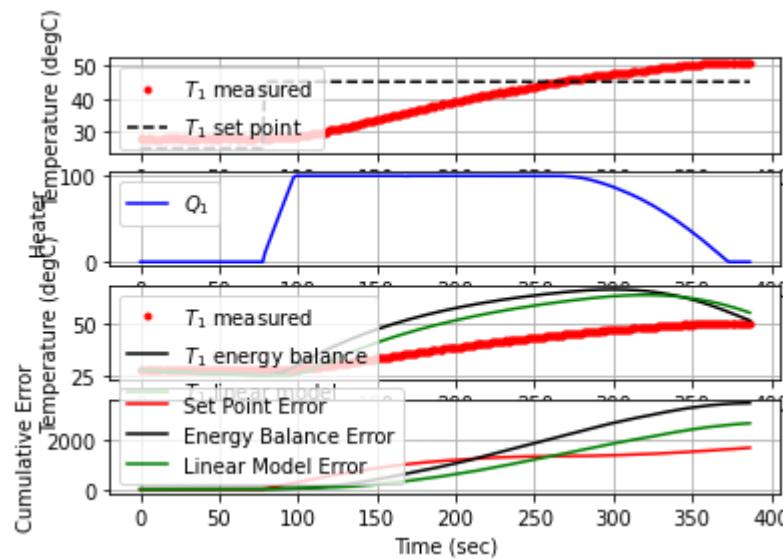
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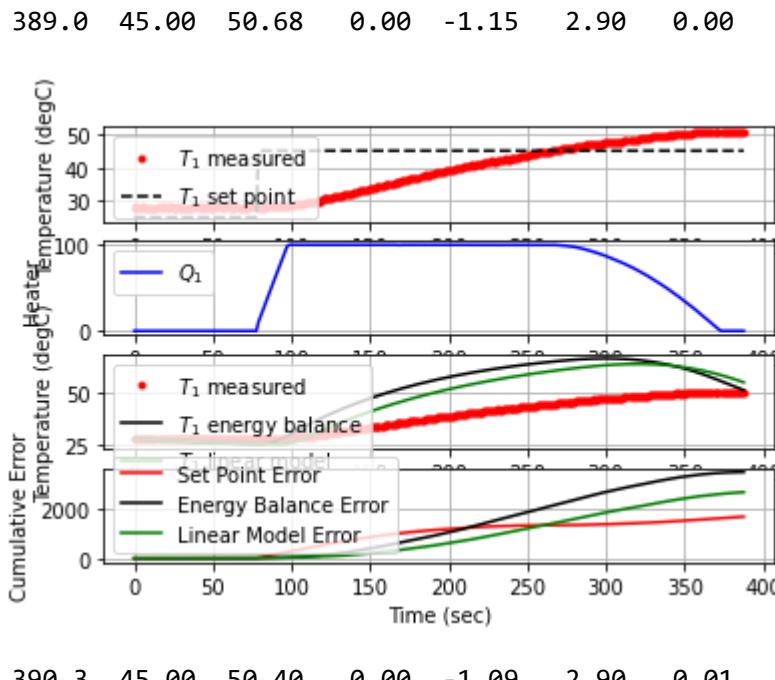


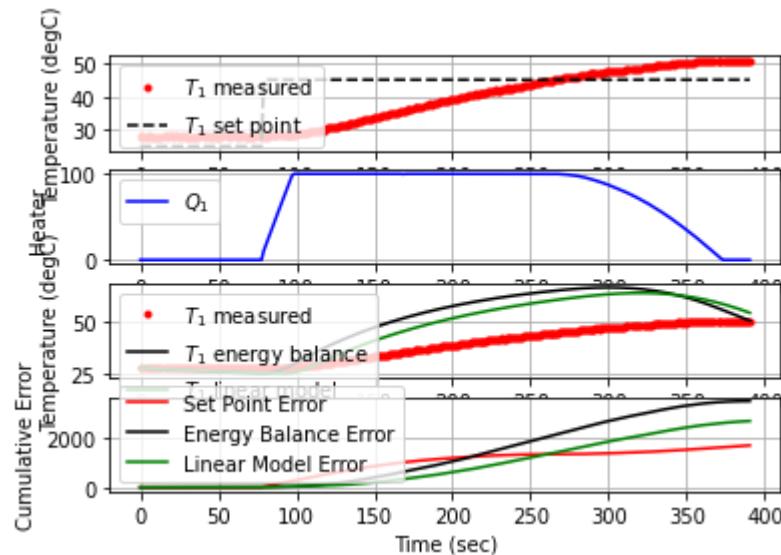
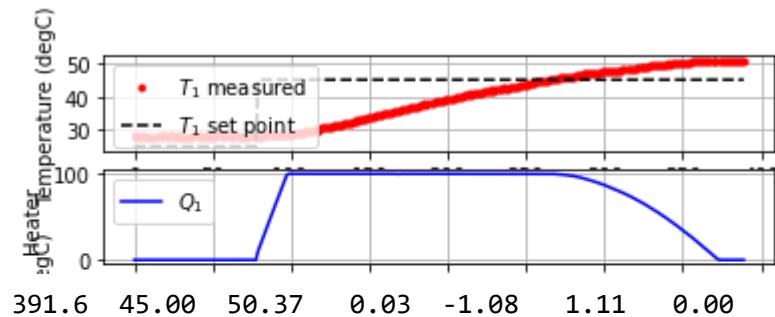
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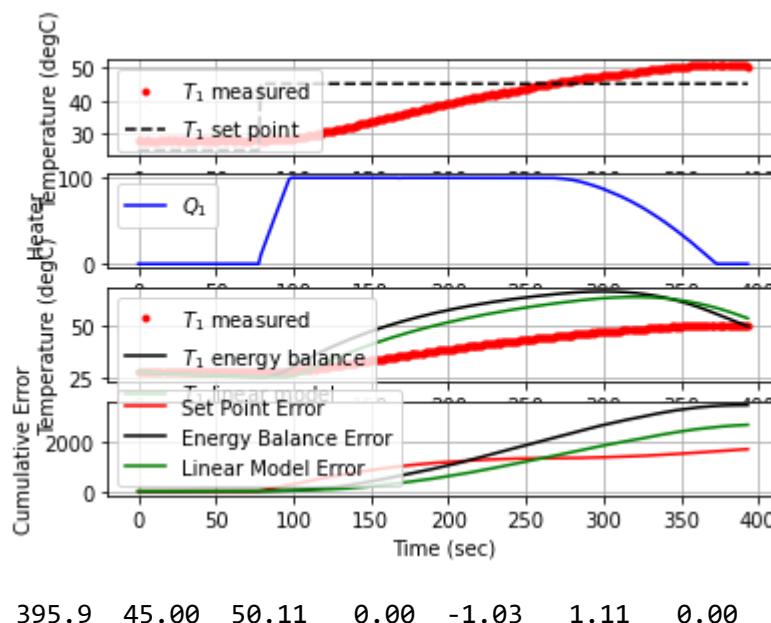
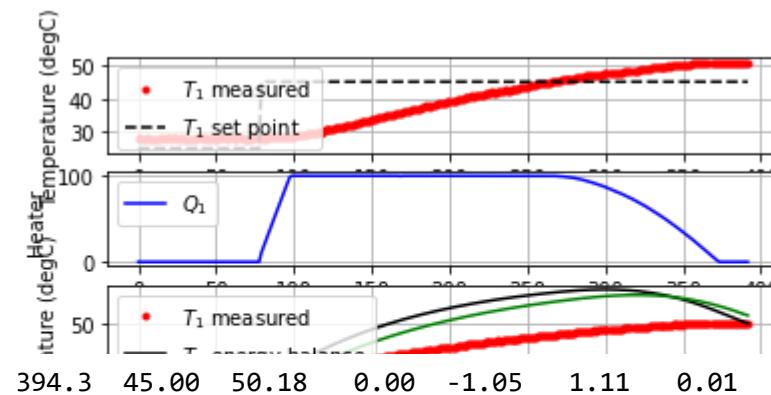


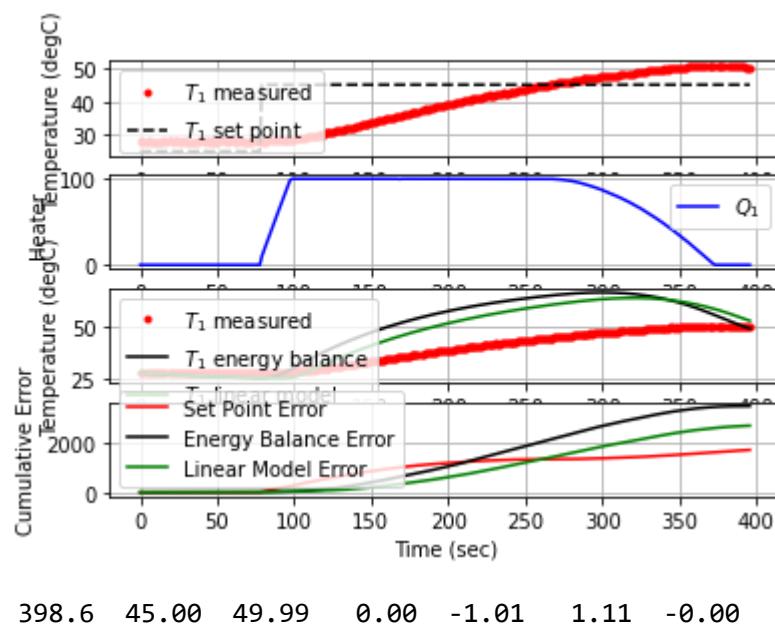
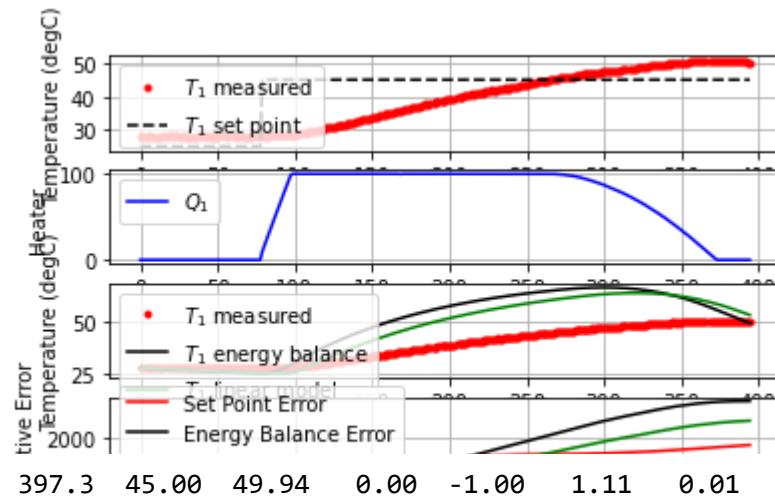
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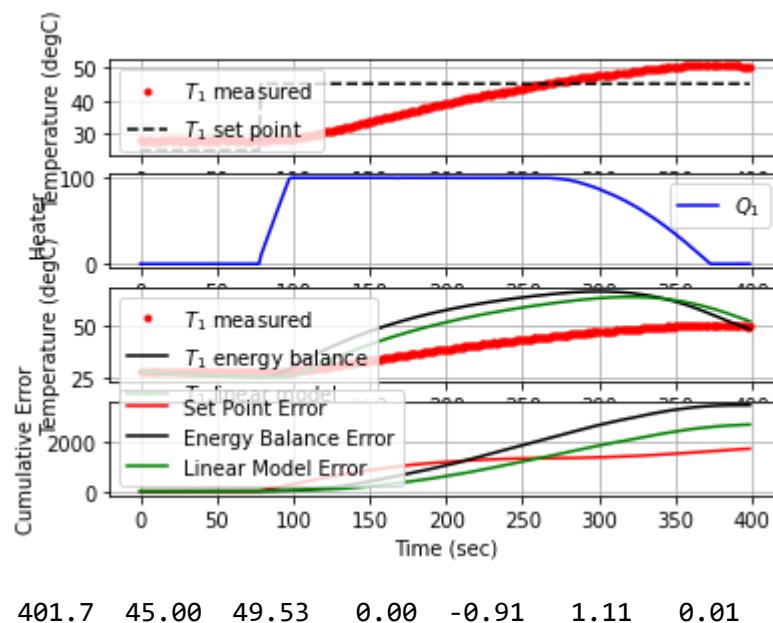
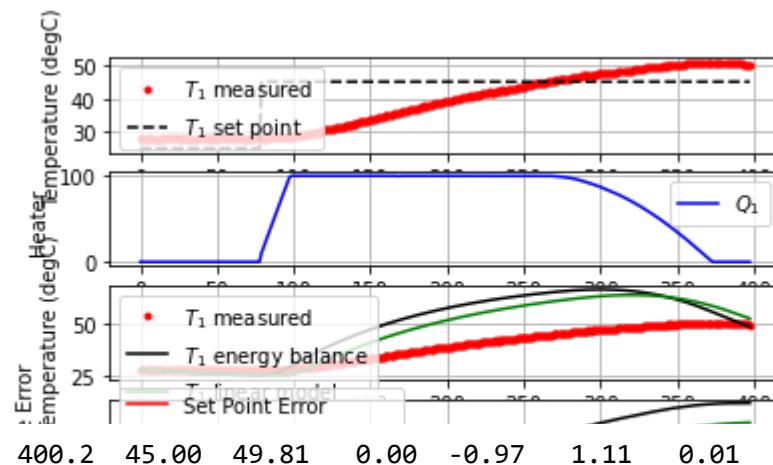


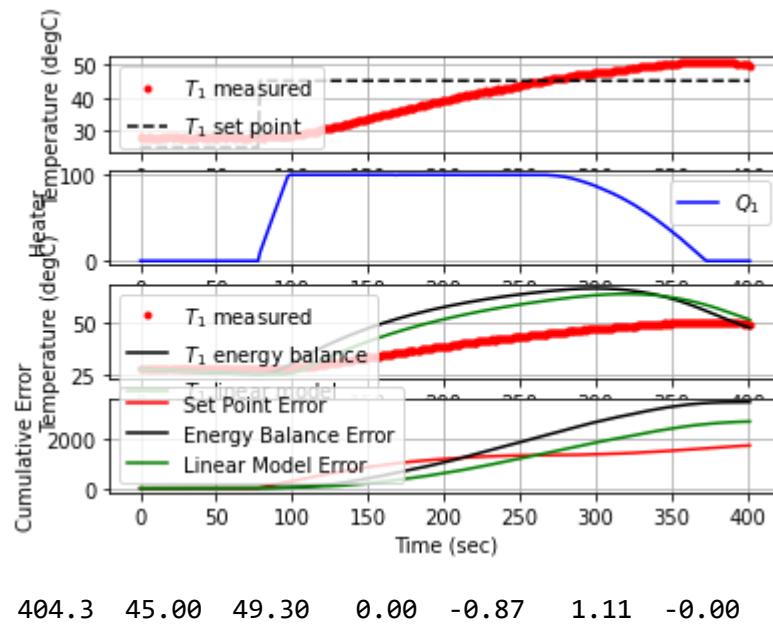
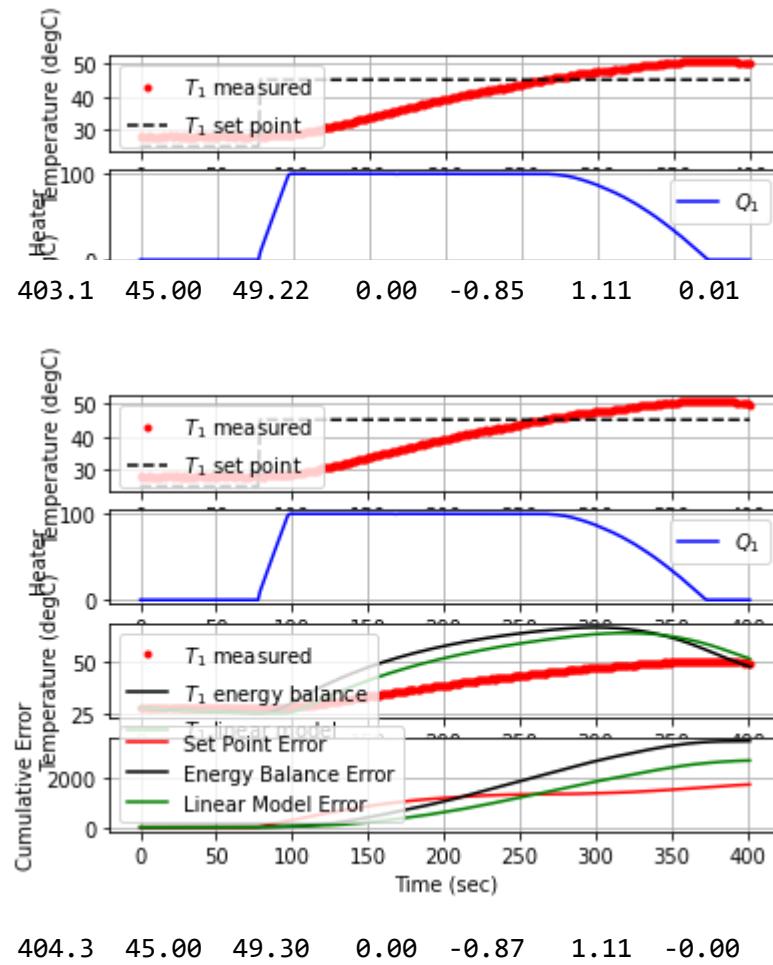


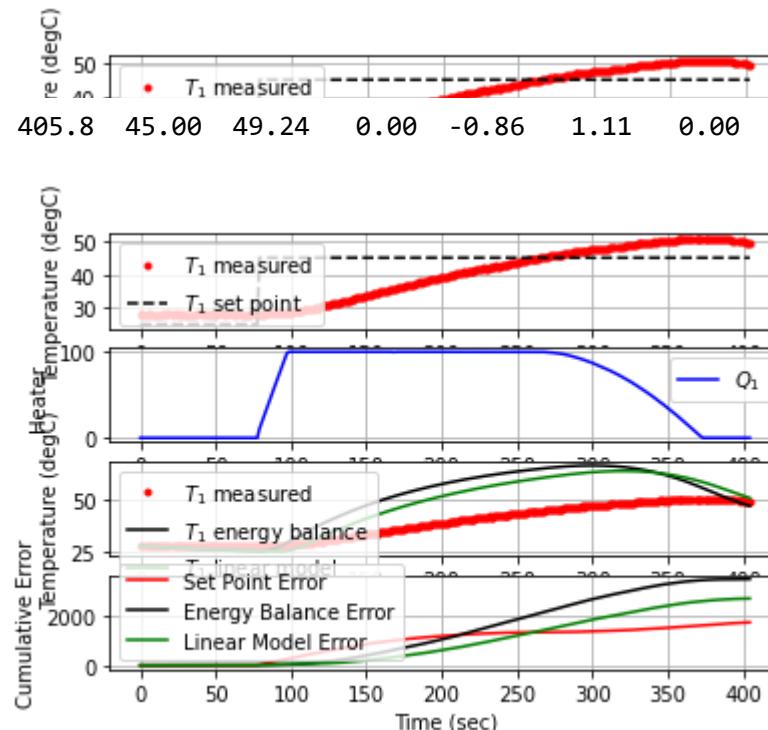




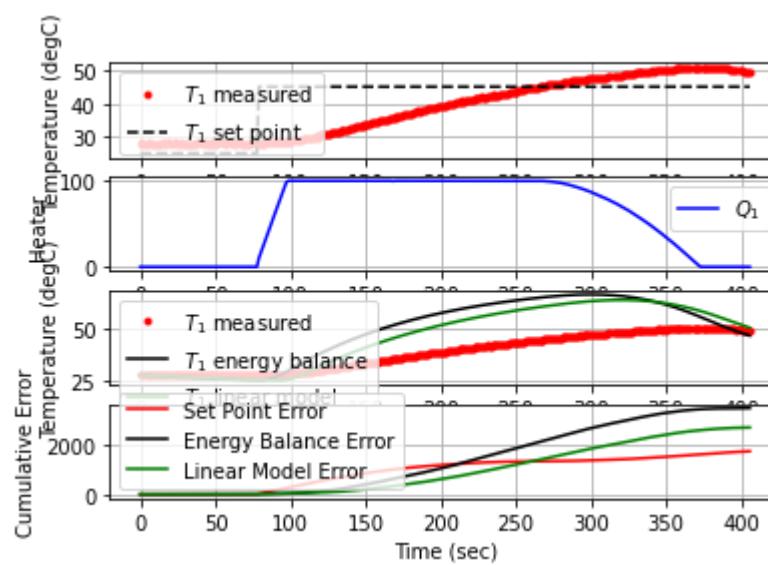




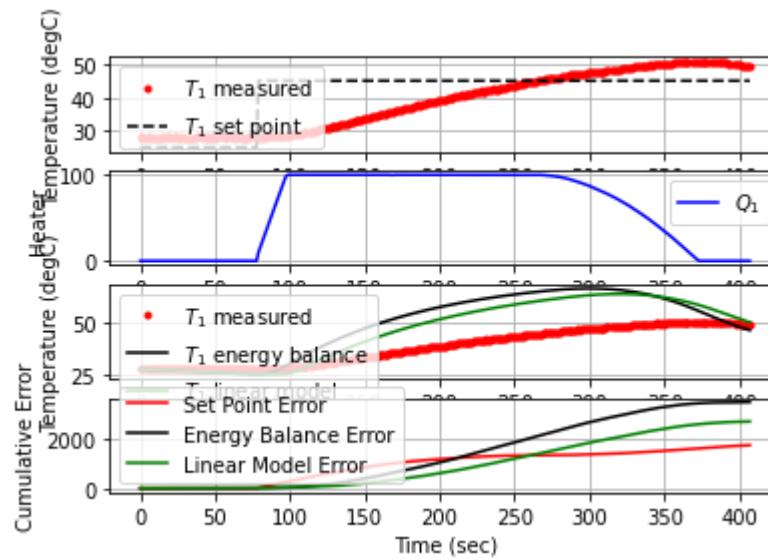




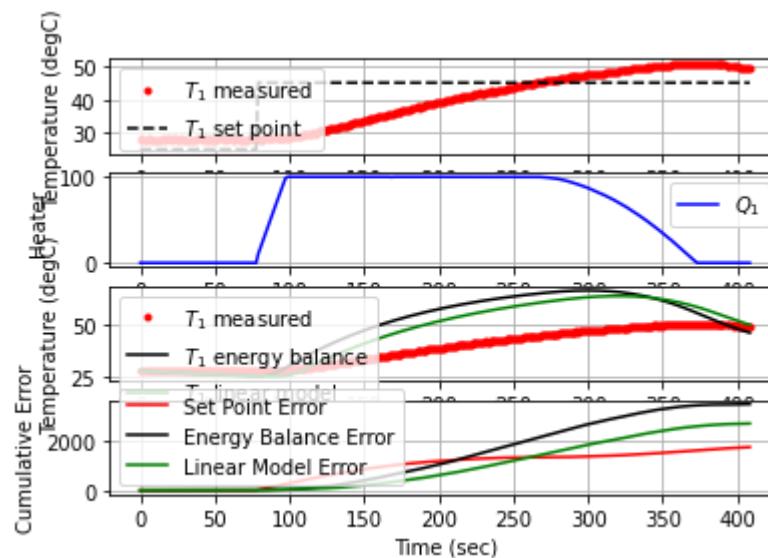
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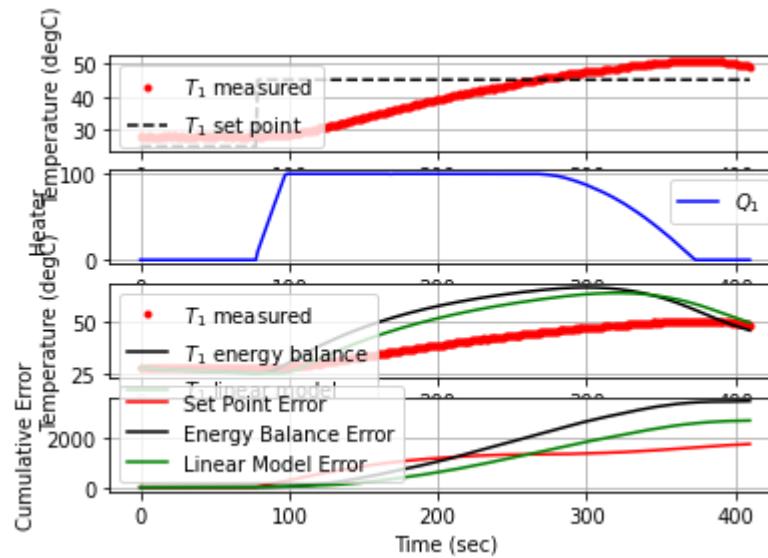
408.4 45.00 49.20 0.00 -0.85 1.11 0.00



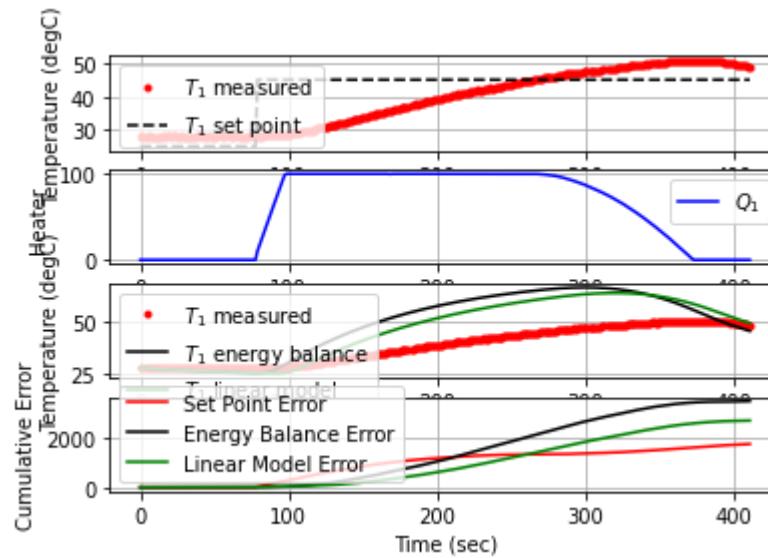
409.7 45.00 48.97 0.00 -0.80 1.11 0.01



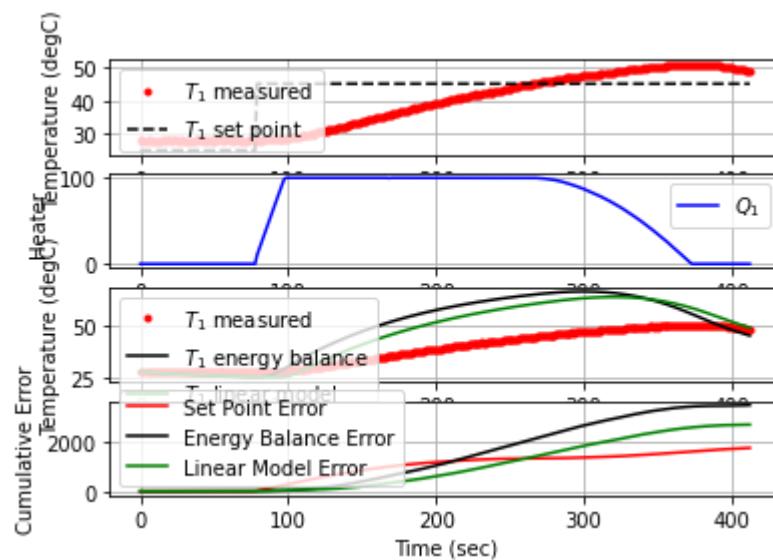
410.9 45.00 48.94 0.00 -0.80 1.11 0.00



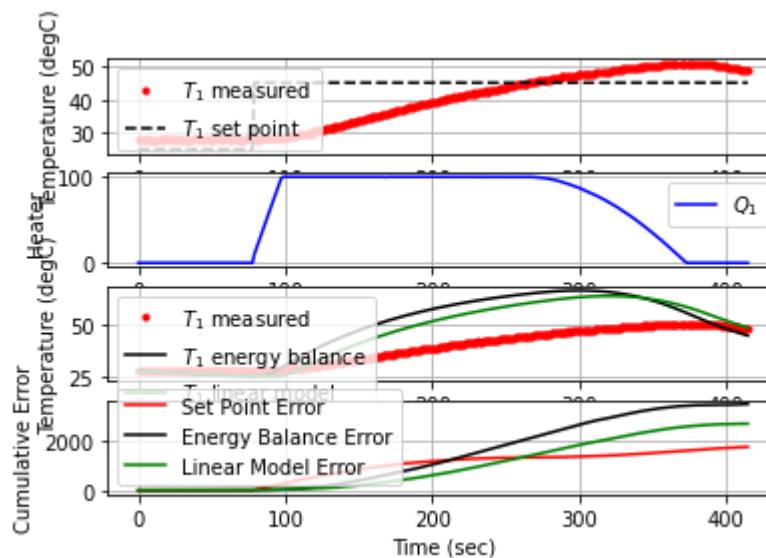
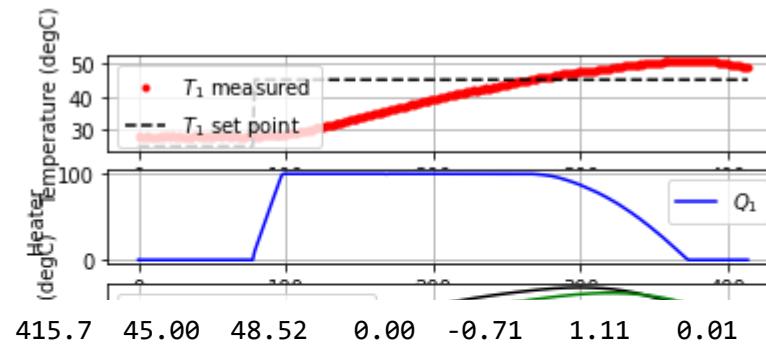
412.3 45.00 48.82 0.00 -0.77 1.11 0.01



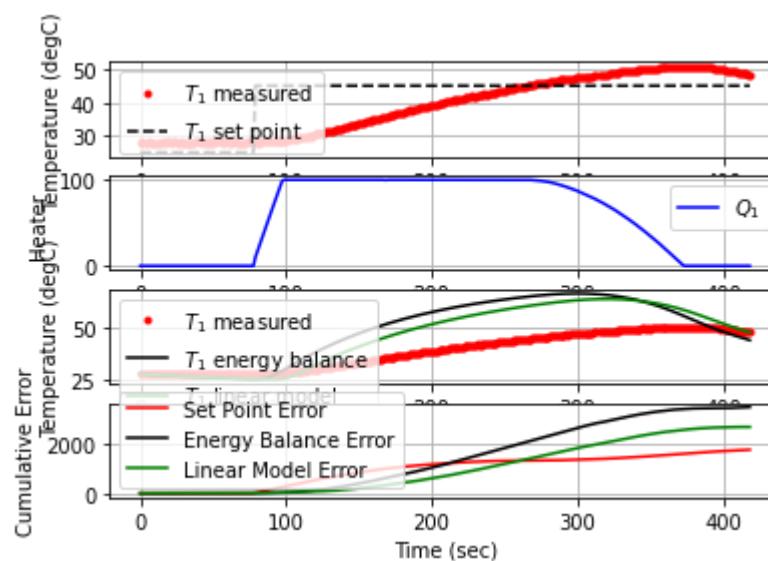
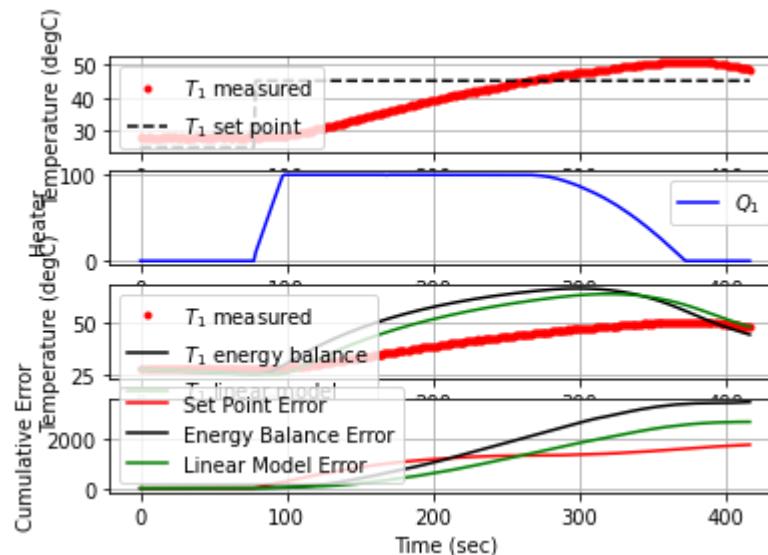
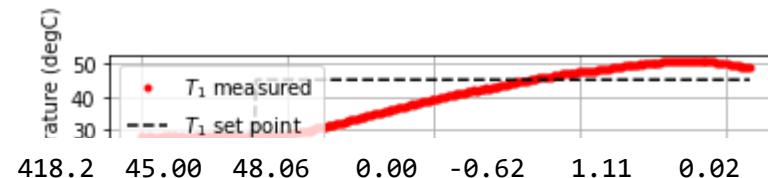
413.5 45.00 48.76 0.00 -0.76 1.11 0.00



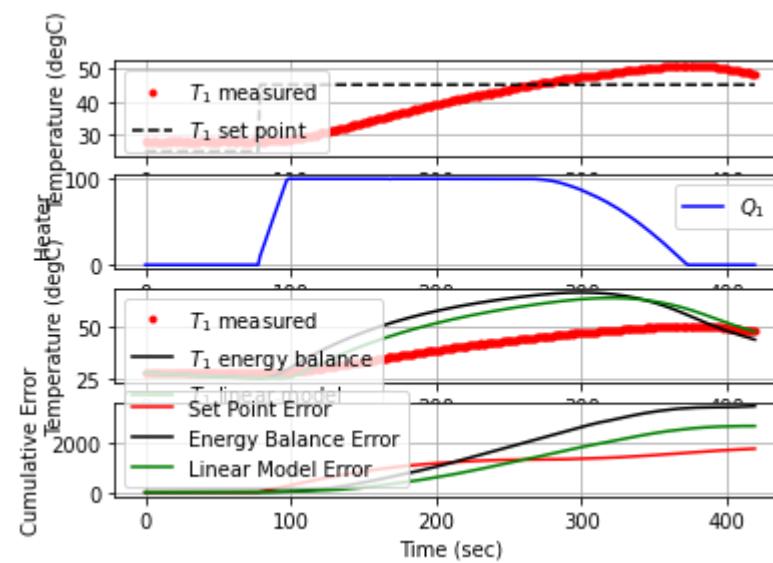
414.6 45.00 48.62 0.00 -0.73 1.11 0.01



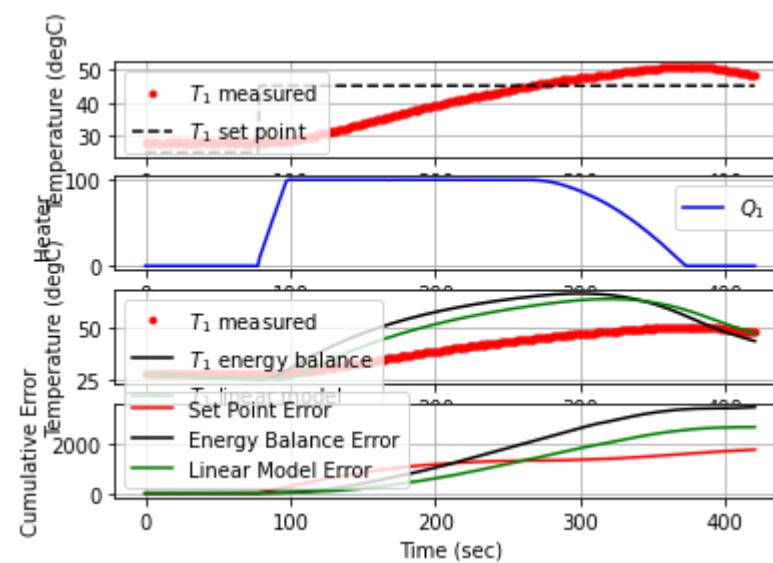
416.9 45.00 48.36 0.00 -0.68 1.11 0.01



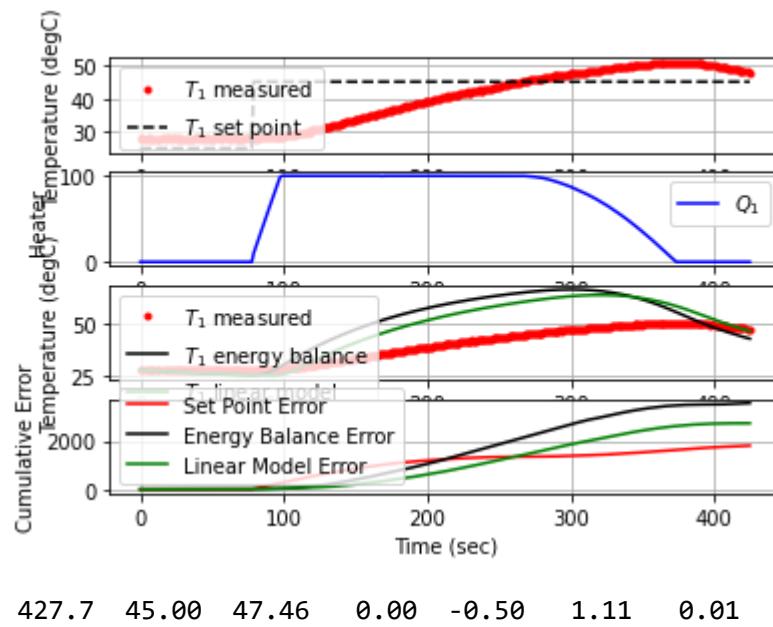
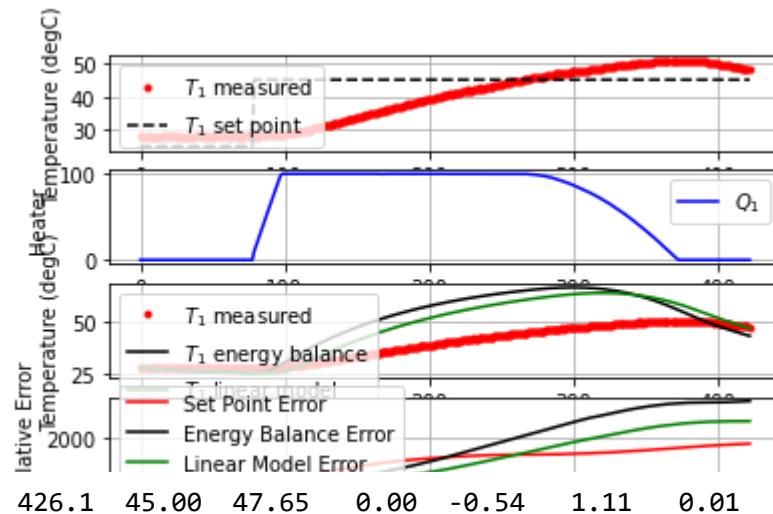
420.5 45.00 48.09 0.00 -0.62 1.11 0.01

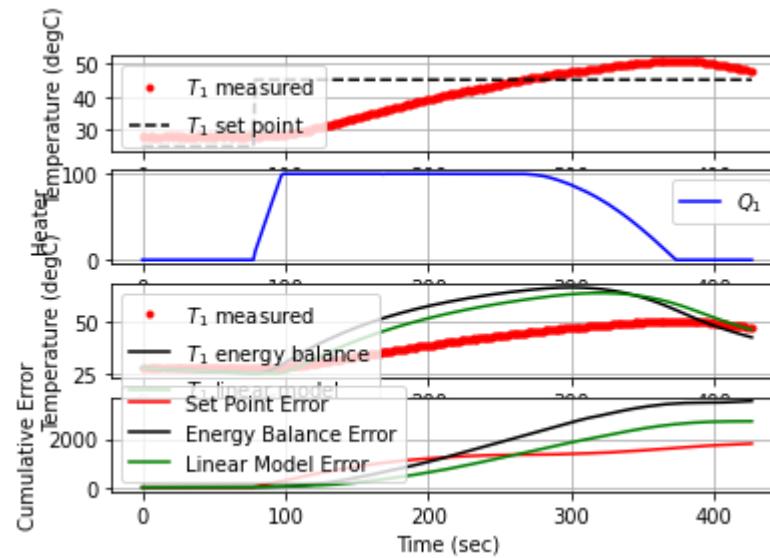


422.5 45.00 47.96 0.00 -0.60 1.11 0.00

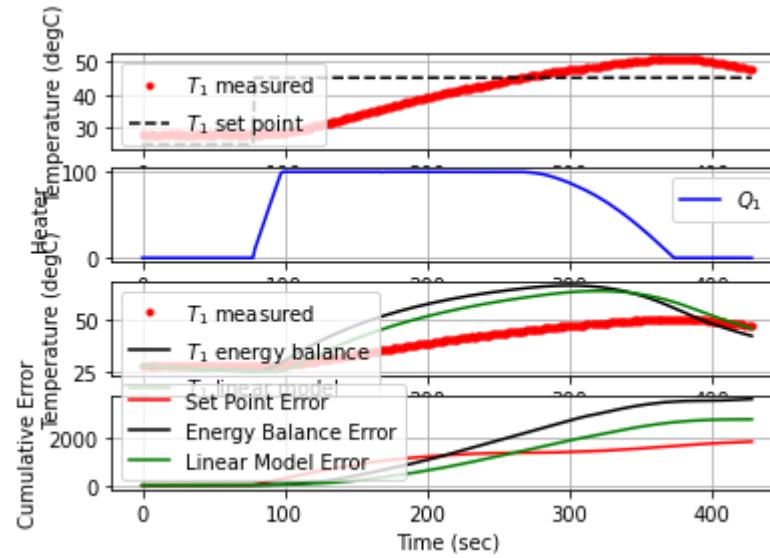


424.4 45.00 47.80 0.00 -0.57 1.11 0.01

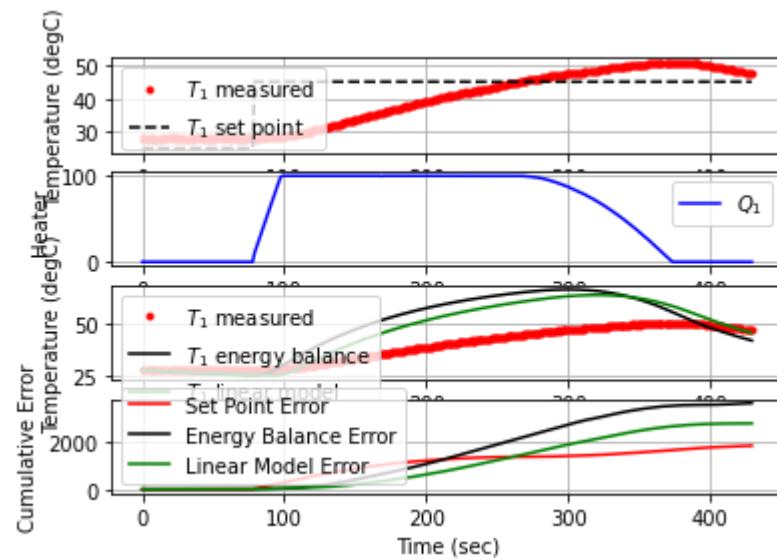




429.1 45.00 47.29 0.00 -0.46 1.11 0.01

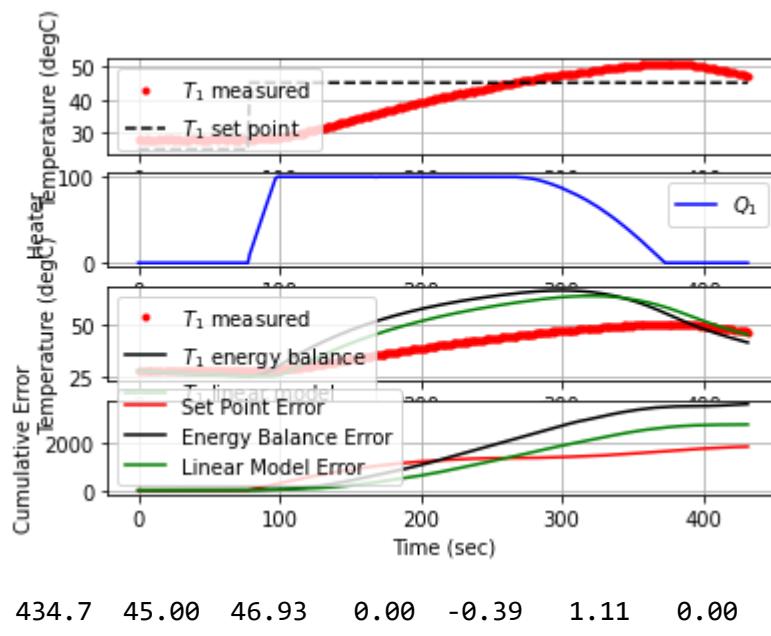
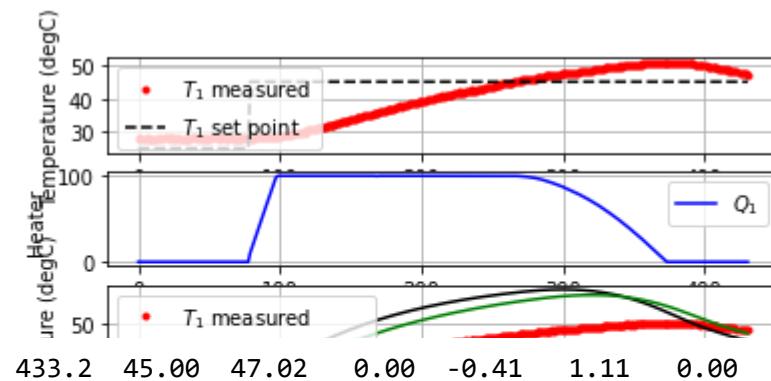


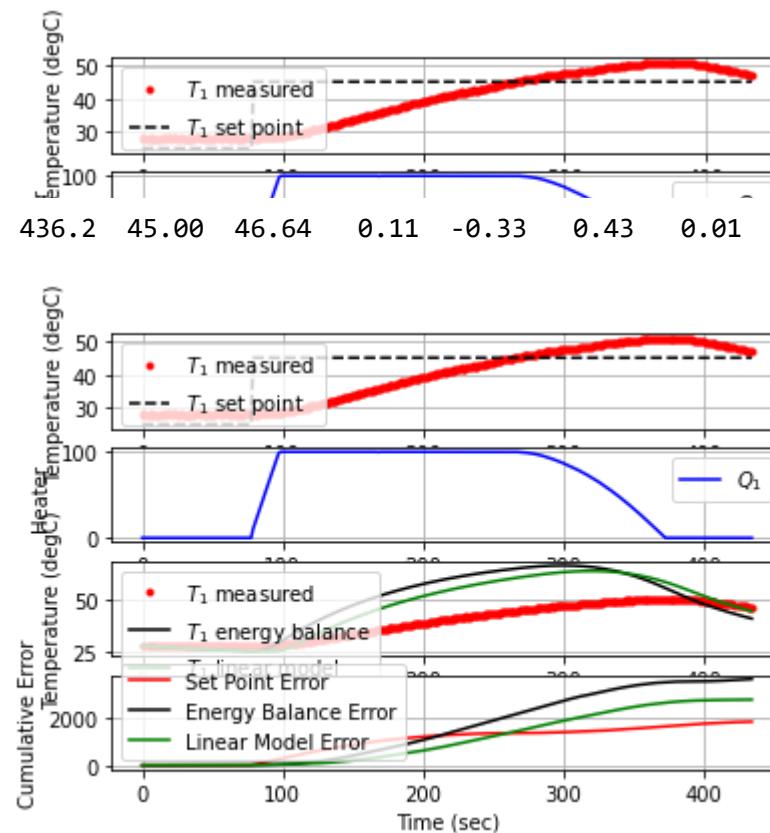
430.4 45.00 47.24 0.00 -0.45 1.11 0.00



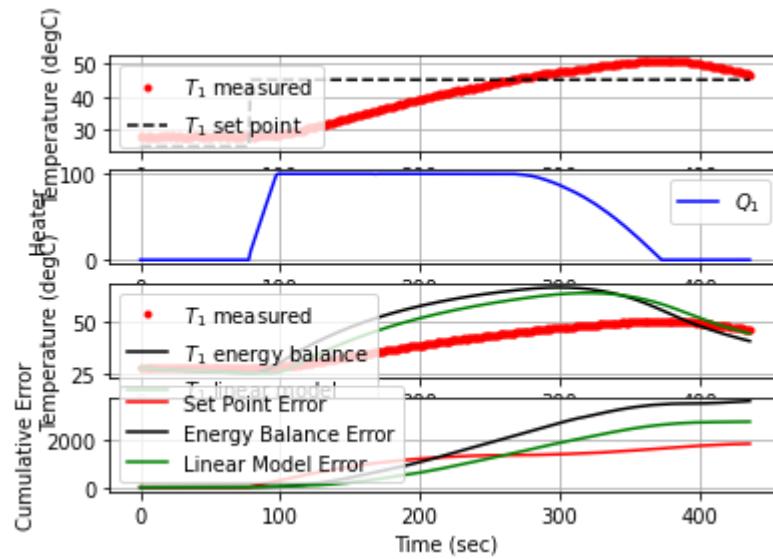
Connected to MQTT Broker!

431.7 45.00 47.04 0.00 -0.41 1.11 0.01

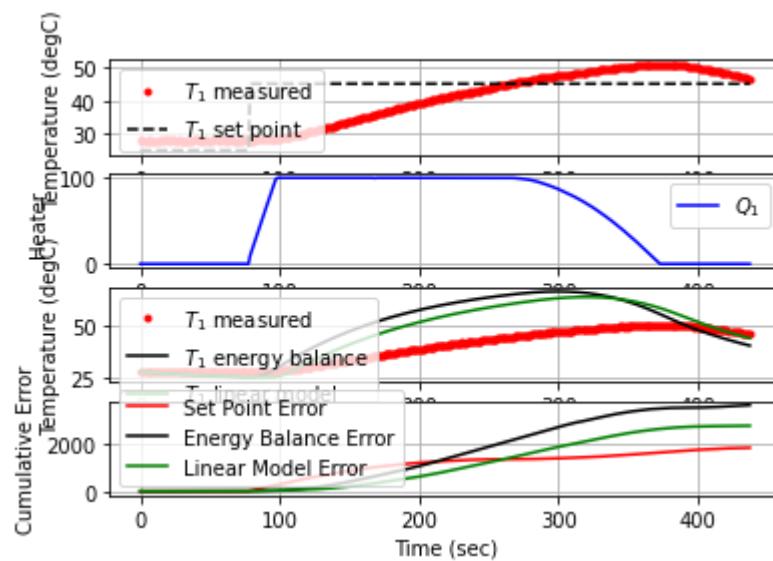




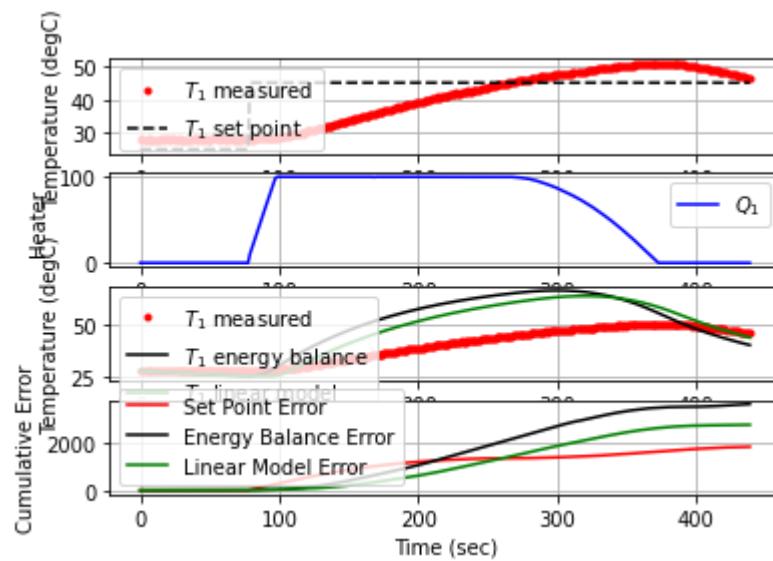
437.6 45.00 46.63 0.00 -0.33 0.43 0.00



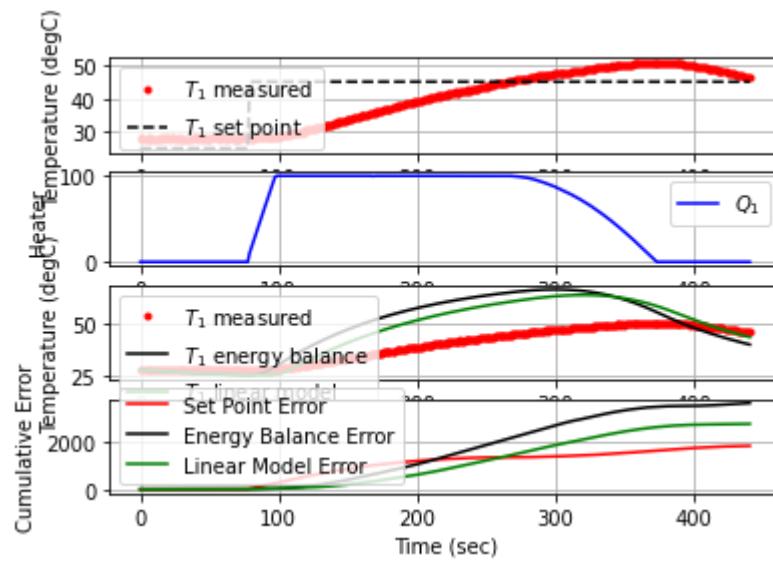
439.0 45.00 46.62 0.00 -0.33 0.43 0.00



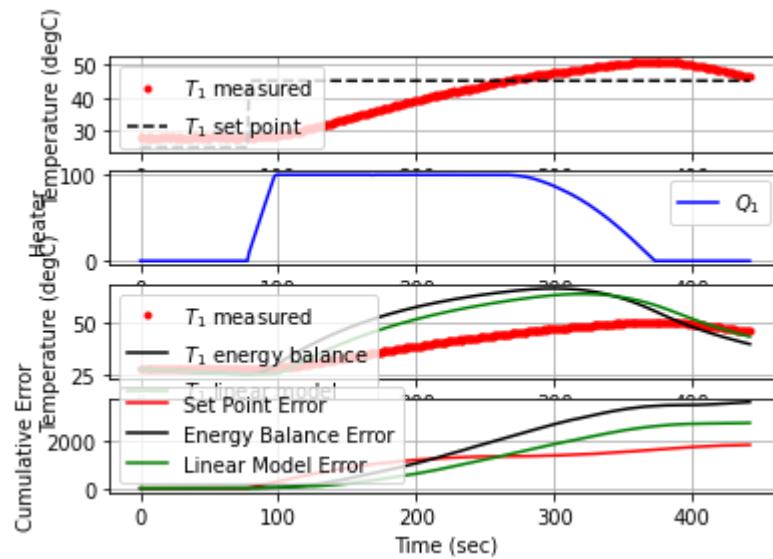
440.4 45.00 46.43 0.00 -0.29 0.43 0.01



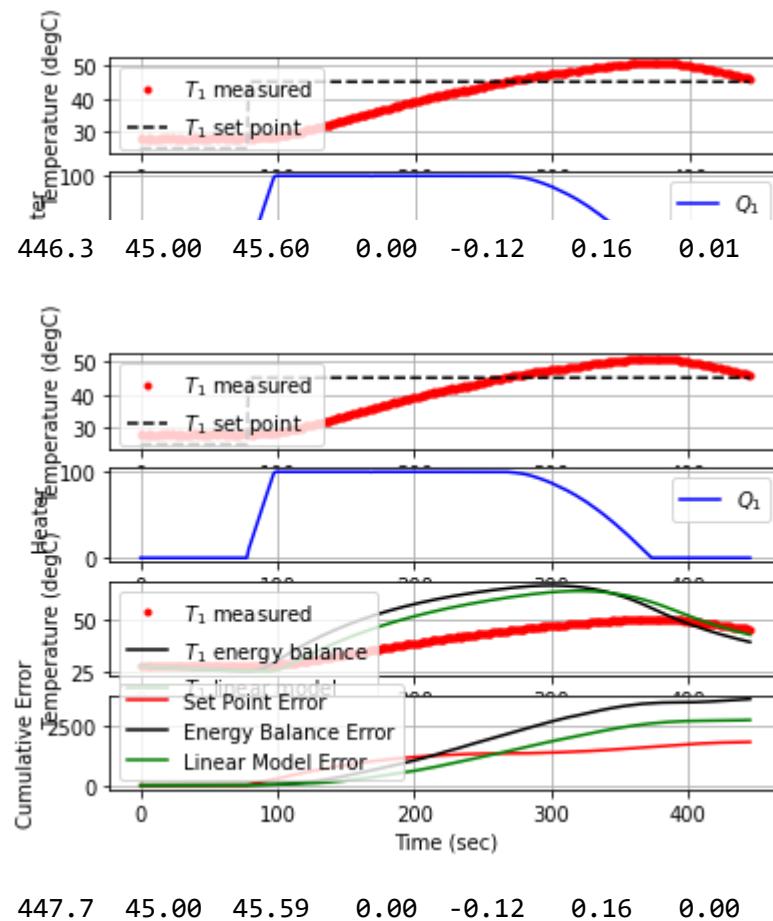
441.9 45.00 46.21 0.00 -0.25 0.43 0.01



443.6 45.00 46.08 0.00 -0.22 0.43 0.01

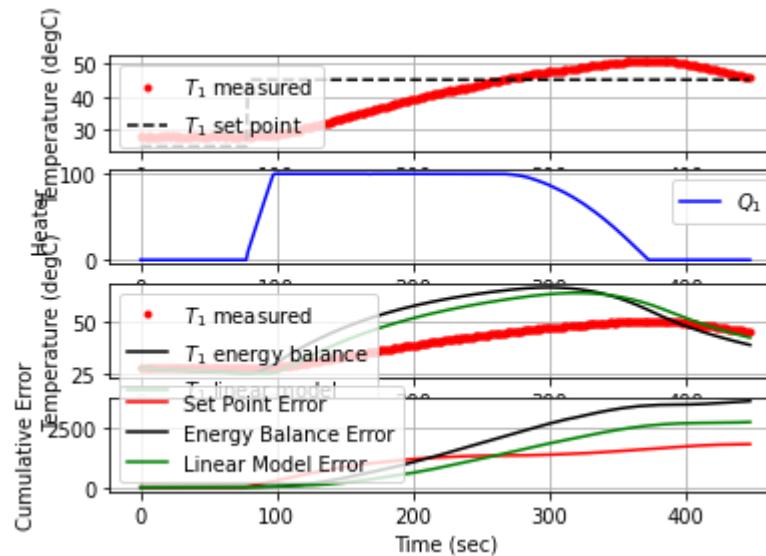


444.9 45.00 45.72 0.03 -0.15 0.16 0.02

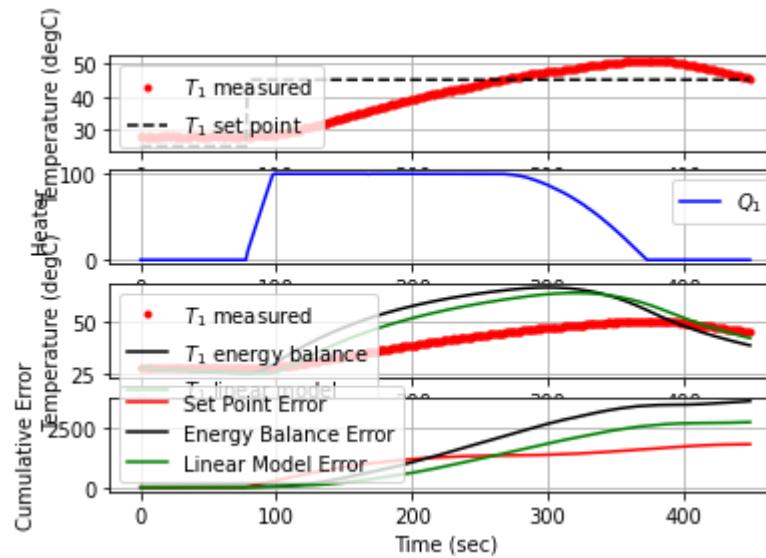


447.7 45.00 45.59 0.00 -0.12 0.16 0.00

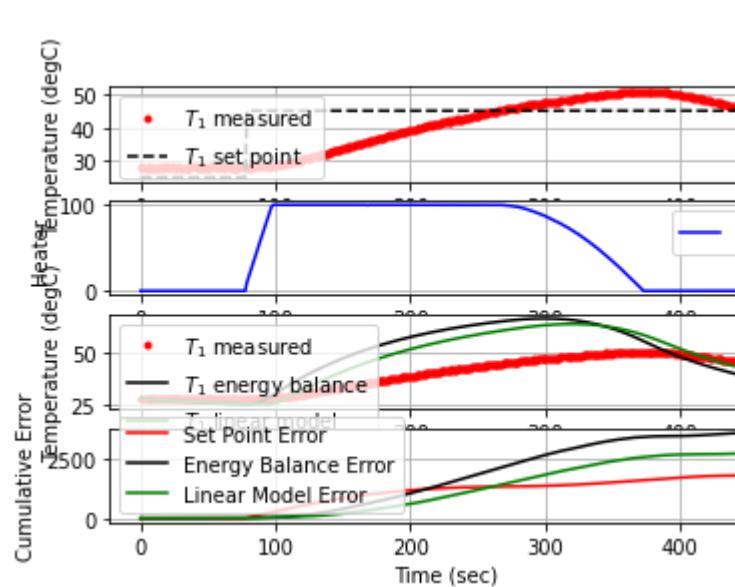
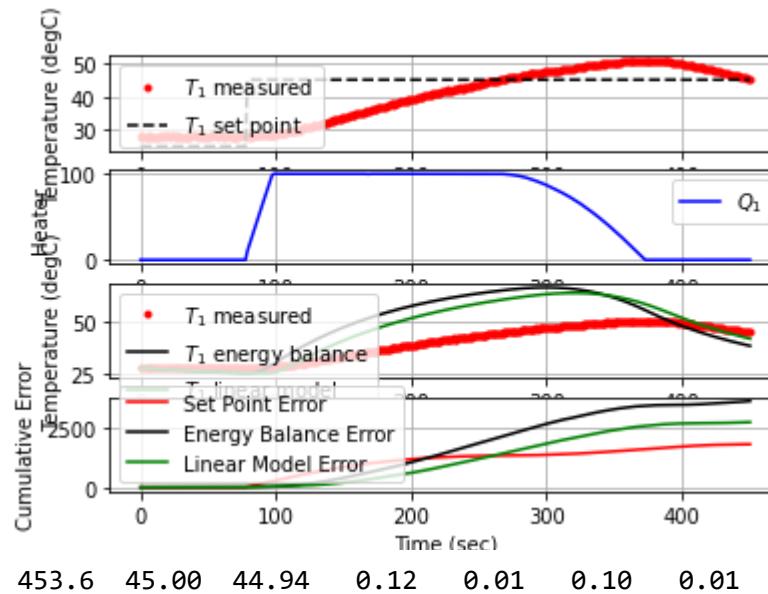
degC  
449.1 45.00 45.32 0.00 -0.07 0.16 0.01



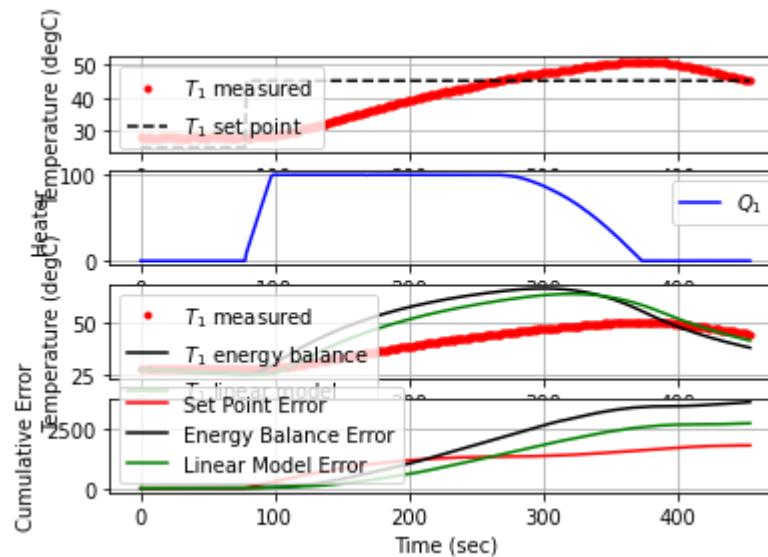
450.7 45.00 45.15 0.08 -0.03 0.10 0.01



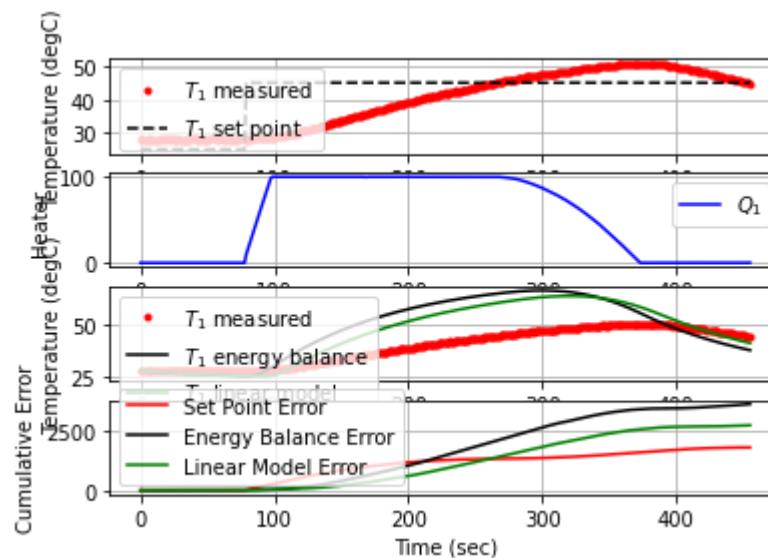
452.1 45.00 45.07 0.06 -0.01 0.07 0.00



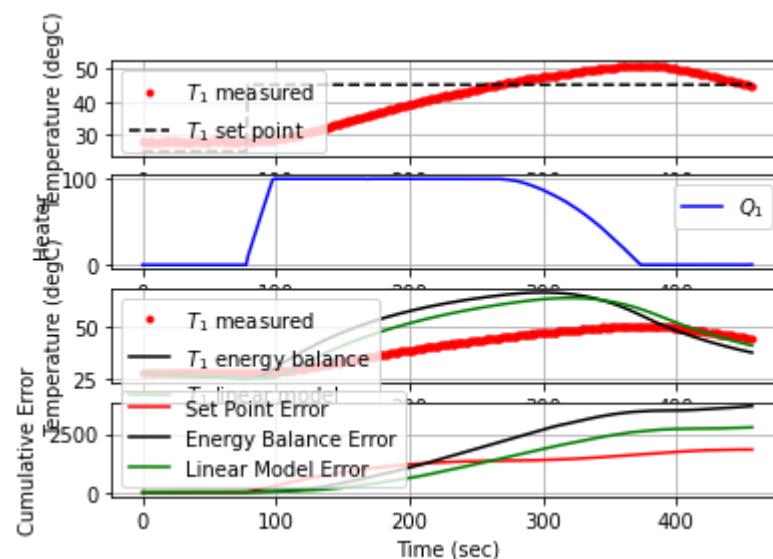
455.1 45.00 44.74 0.28 0.06 0.21 0.01



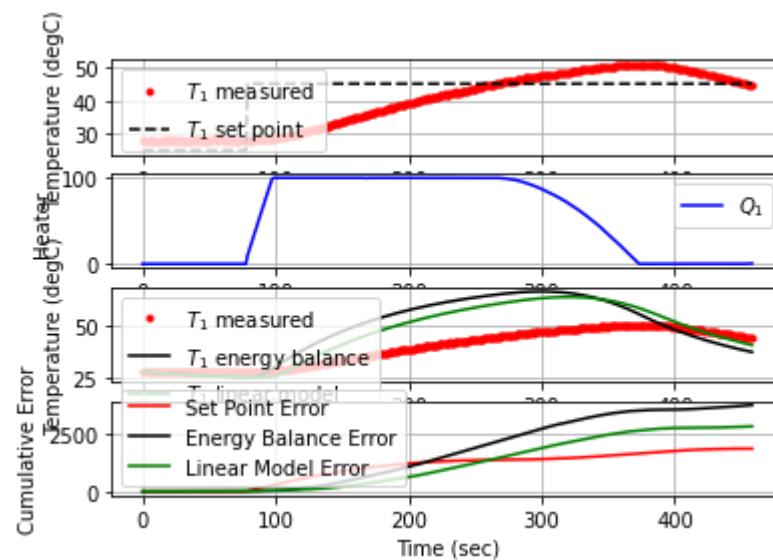
456.6 45.00 44.72 0.38 0.06 0.32 0.00



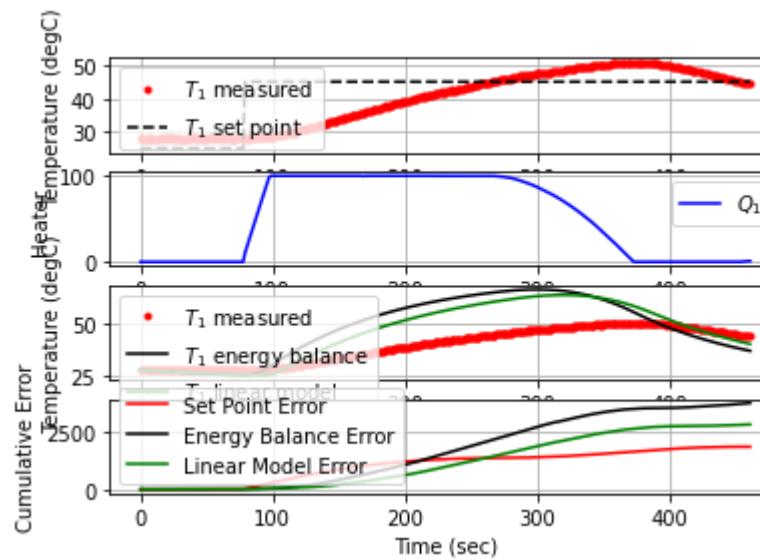
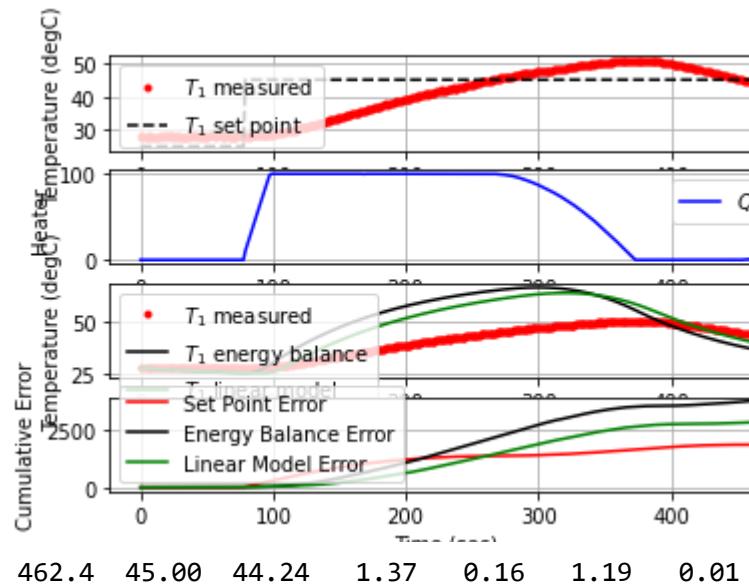
458.1 45.00 44.63 0.56 0.08 0.48 0.00



459.7 45.00 44.51 0.81 0.10 0.70 0.01

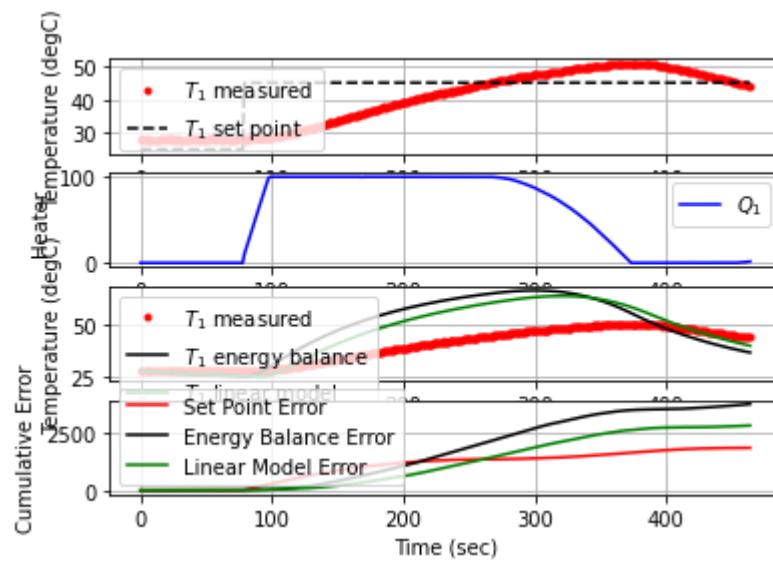
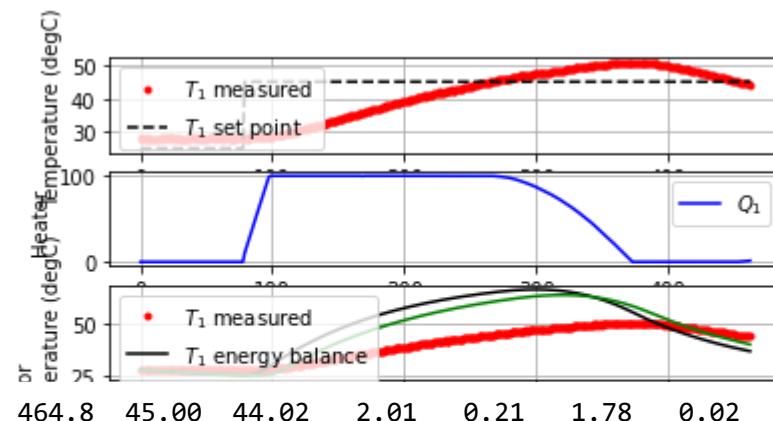


461.1 45.00 44.43 1.05 0.12 0.93 0.00

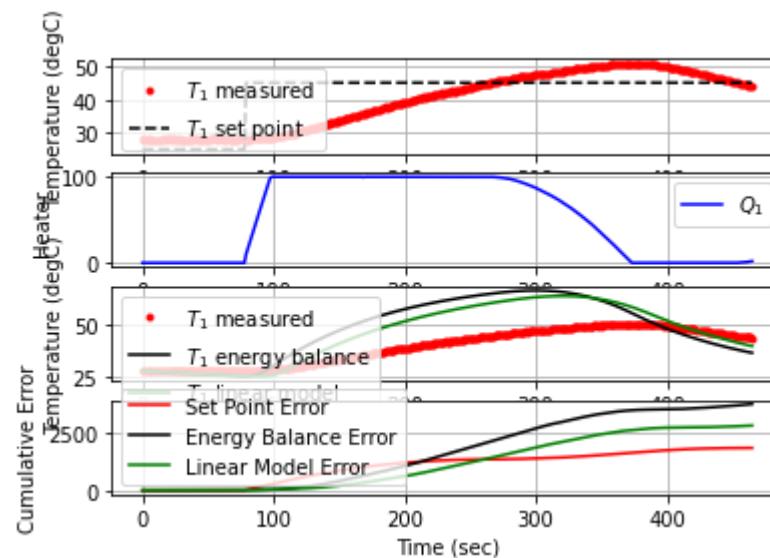


462.4 45.00 44.24 1.37 0.16 1.19 0.01

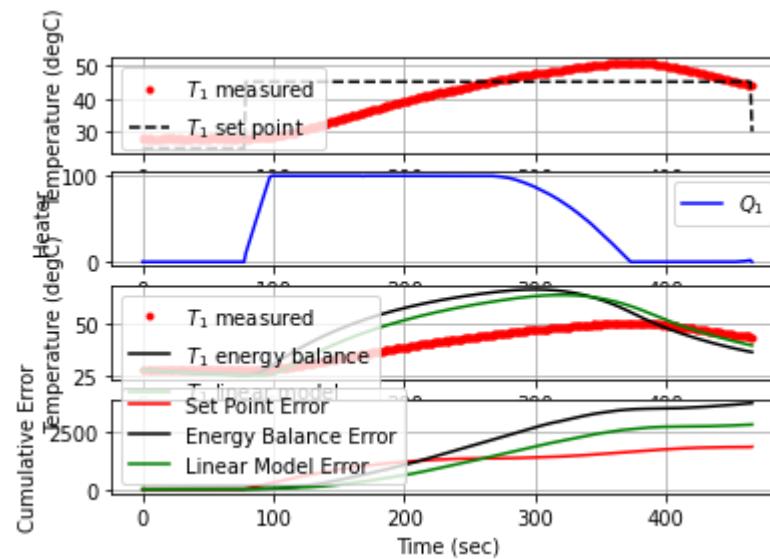
463.6 45.00 44.25 1.61 0.16 1.45 -0.00



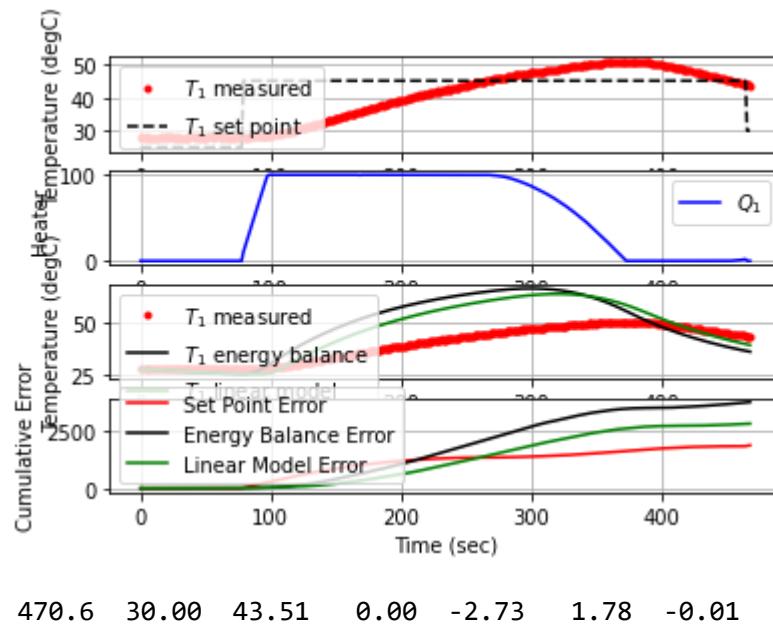
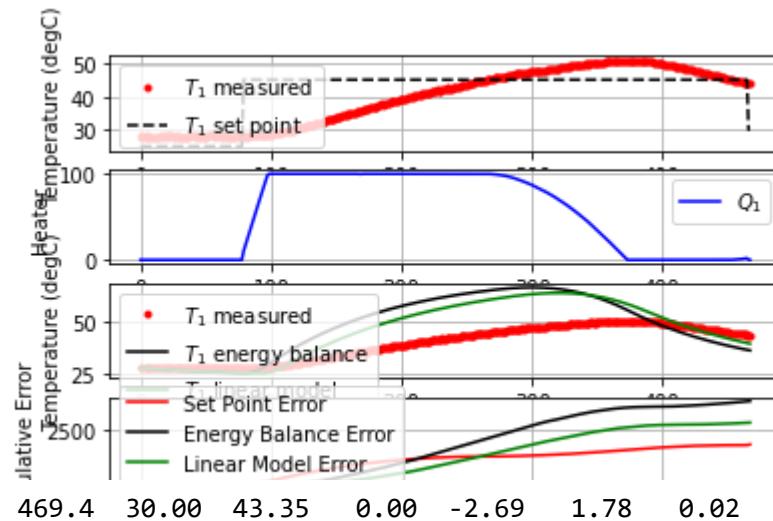
466.0 30.00 43.97 0.00 -2.82 1.78 0.00

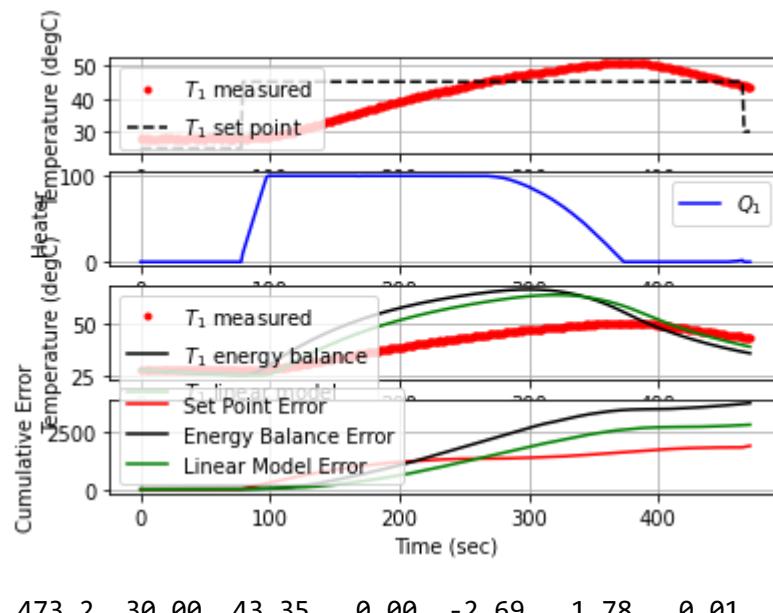
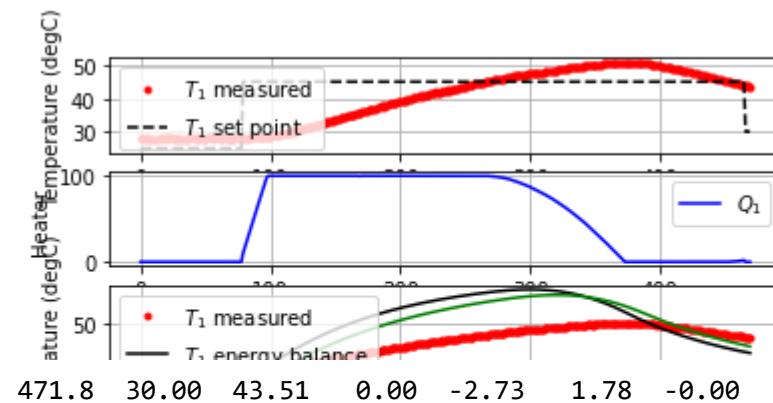


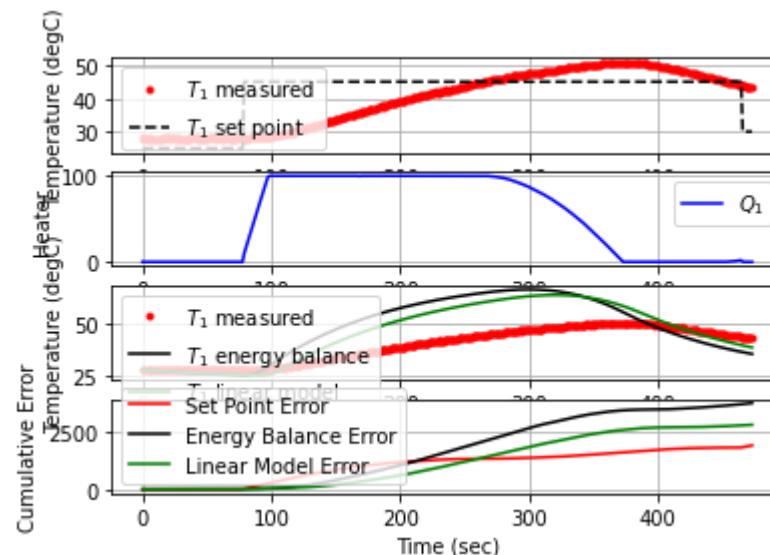
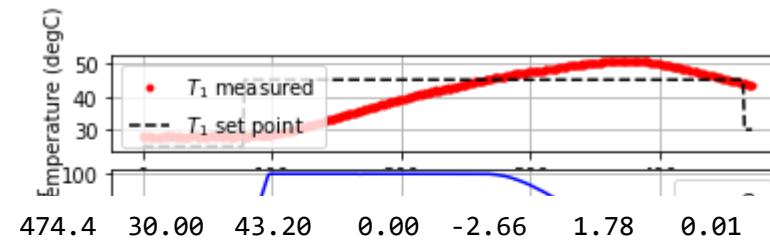
467.1 30.00 43.68 0.00 -2.76 1.78 0.02



468.2 30.00 43.64 0.00 -2.75 1.78 0.00

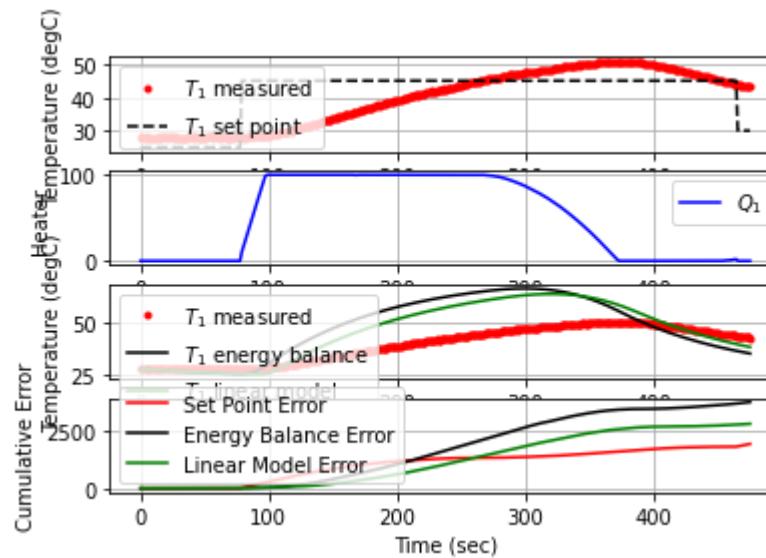




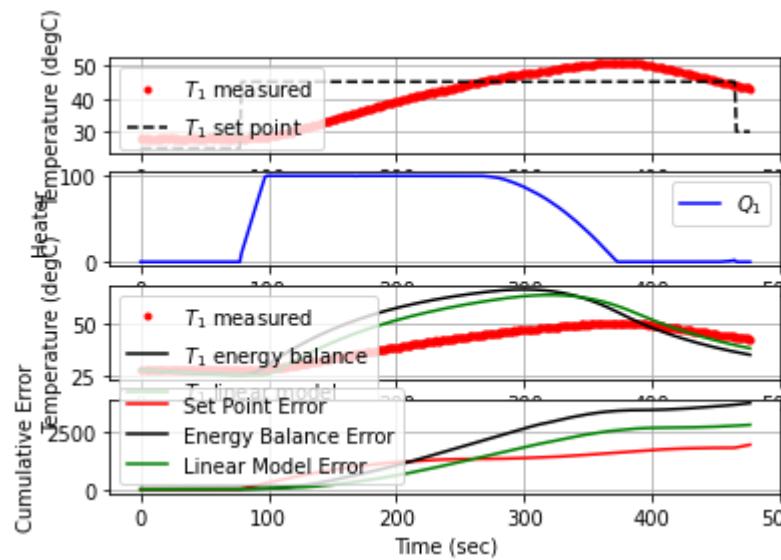


475.6 30.00 43.07 0.00 -2.64 1.78 0.01

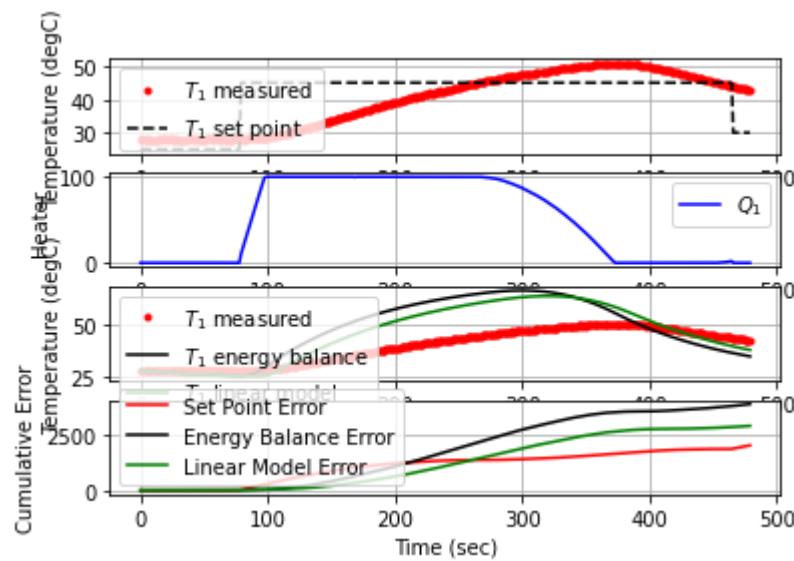
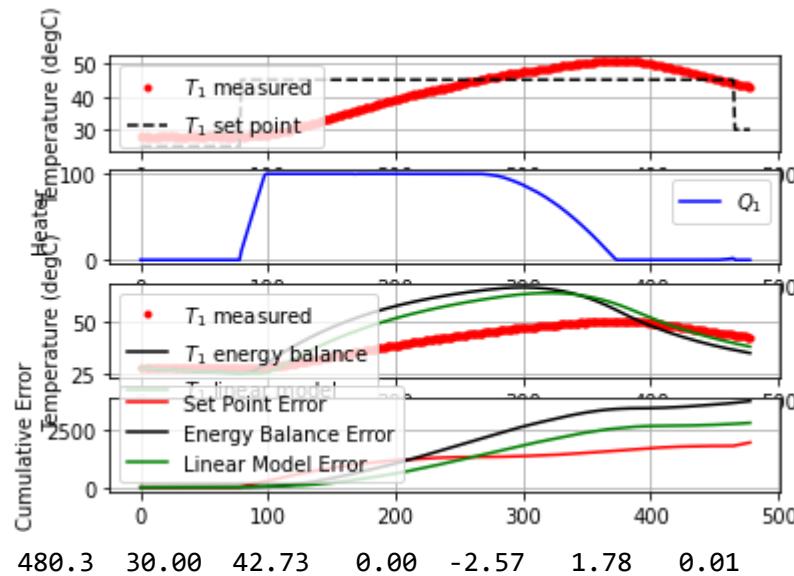
476.7 30.00 42.92 0.00 -2.61 1.78 0.01

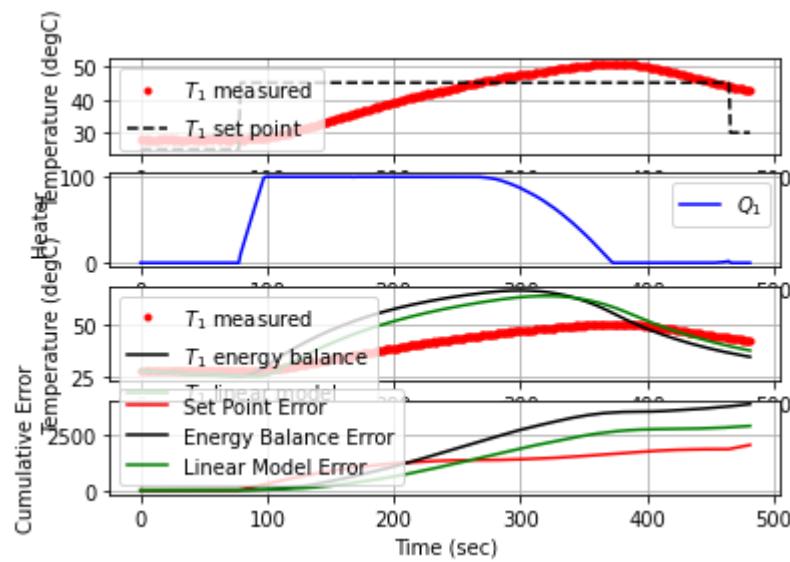
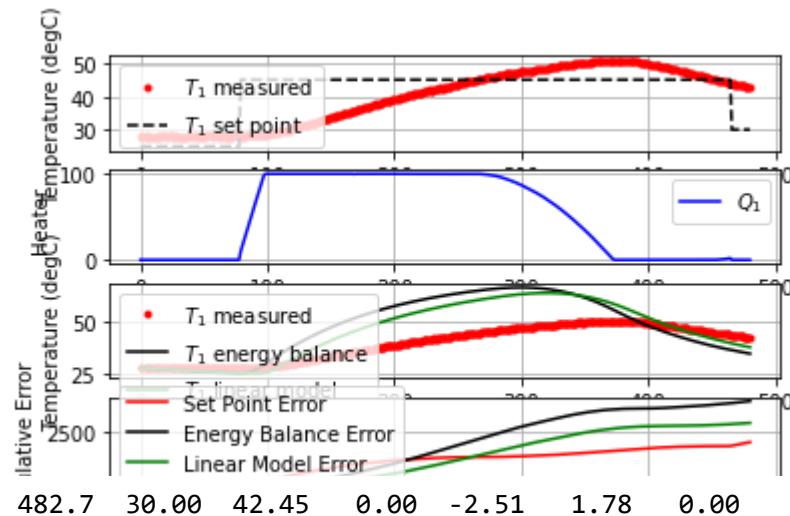


477.8 30.00 42.96 0.00 -2.62 1.78 -0.00

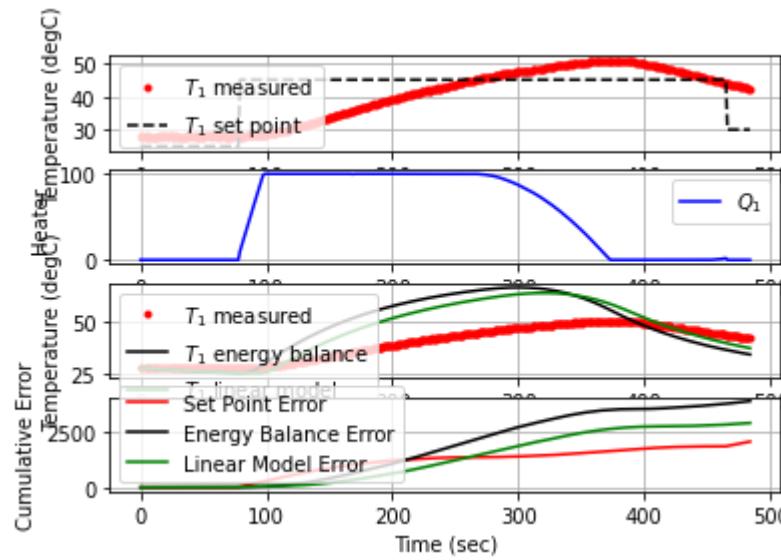
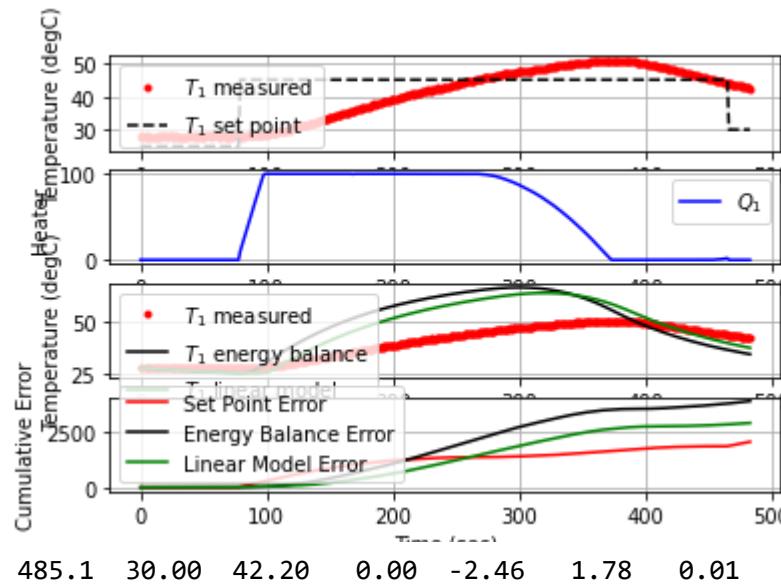


479.1 30.00 42.93 0.00 -2.61 1.78 0.00

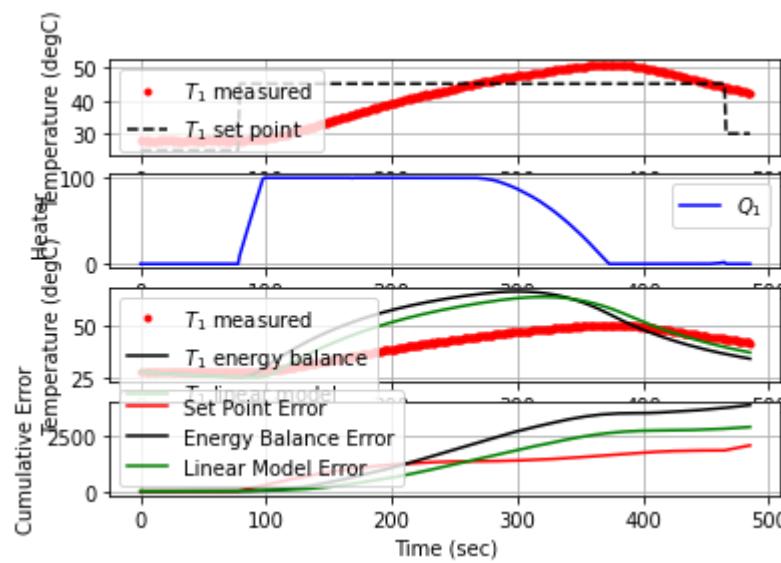




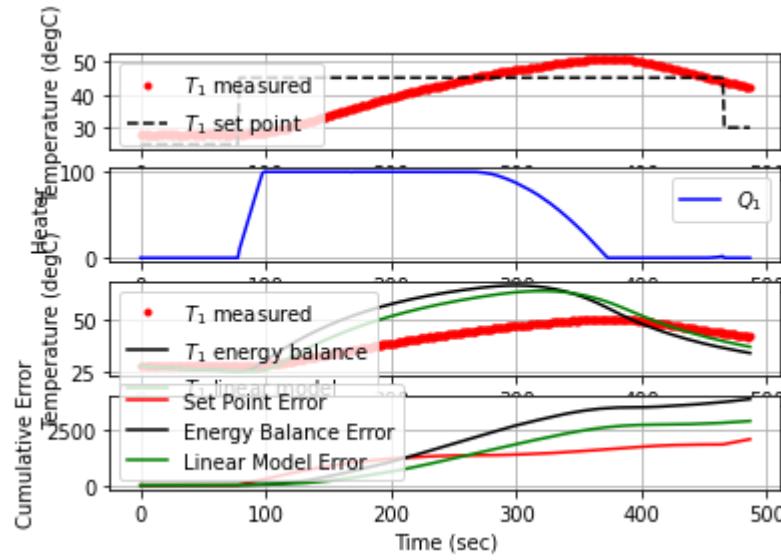
483.9 30.00 42.34 0.00 -2.49 1.78 0.01



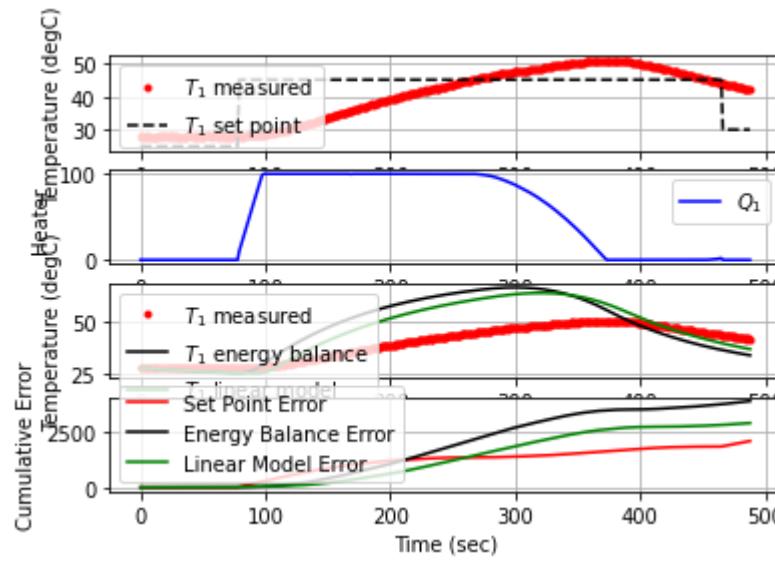
486.5 30.00 42.44 0.00 -2.51 1.78 -0.01  
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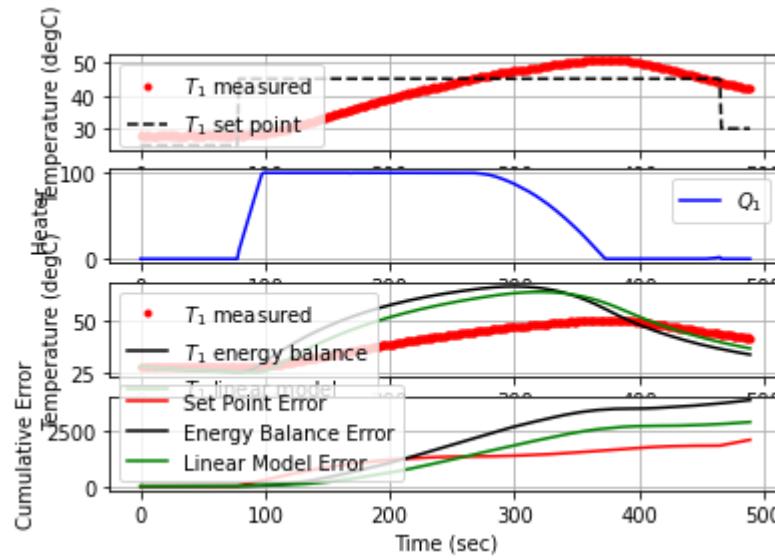
487.8 30.00 42.21 0.00 -2.46 1.78 0.01



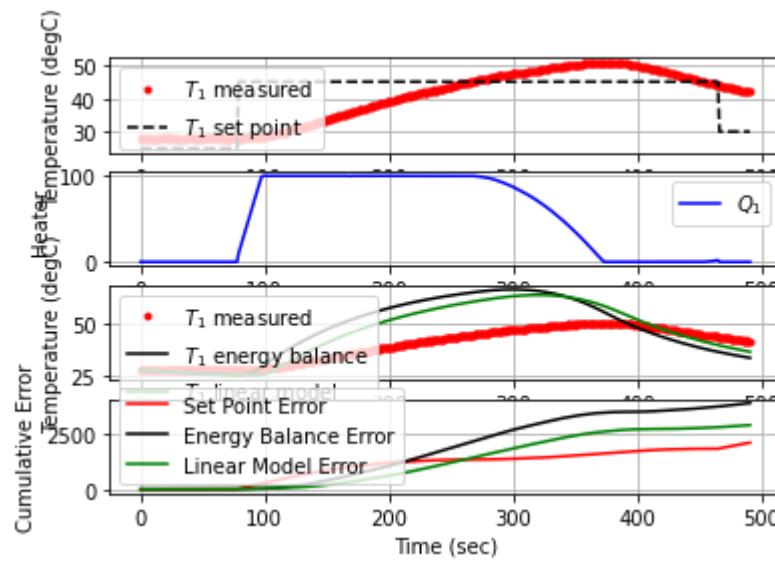
489.0 30.00 42.19 0.00 -2.46 1.78 0.00



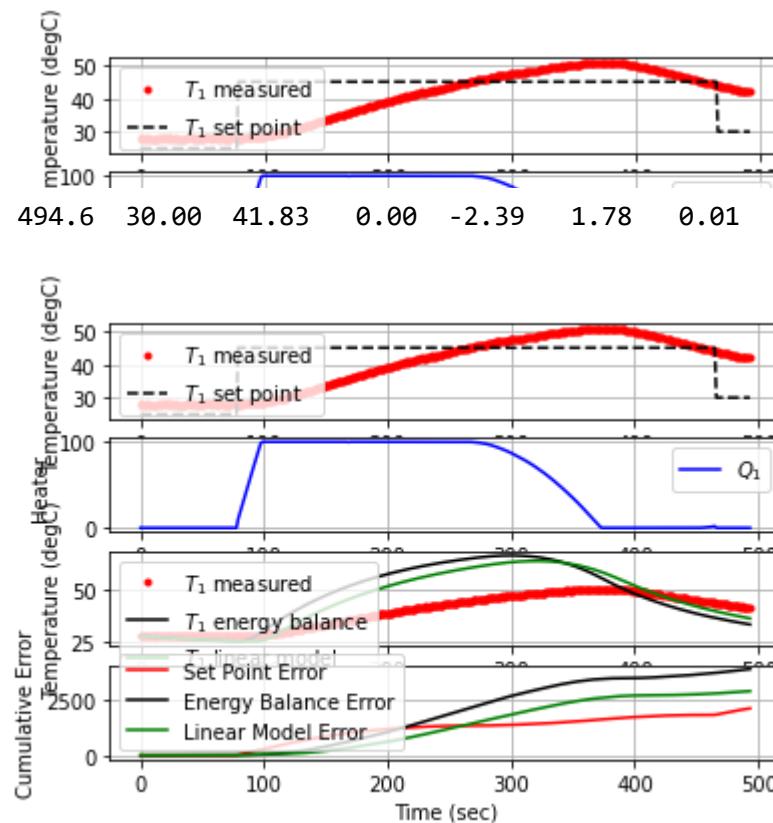
490.6 30.00 42.18 0.00 -2.46 1.78 0.00



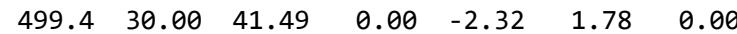
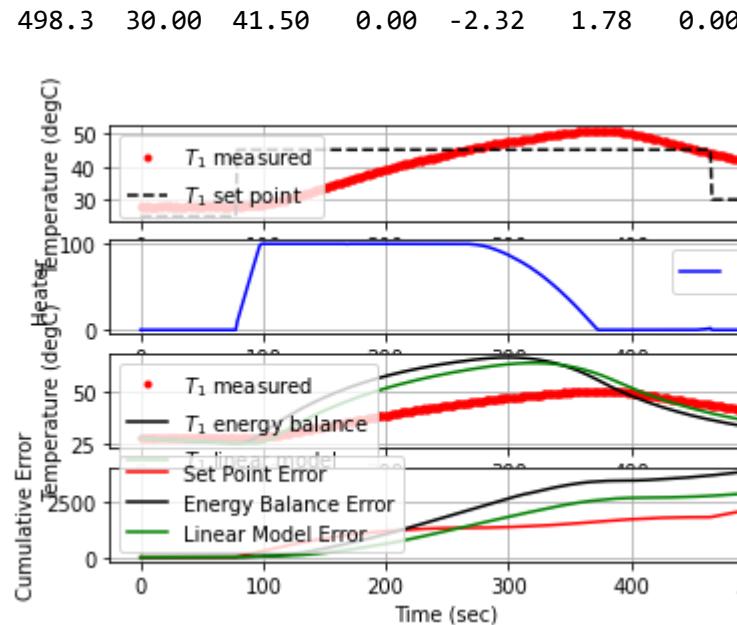
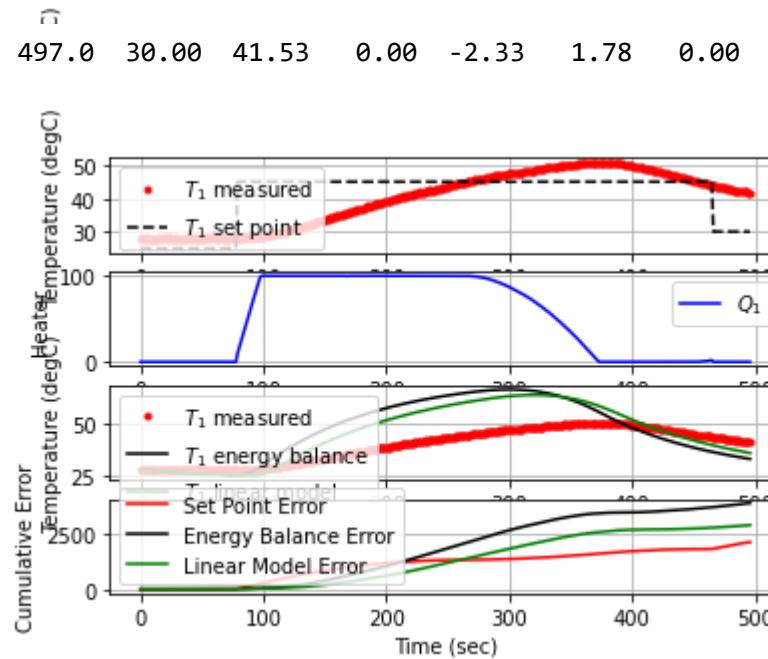
491.9 30.00 41.91 0.00 -2.40 1.78 0.01

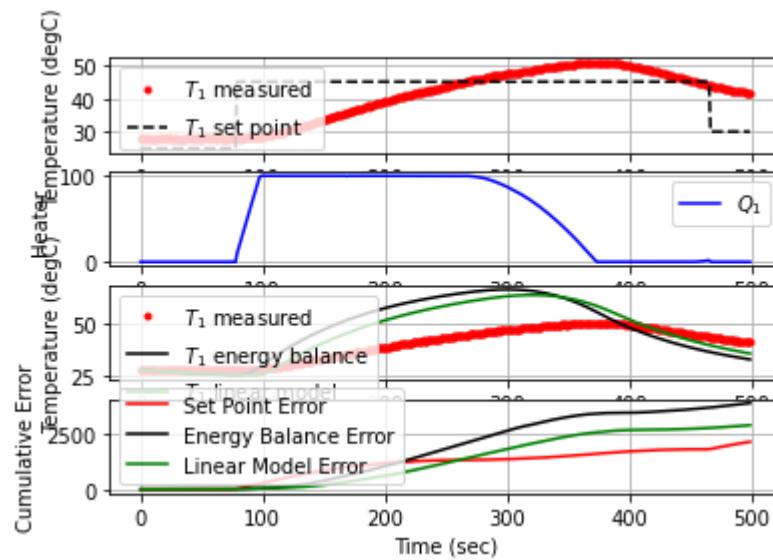


493.3 30.00 42.03 0.00 -2.43 1.78 -0.01

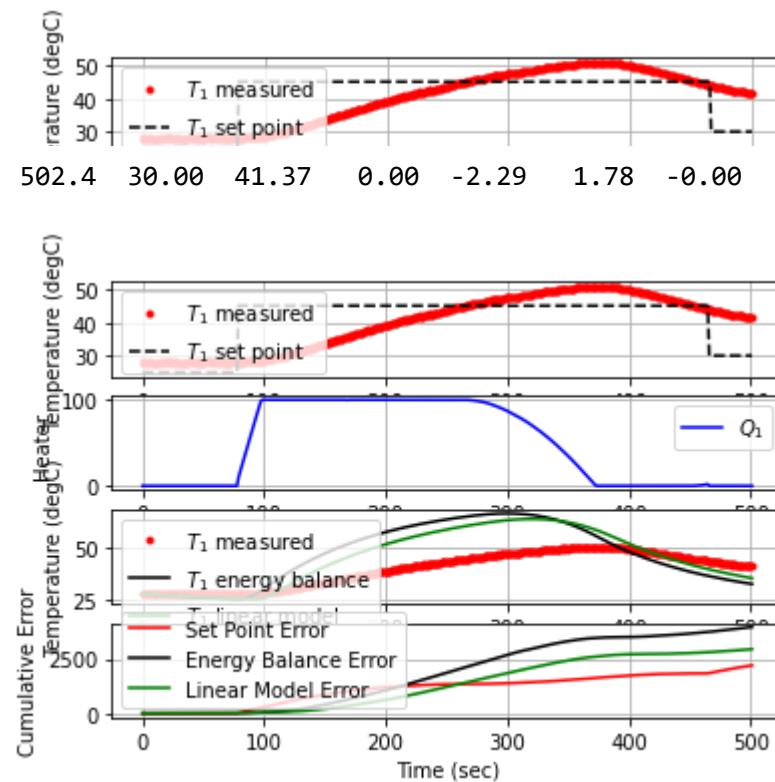


495.8 30.00 41.54 0.00 -2.33 1.78 0.02

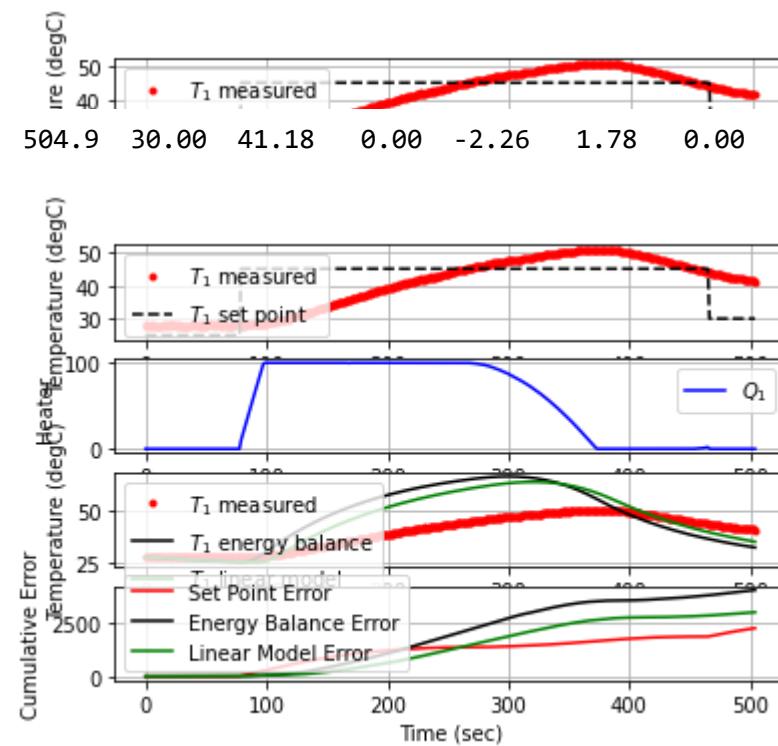




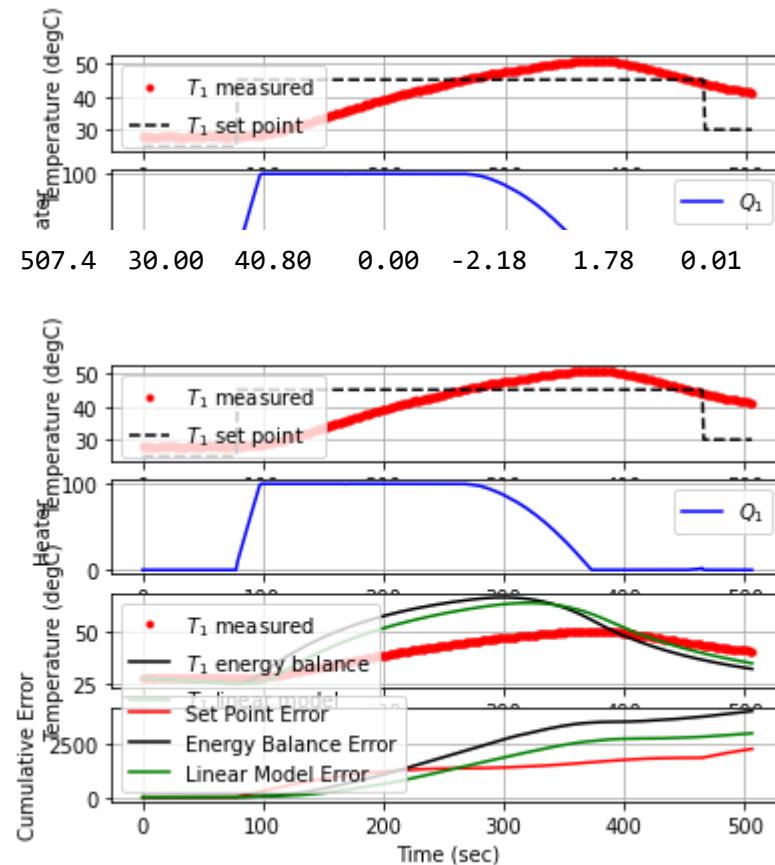
501.2 30.00 41.29 0.00 -2.28 1.78 0.01



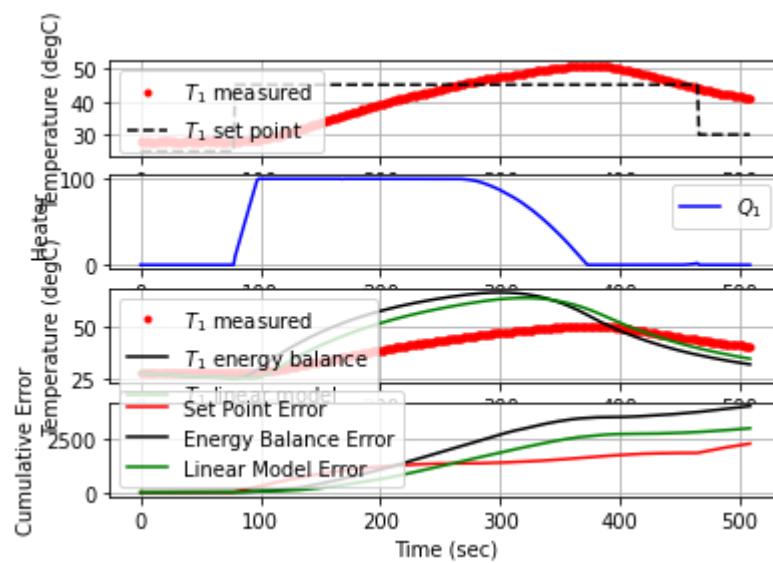
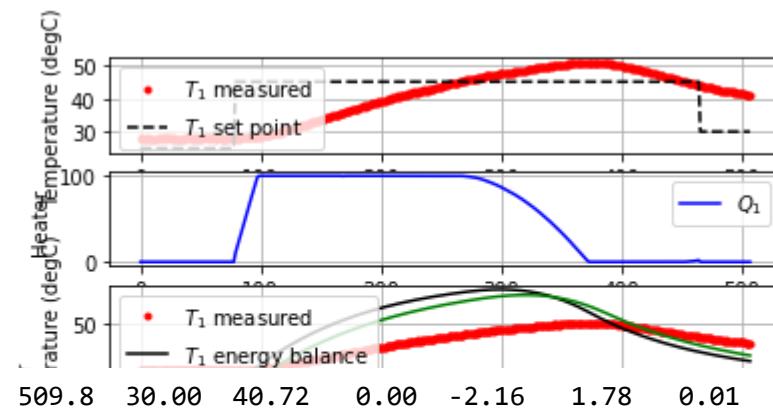
503.7 30.00 41.23 0.00 -2.27 1.78 0.01

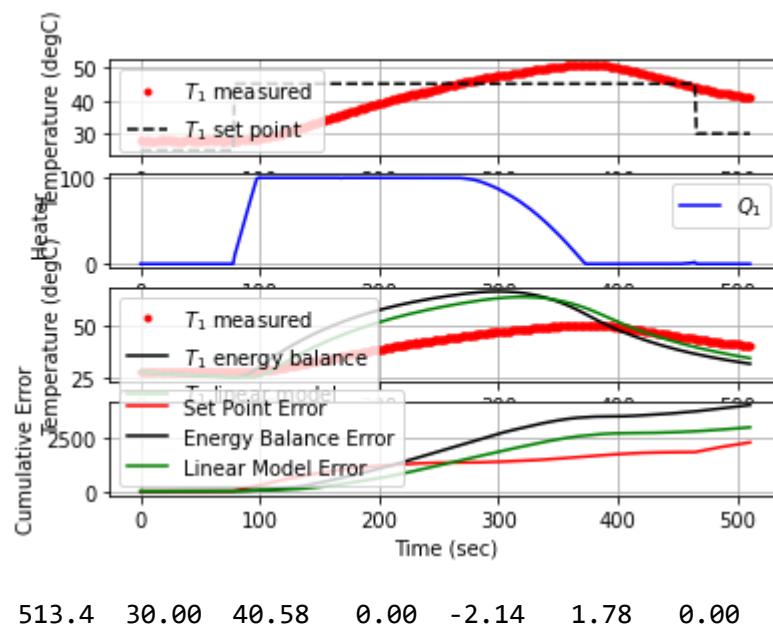
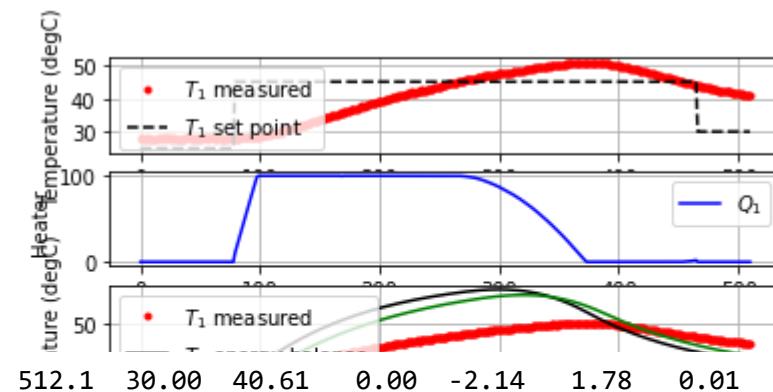


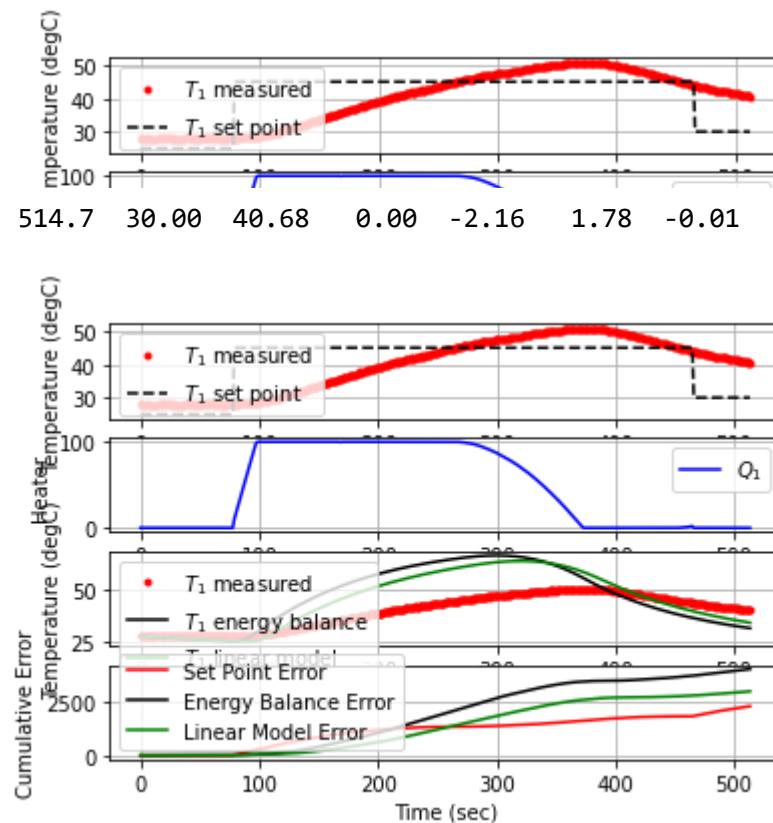
506.1 30.00 40.94 0.00 -2.21 1.78 0.01



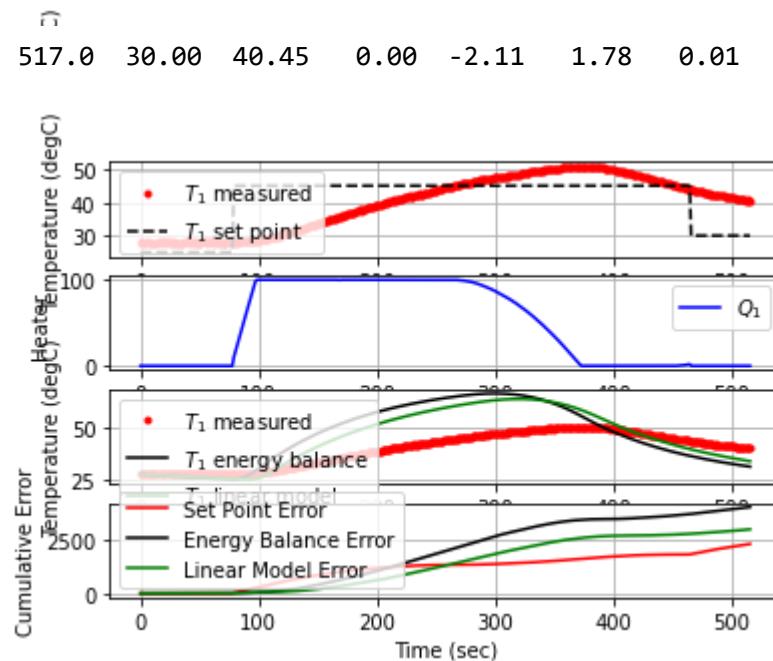
508.6 30.00 40.87 0.00 -2.19 1.78 -0.00



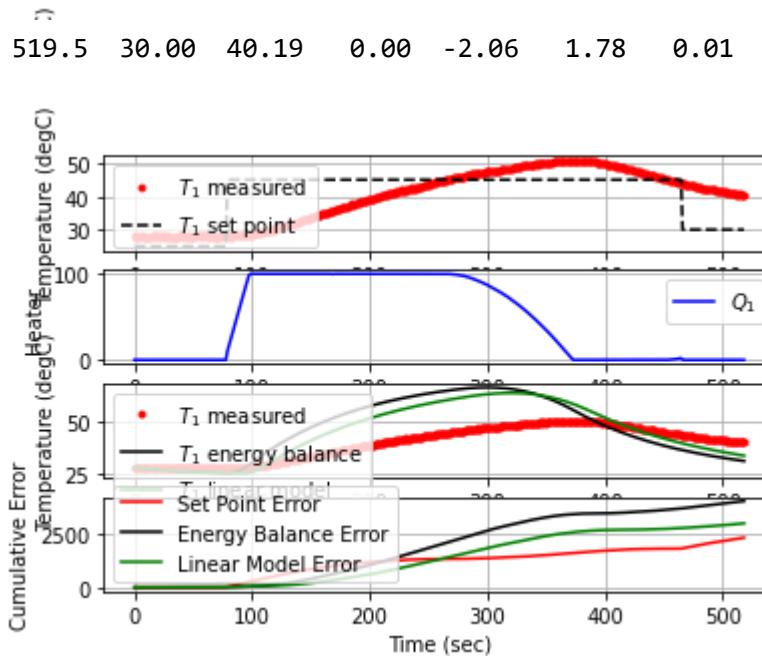




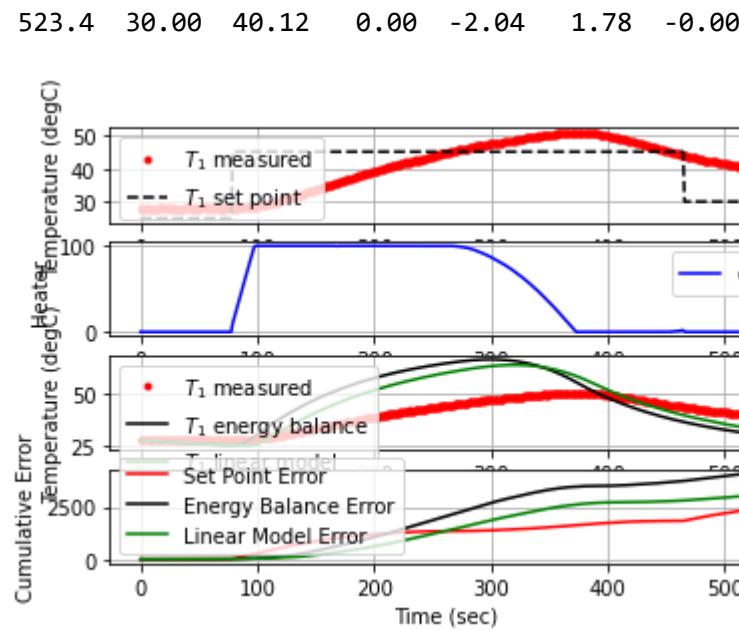
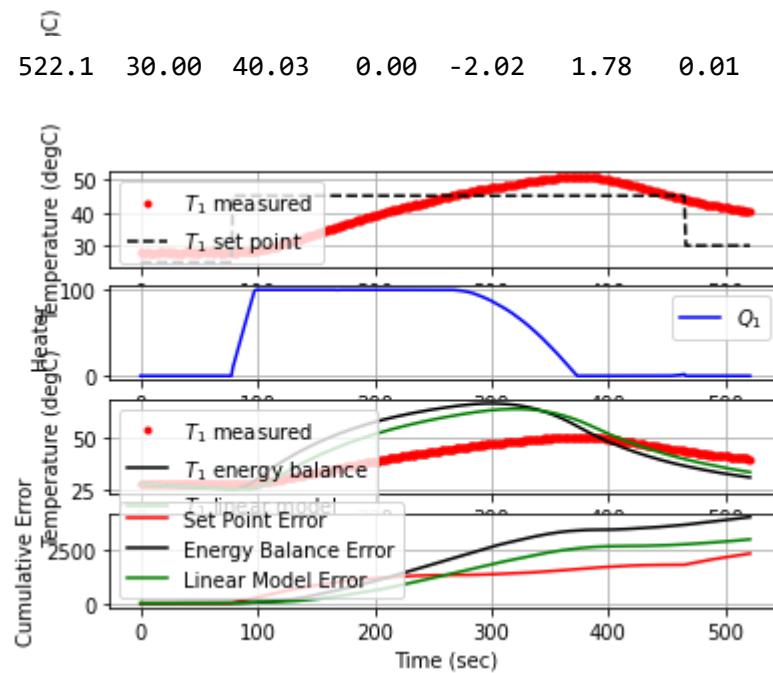
515.8 30.00 40.63 0.00 -2.15 1.78 0.00



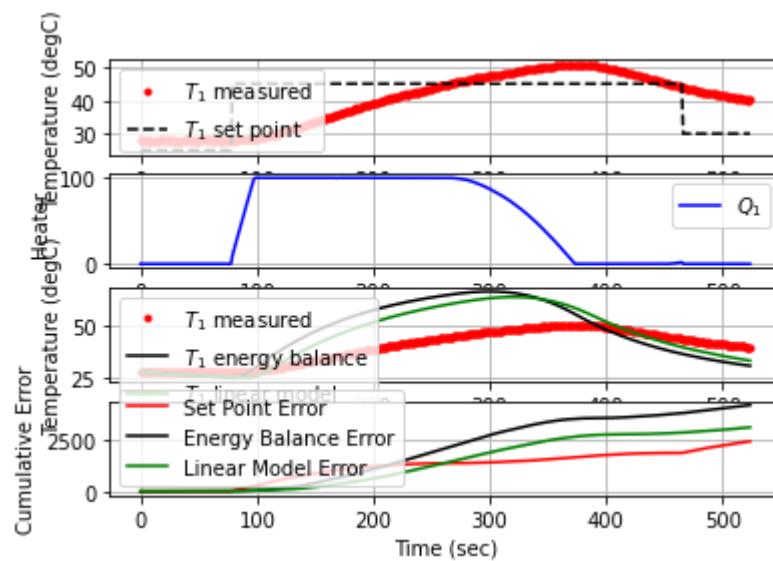
518.2 30.00 40.46 0.00 -2.11 1.78 -0.00



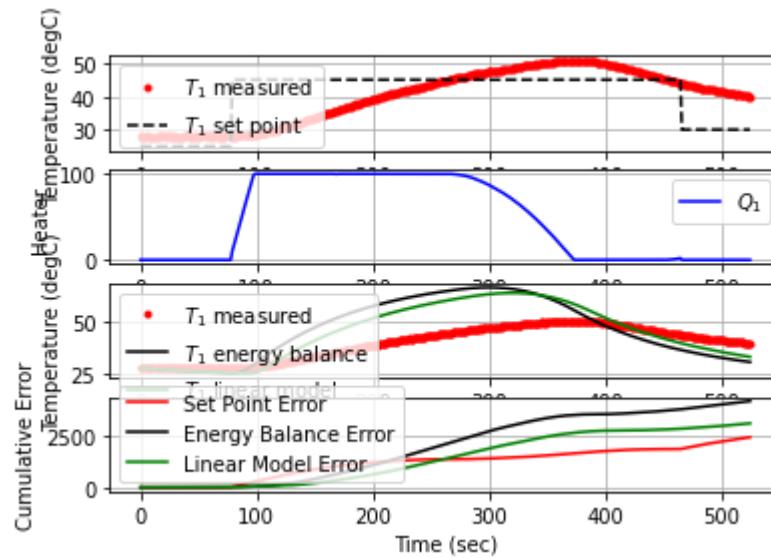
520.9 30.00 40.13 0.00 -2.04 1.78 0.00



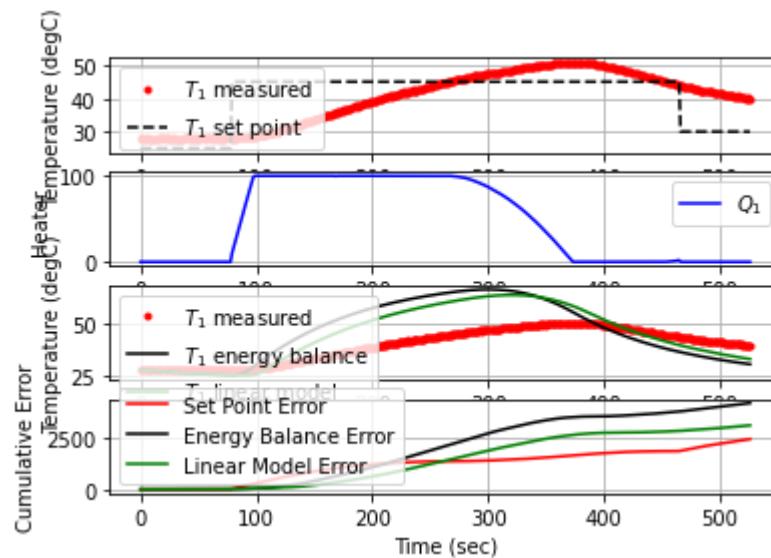
524.7 30.00 39.97 0.00 -2.01 1.78 0.01



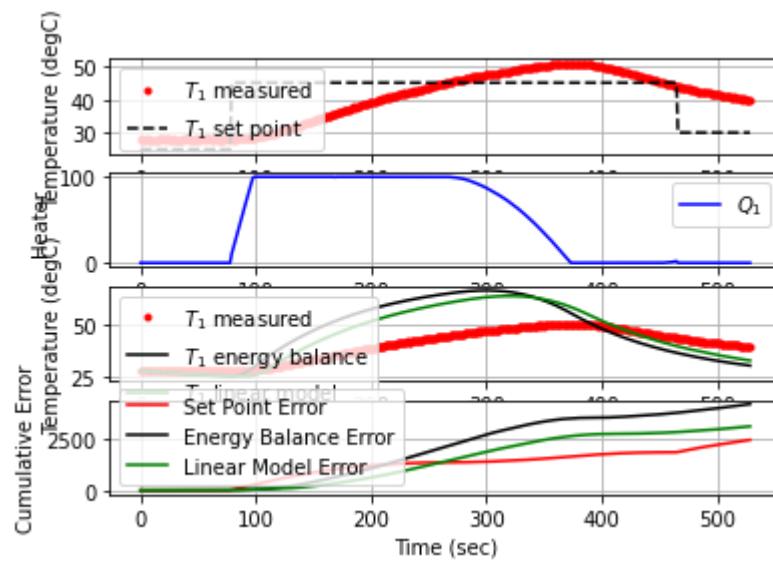
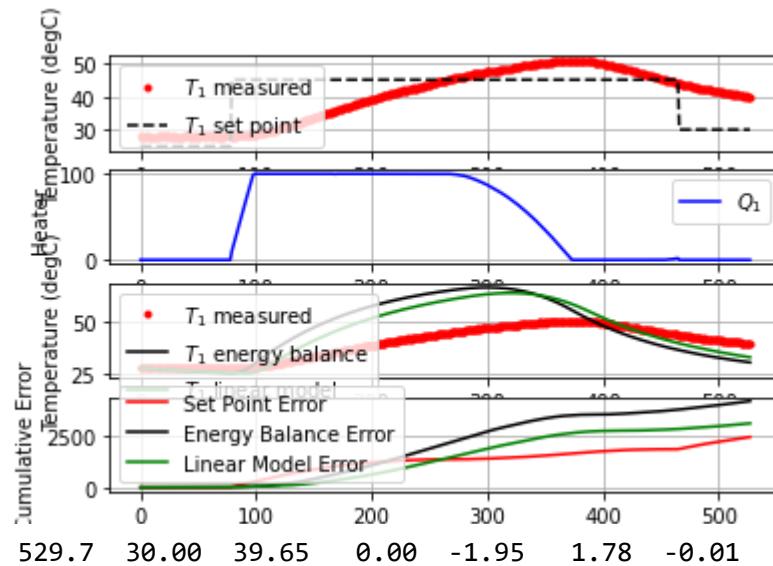
525.9 30.00 39.71 0.00 -1.96 1.78 0.01



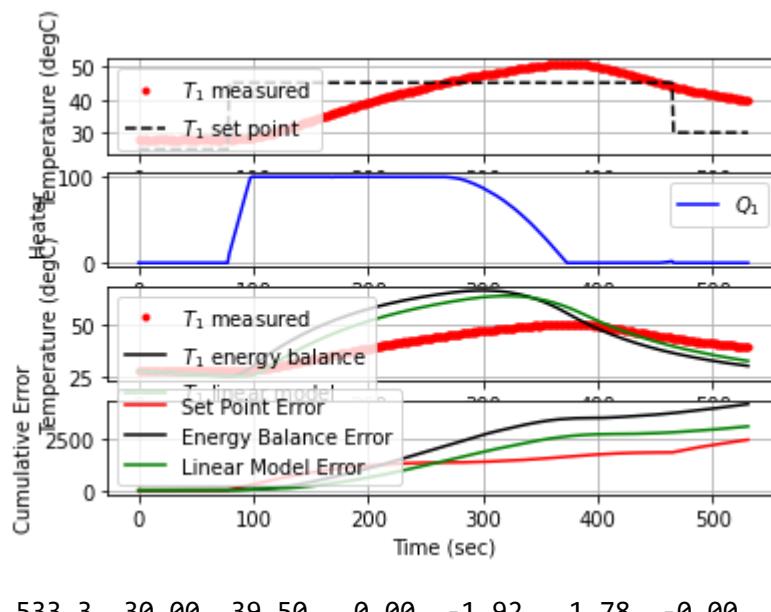
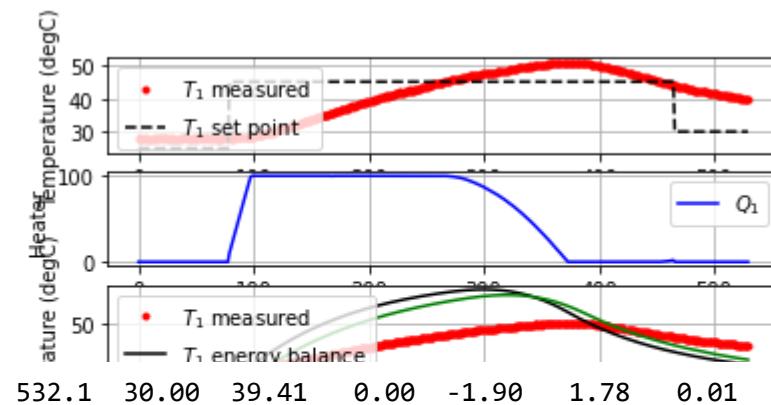
527.1 30.00 39.75 0.00 -1.97 1.78 -0.00

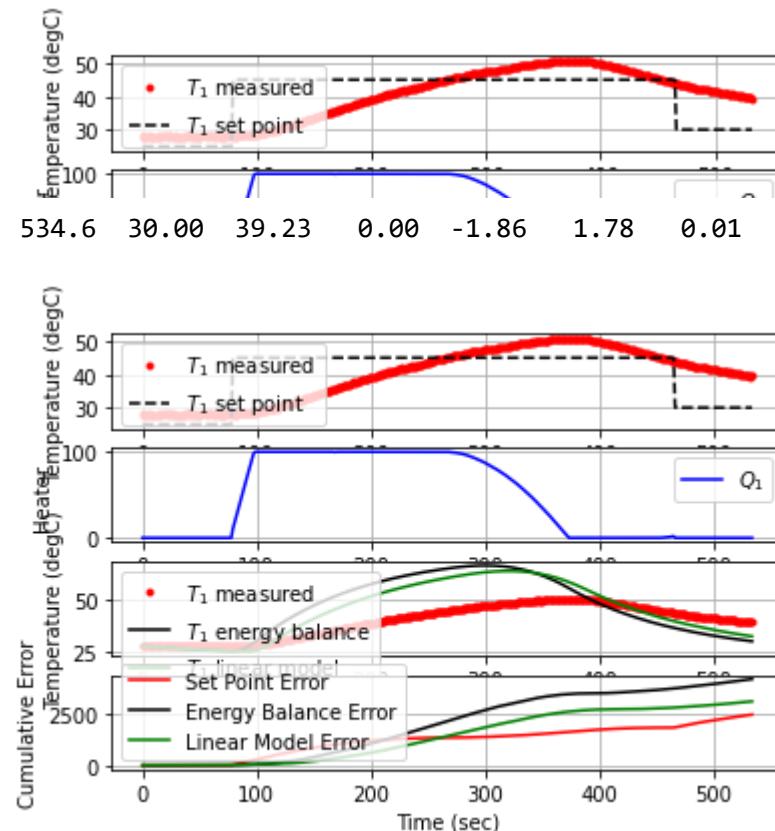


528.5 30.00 39.53 0.00 -1.92 1.78 0.01

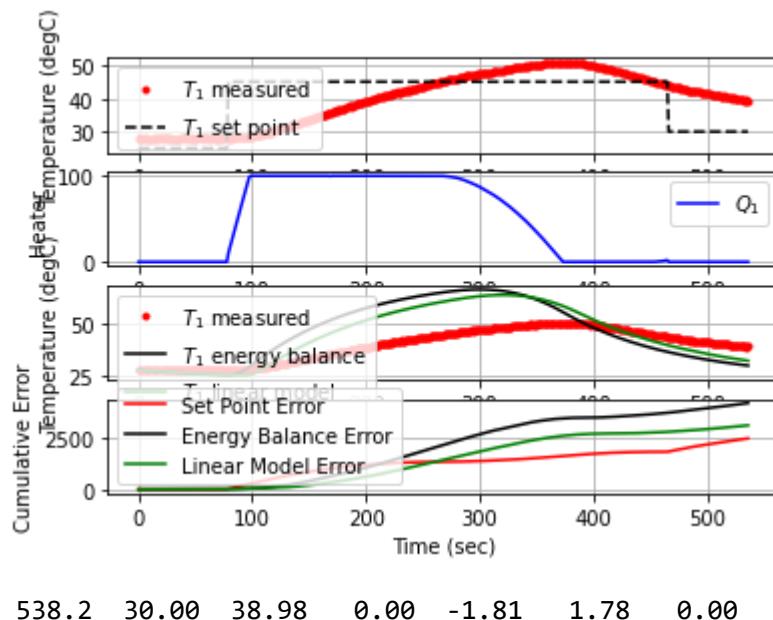
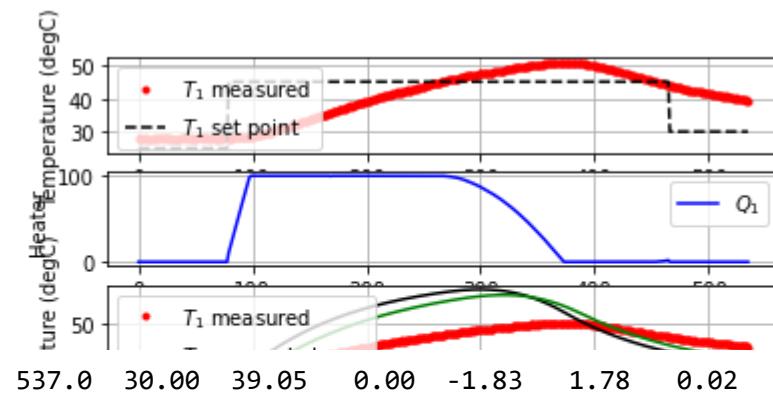


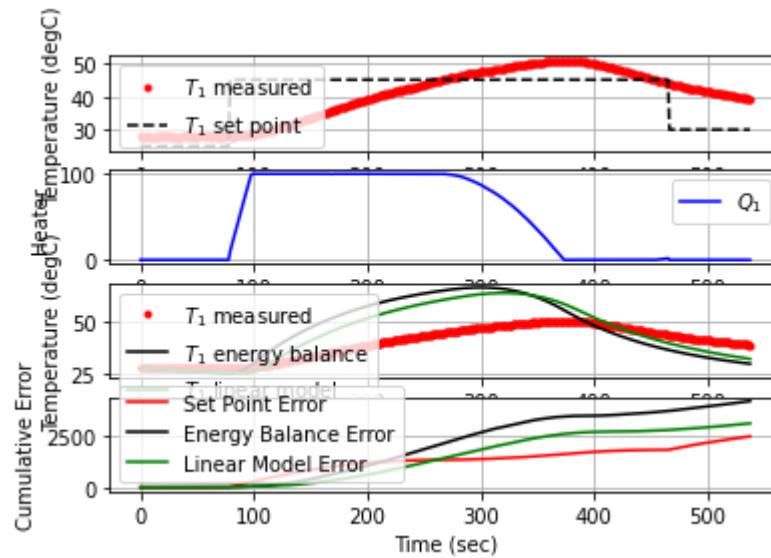
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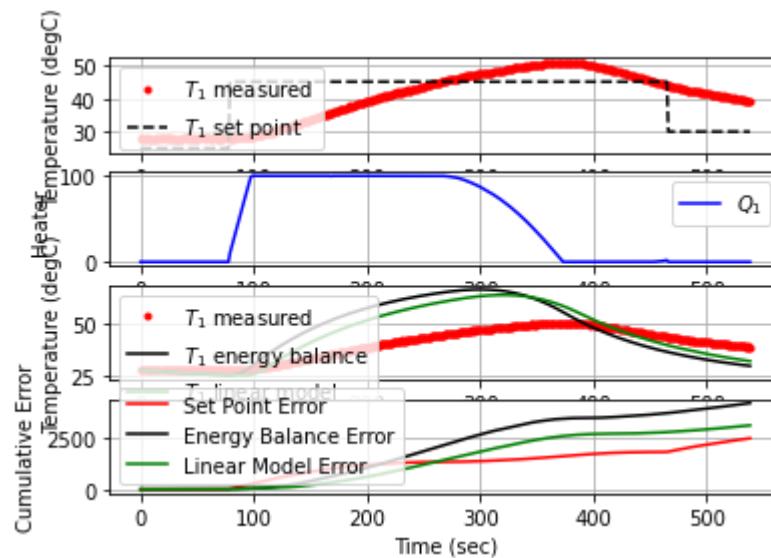


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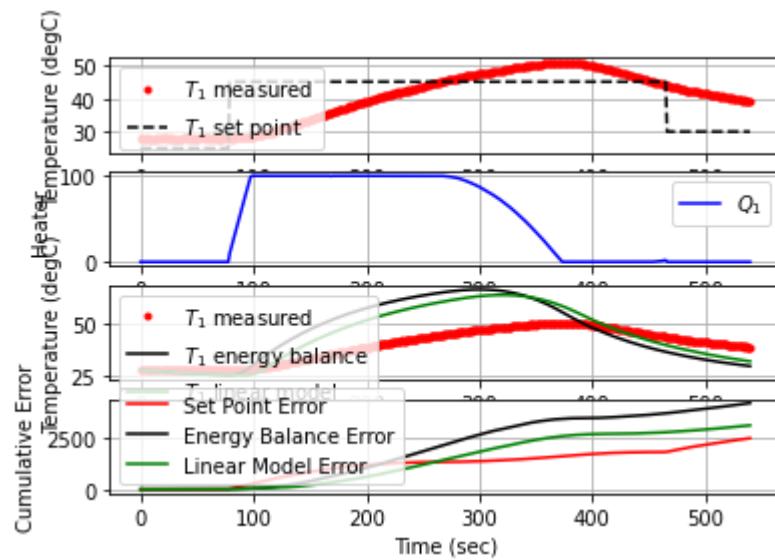




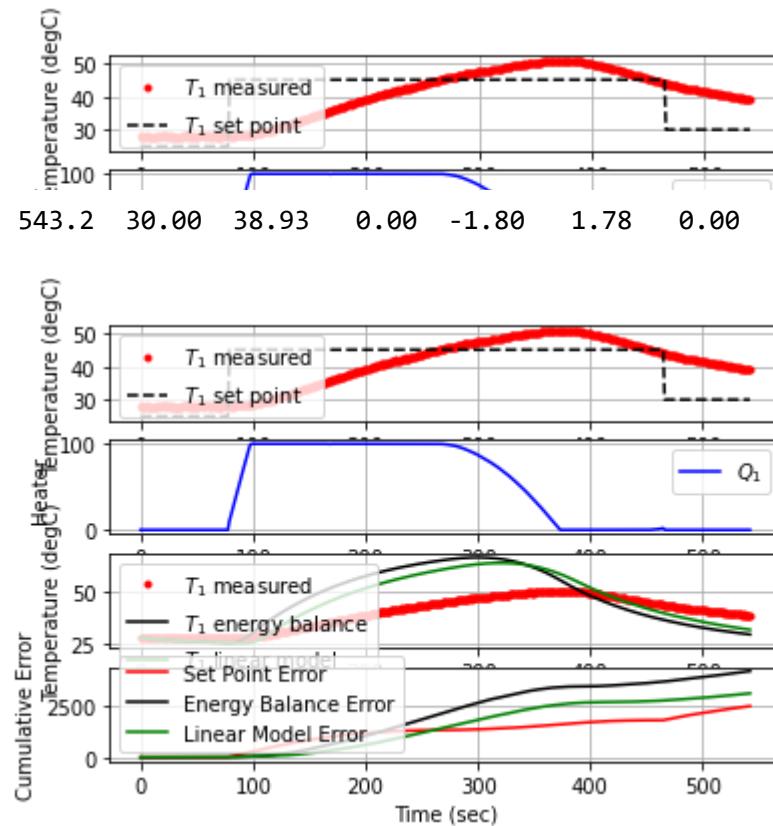
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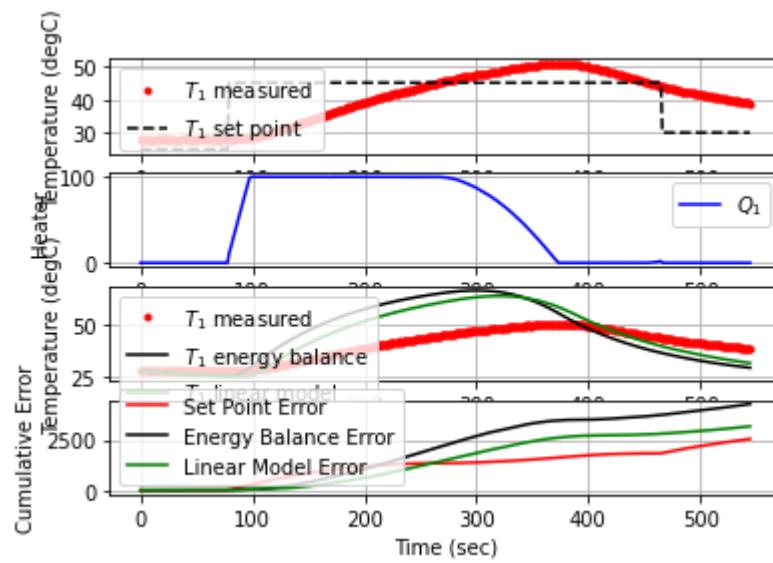
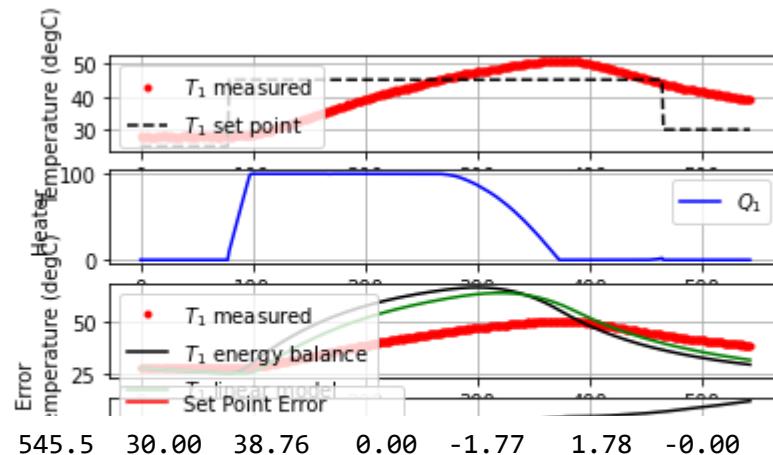
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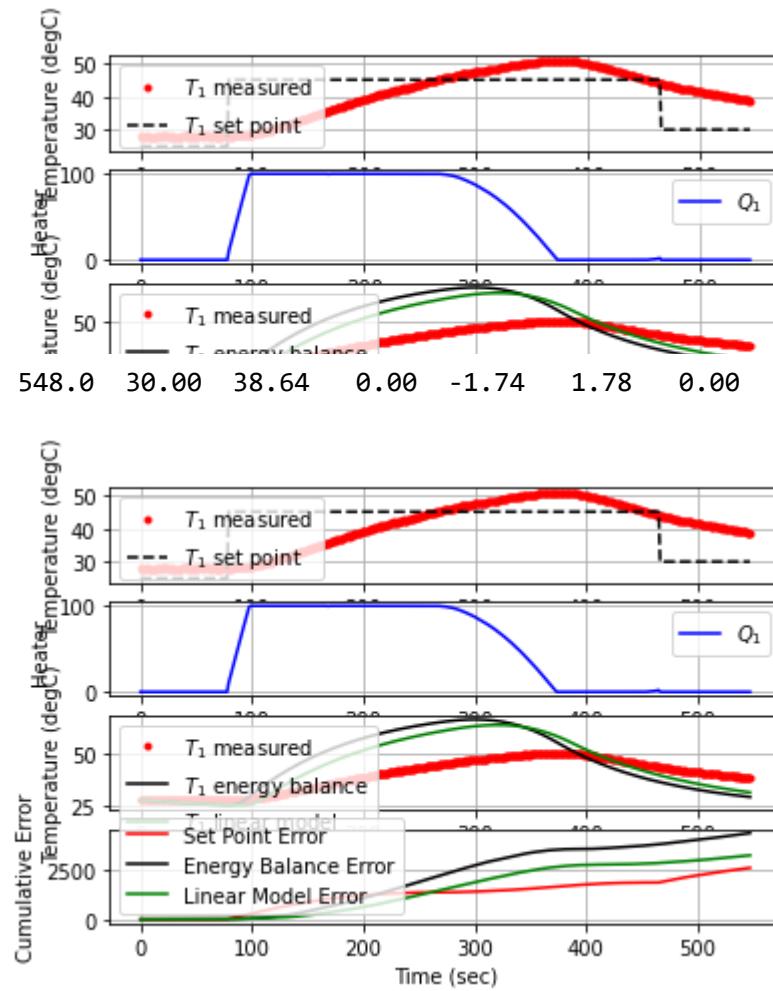
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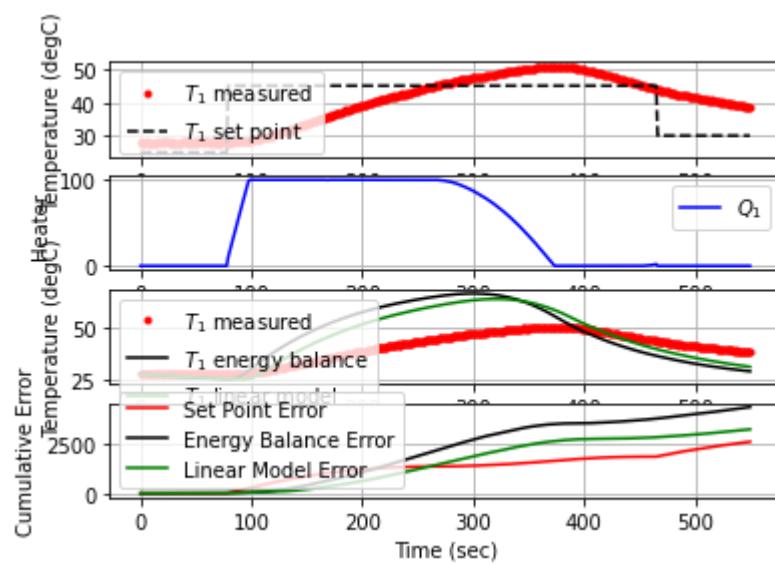
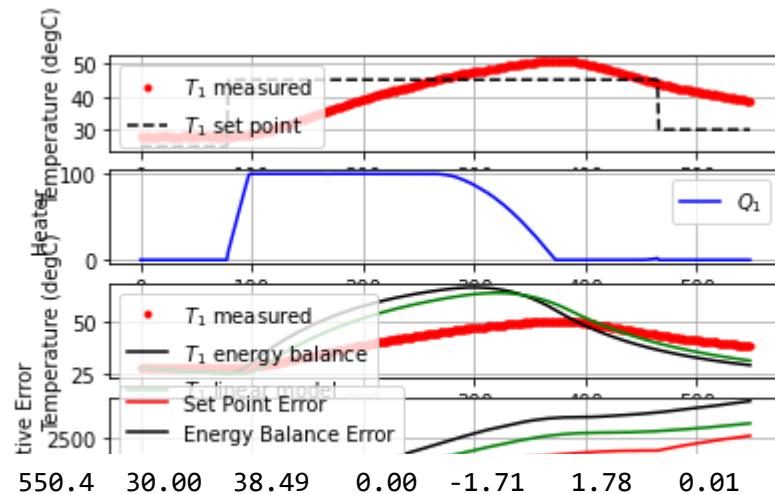


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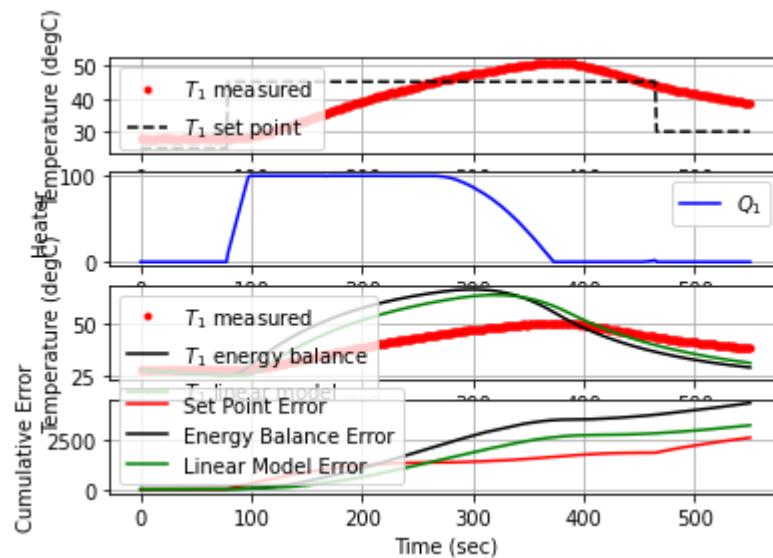


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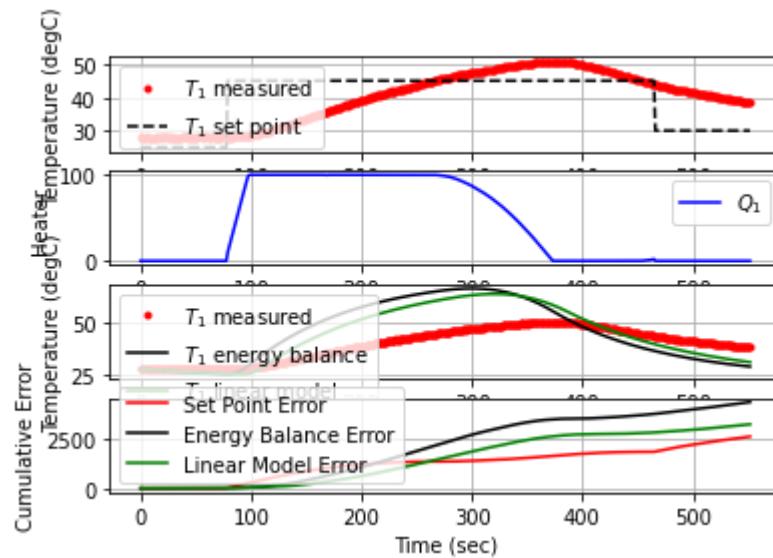




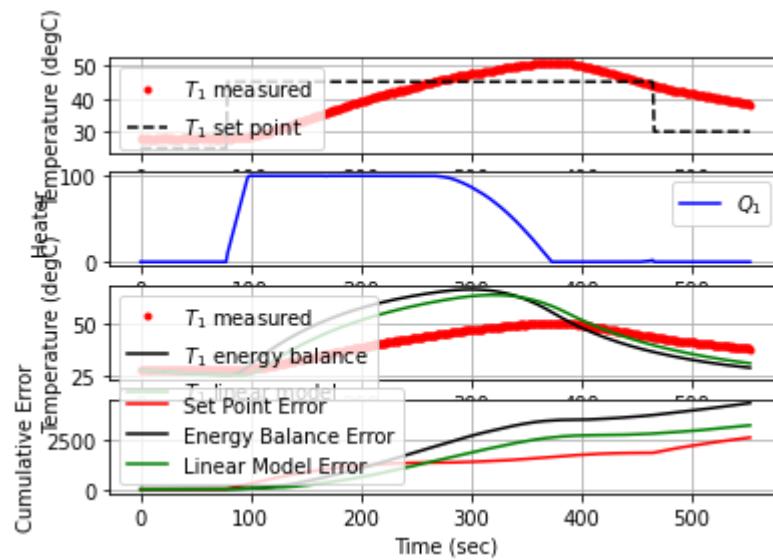
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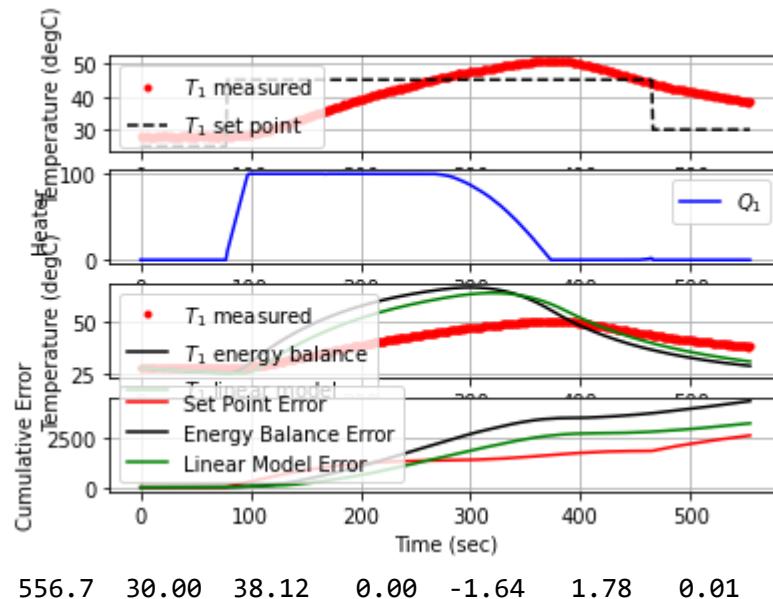
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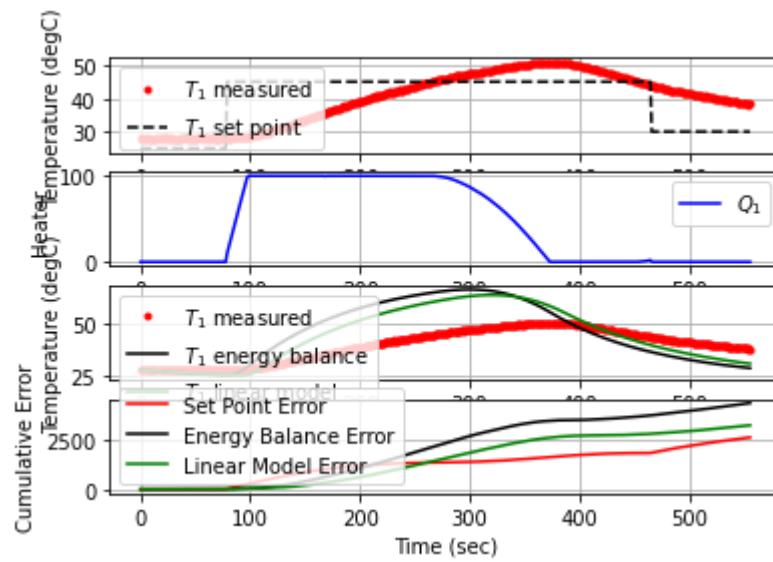
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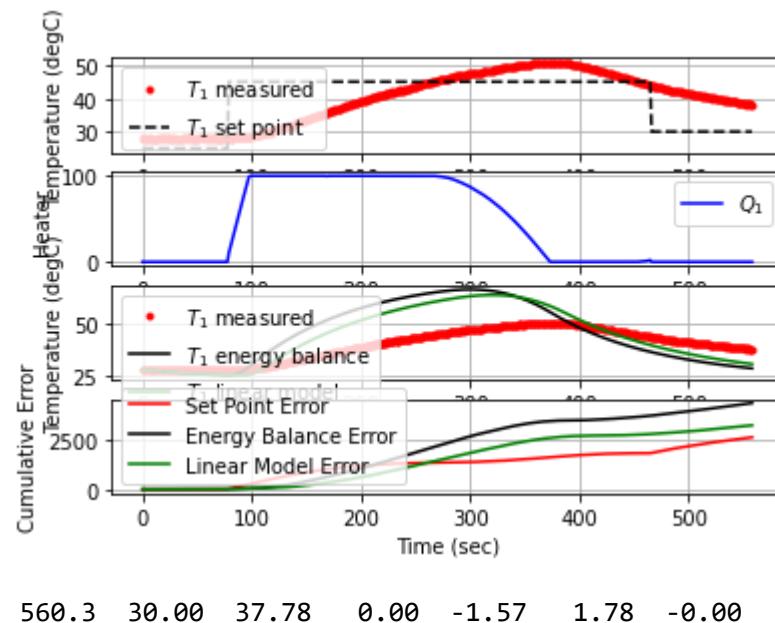
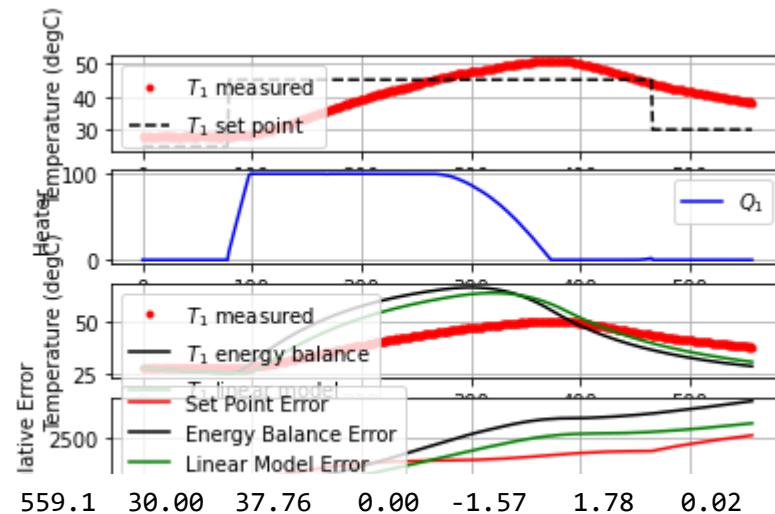
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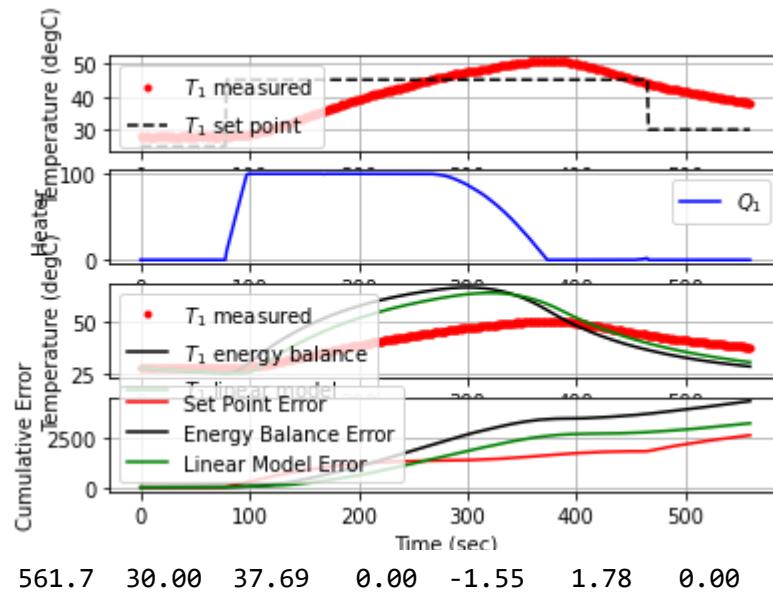


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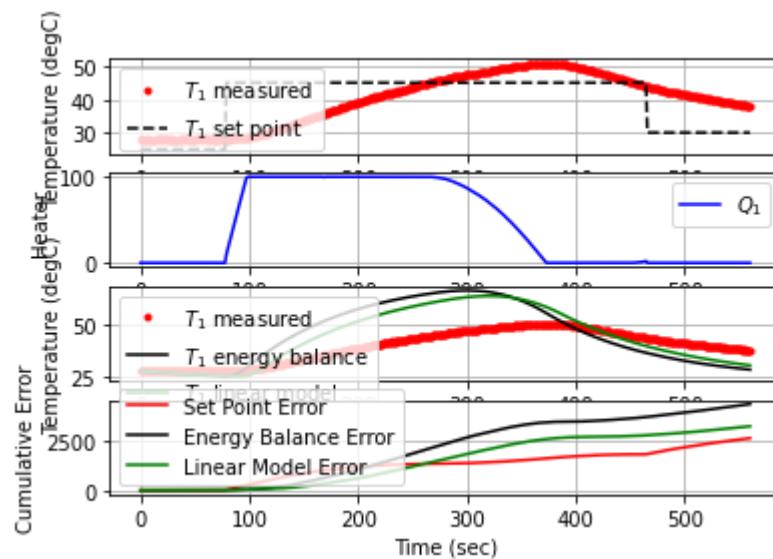


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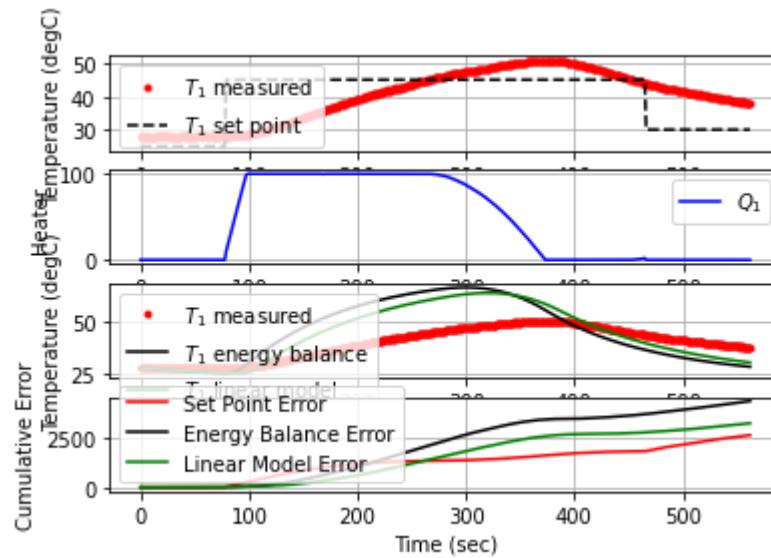




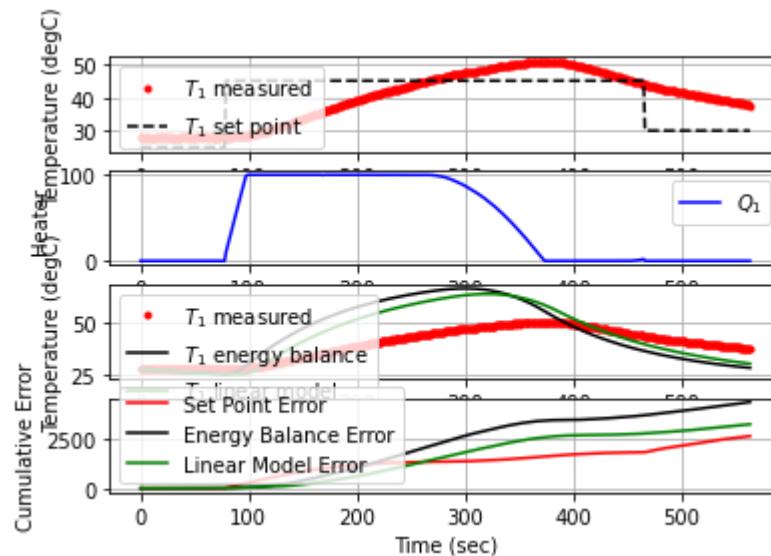
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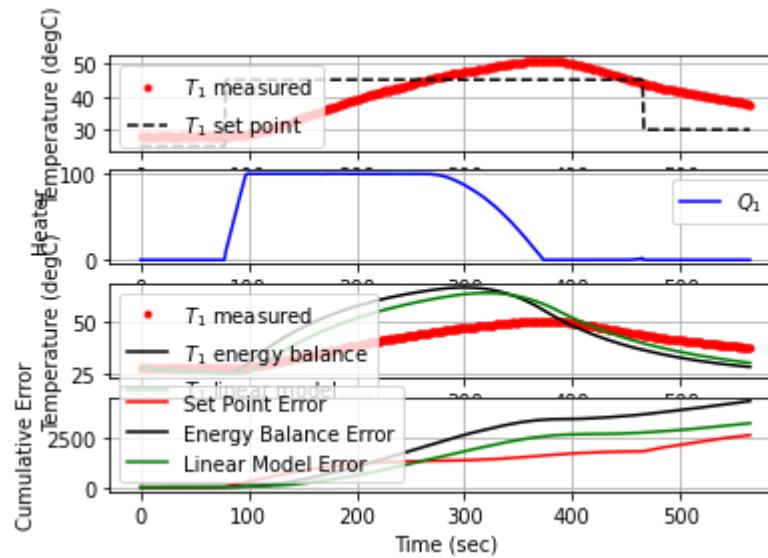
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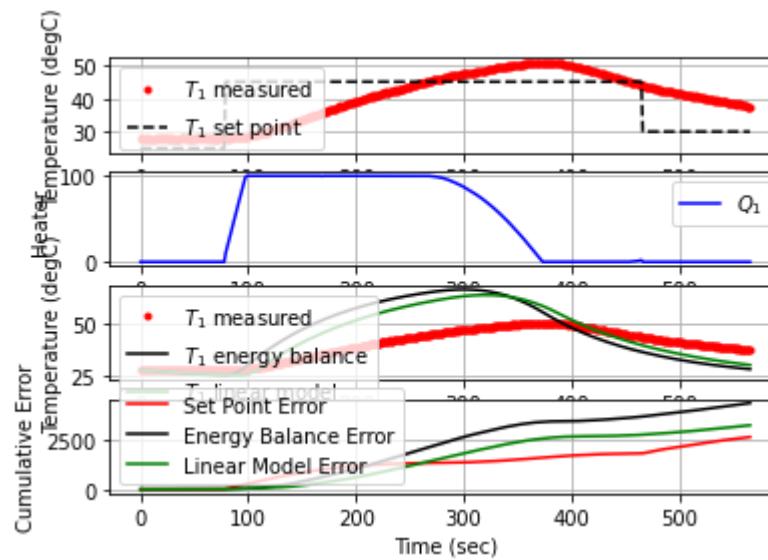
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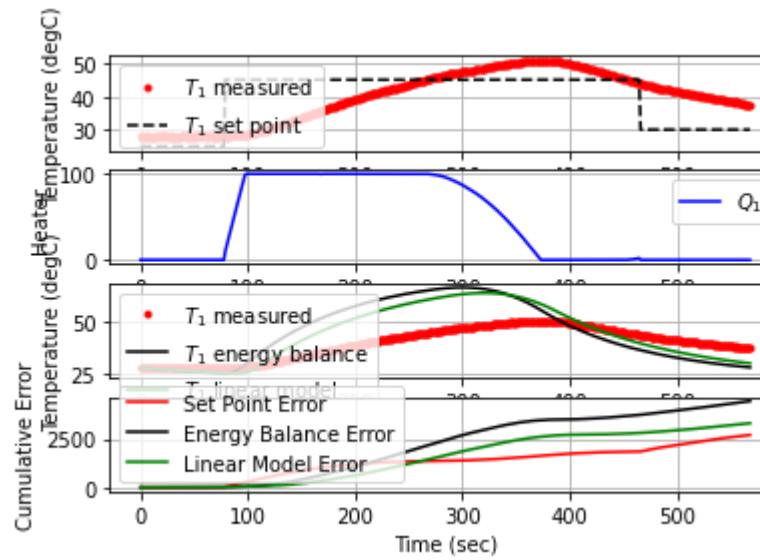
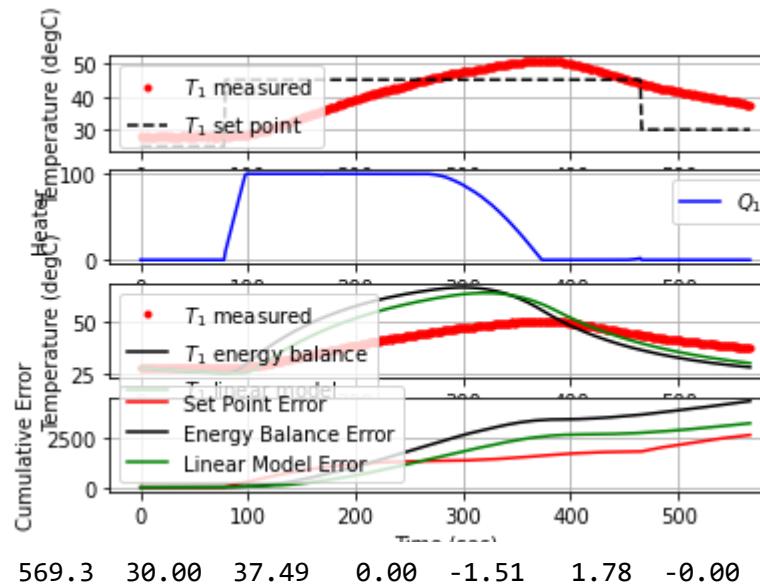
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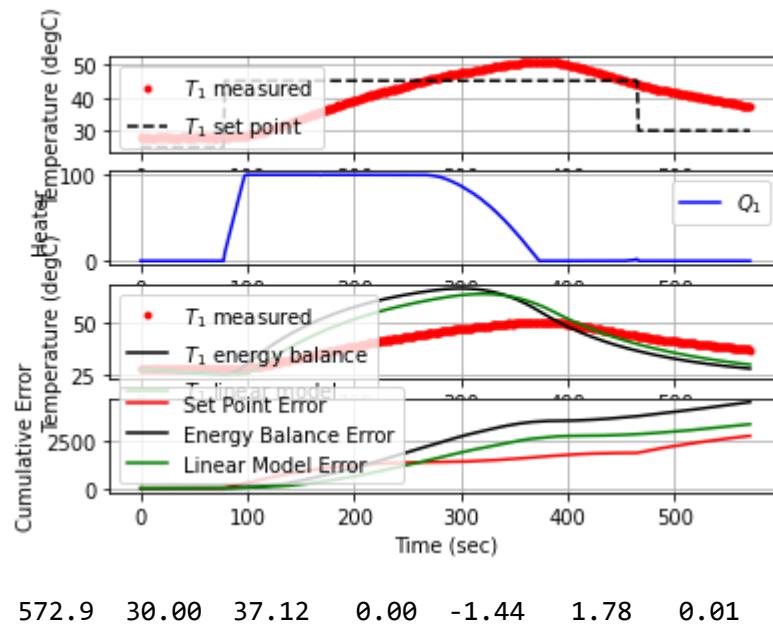
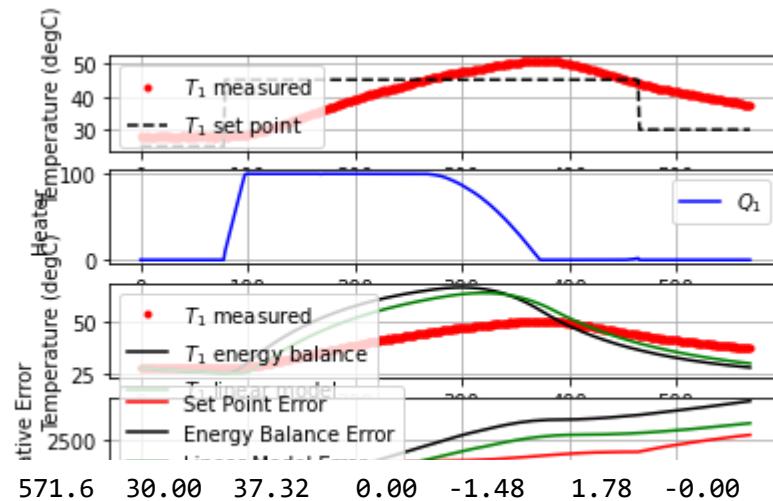
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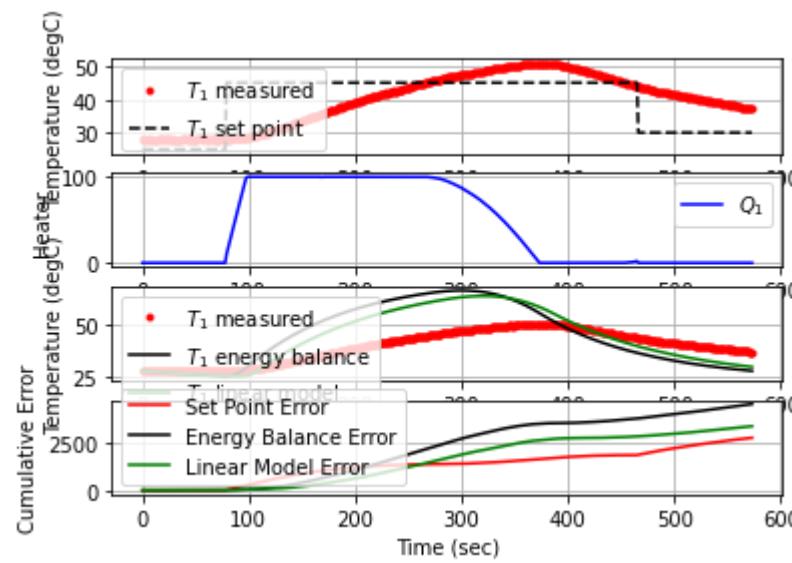
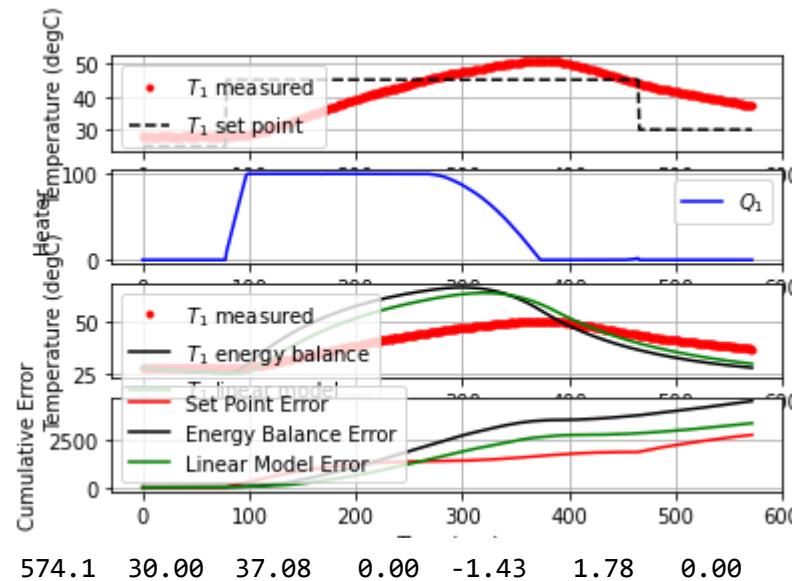


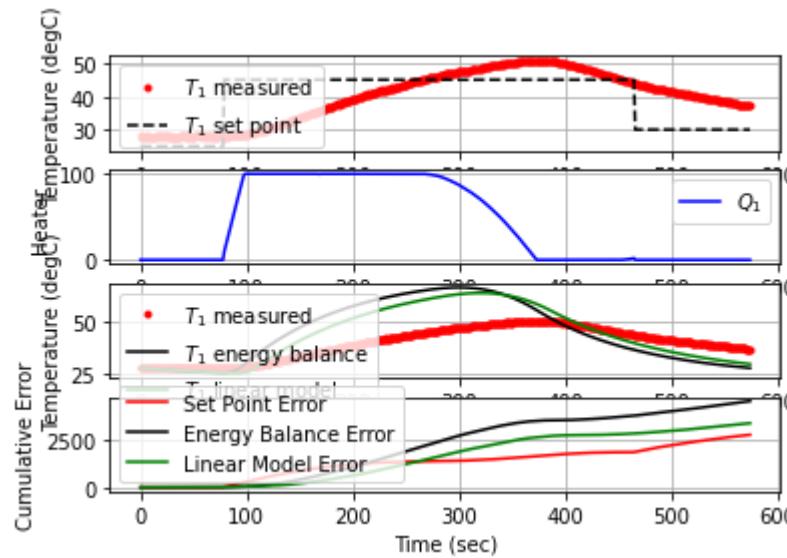
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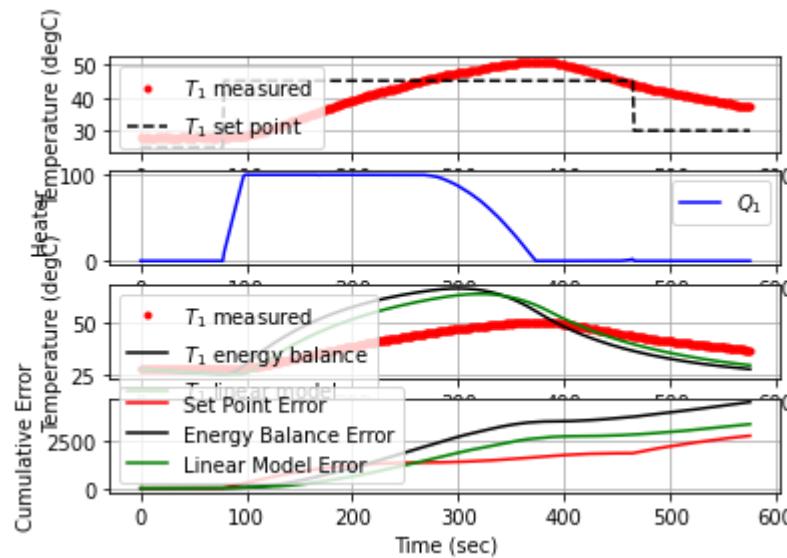
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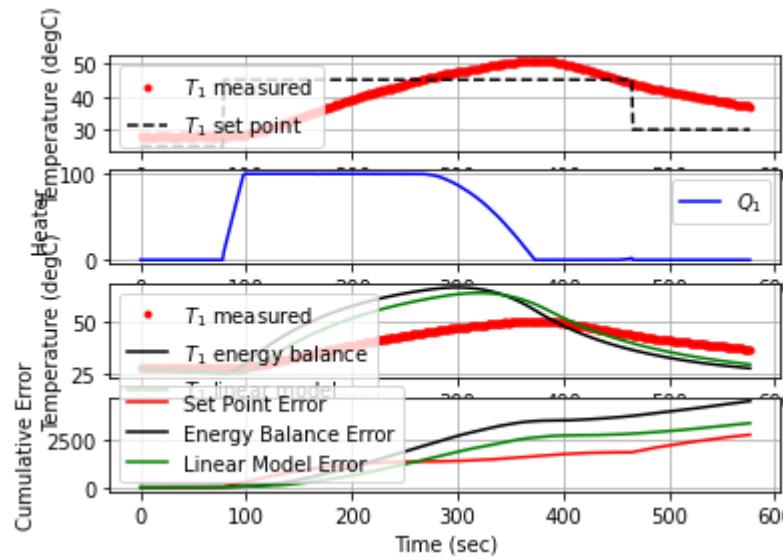




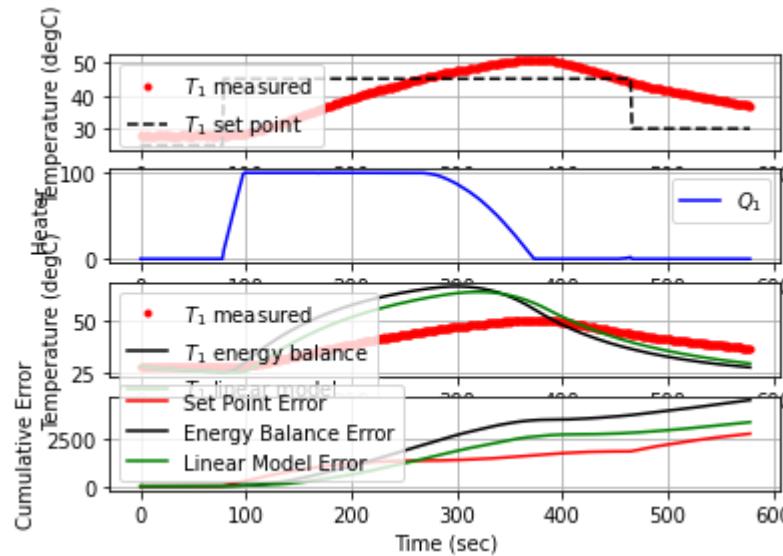
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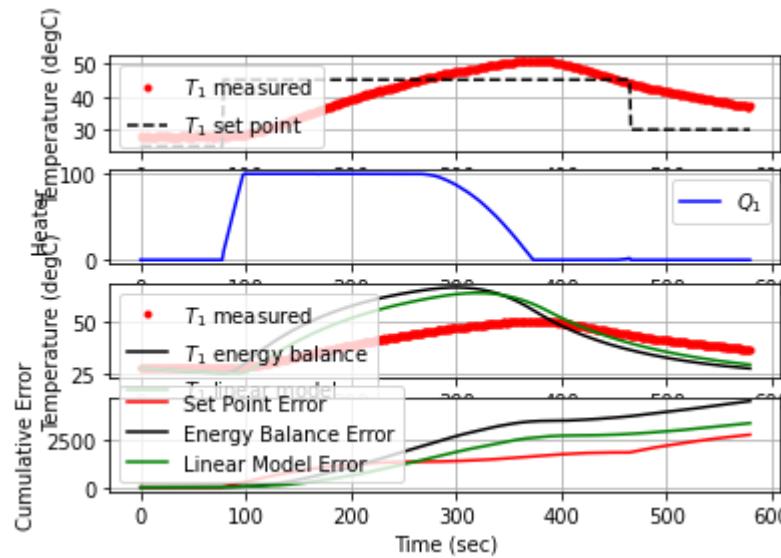
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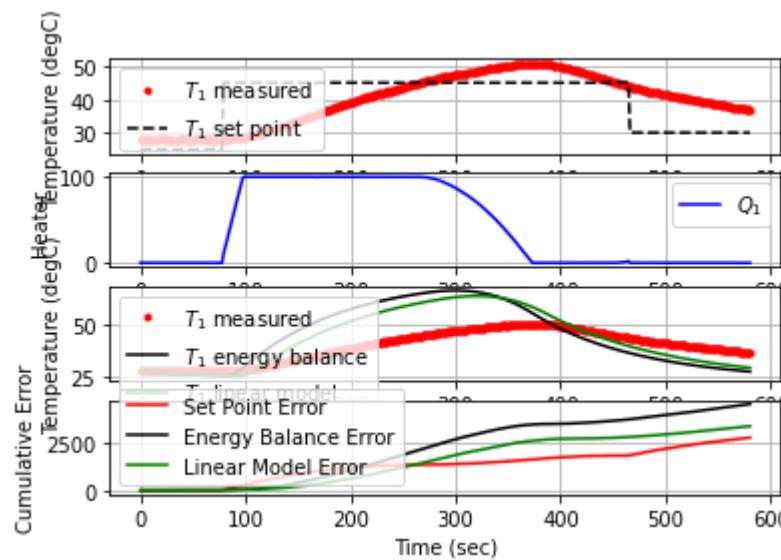
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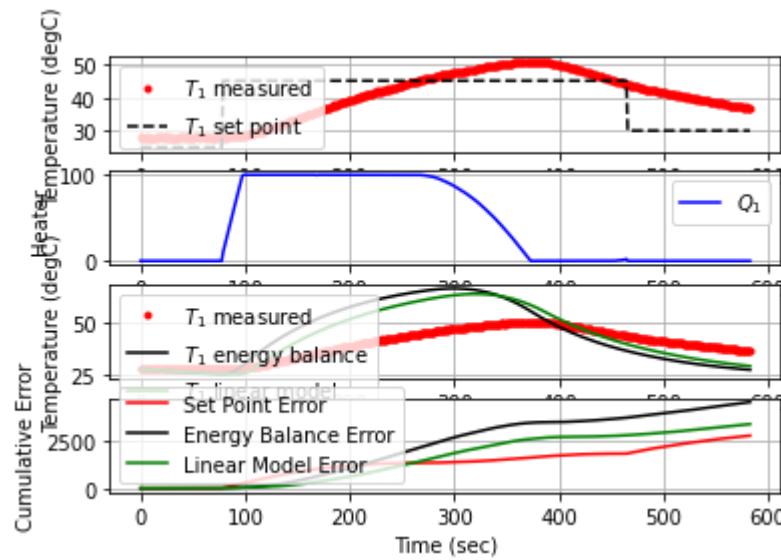
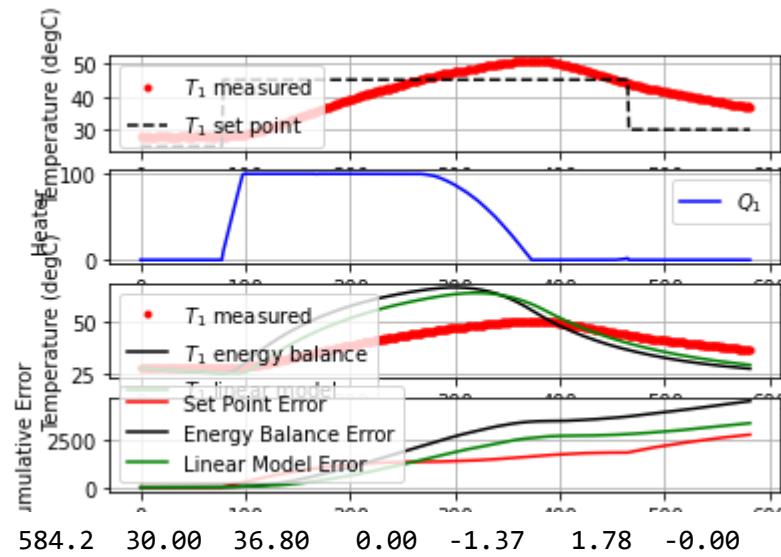
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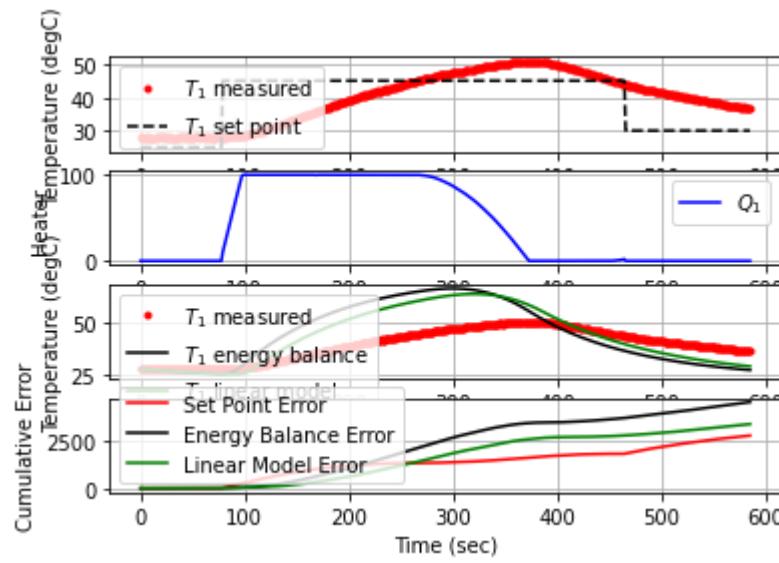
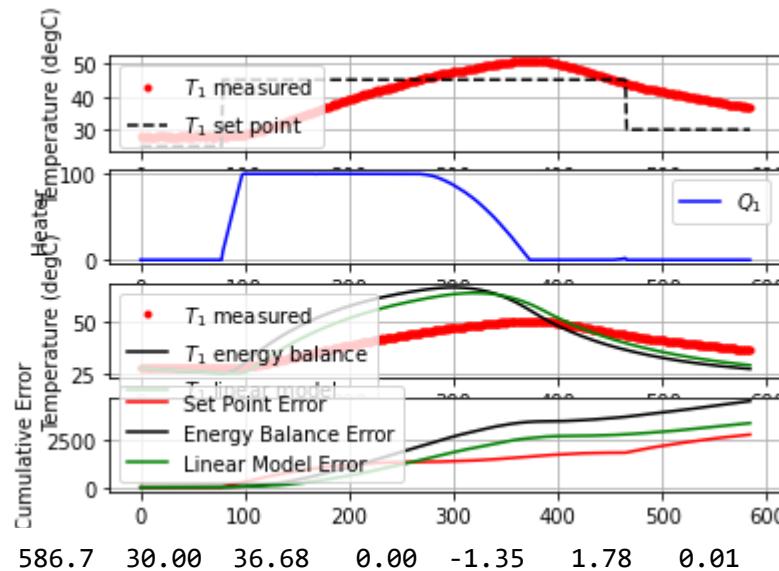


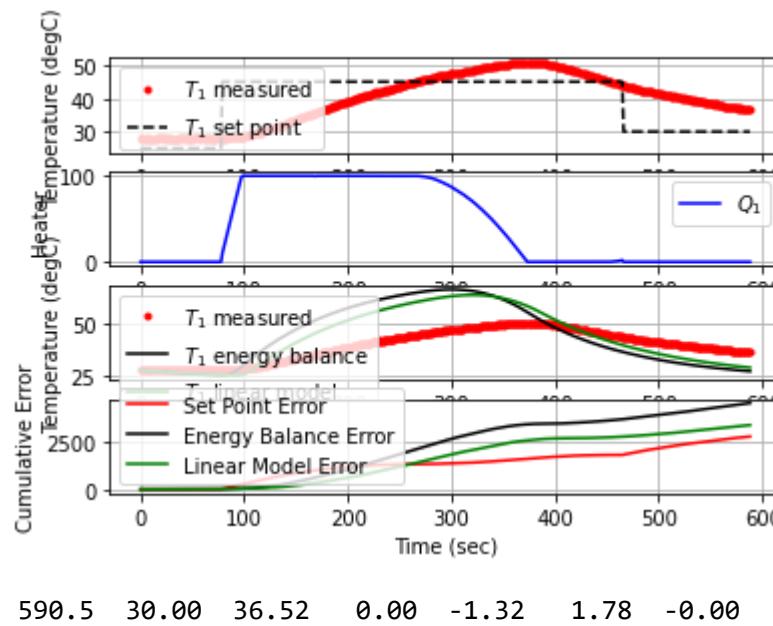
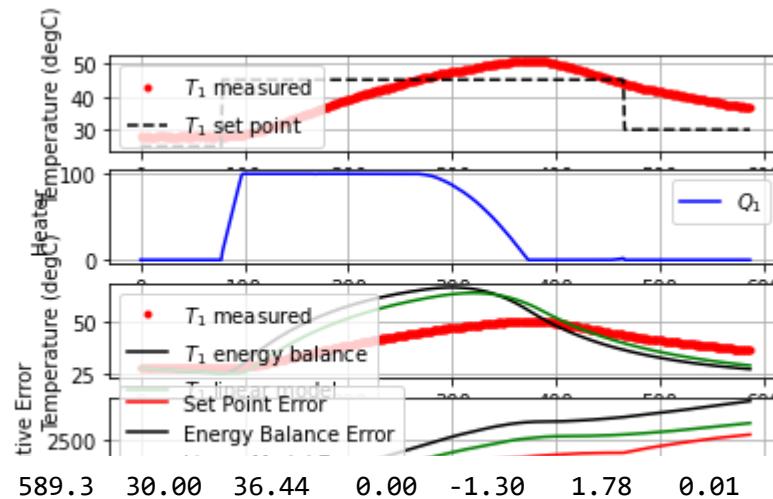
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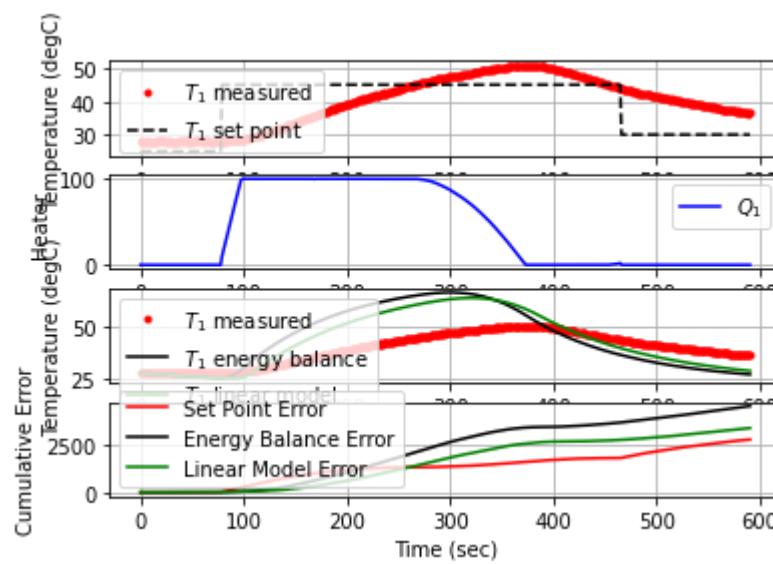
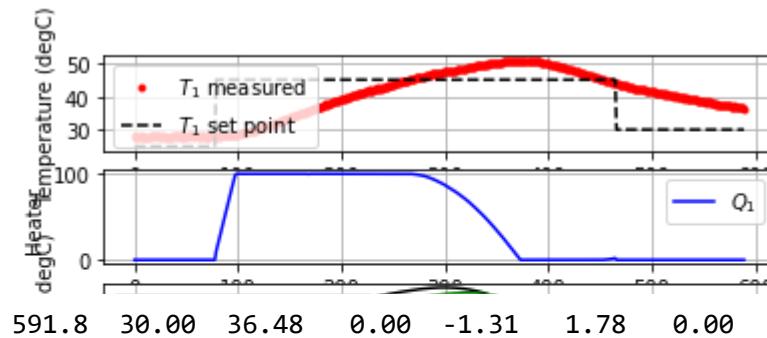


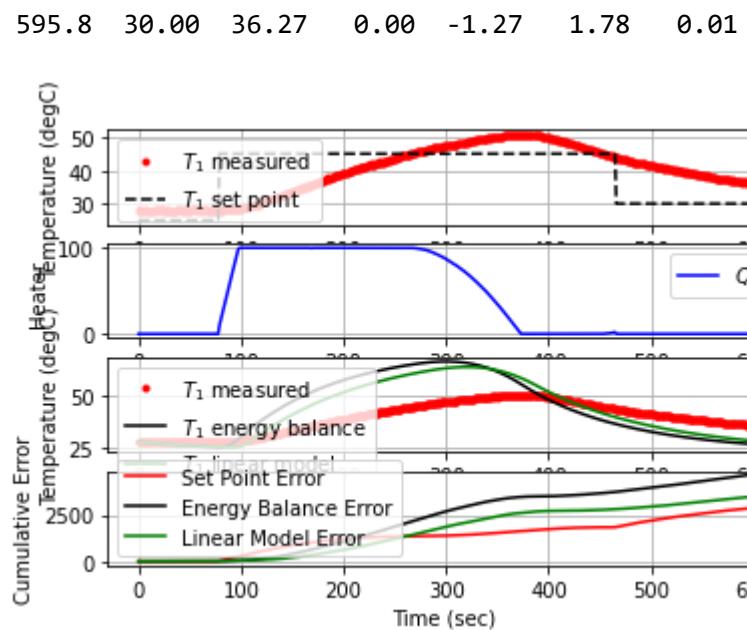
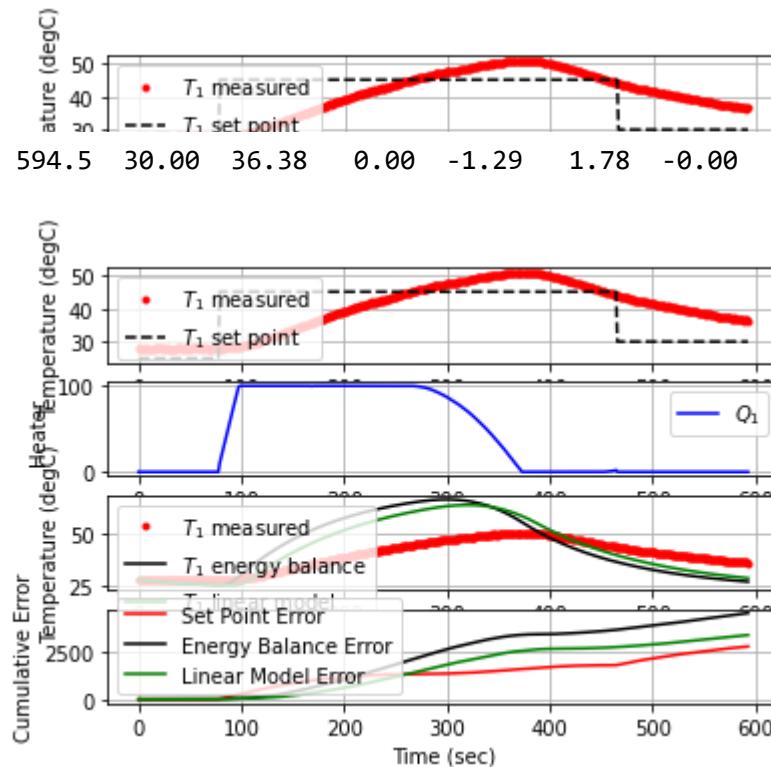
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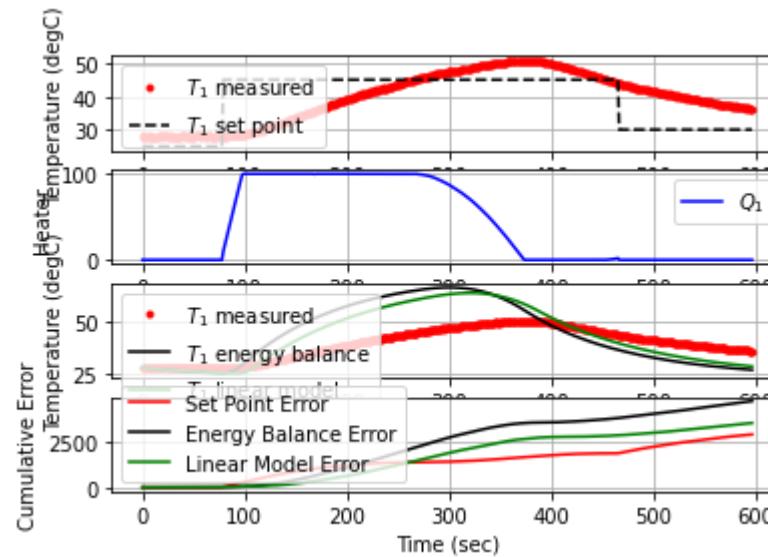




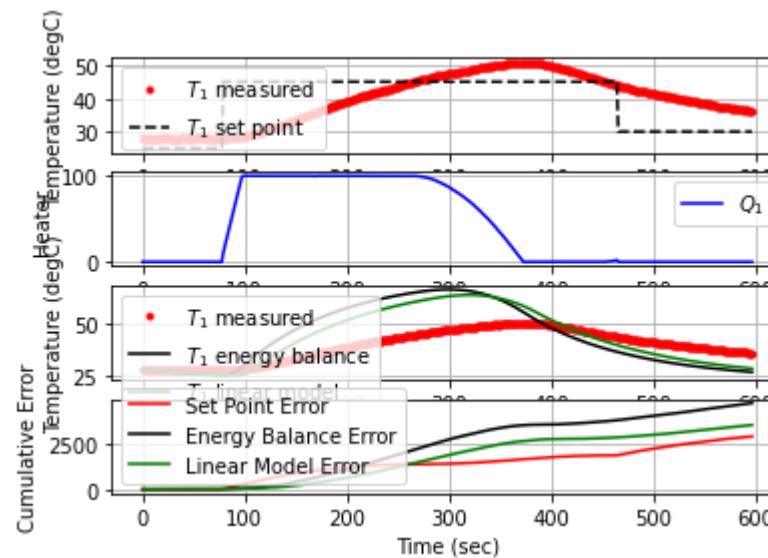


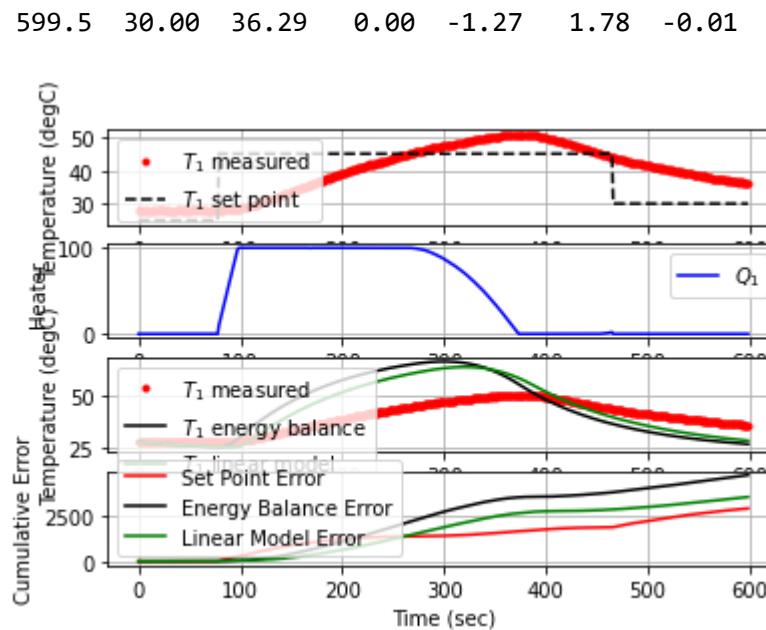


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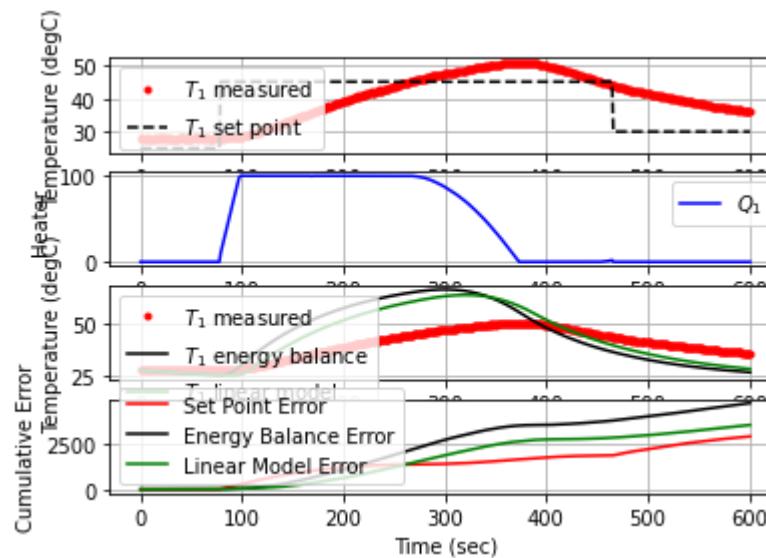
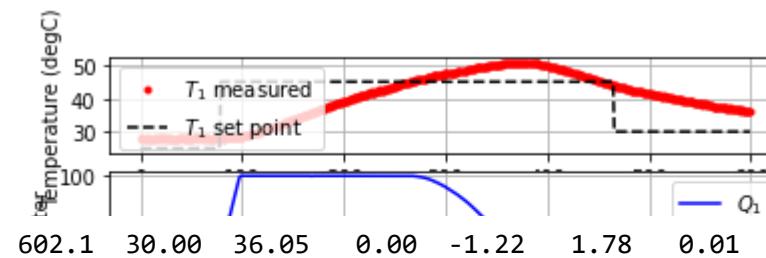


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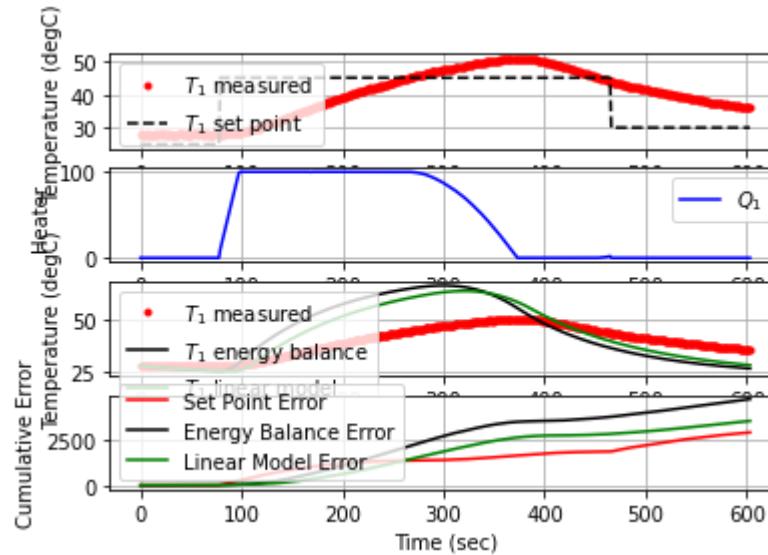




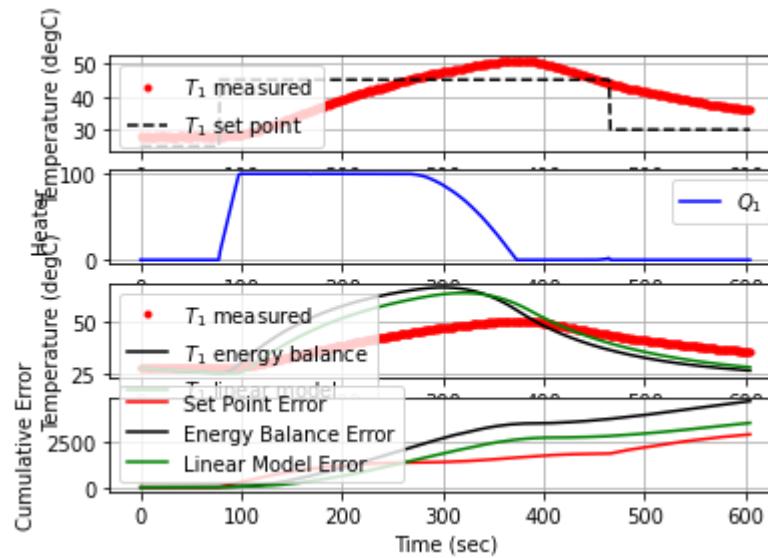
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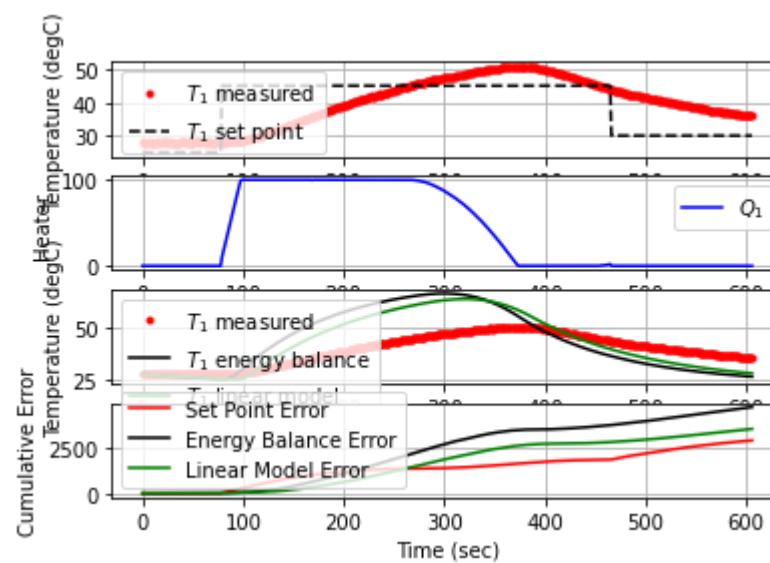
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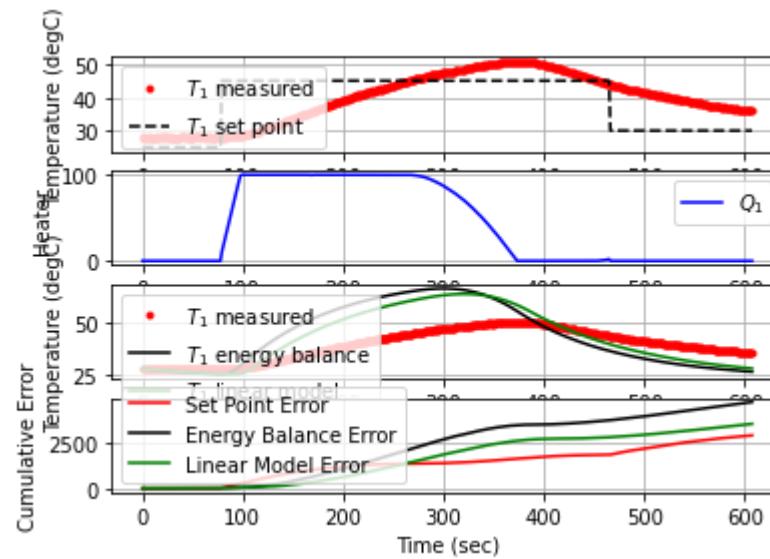
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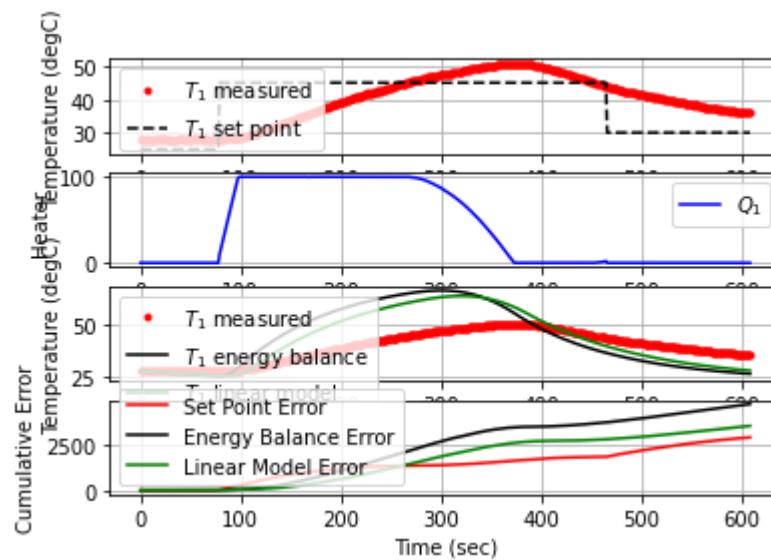
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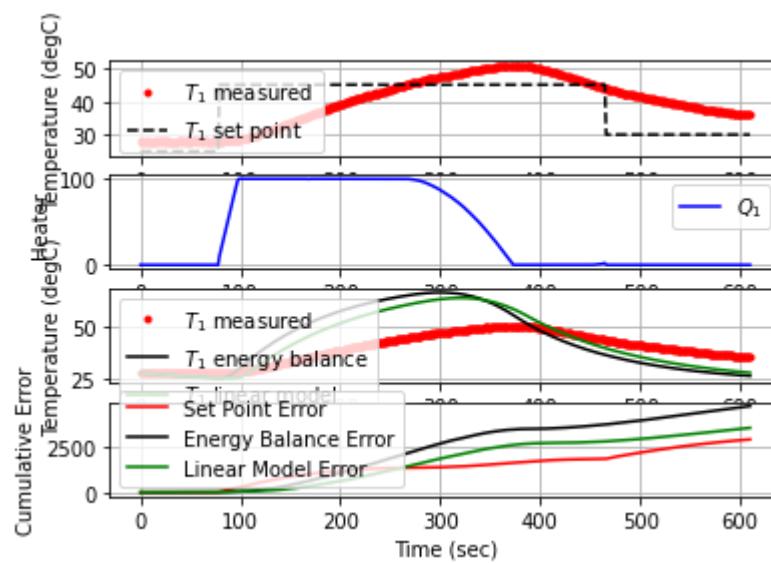
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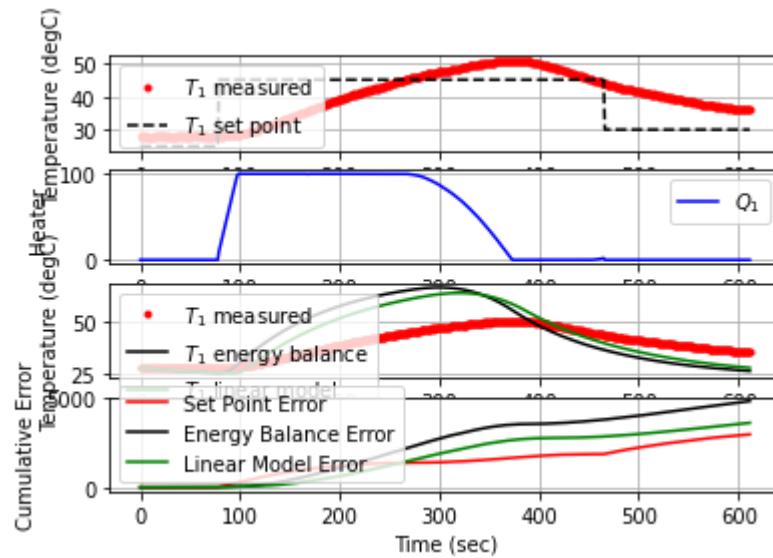
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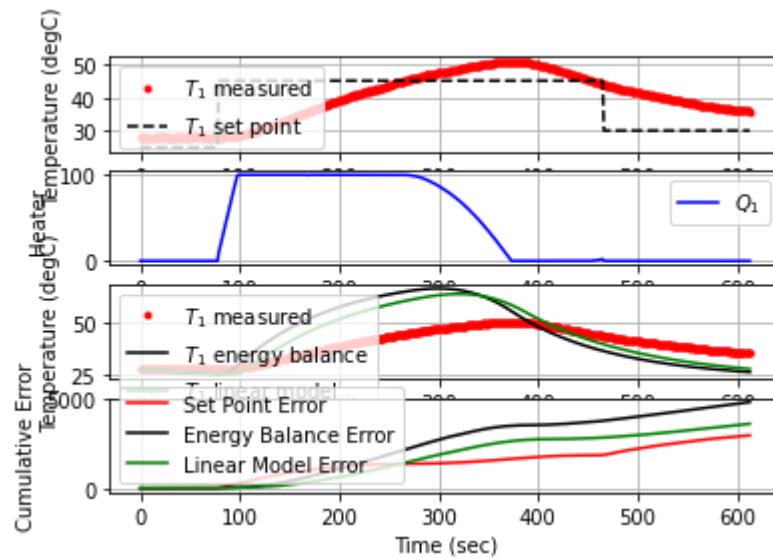
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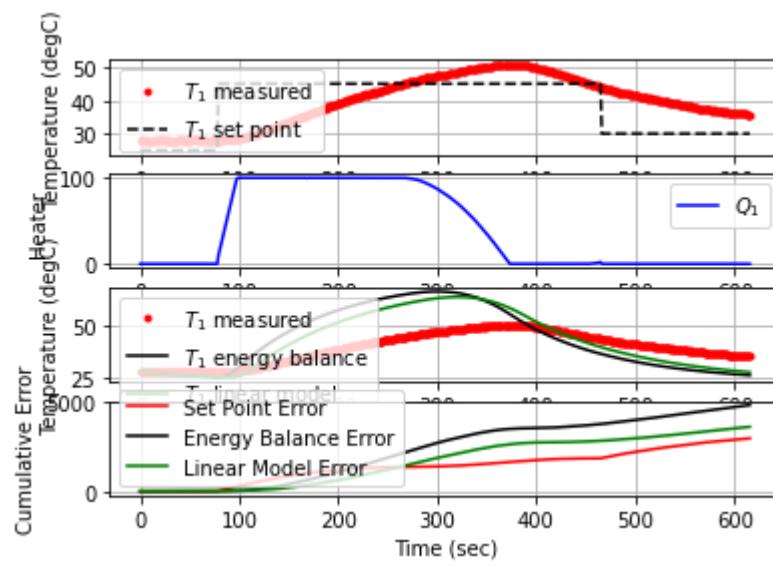
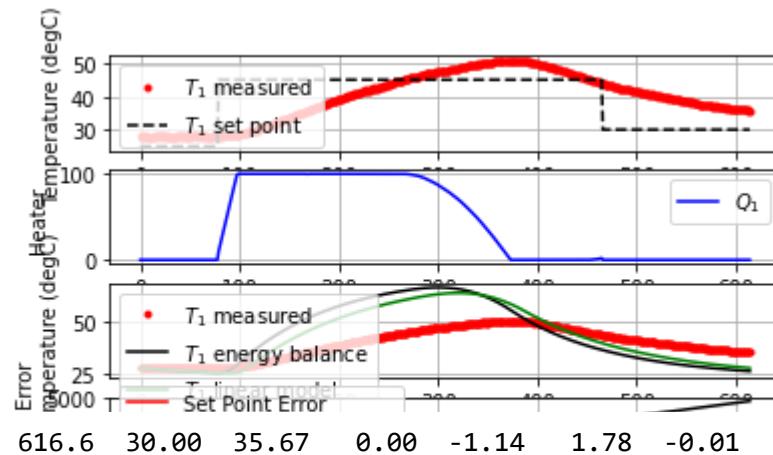
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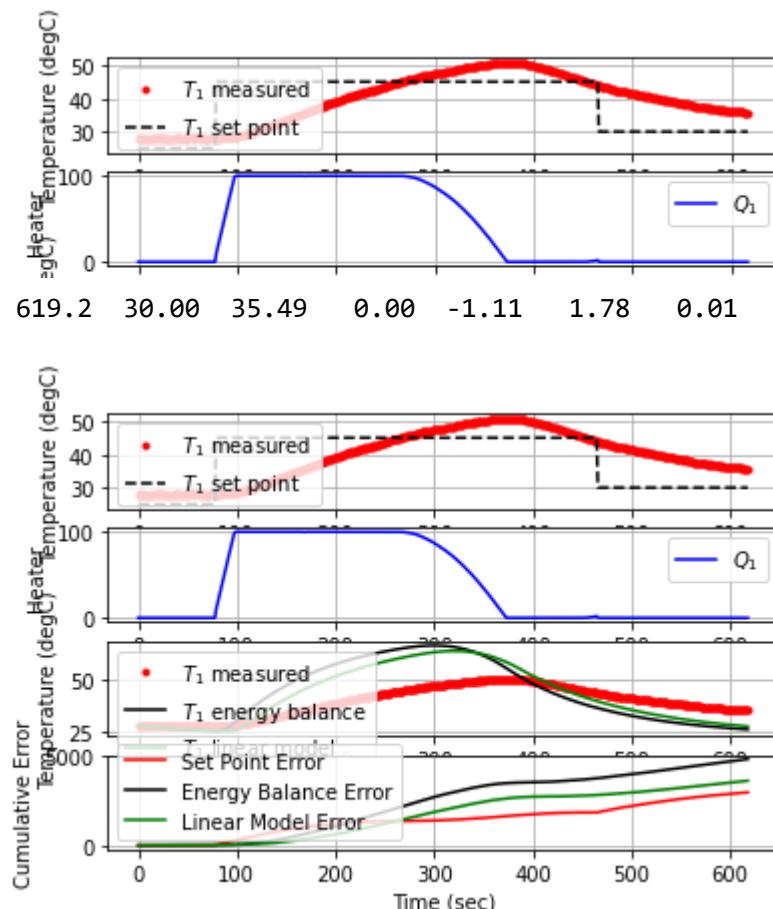
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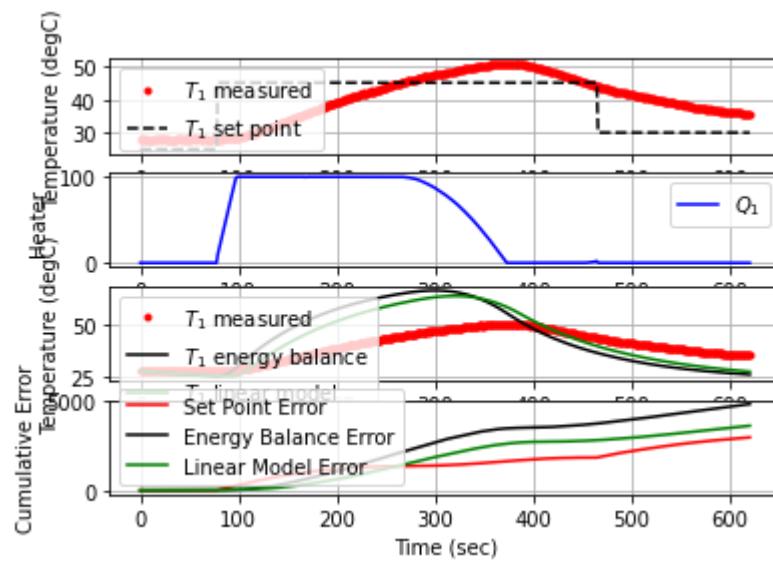
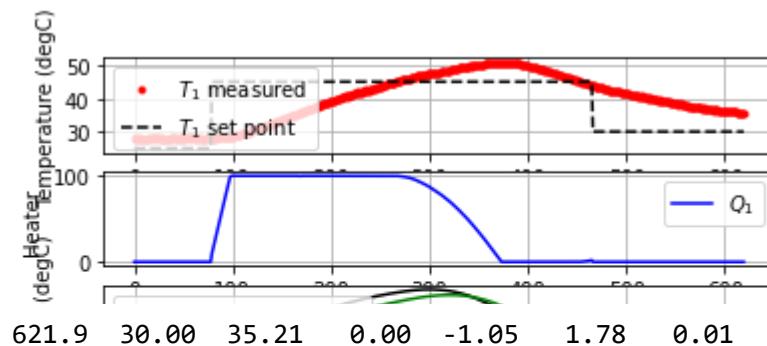
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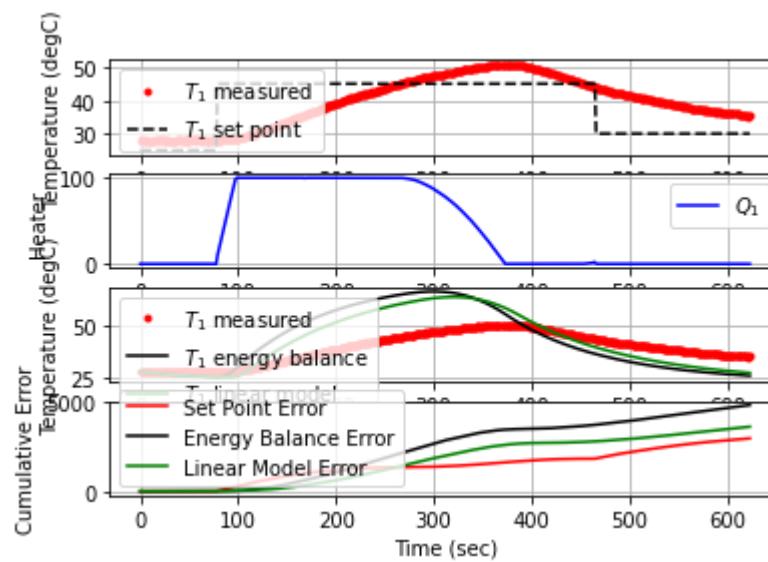
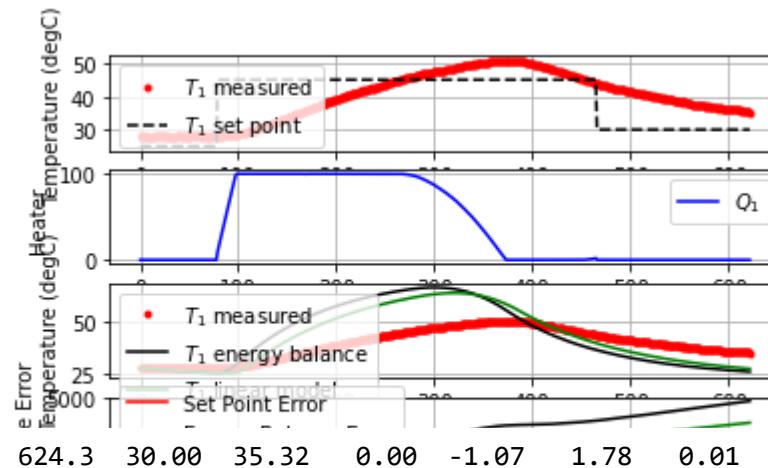
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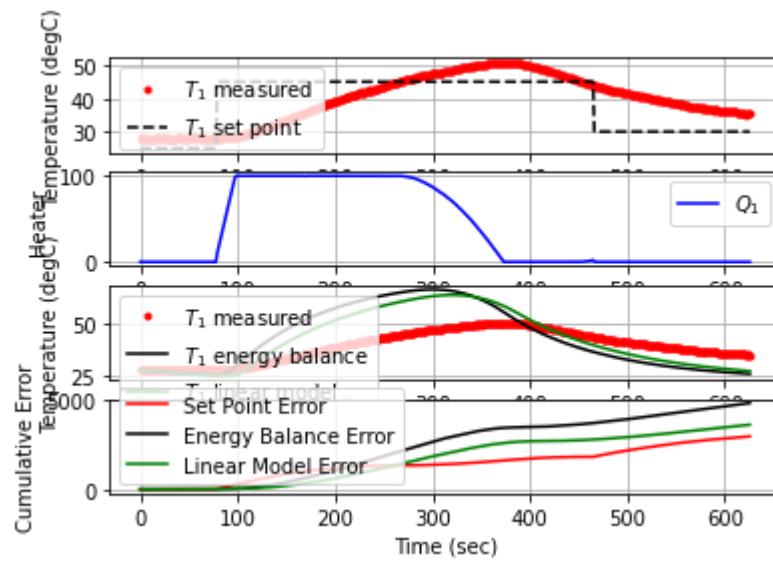
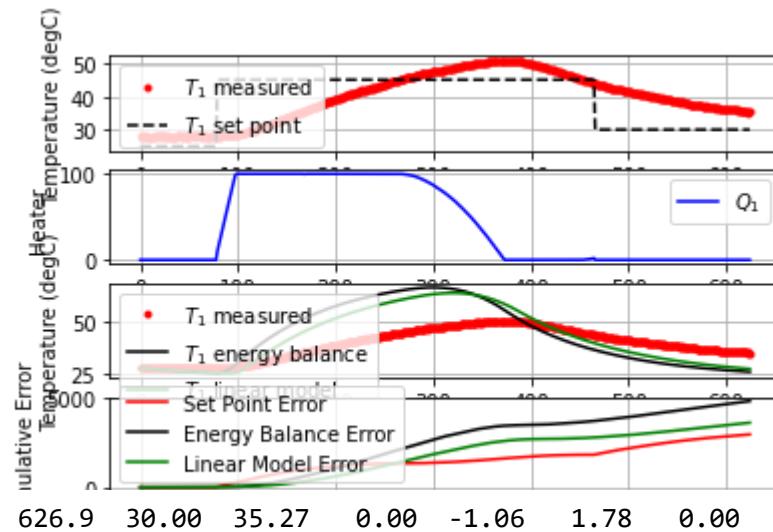


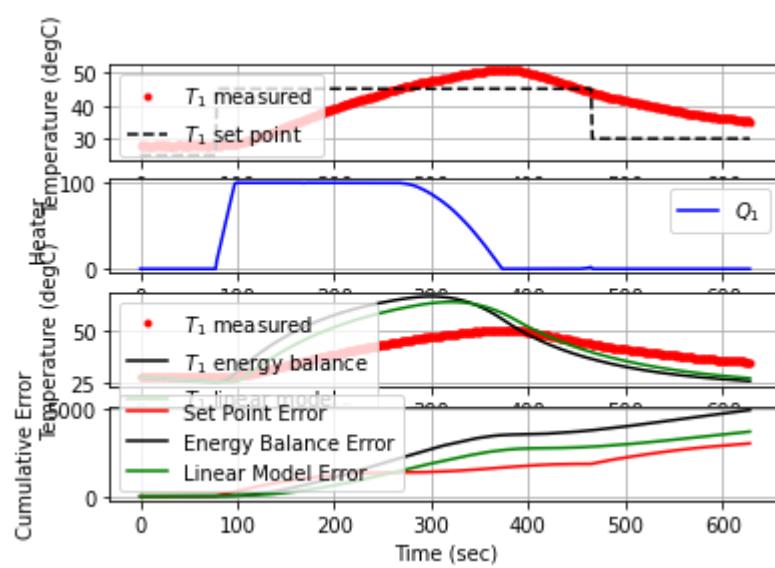
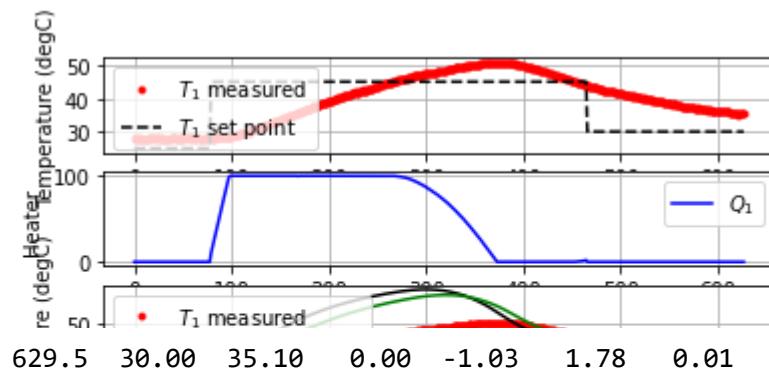
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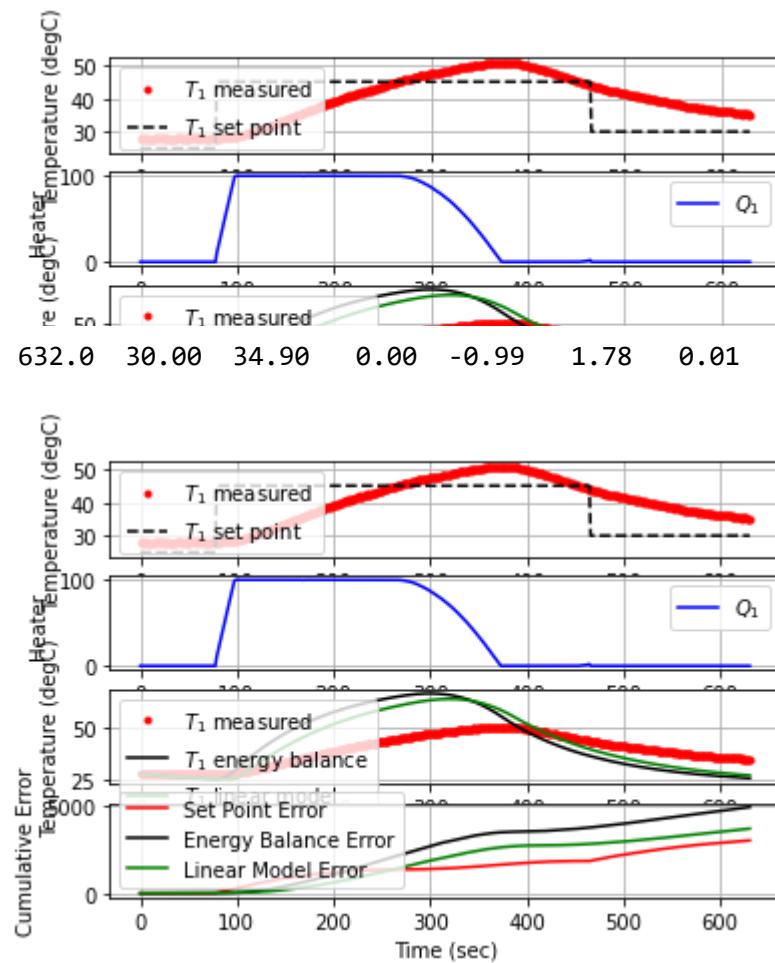
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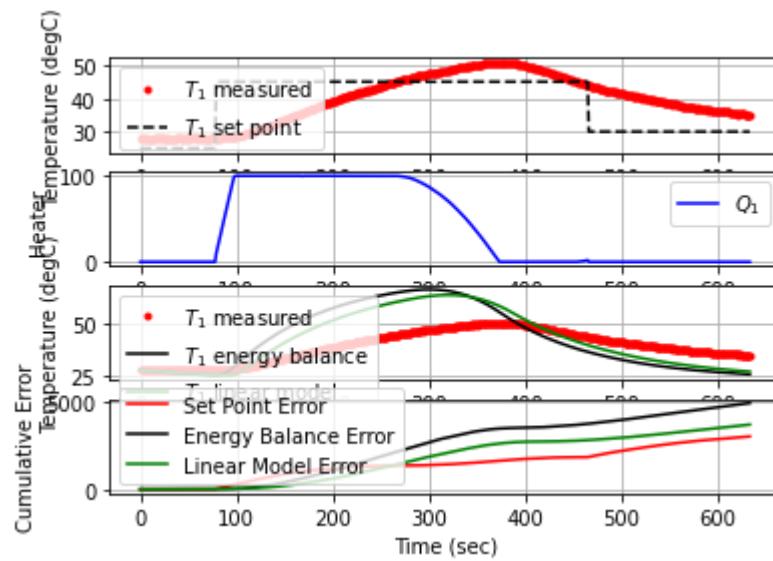
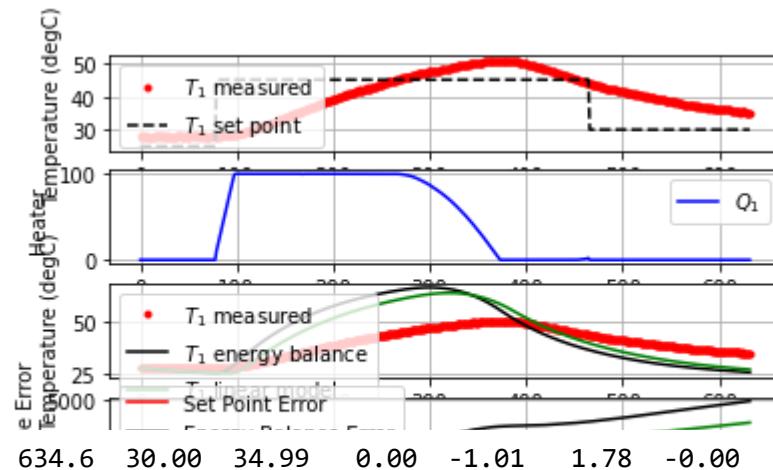




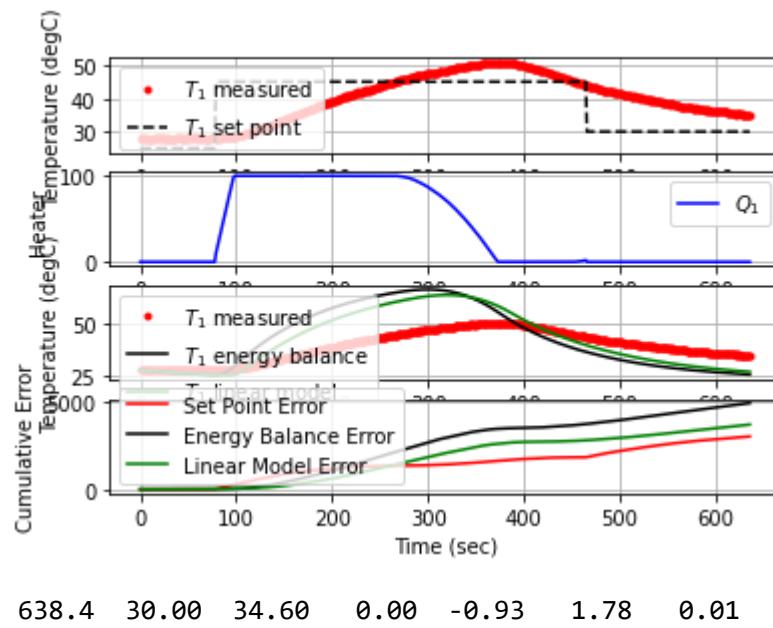
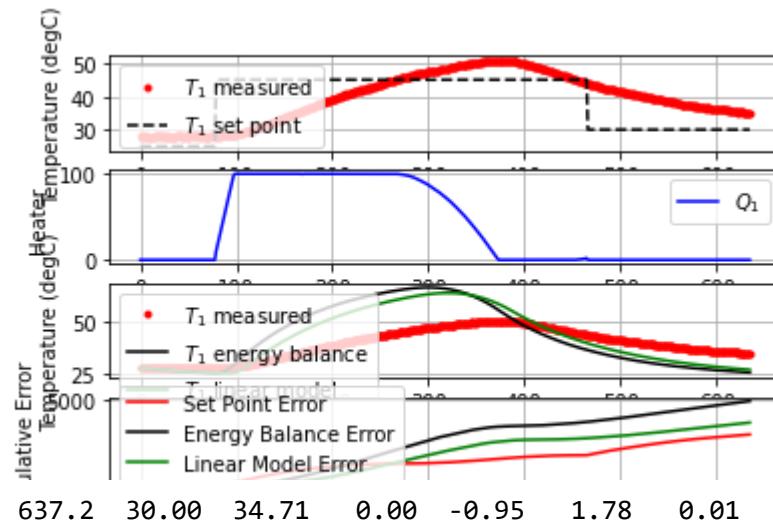
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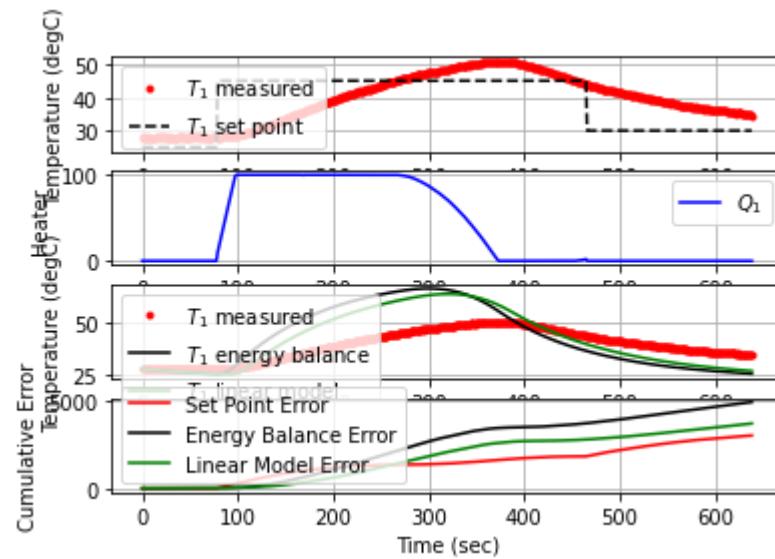
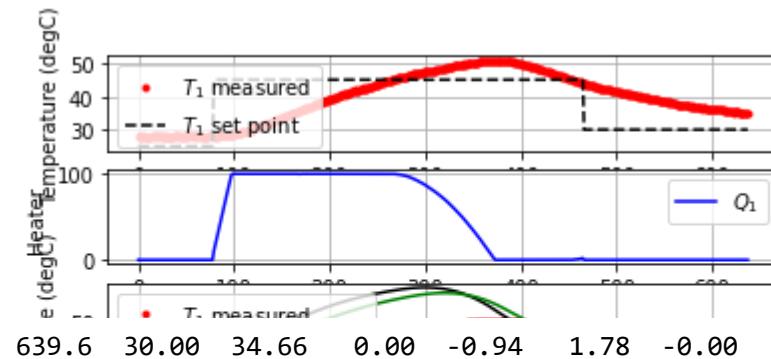


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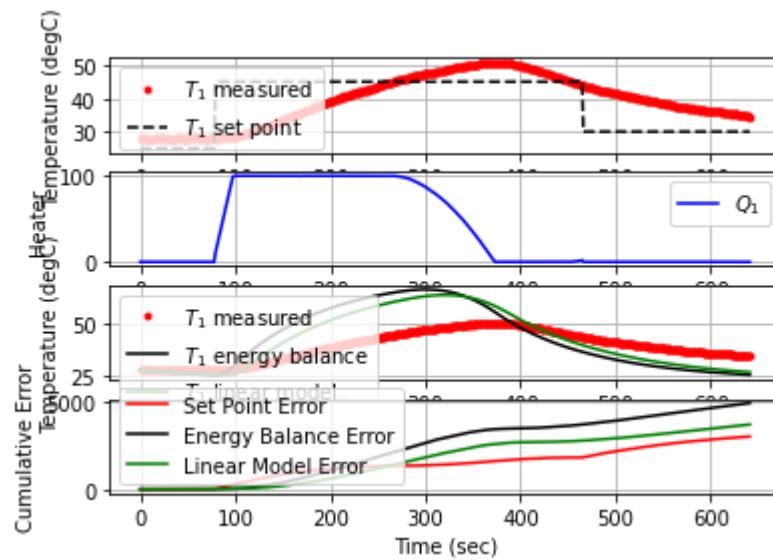
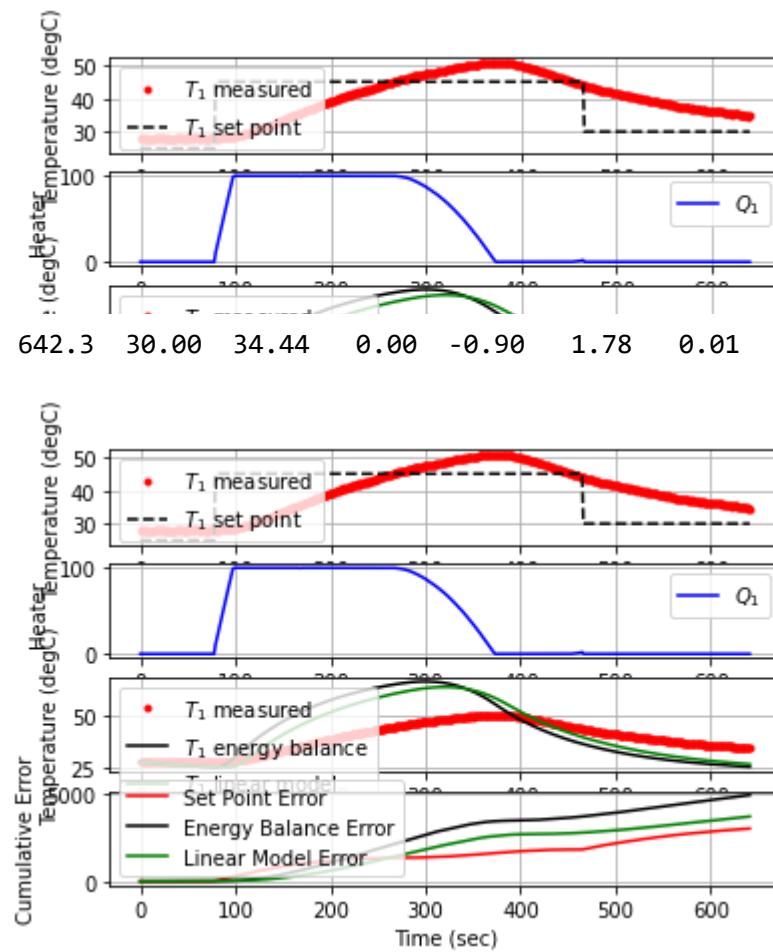


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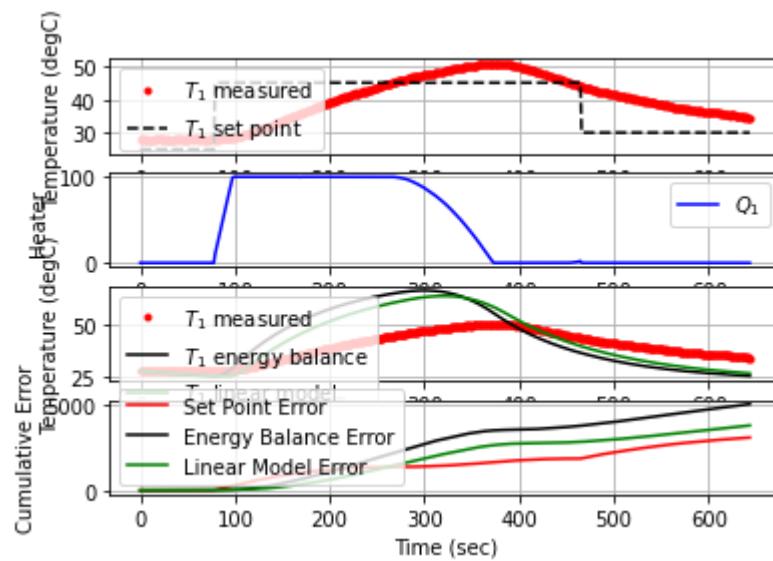
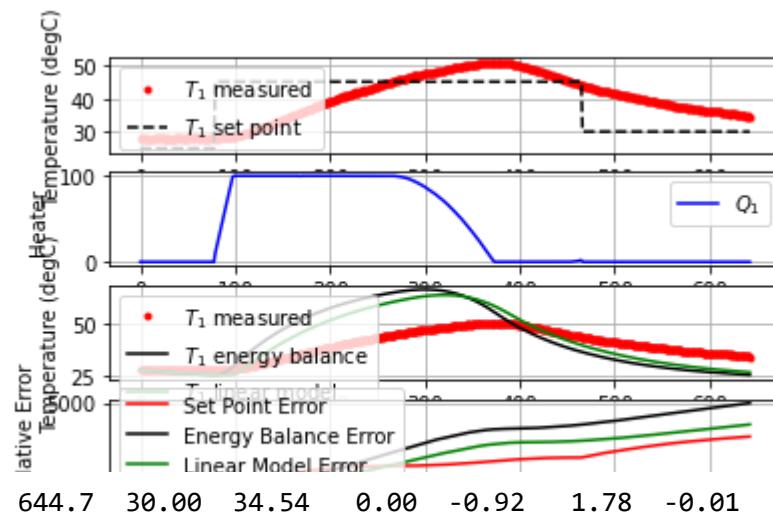




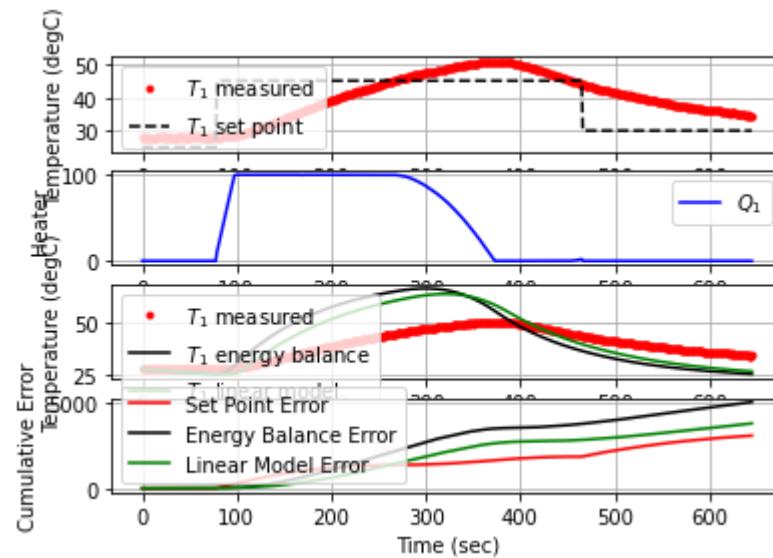
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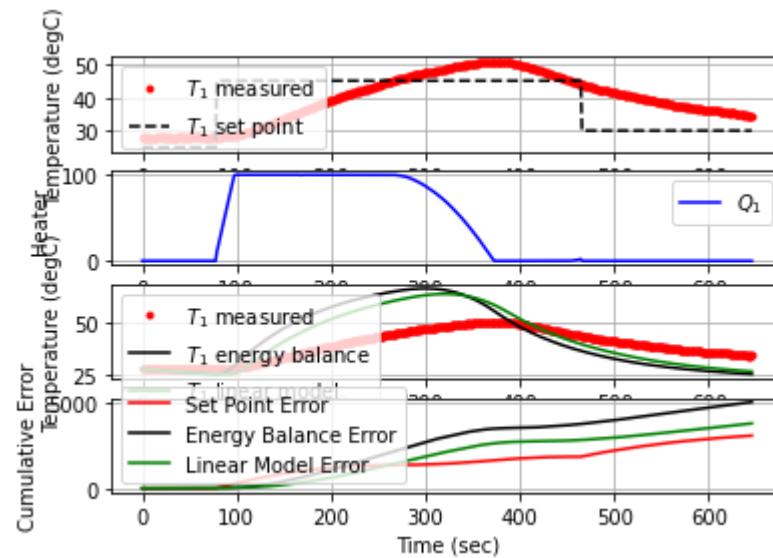
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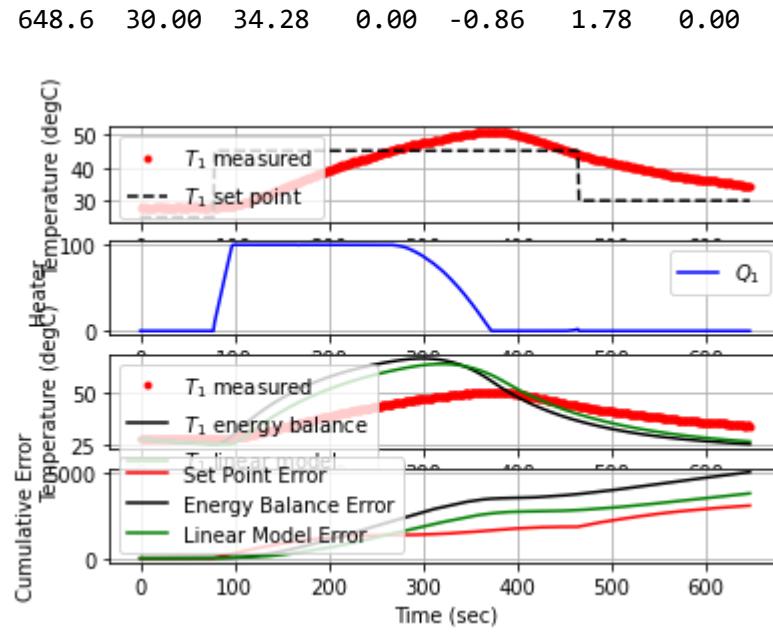


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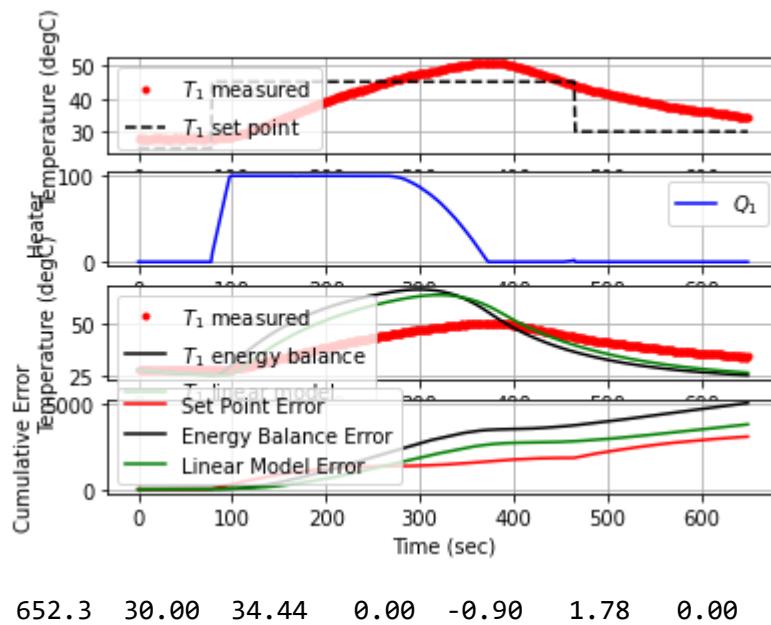
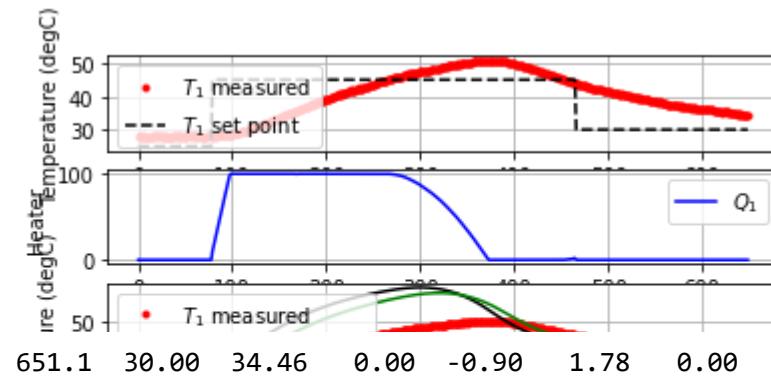


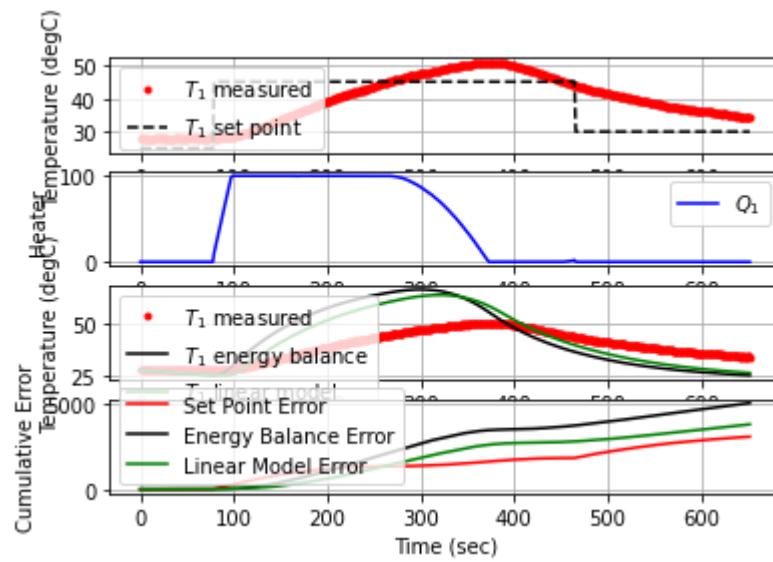
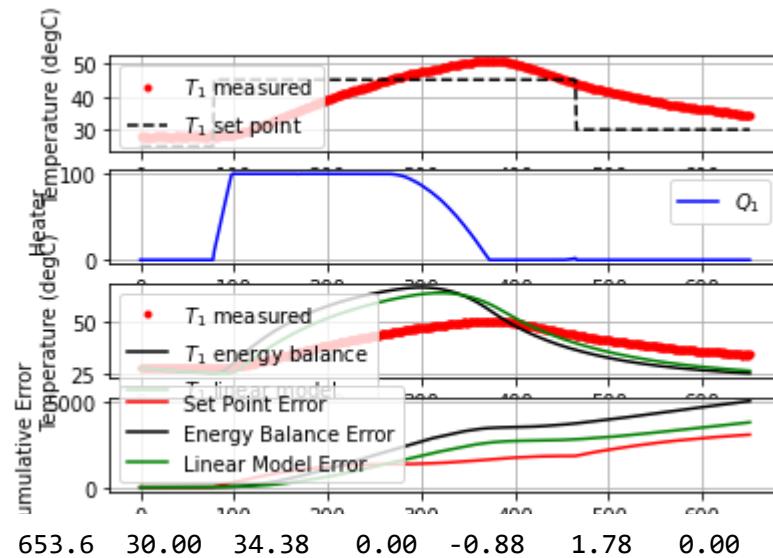
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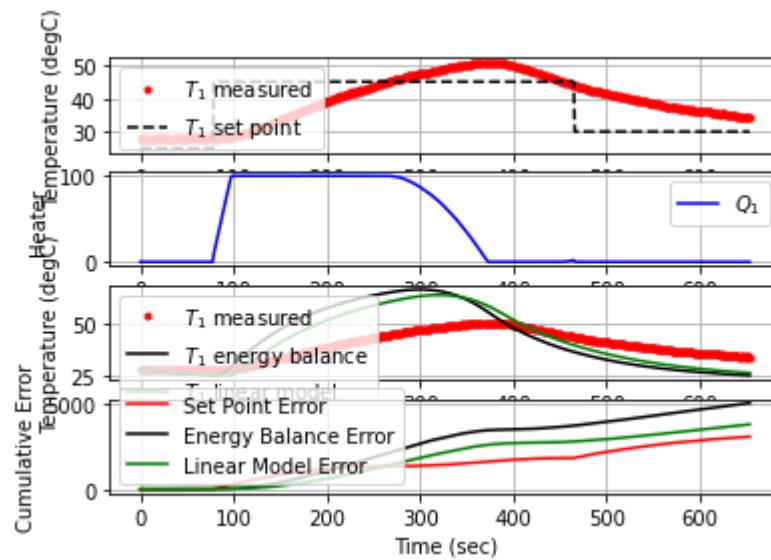
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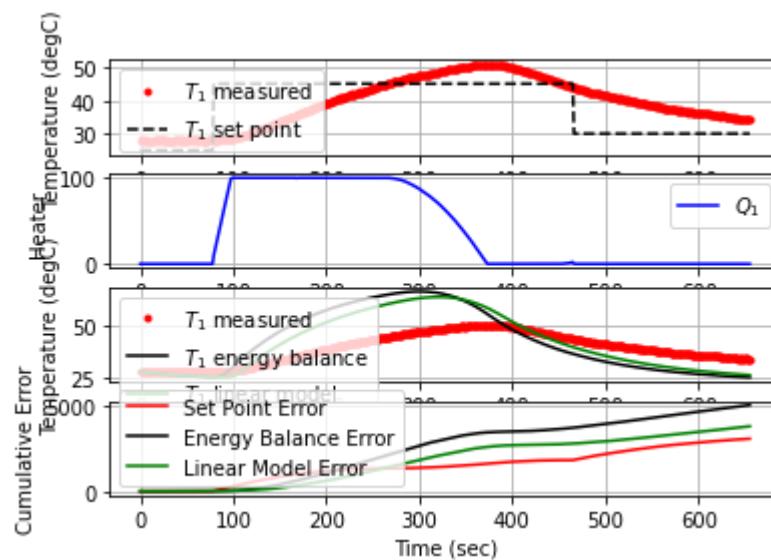


653.6 30.00 34.38 0.00 -0.88 1.78 0.00

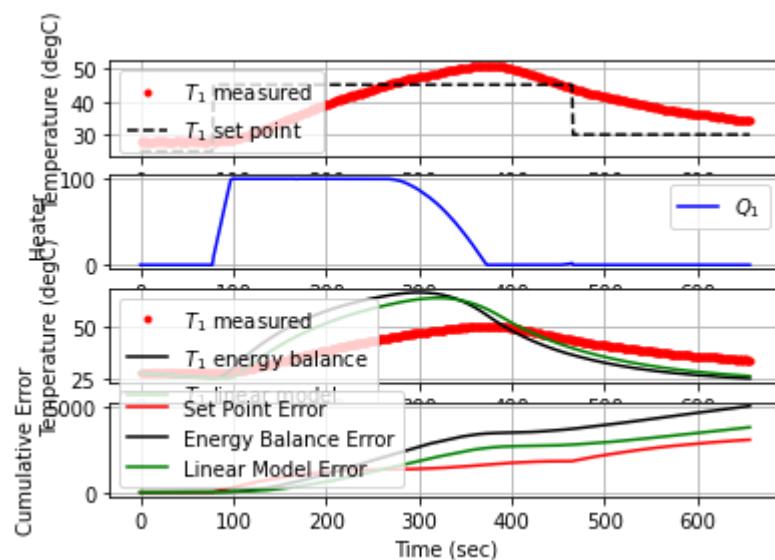
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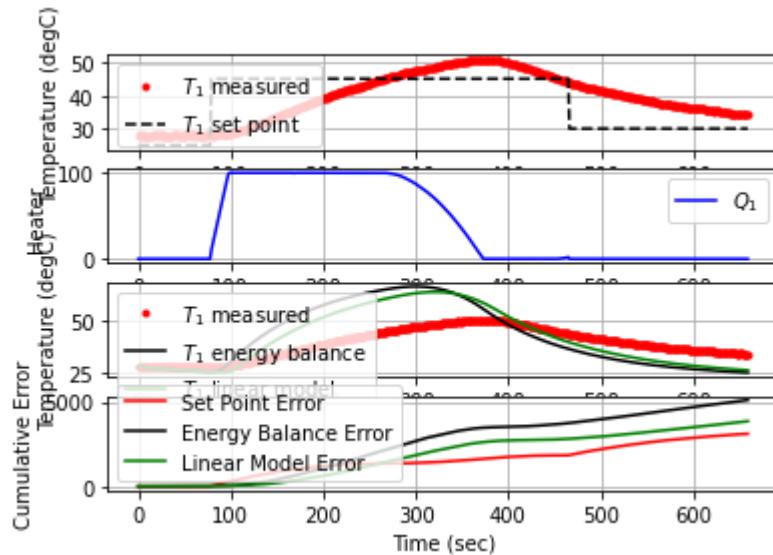
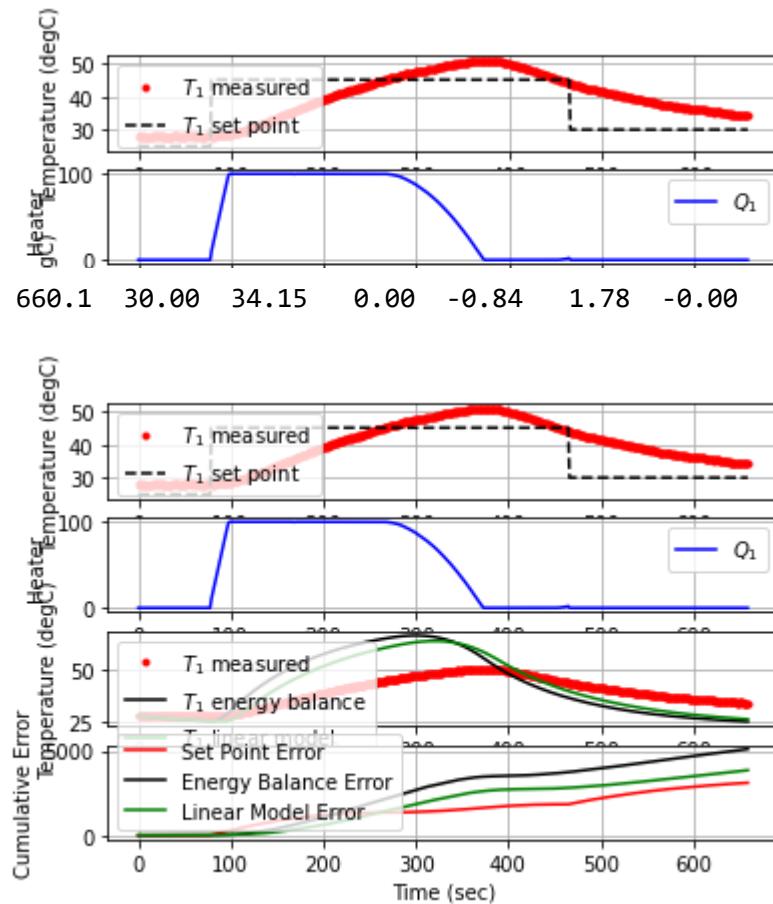
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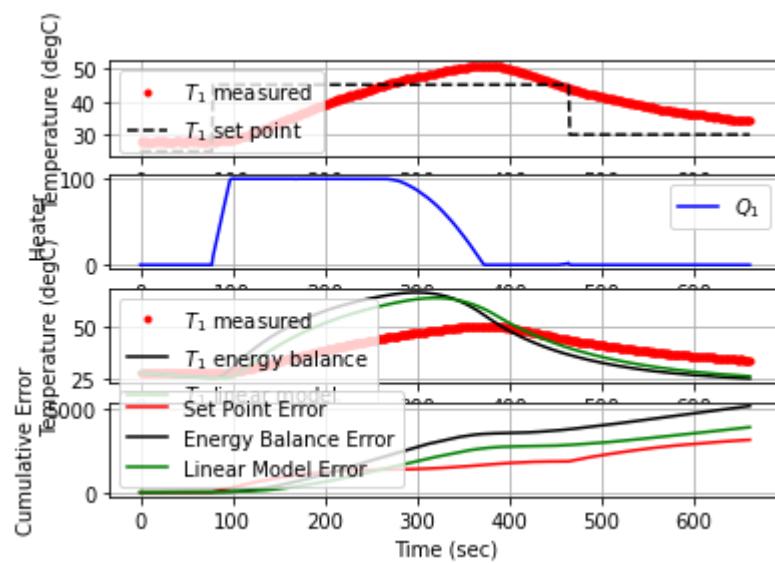
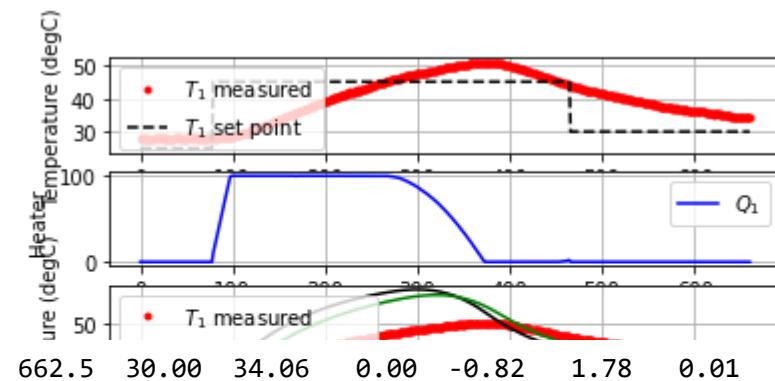
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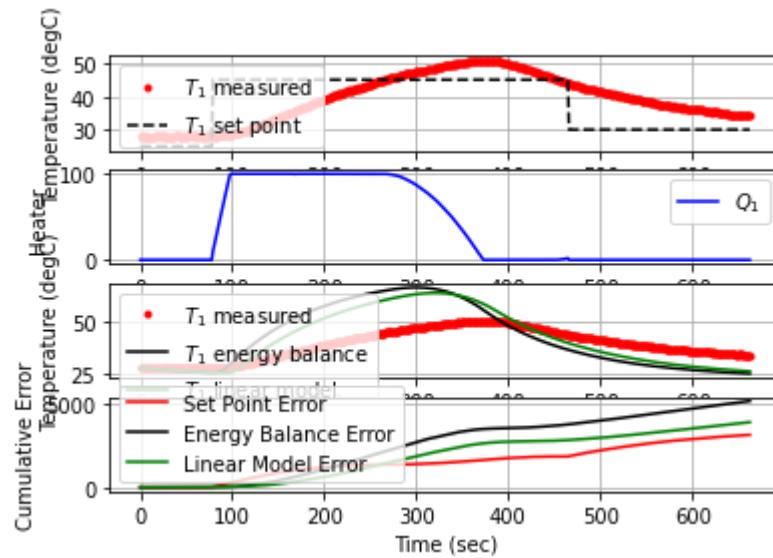
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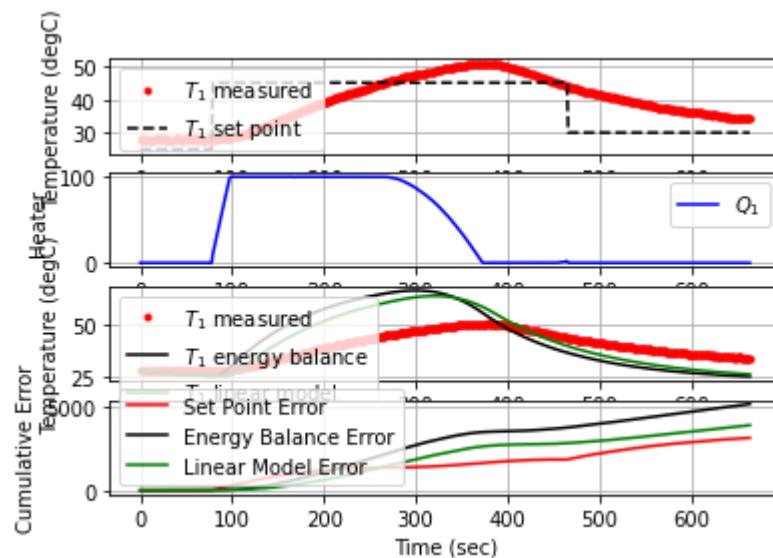
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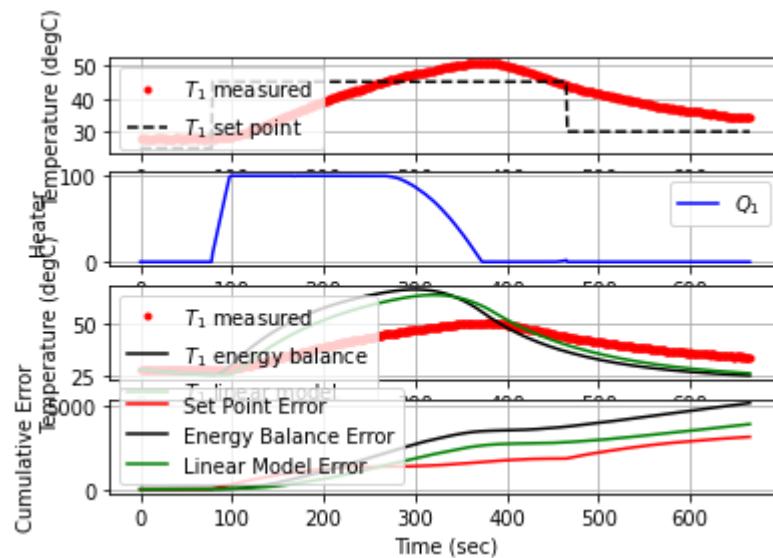
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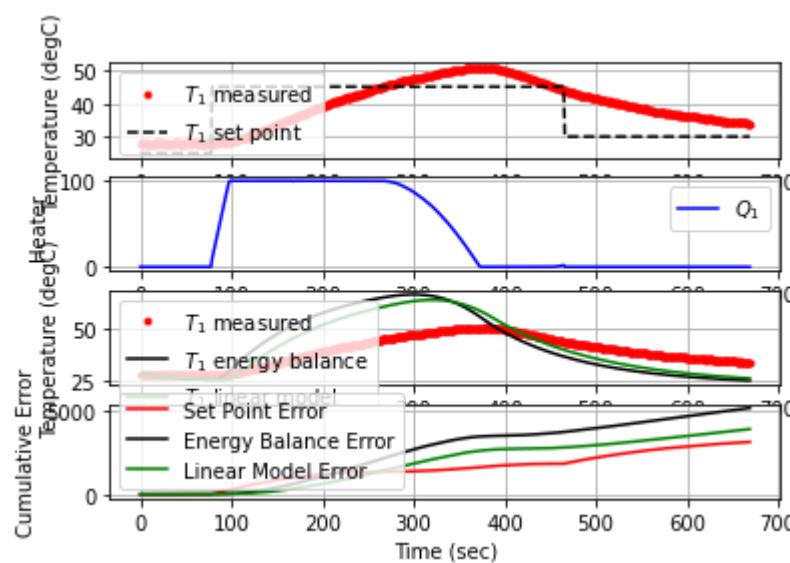
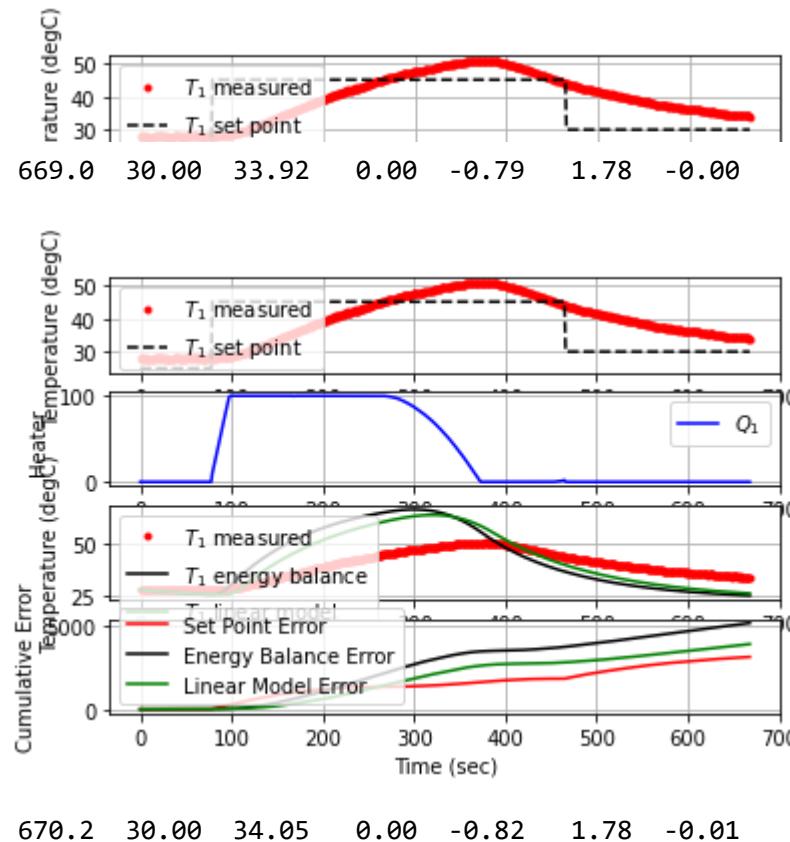
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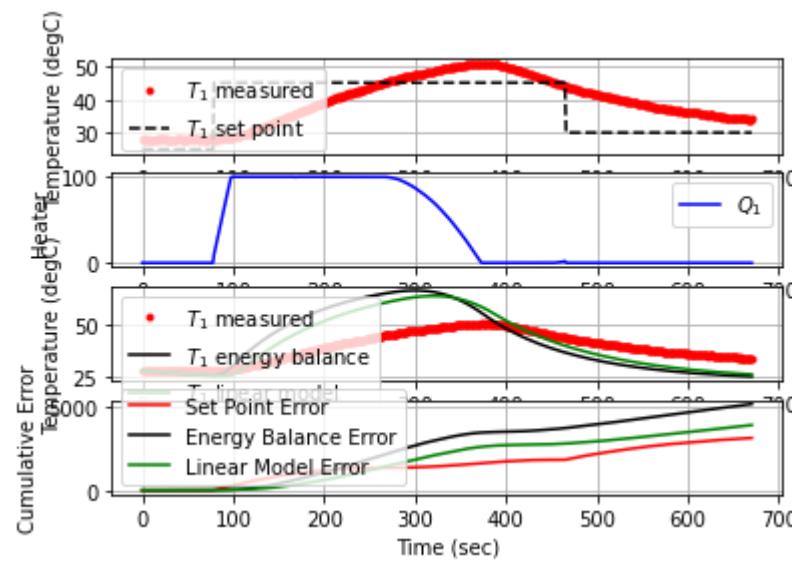
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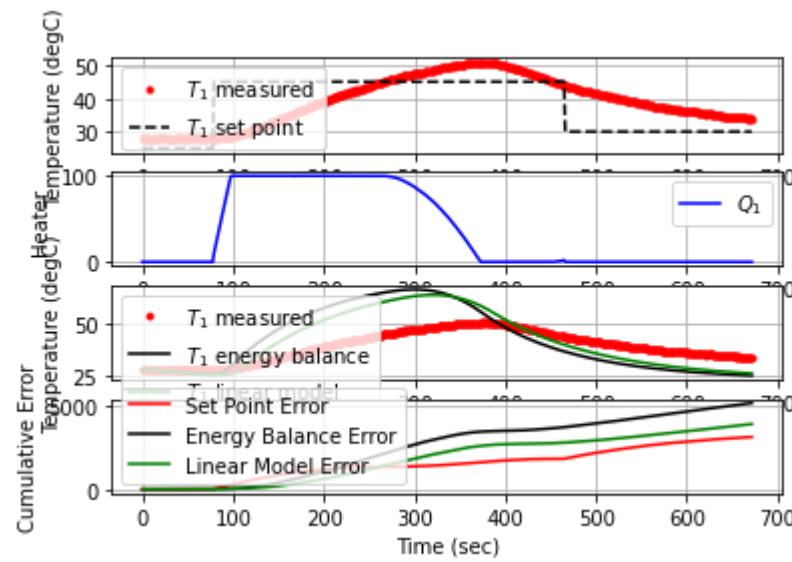
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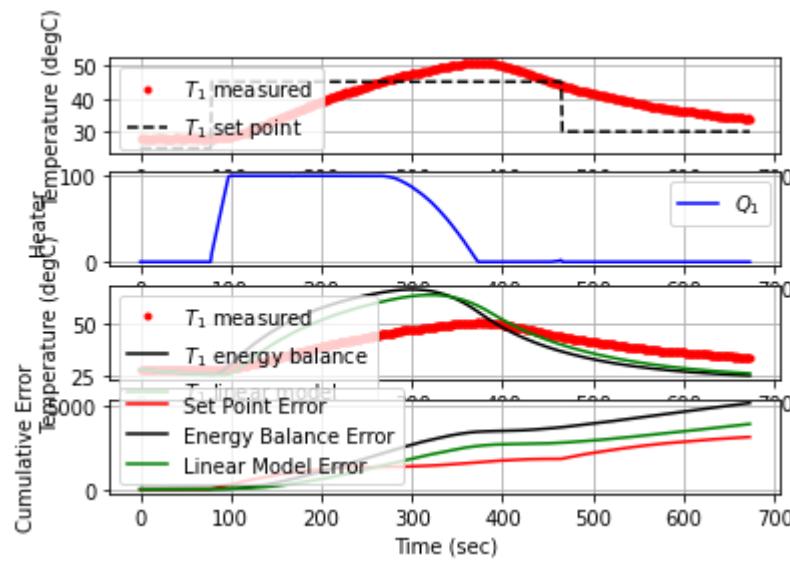
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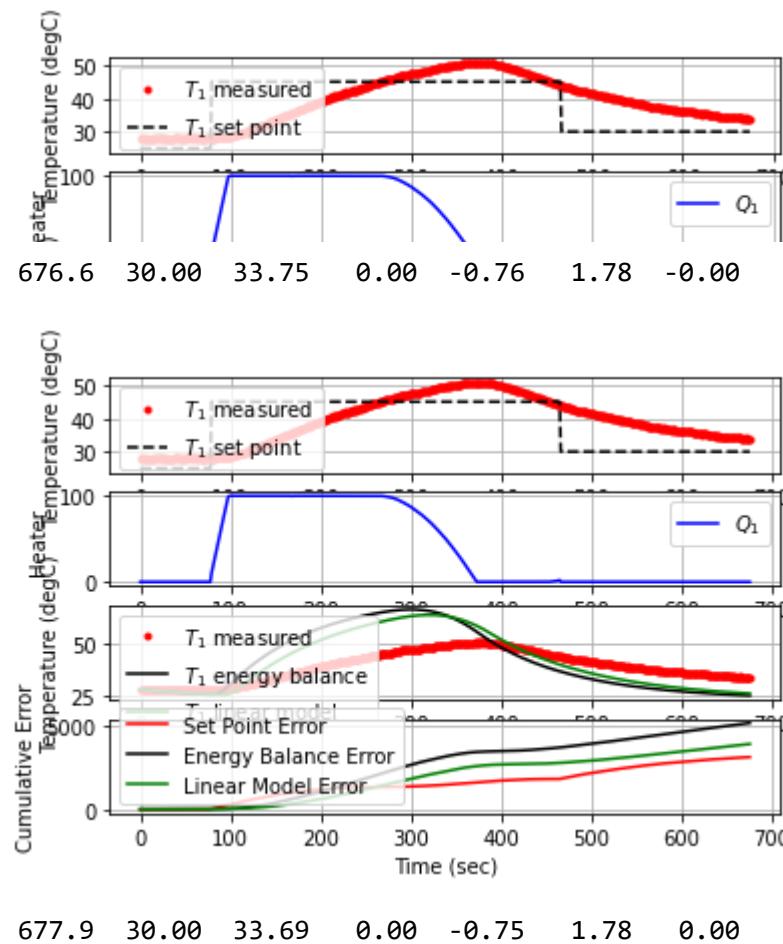
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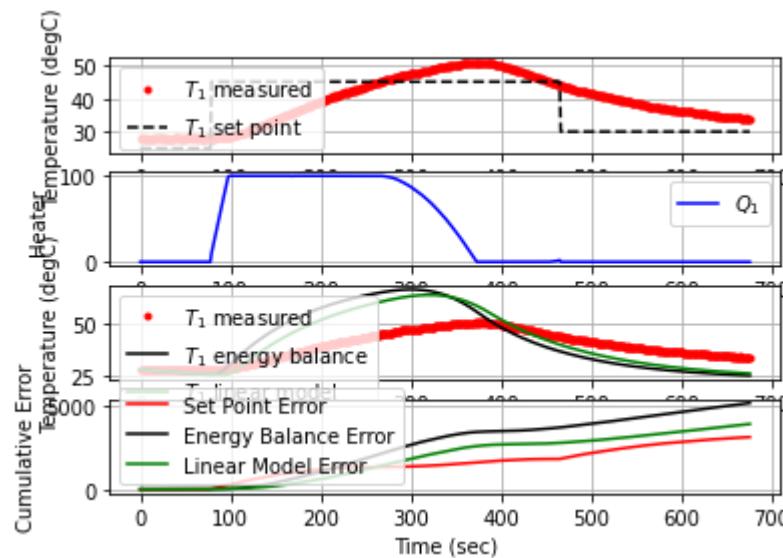
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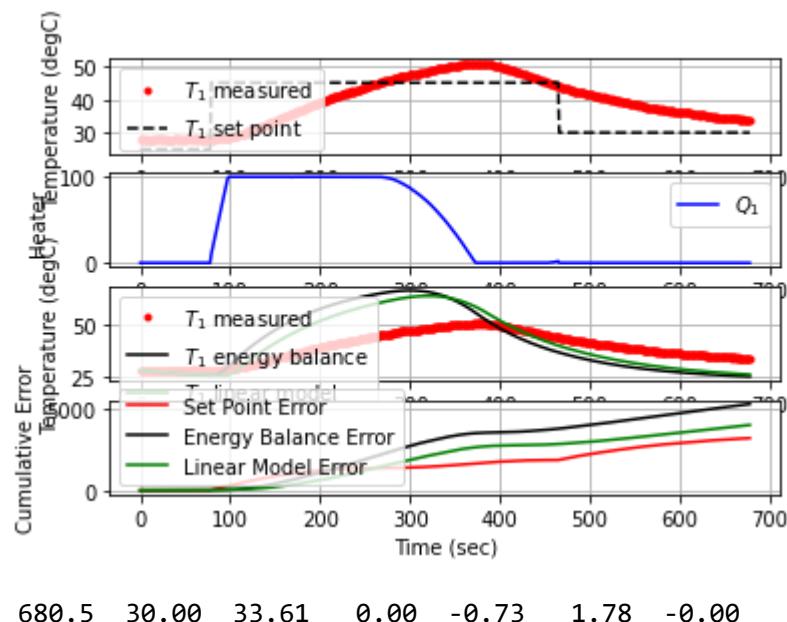
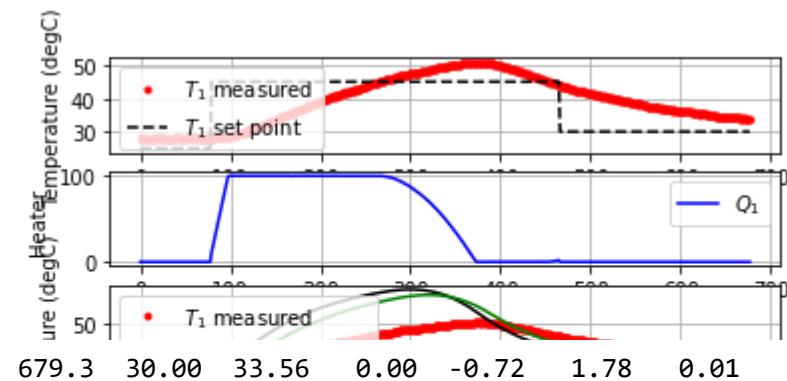


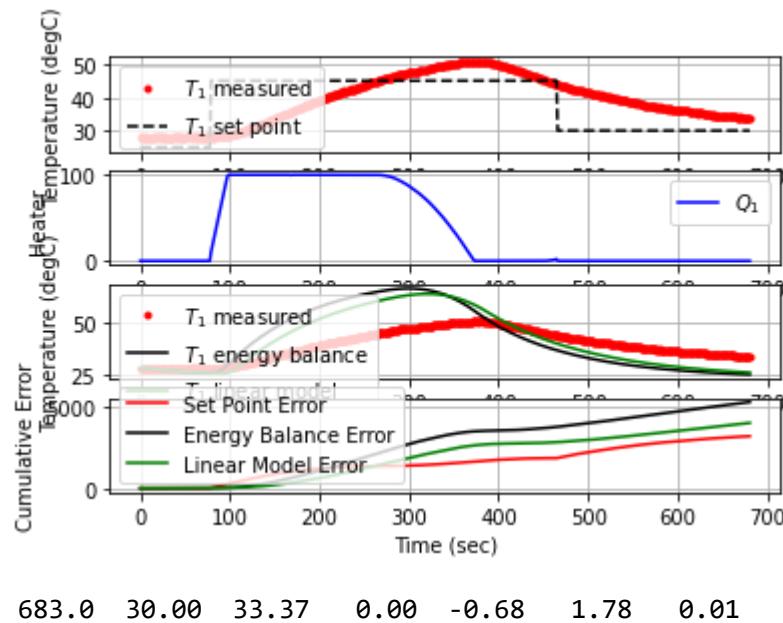
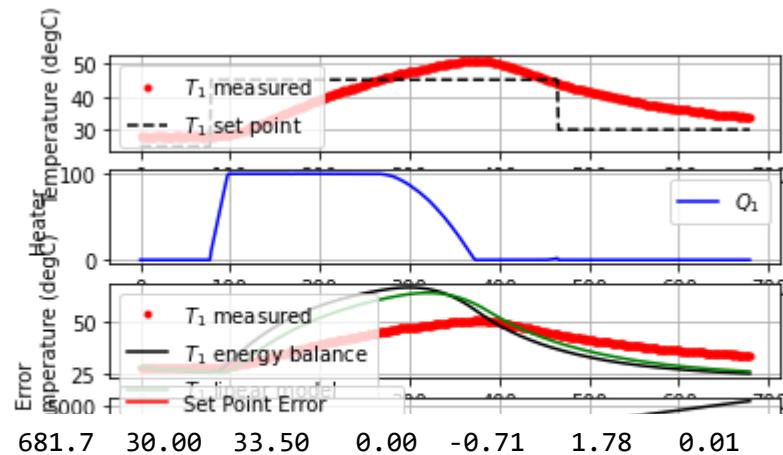
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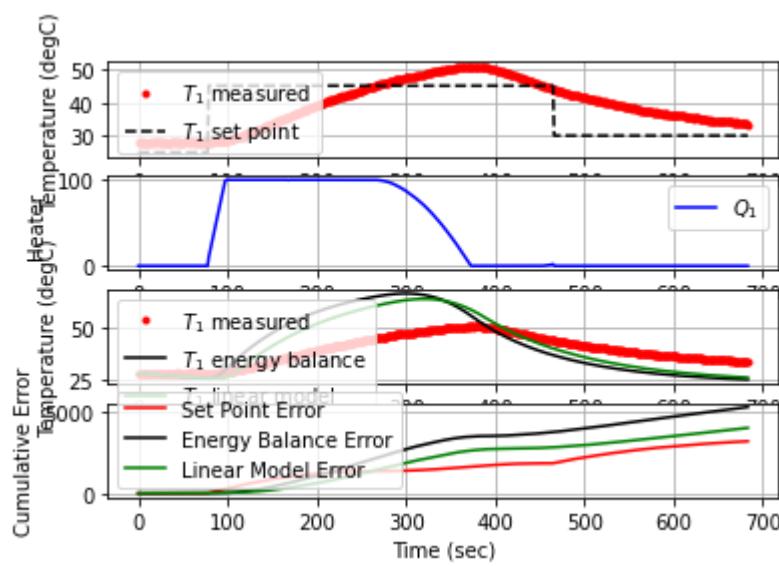
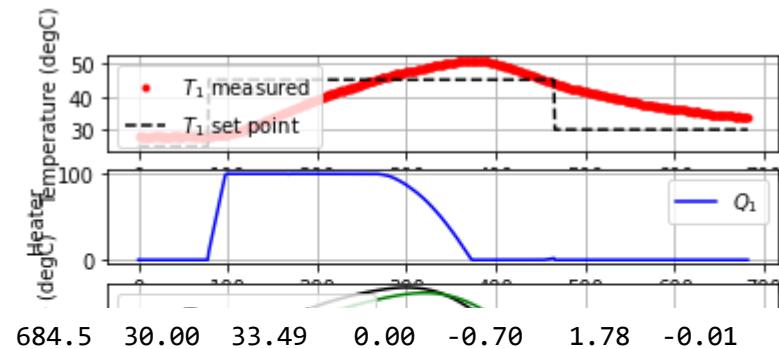


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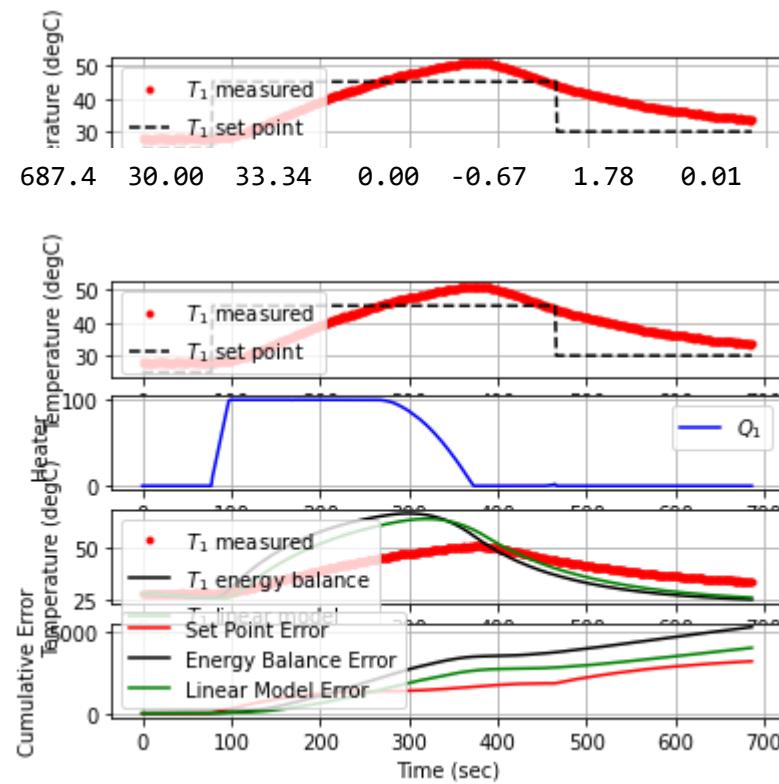




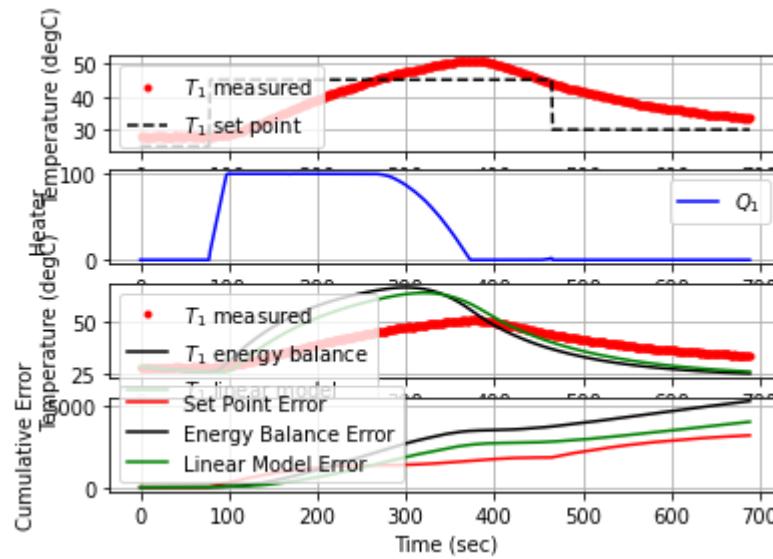
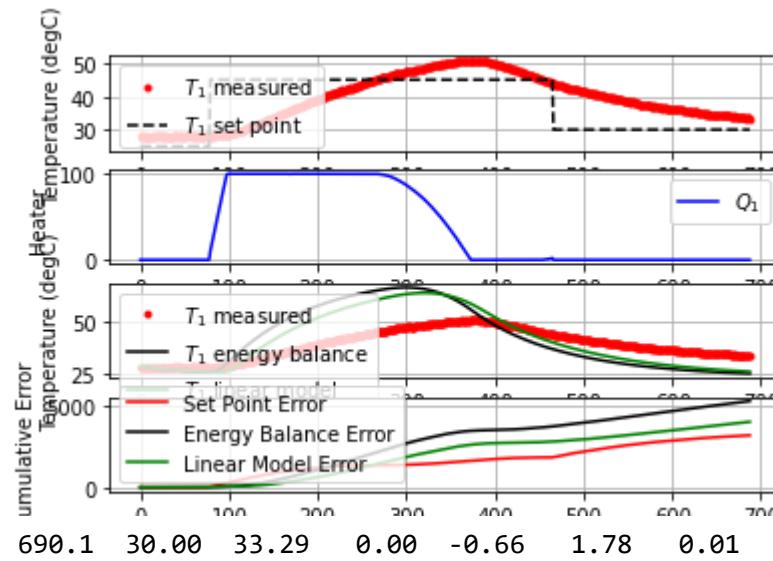




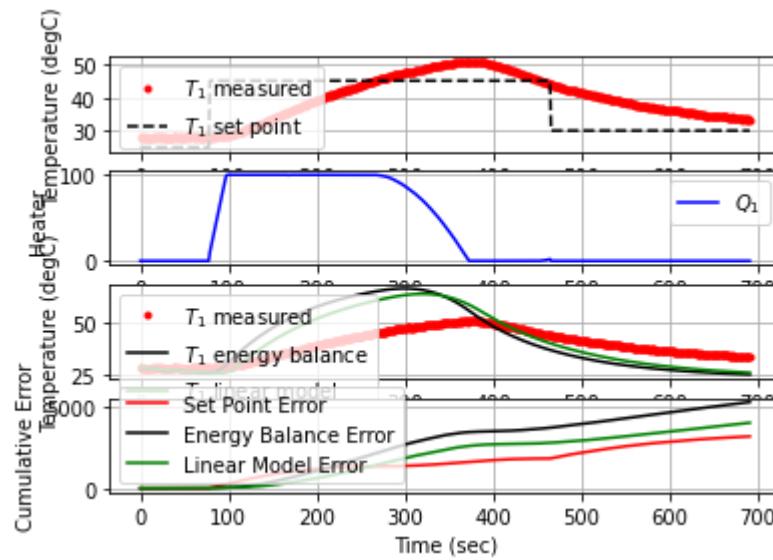
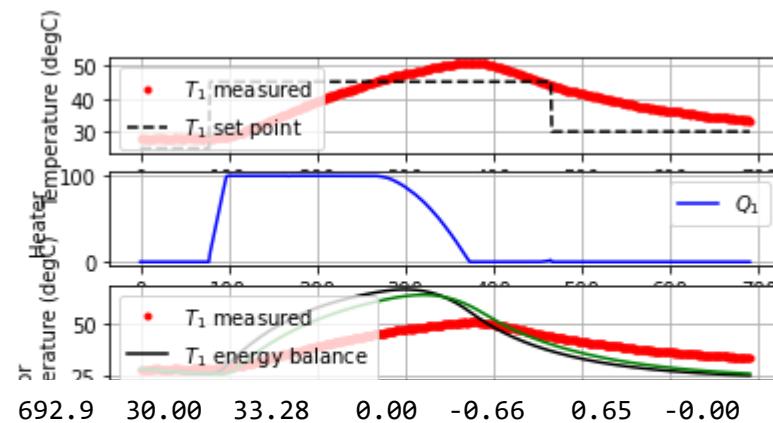
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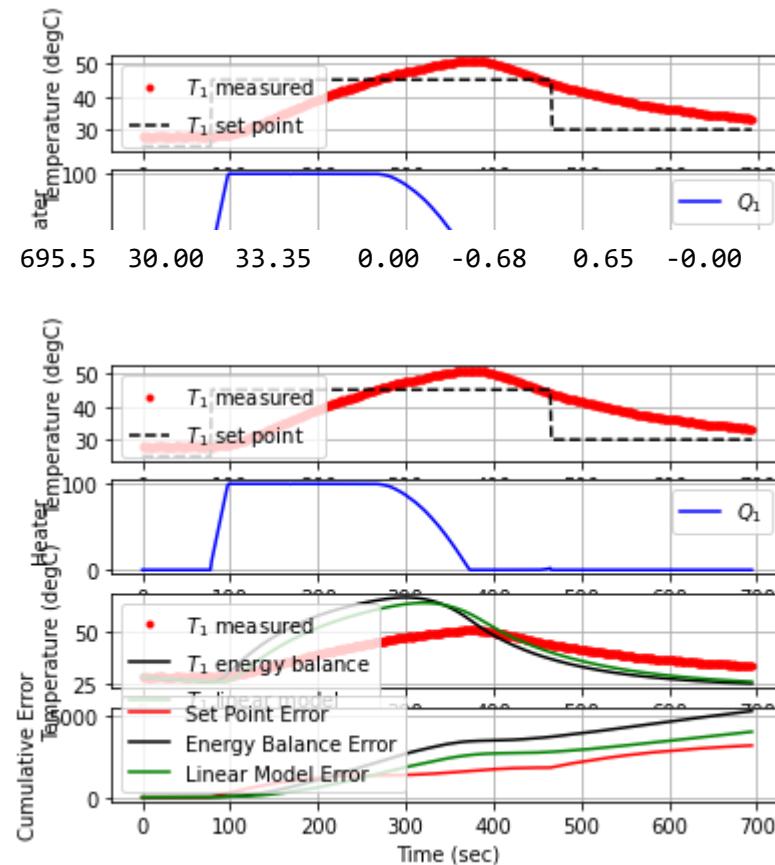
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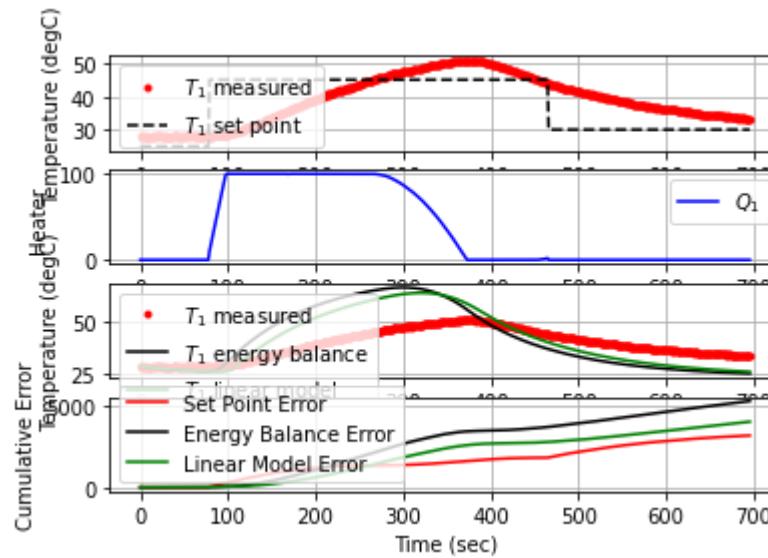
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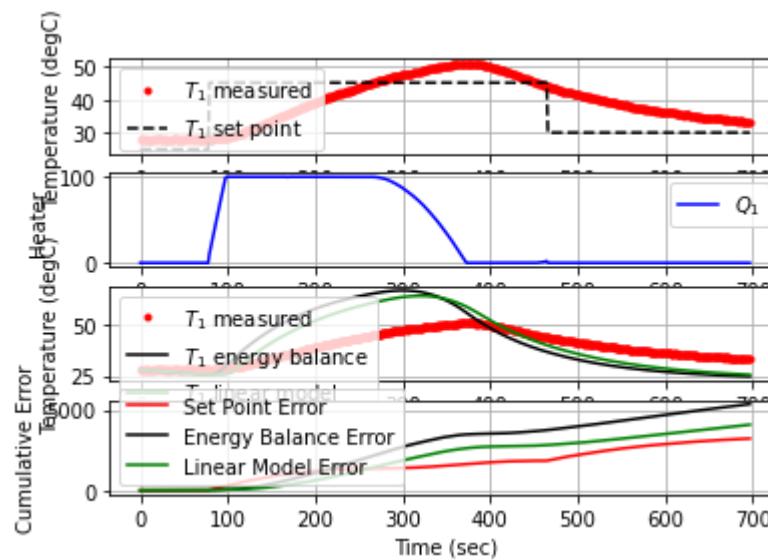
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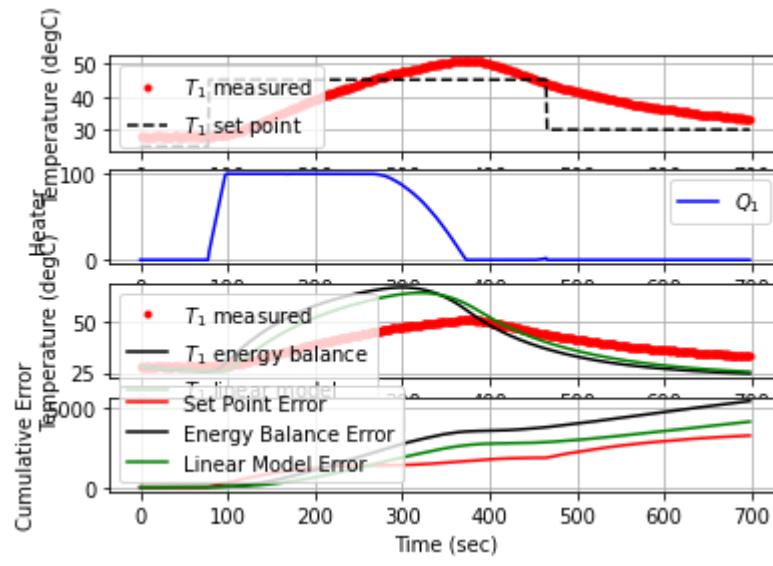
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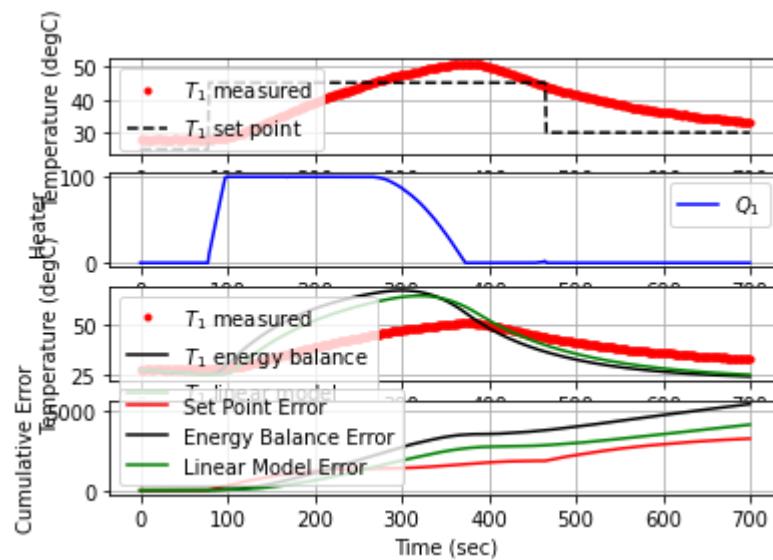
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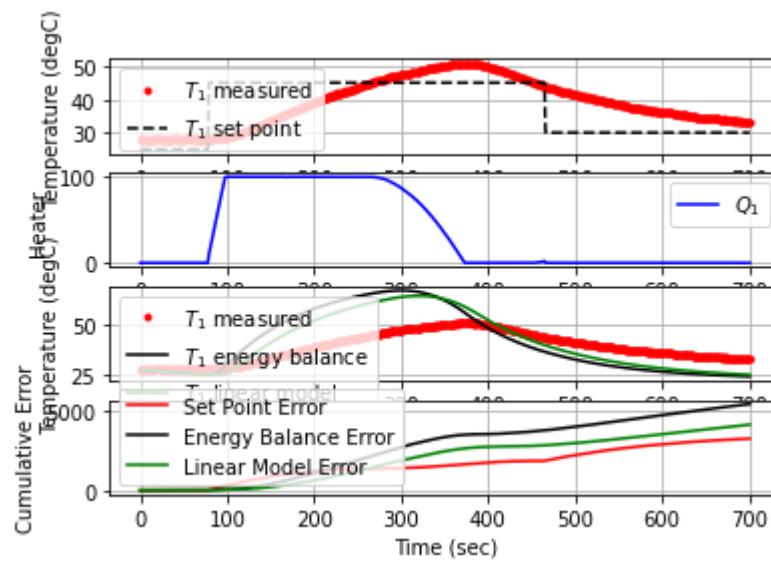
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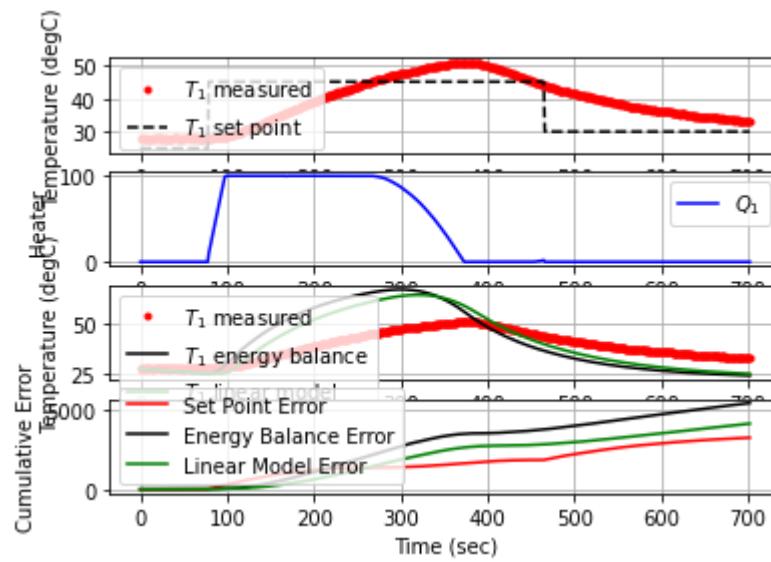
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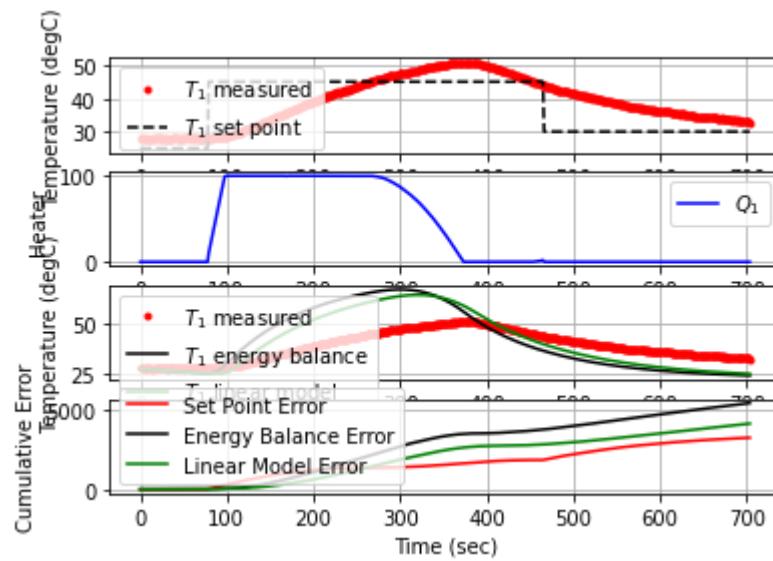
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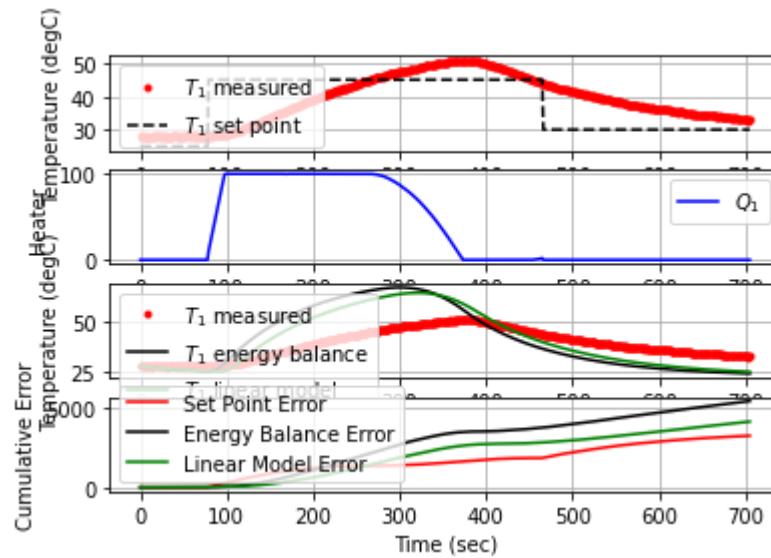
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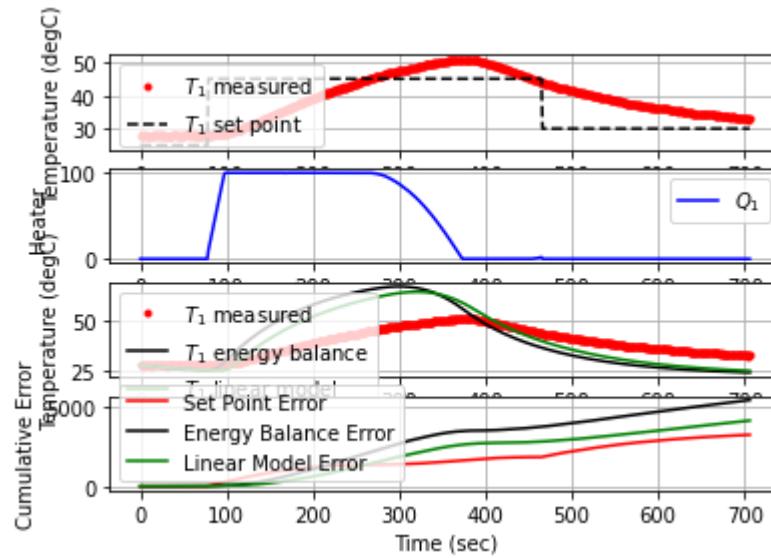
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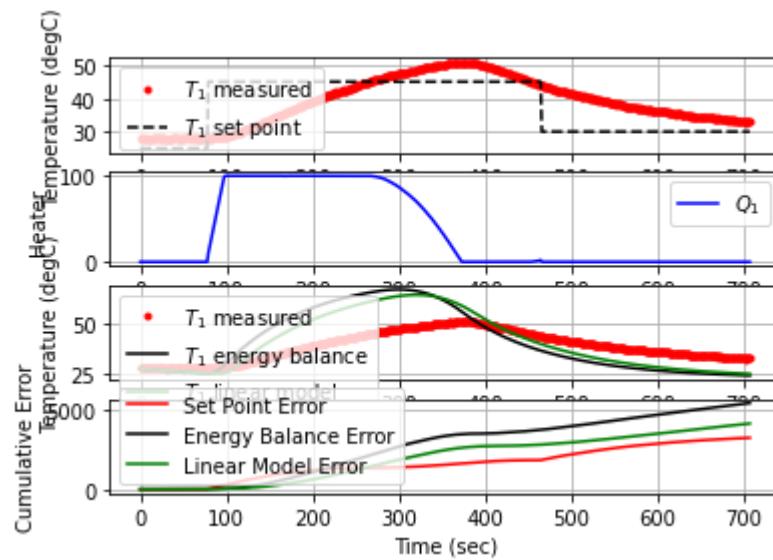
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707.4 30.00 32.94 0.00 -0.59 0.65 -0.00

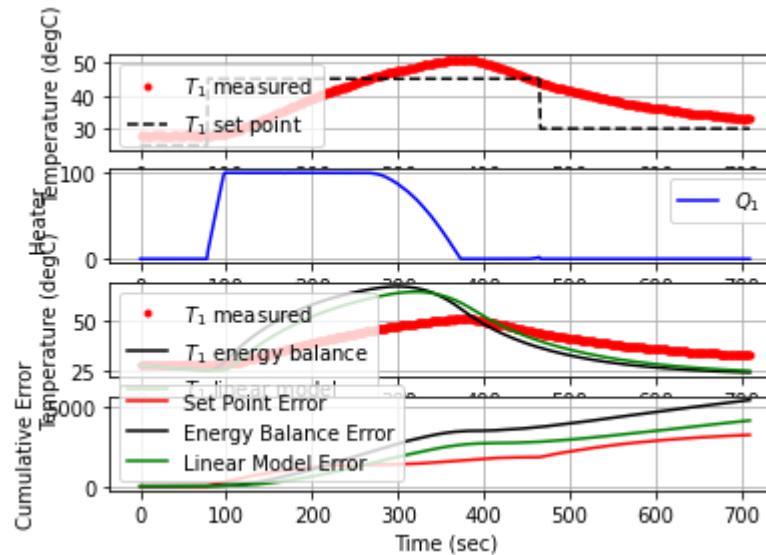


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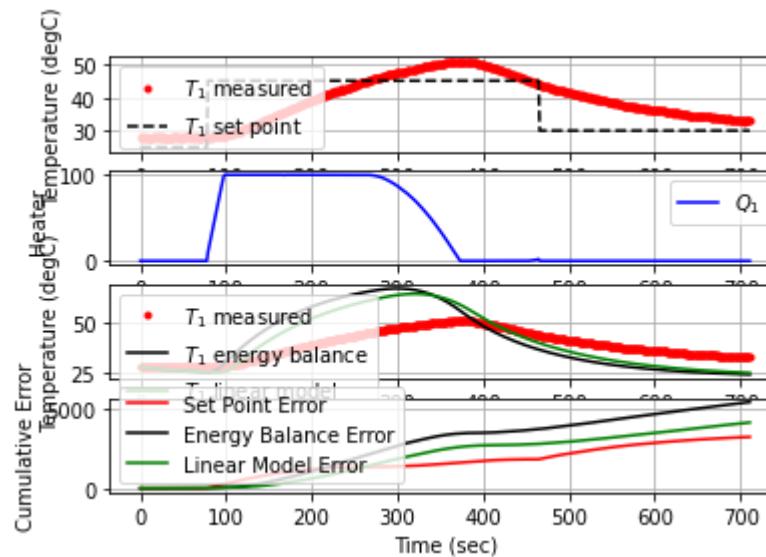


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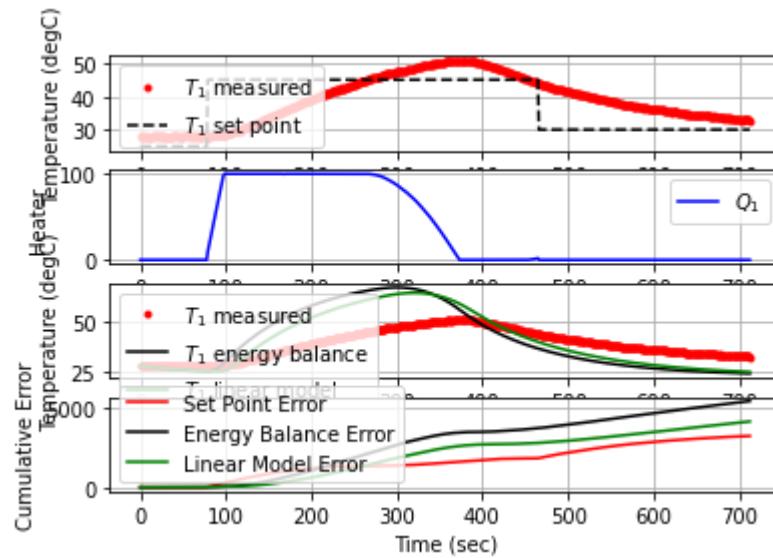
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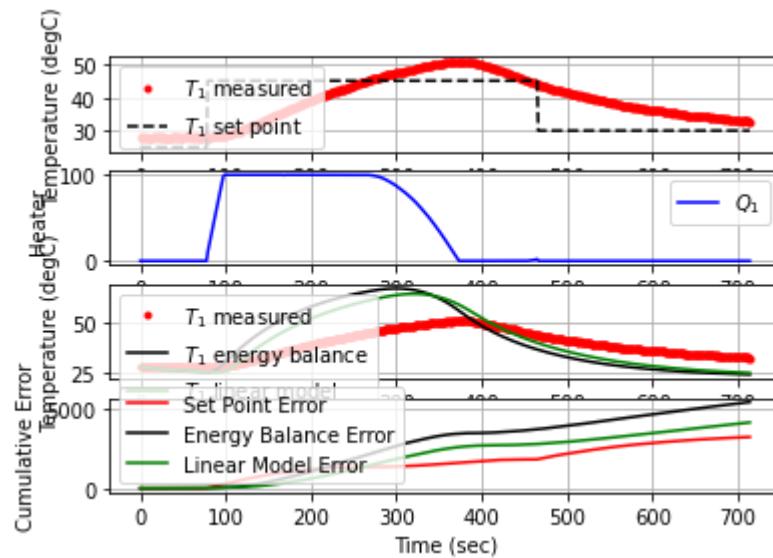
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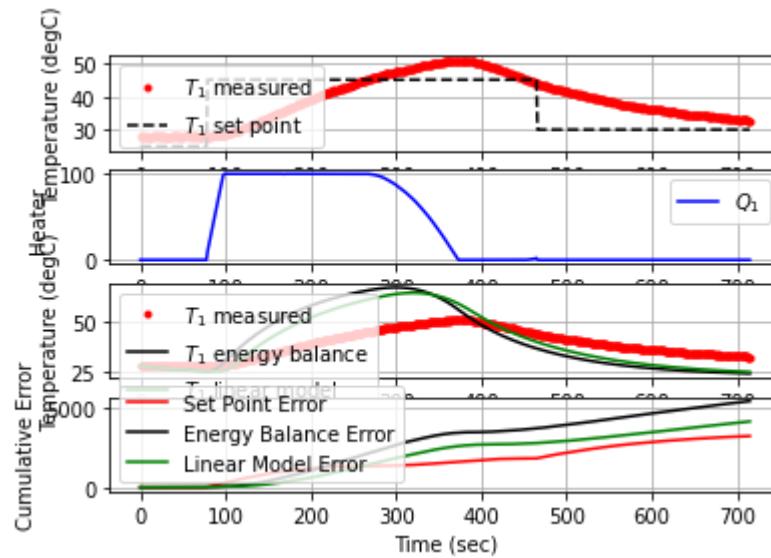
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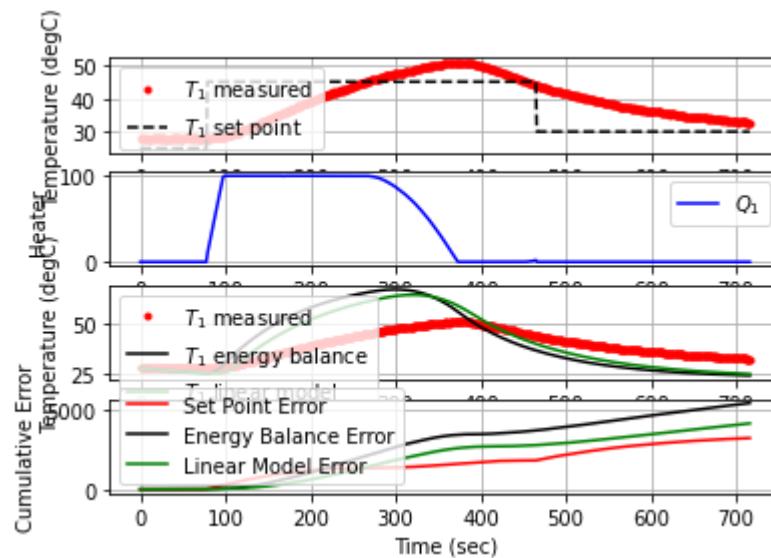
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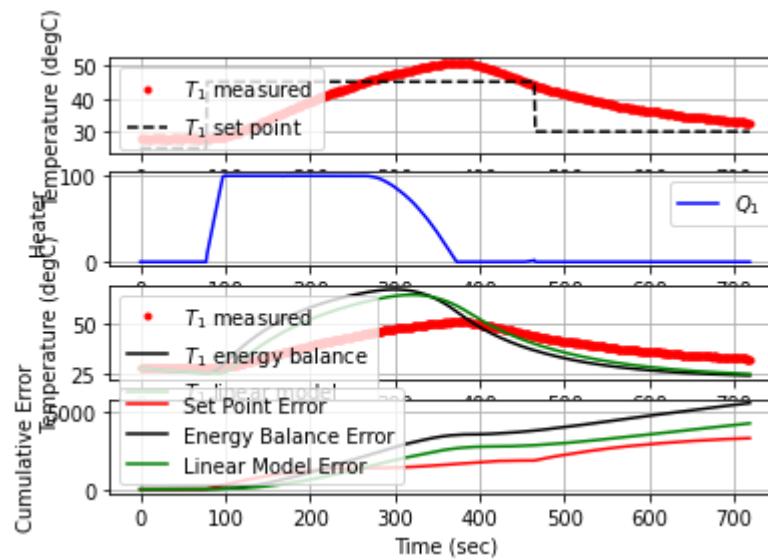
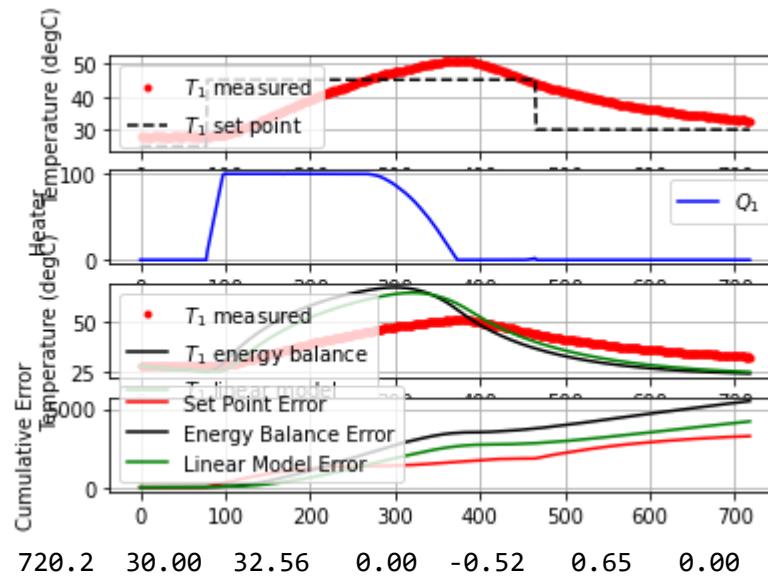
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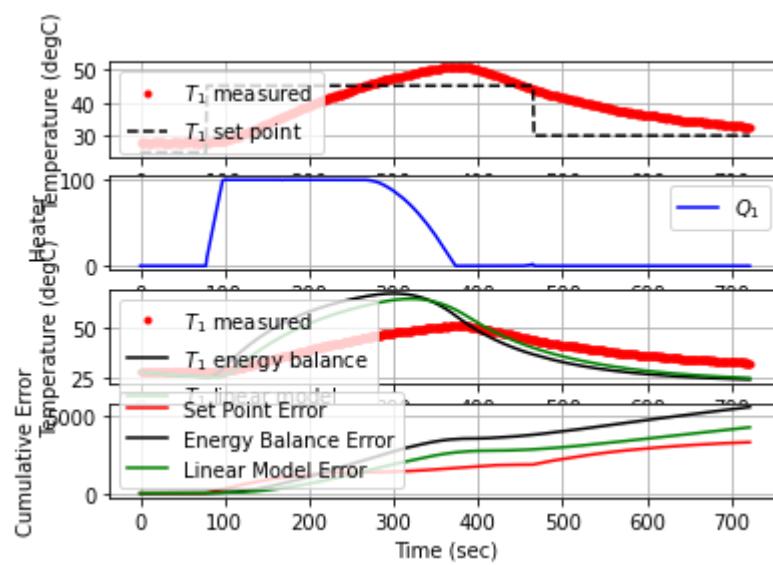
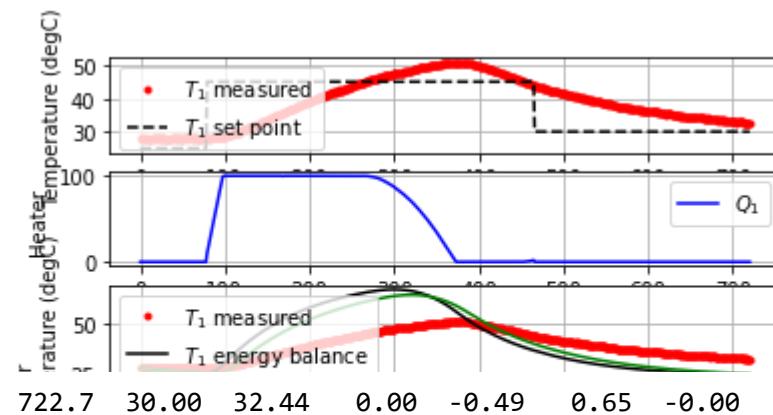
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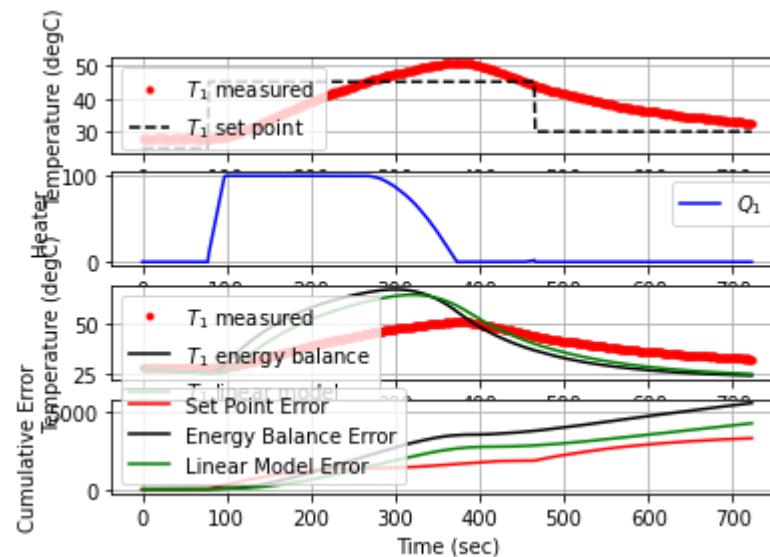
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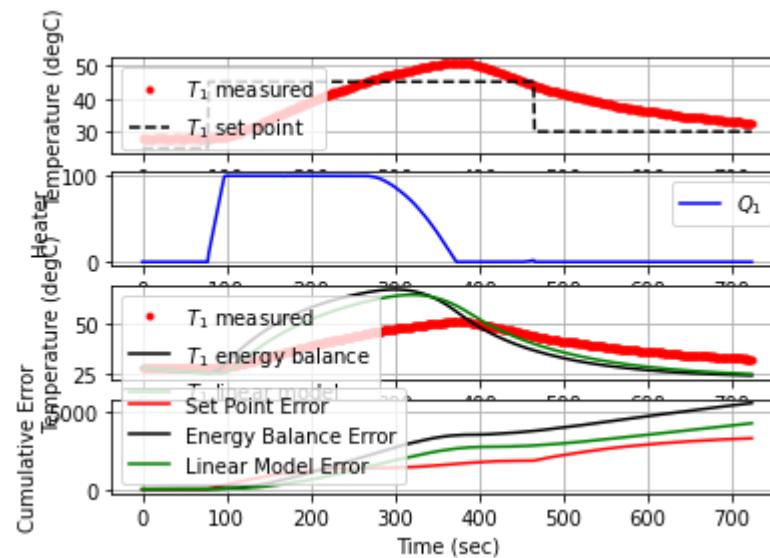
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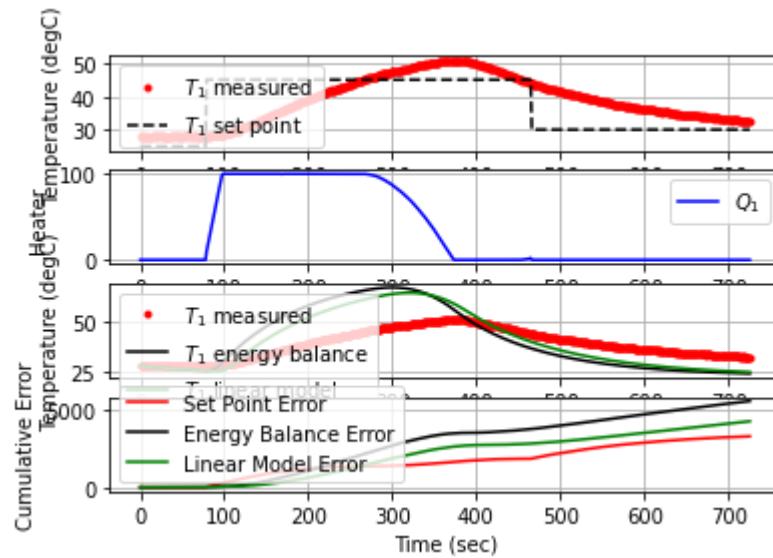
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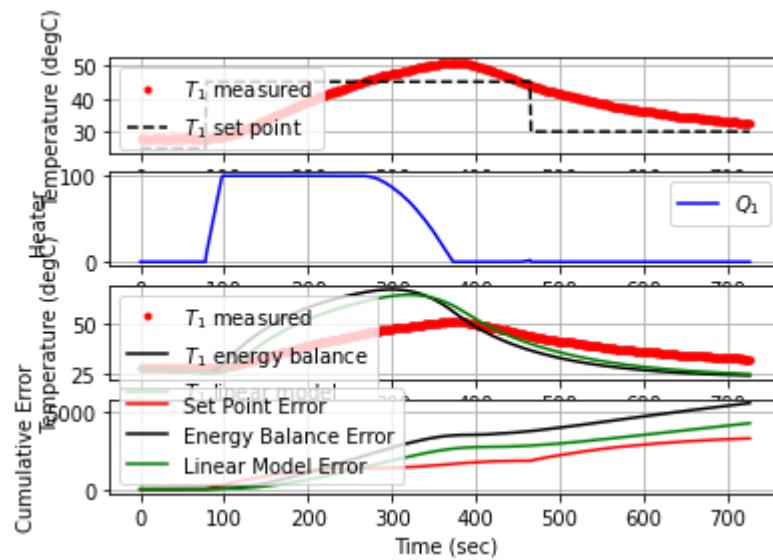
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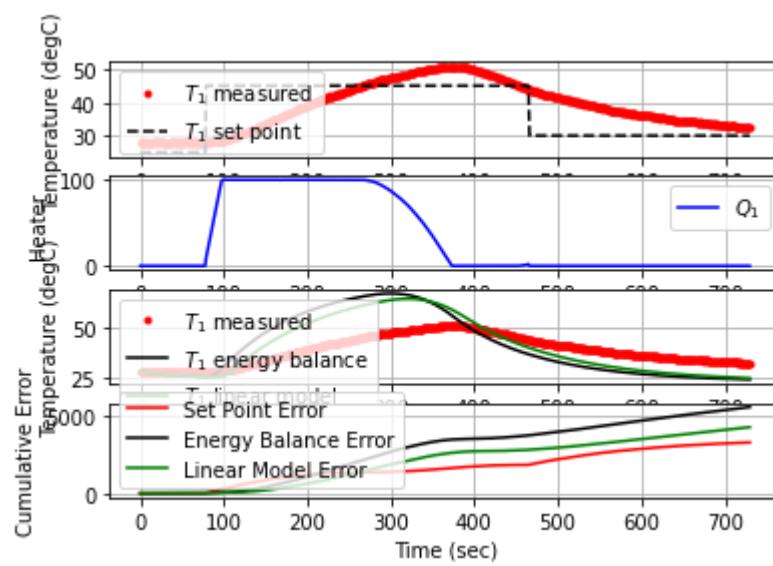
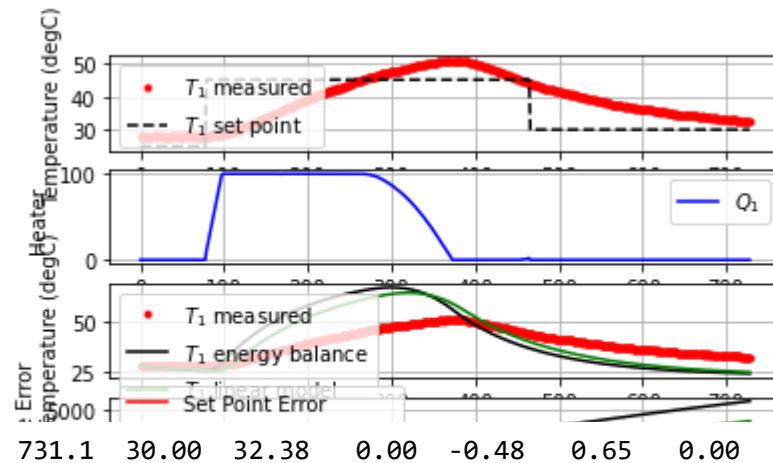
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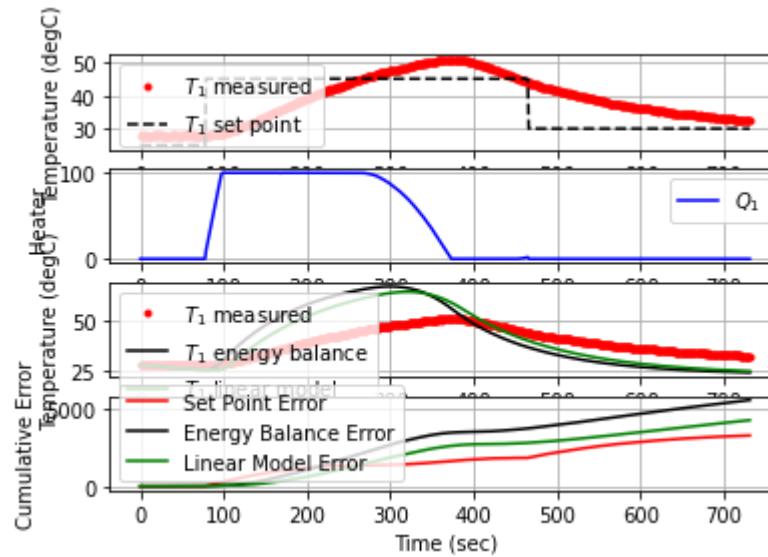
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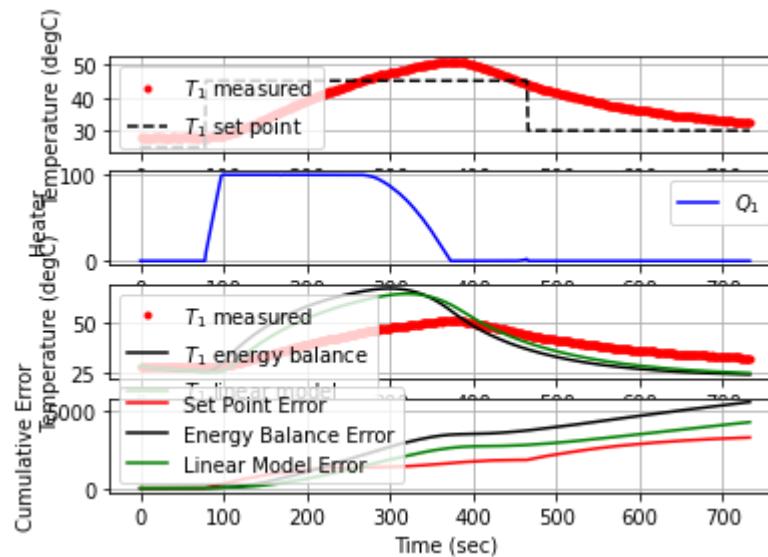
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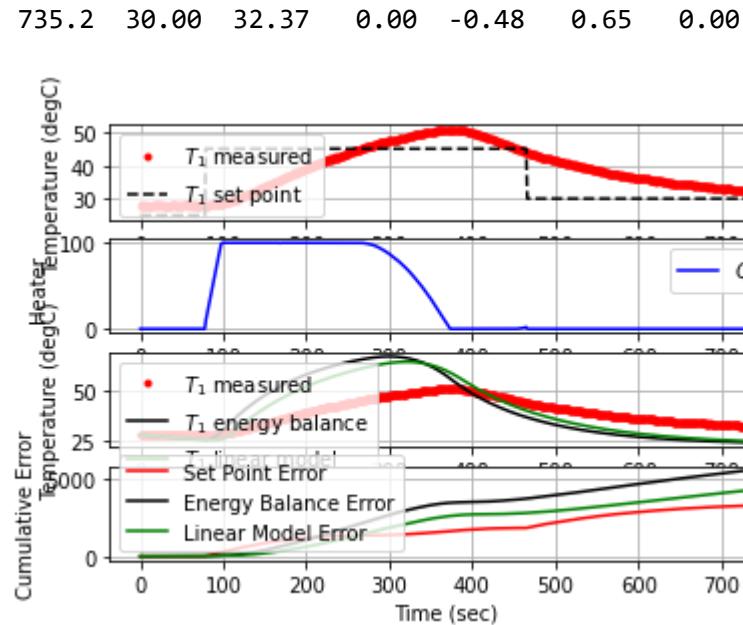


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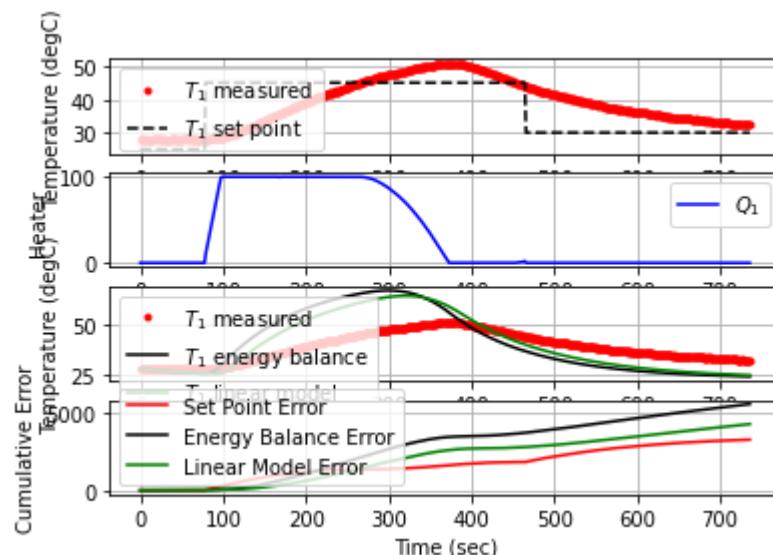
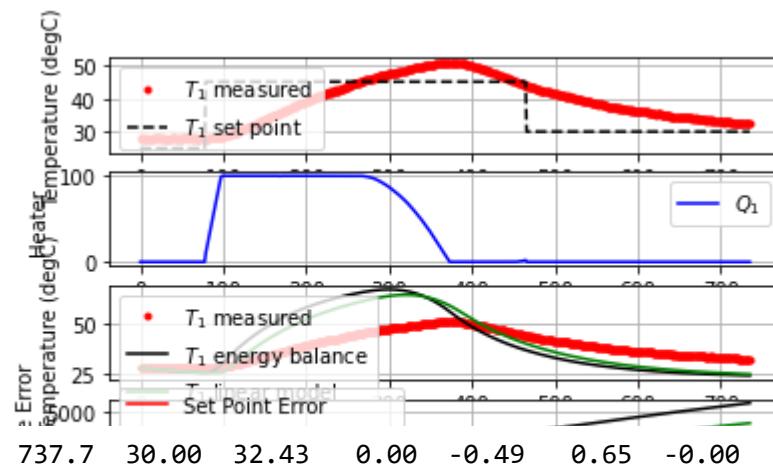


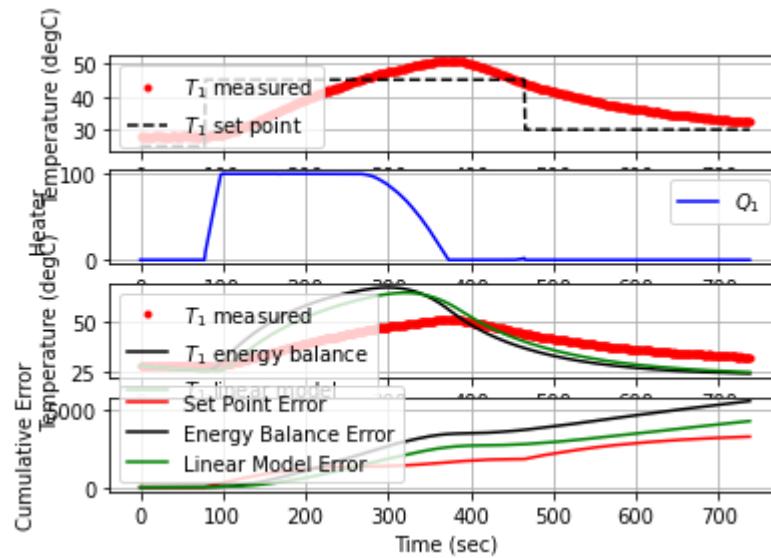
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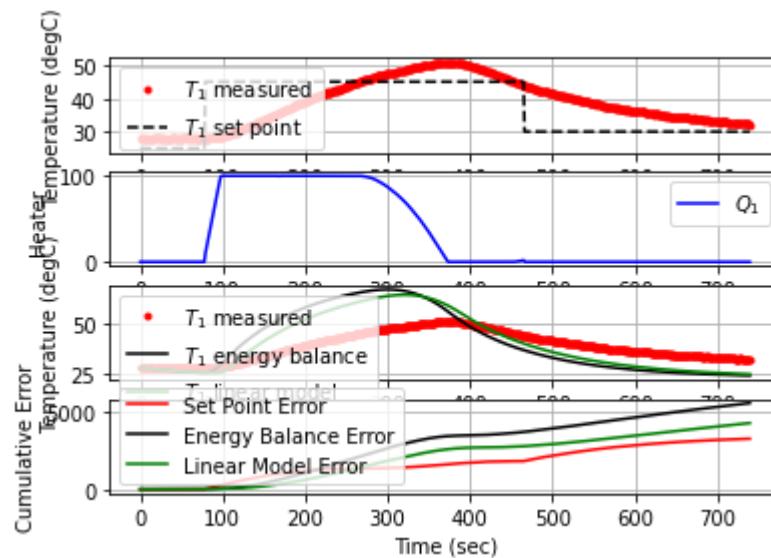


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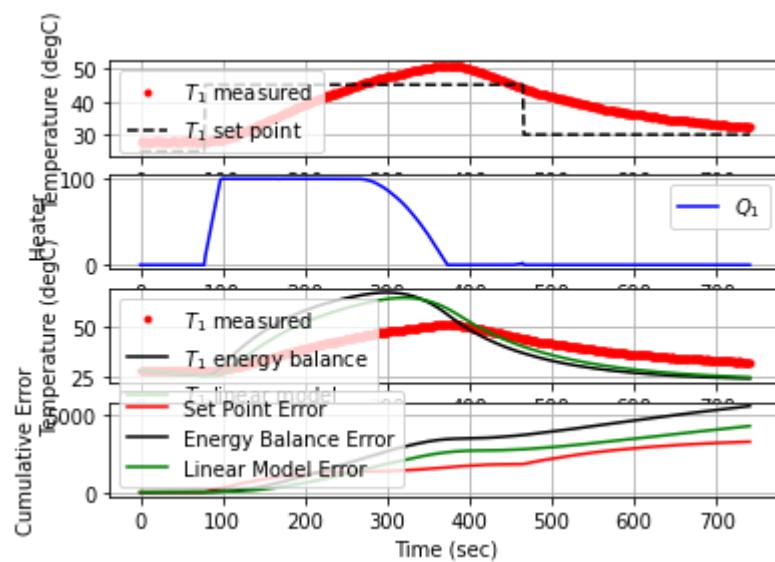




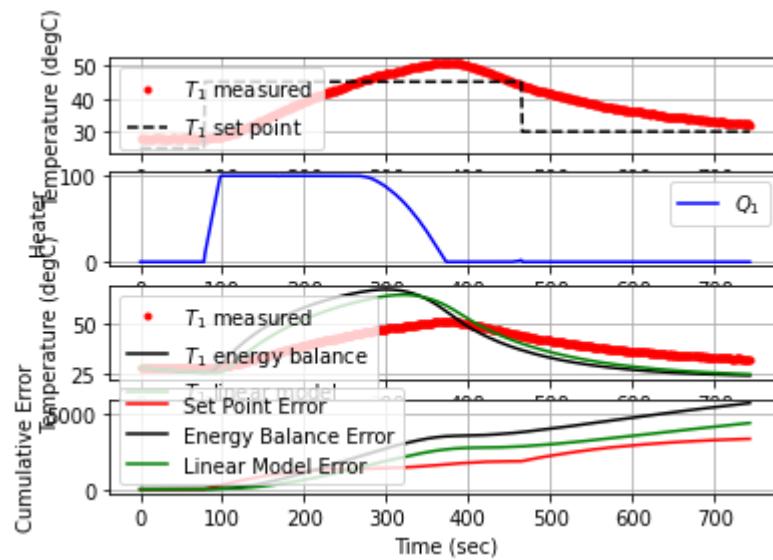
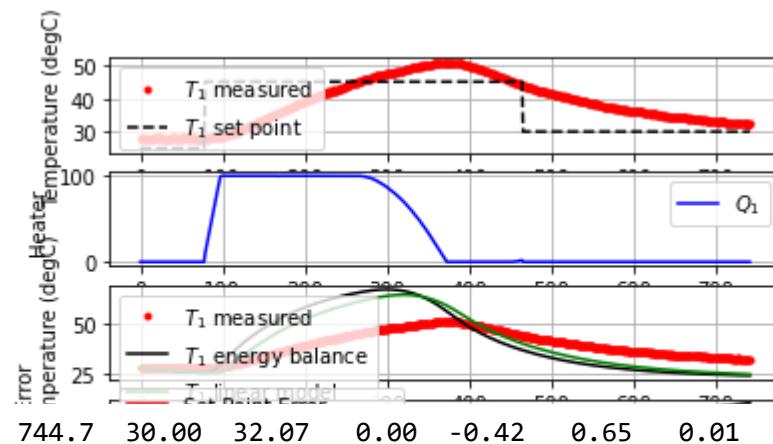
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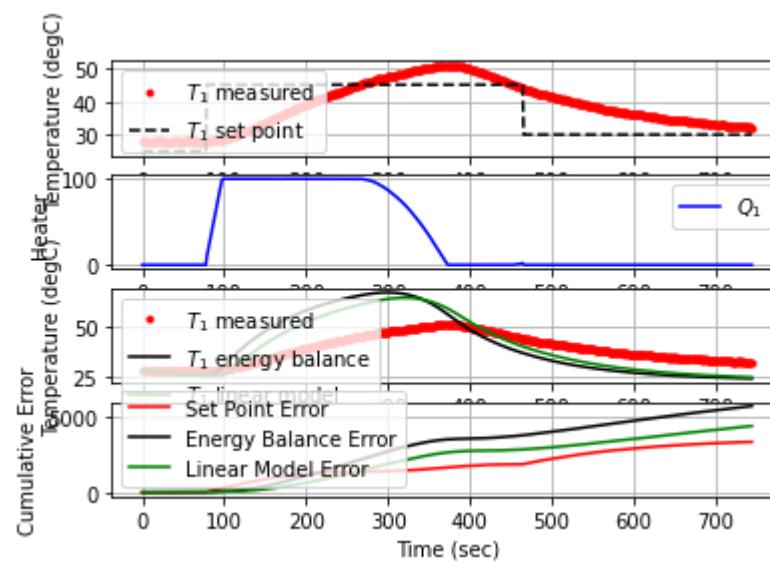
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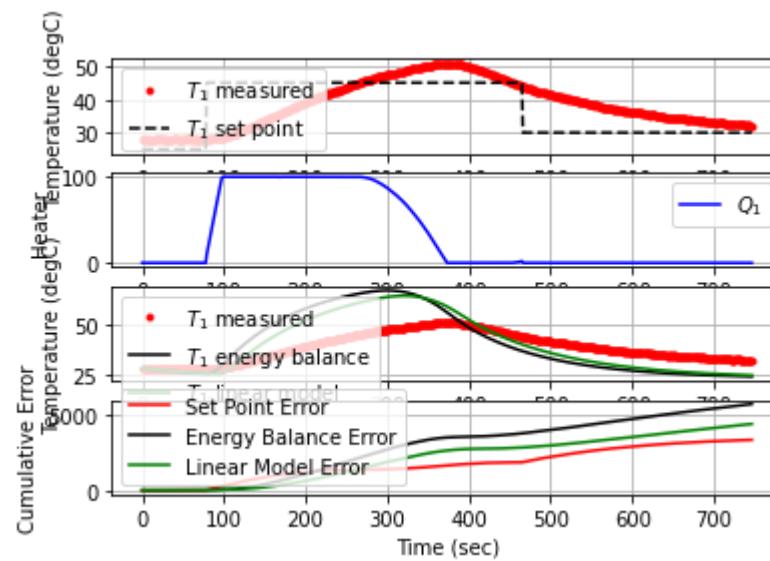
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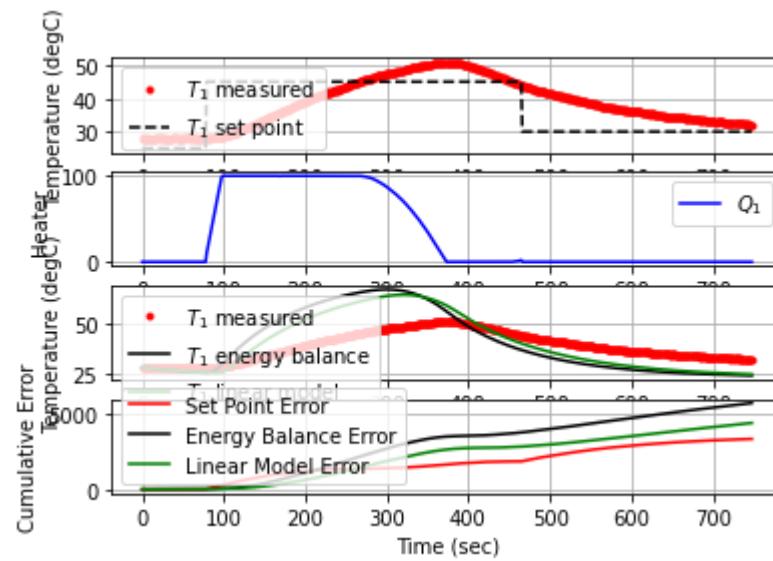
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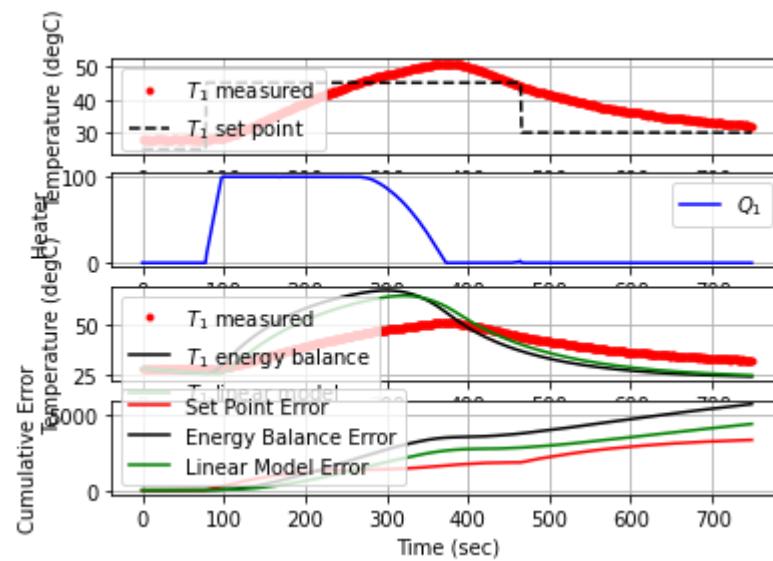
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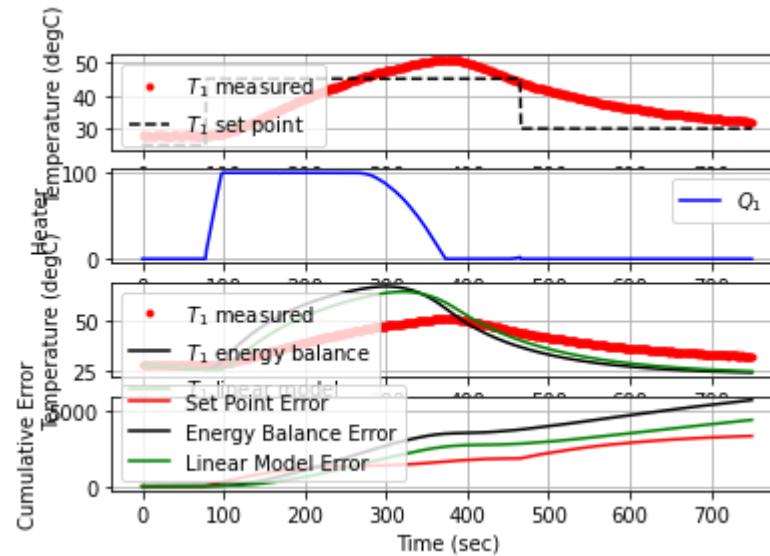
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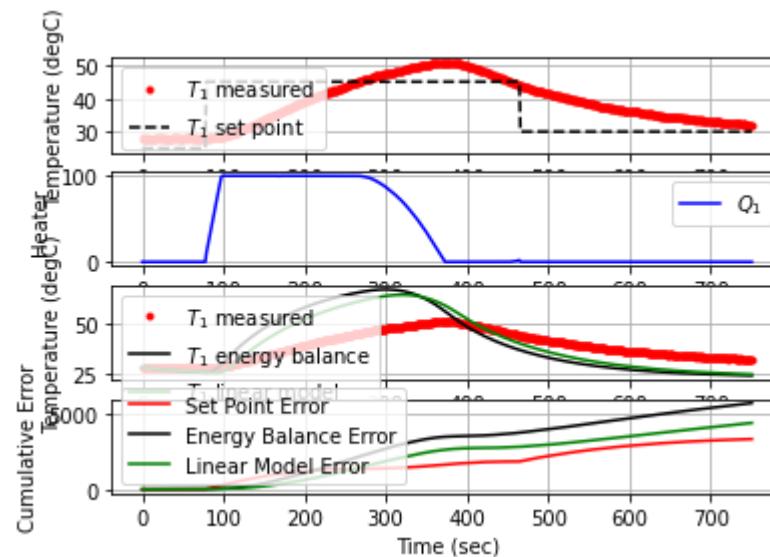
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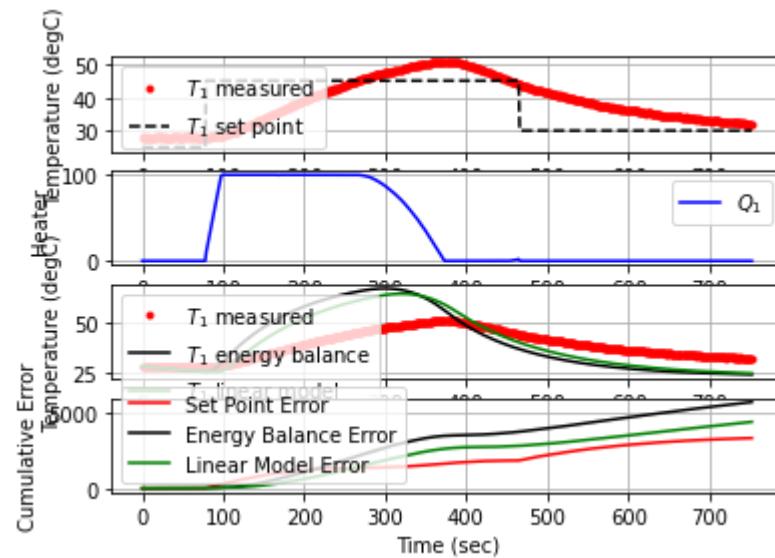
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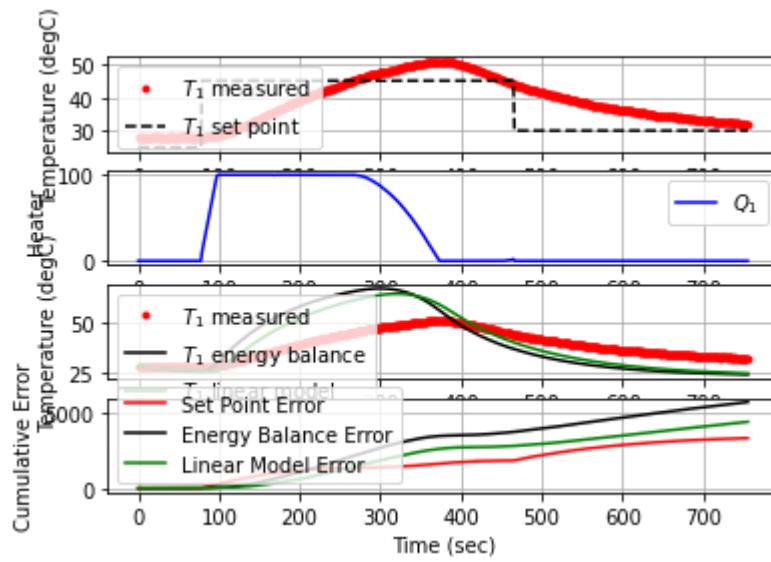
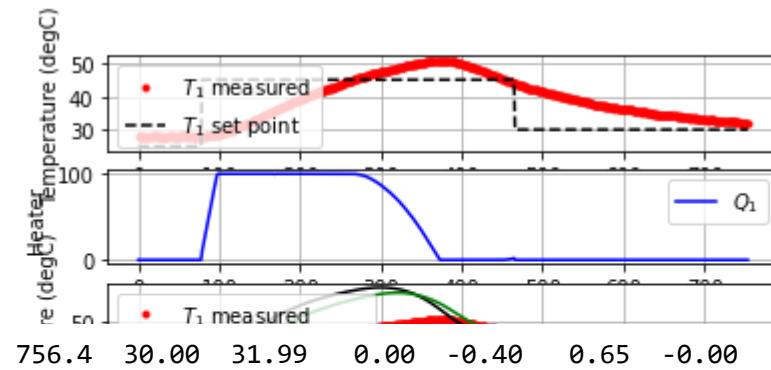
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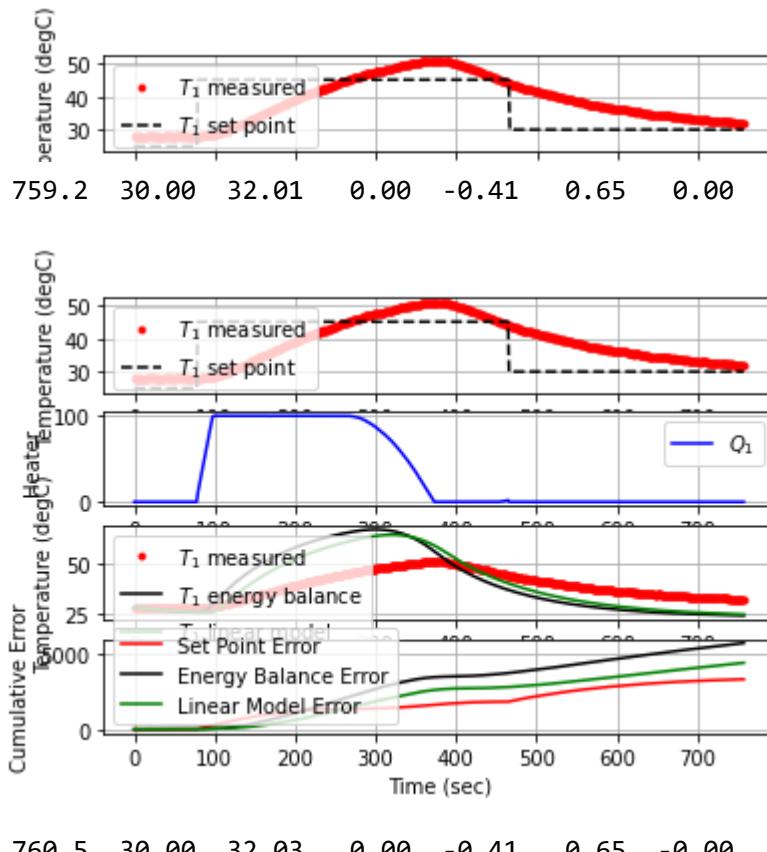


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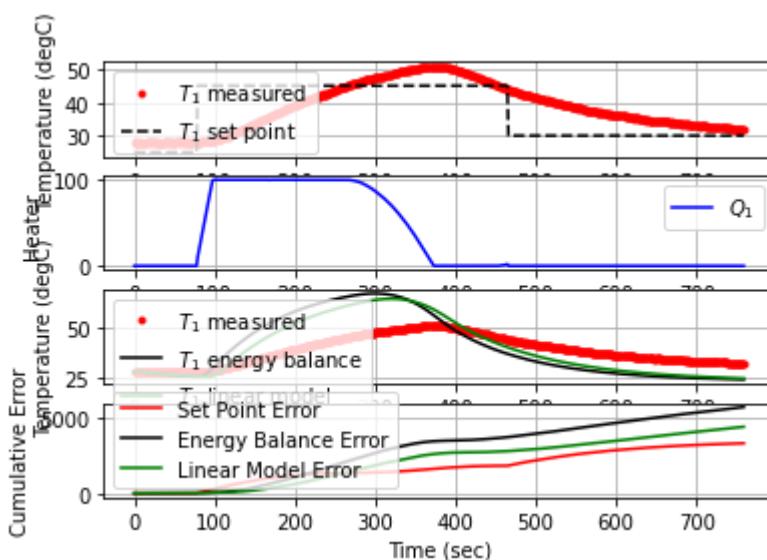


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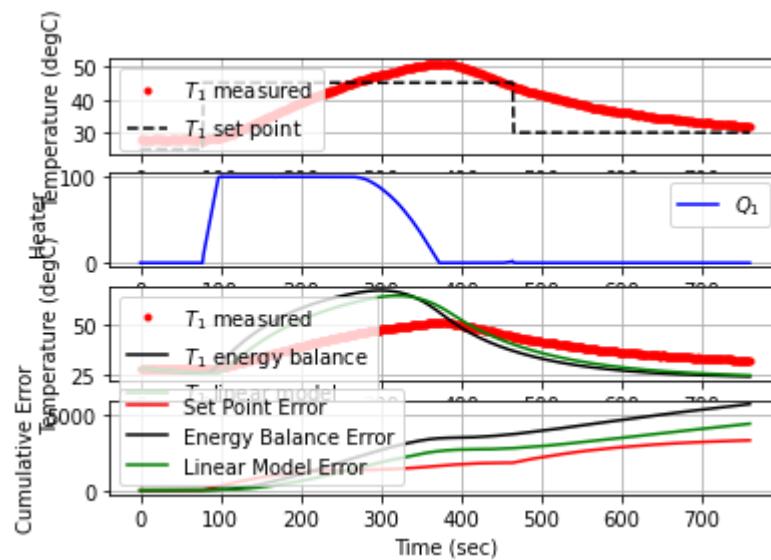




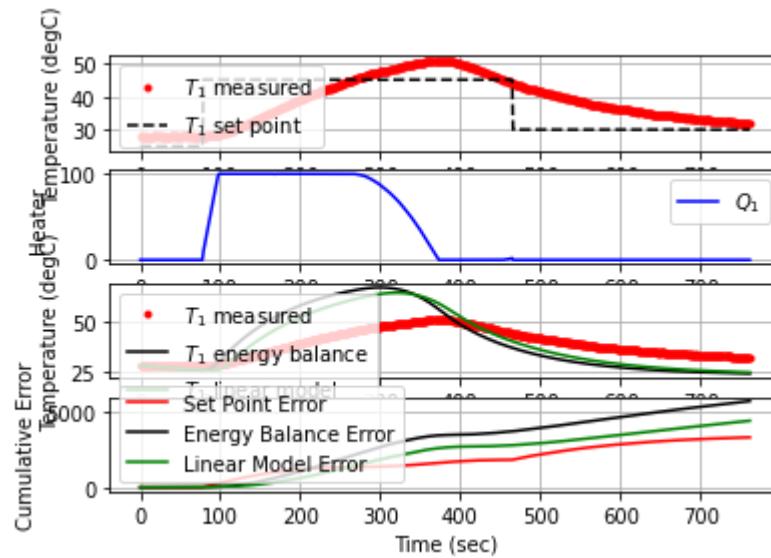
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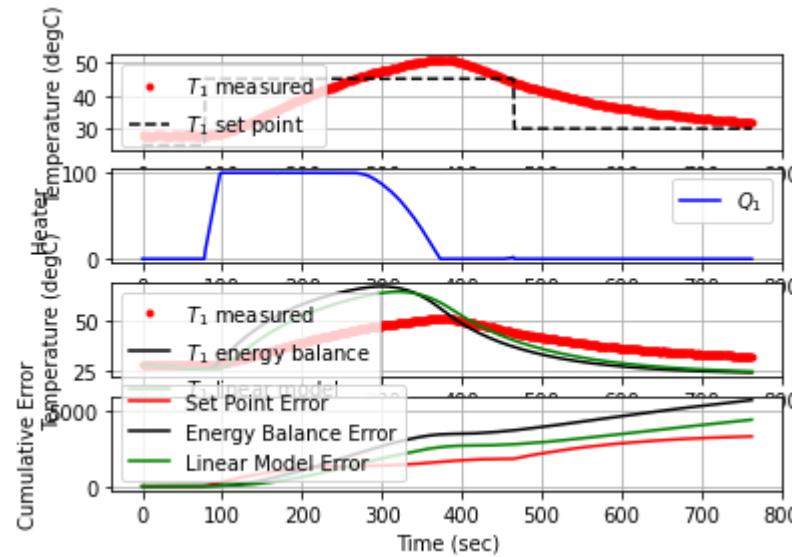
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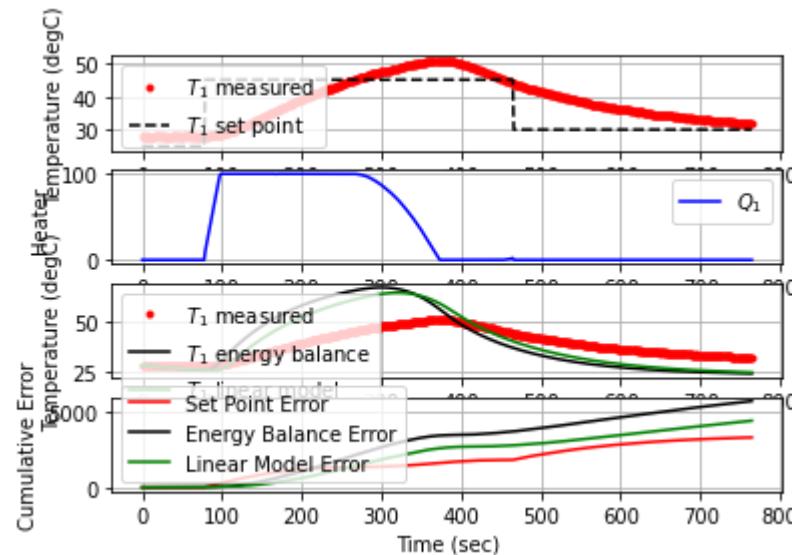
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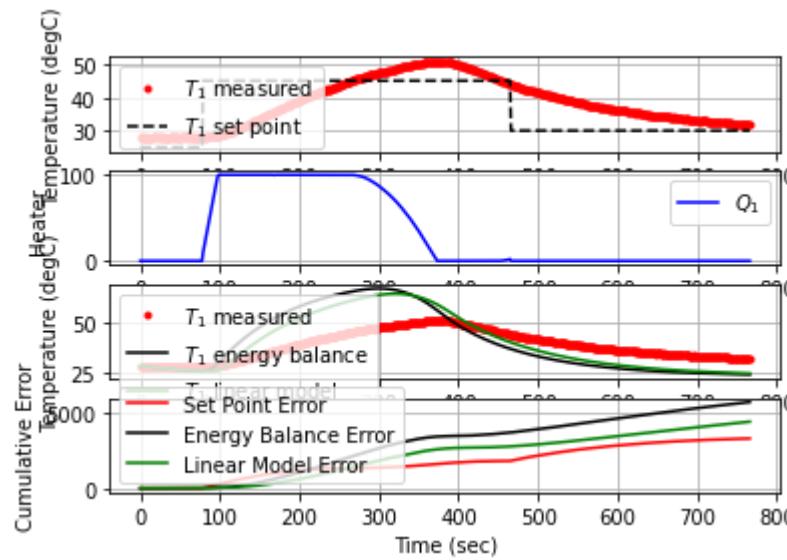
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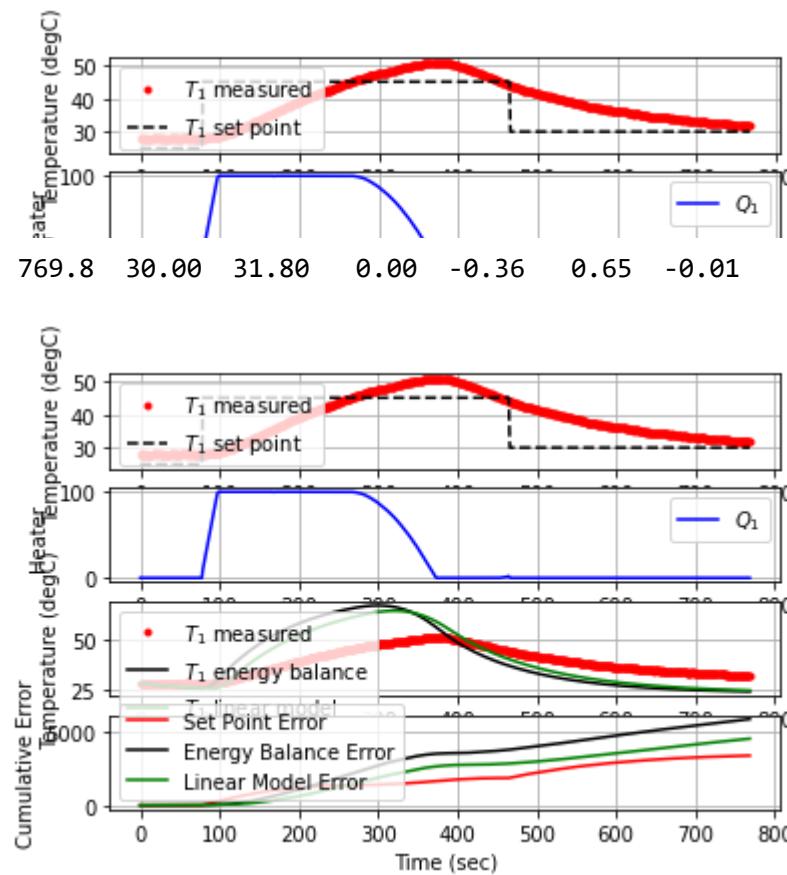
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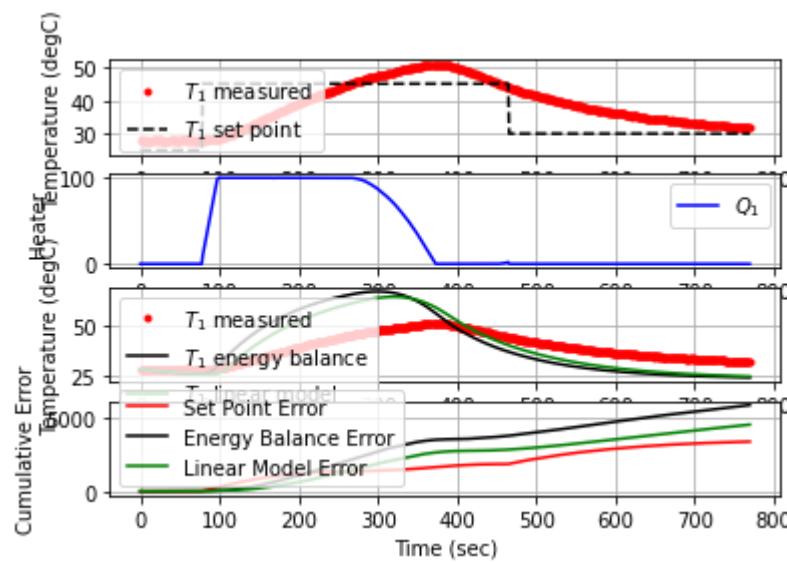
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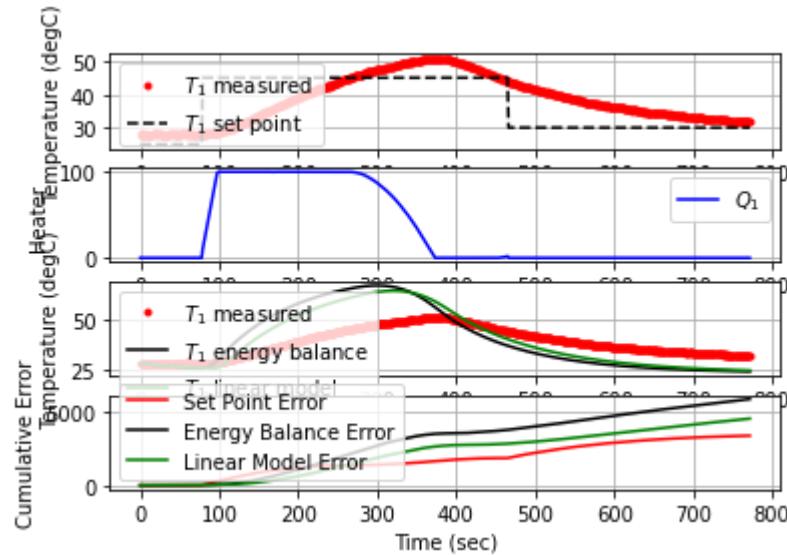
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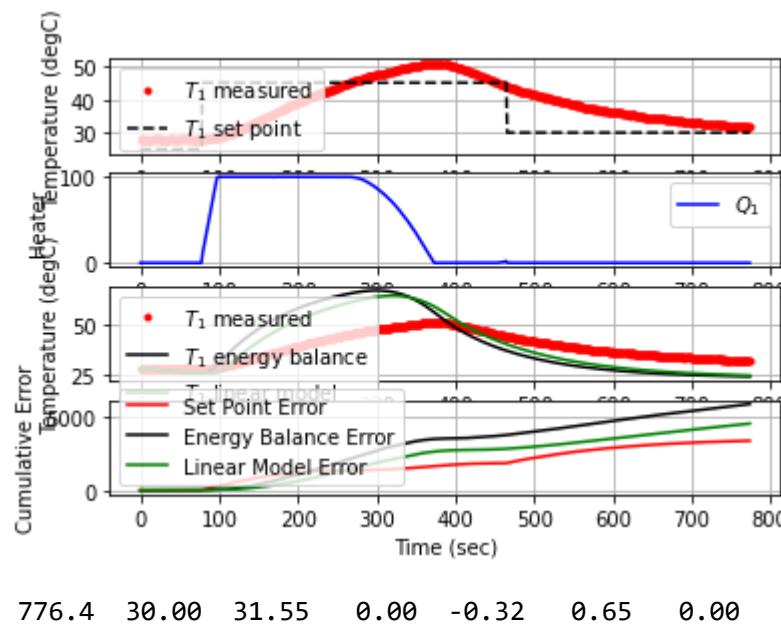
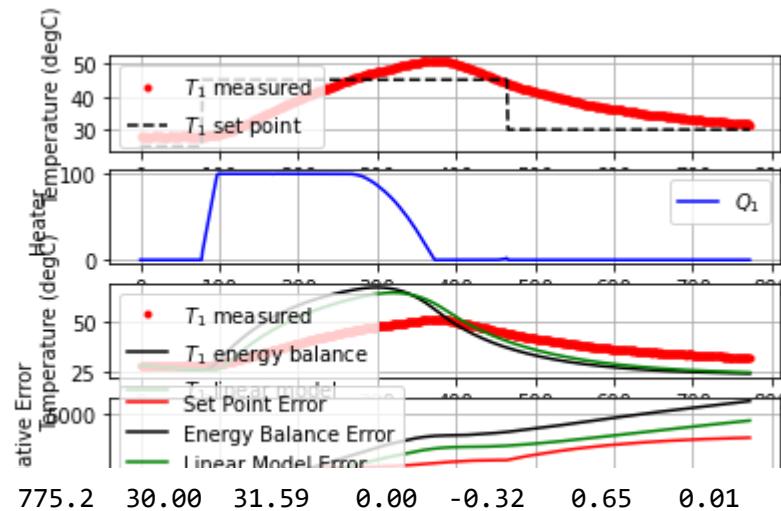
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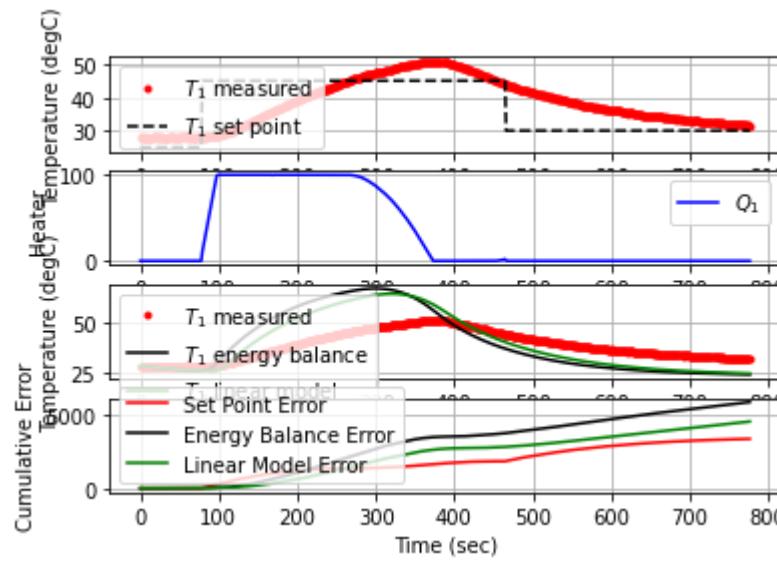
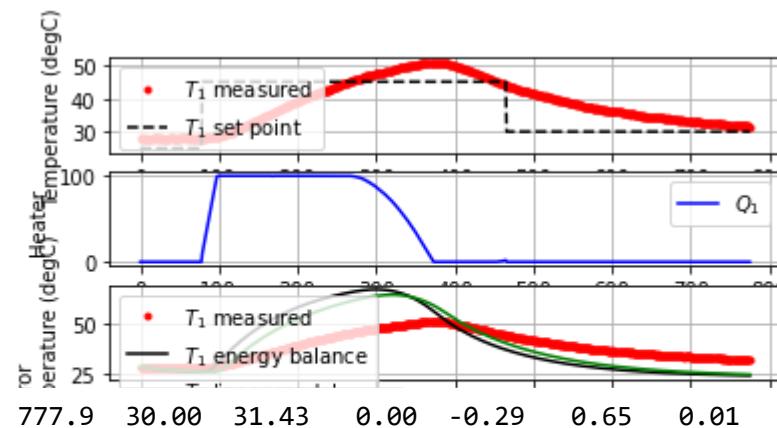


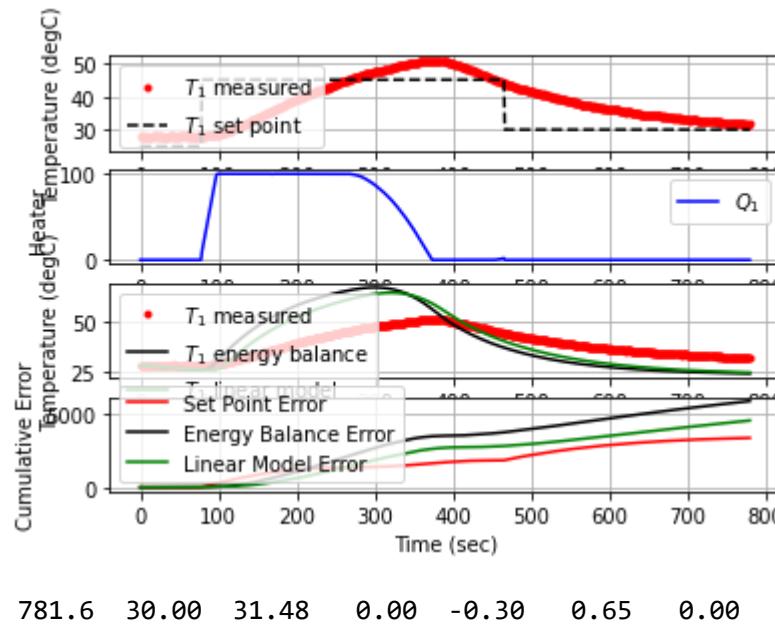
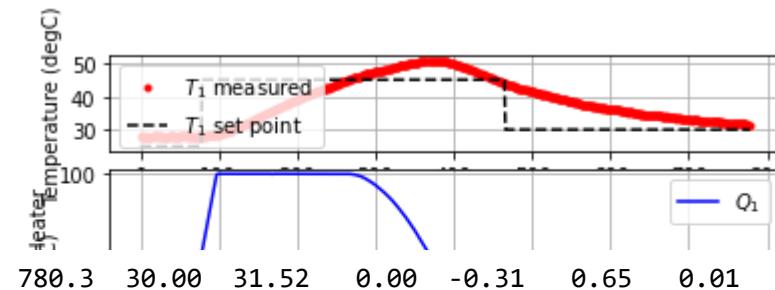
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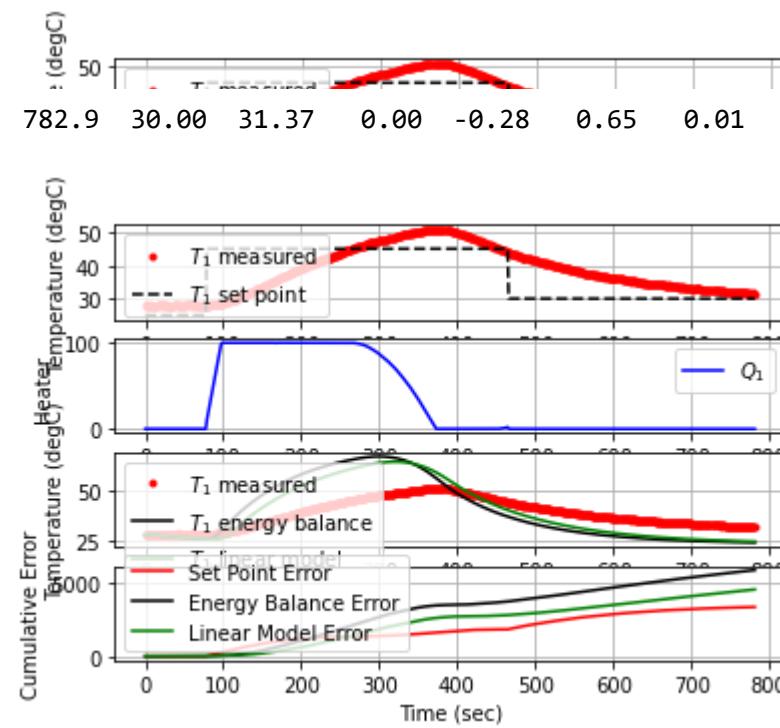
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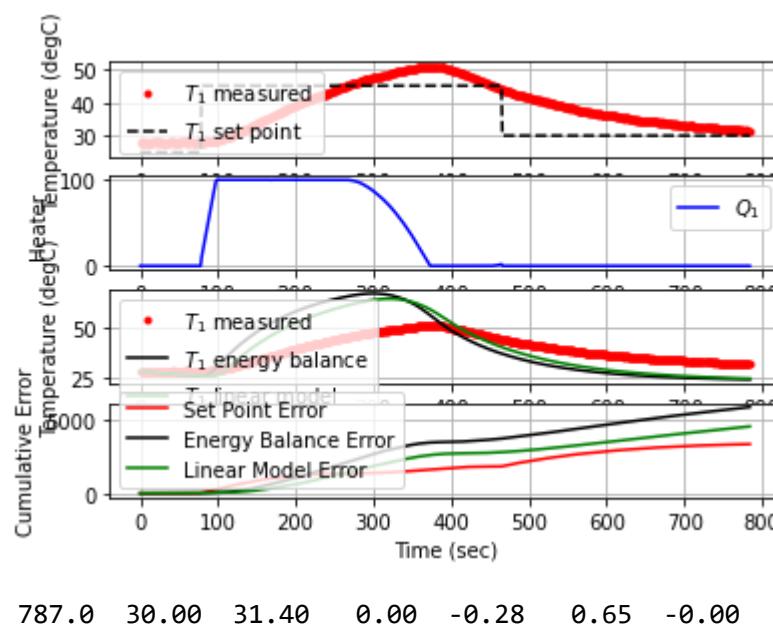
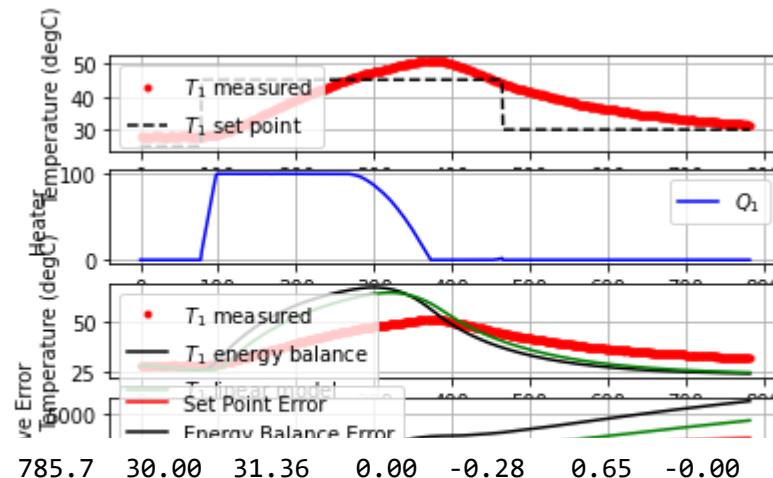


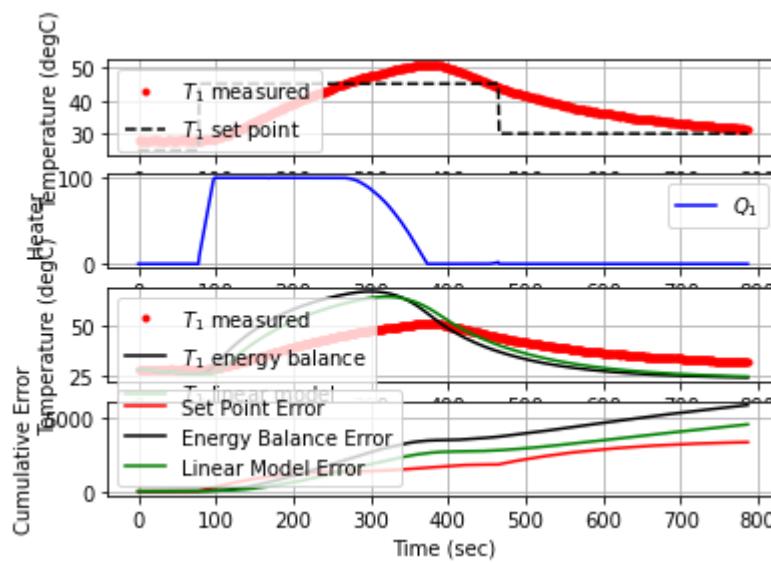
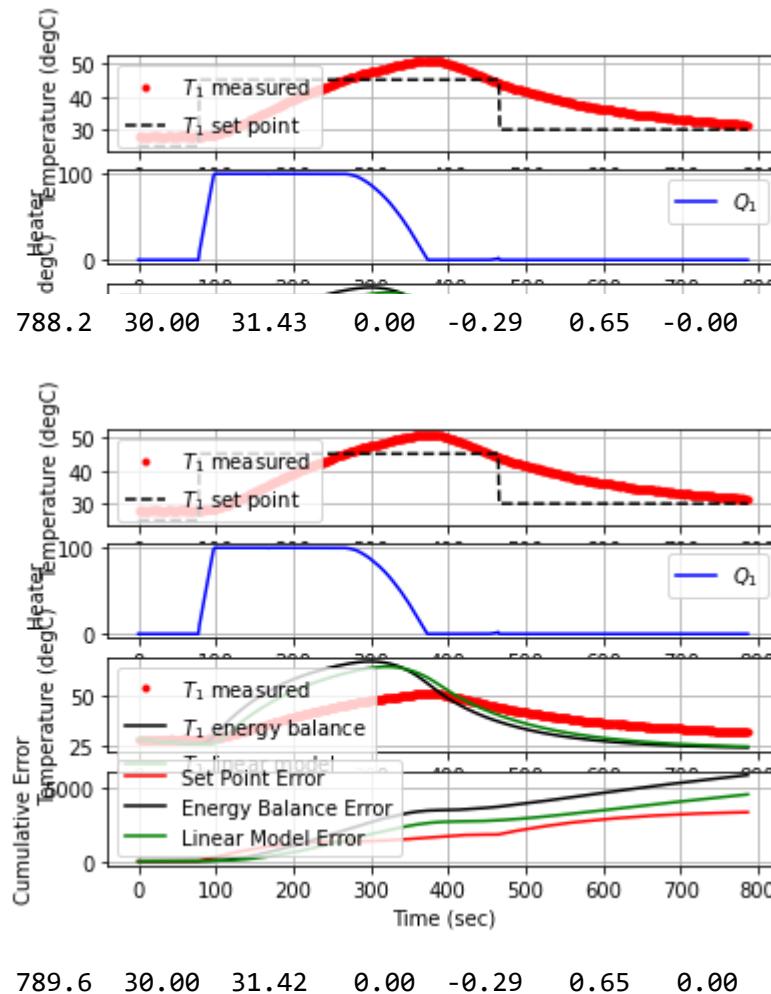


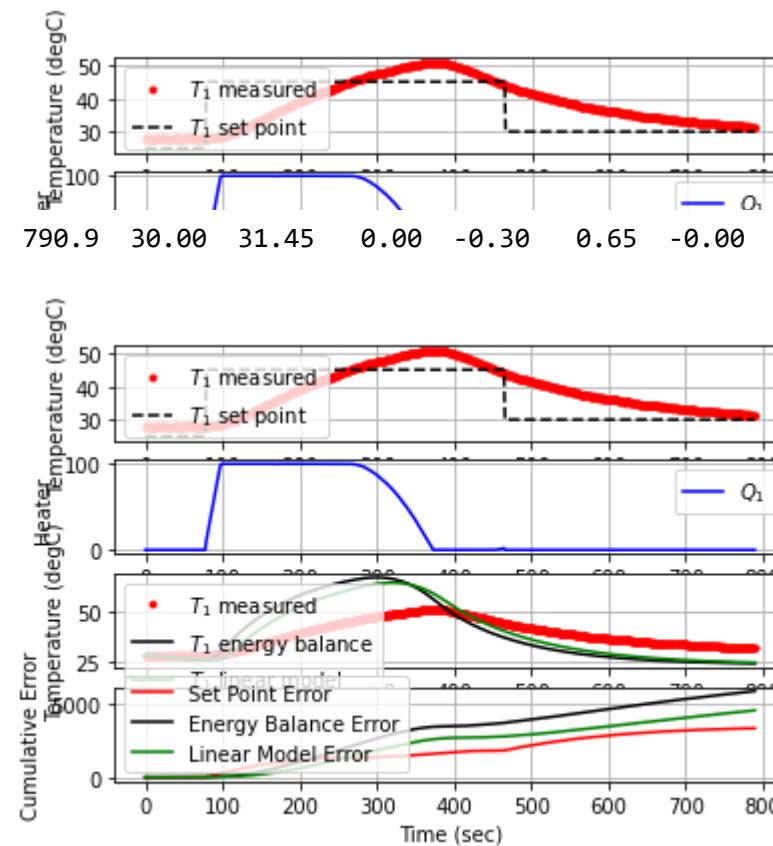
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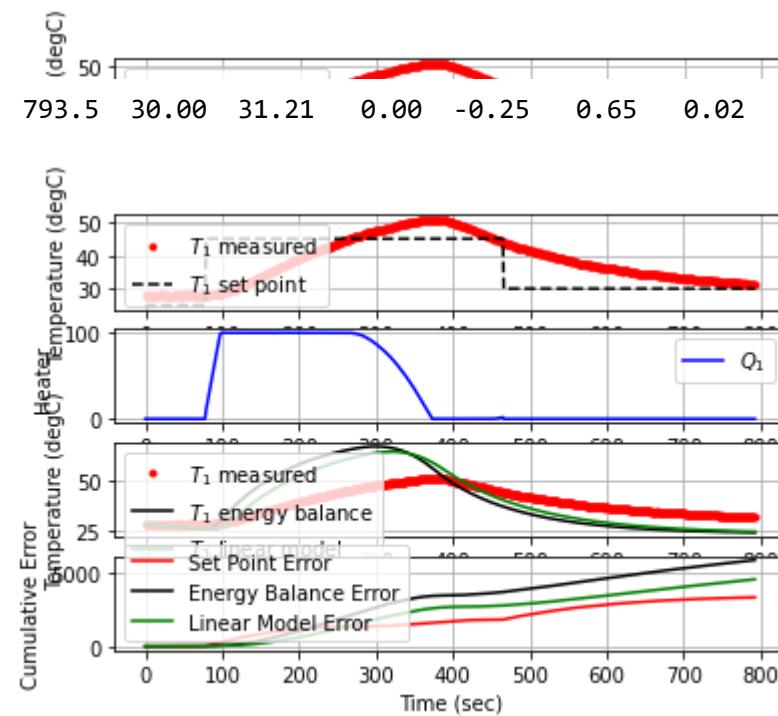




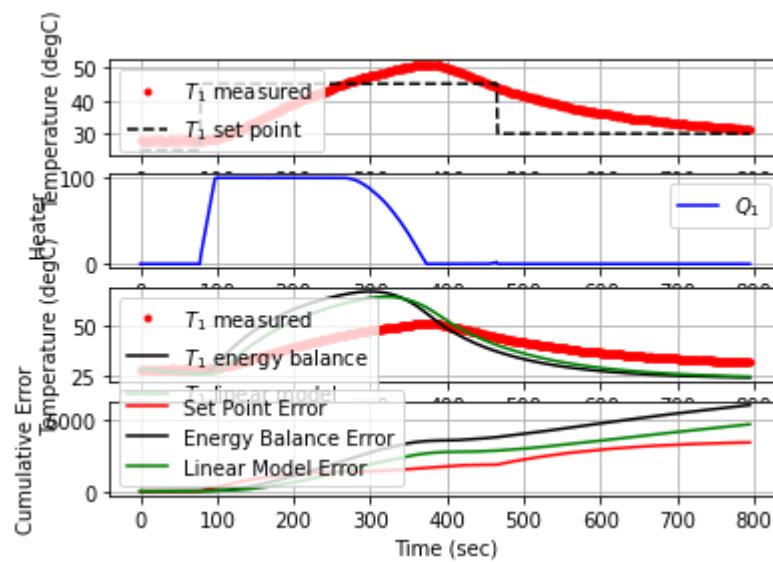
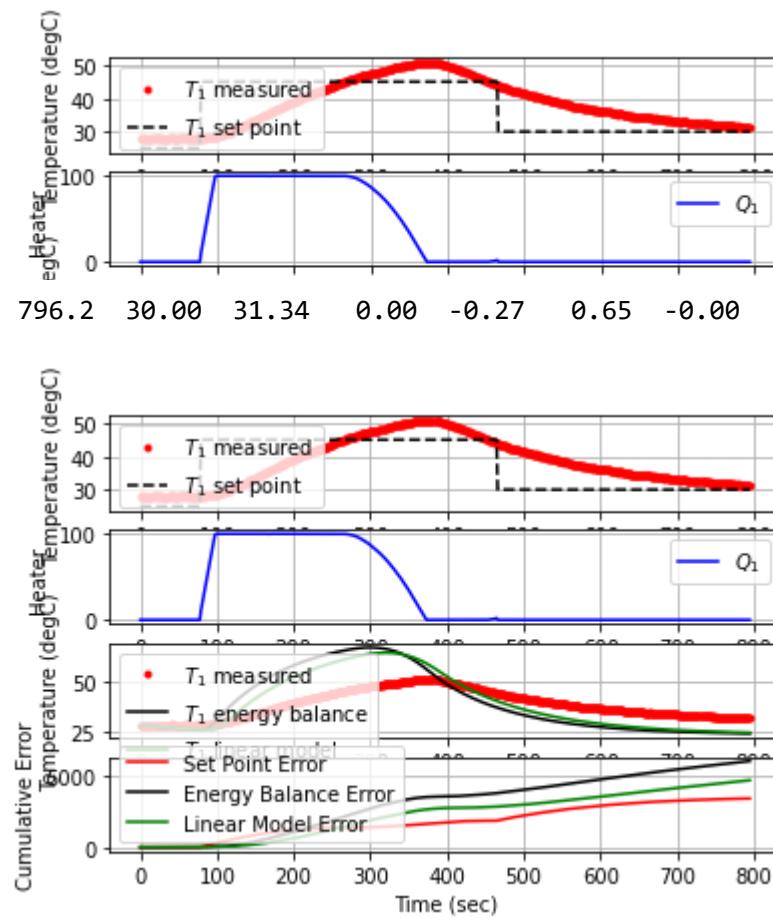


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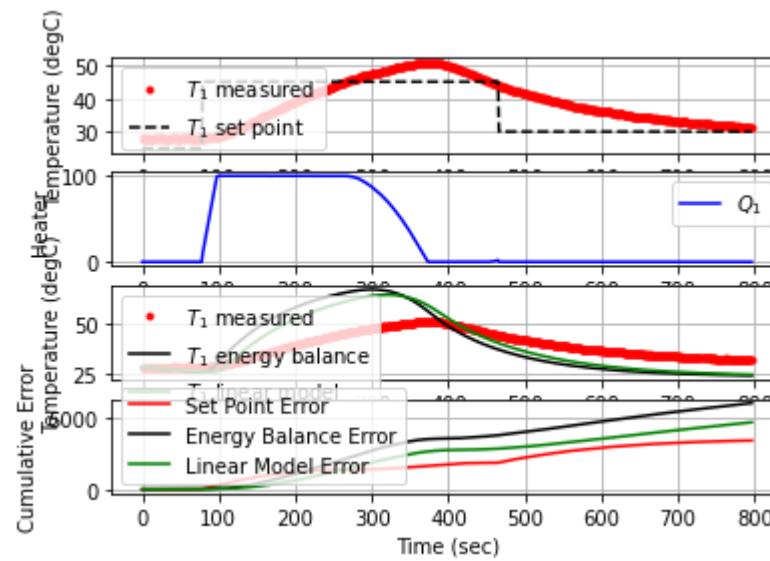




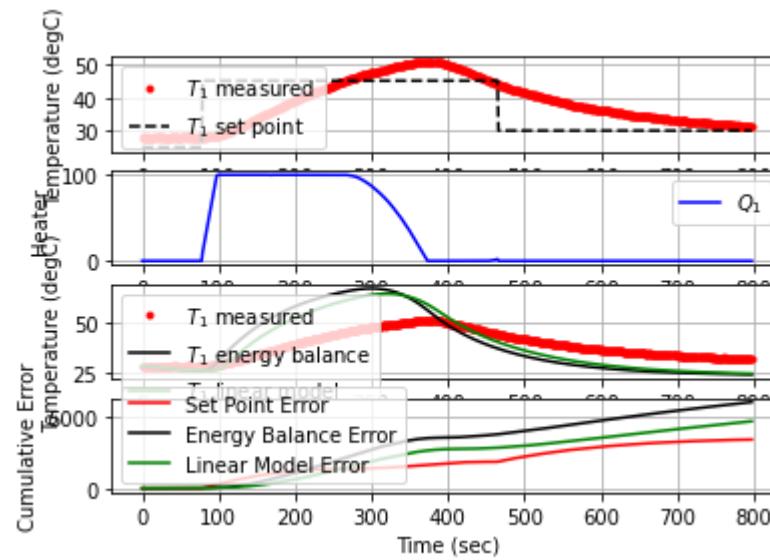
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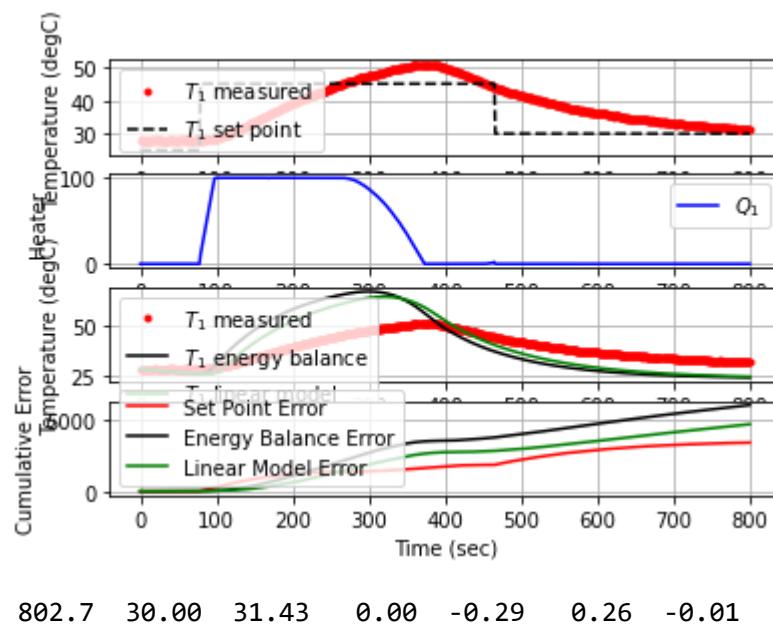
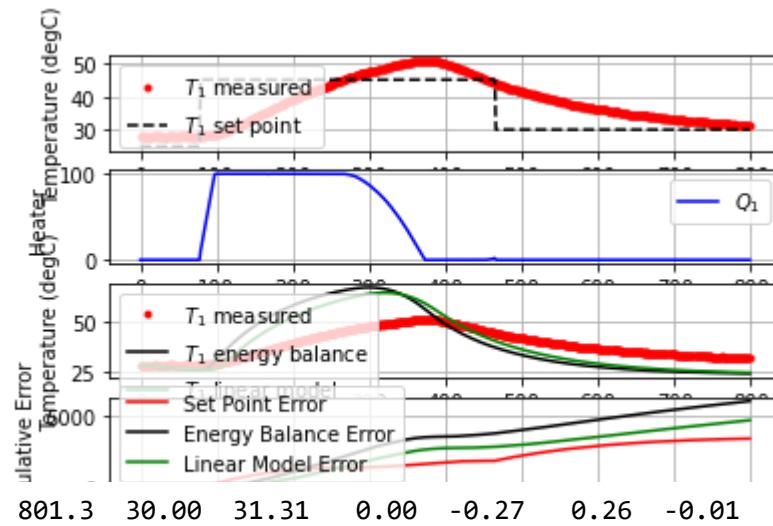
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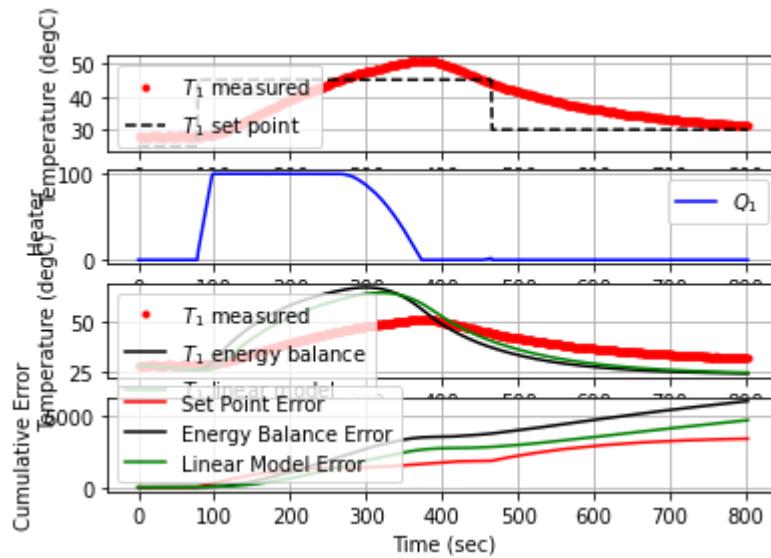
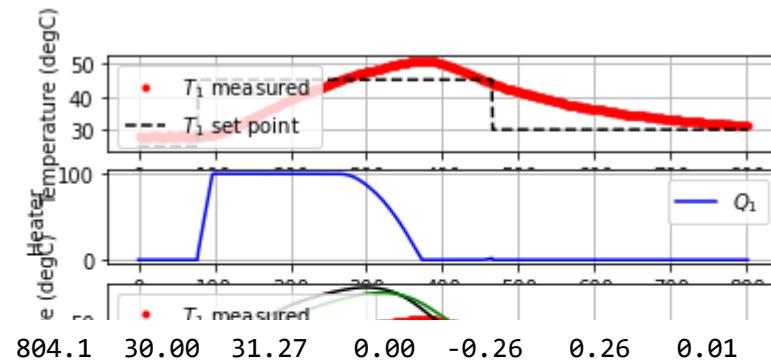


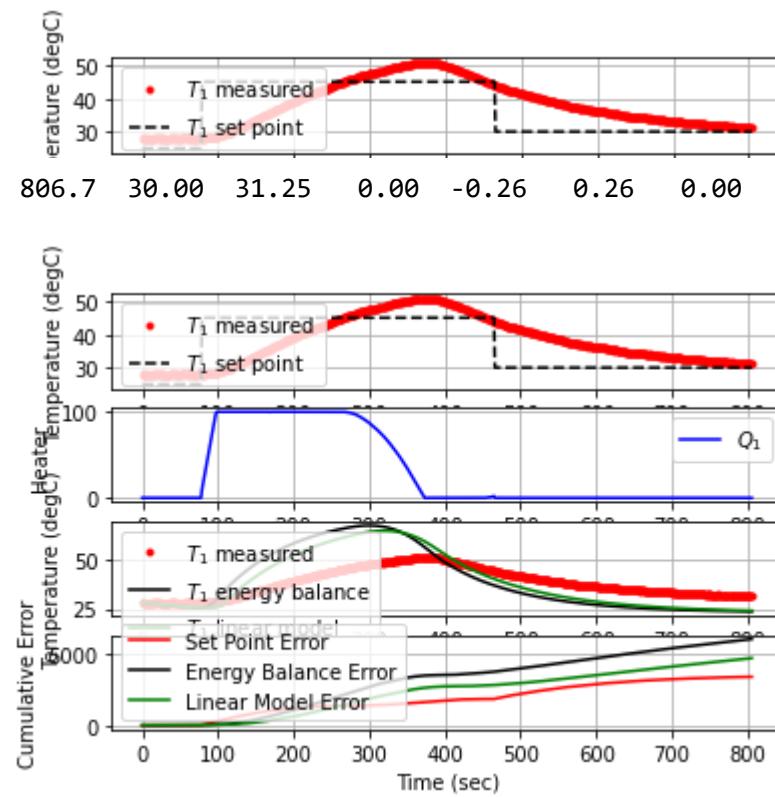
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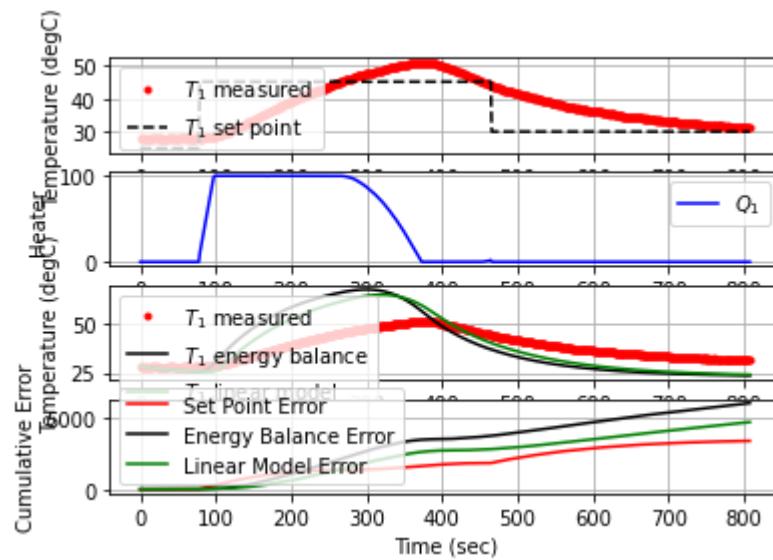
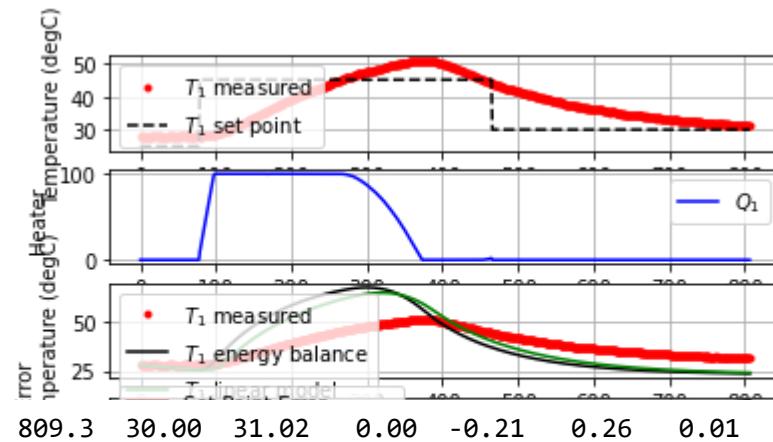
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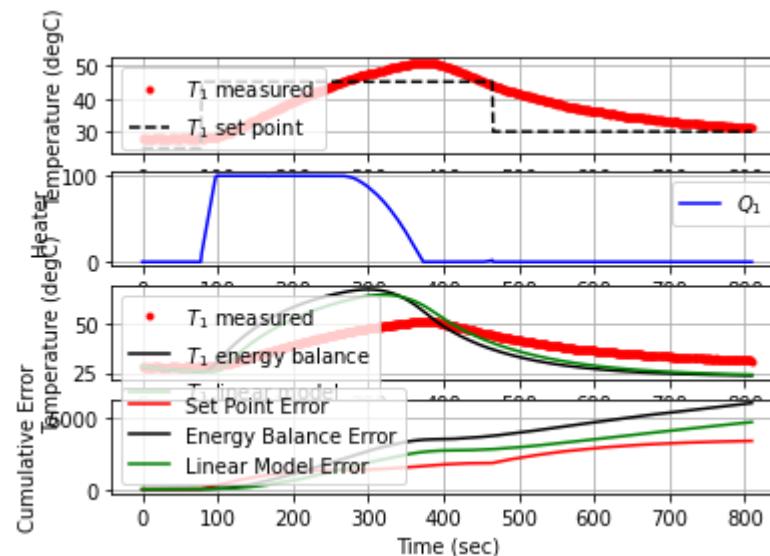




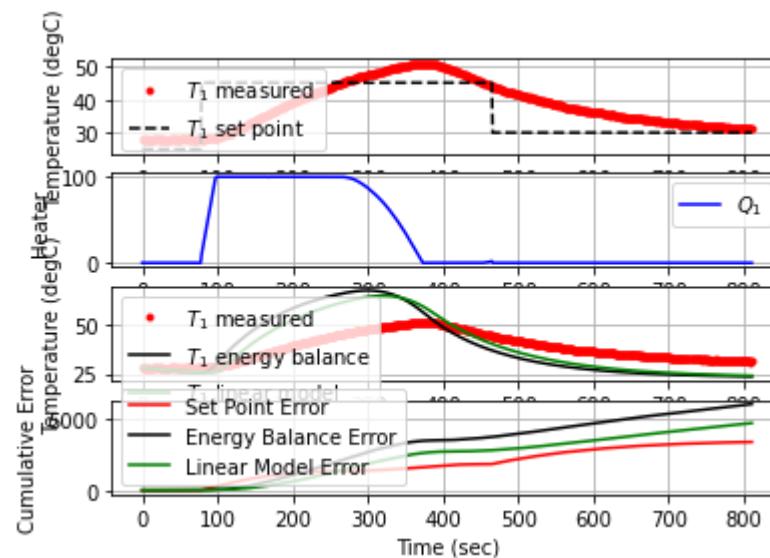
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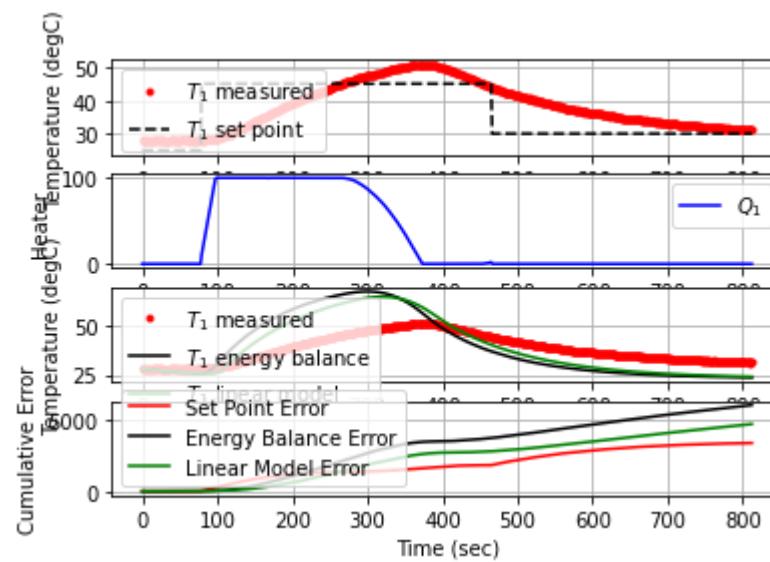
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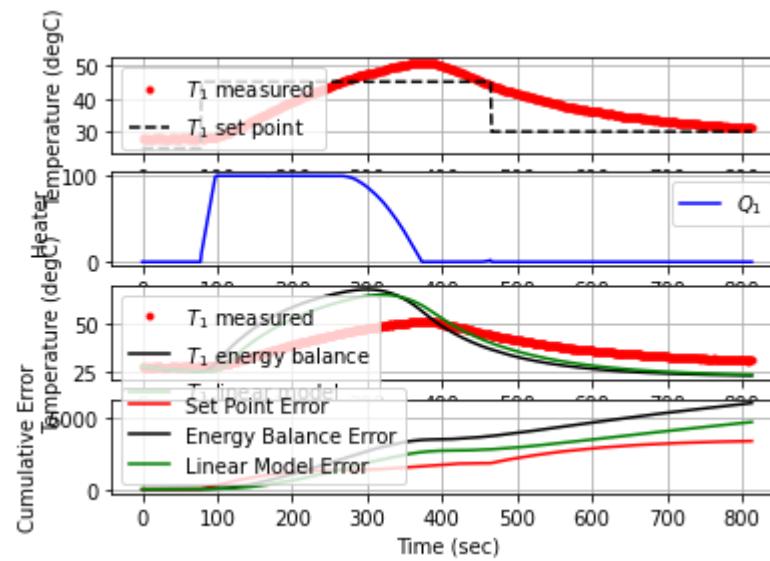
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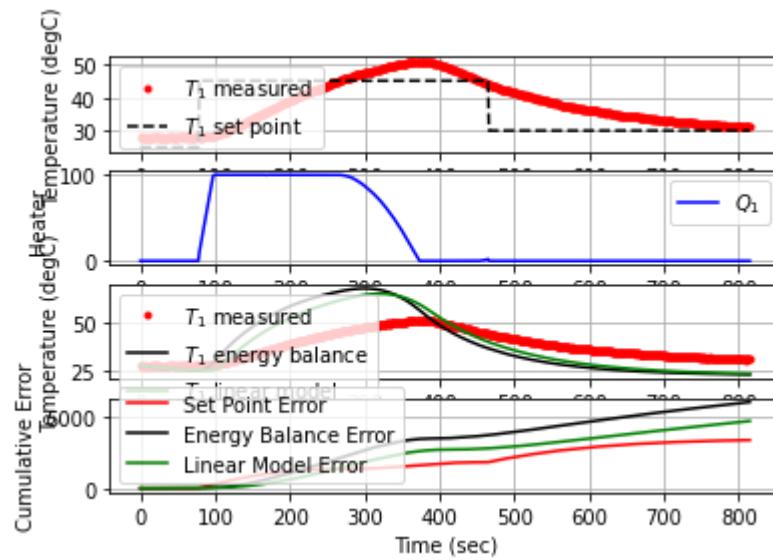
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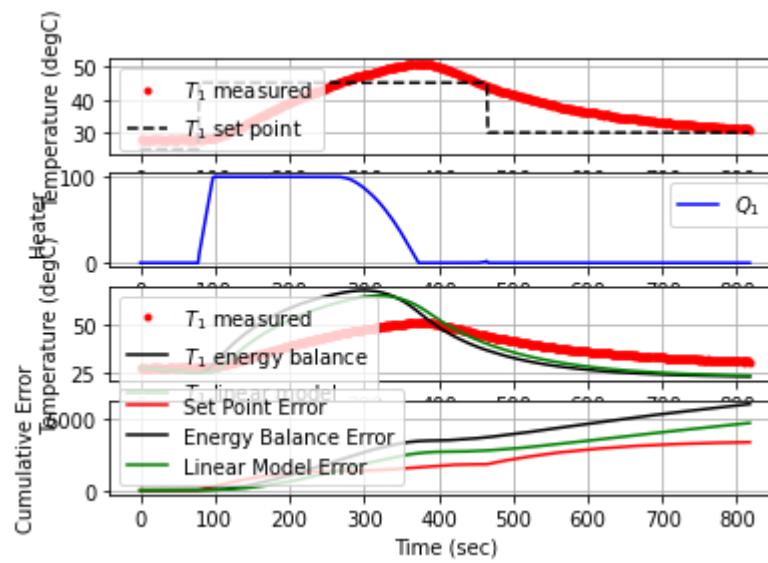
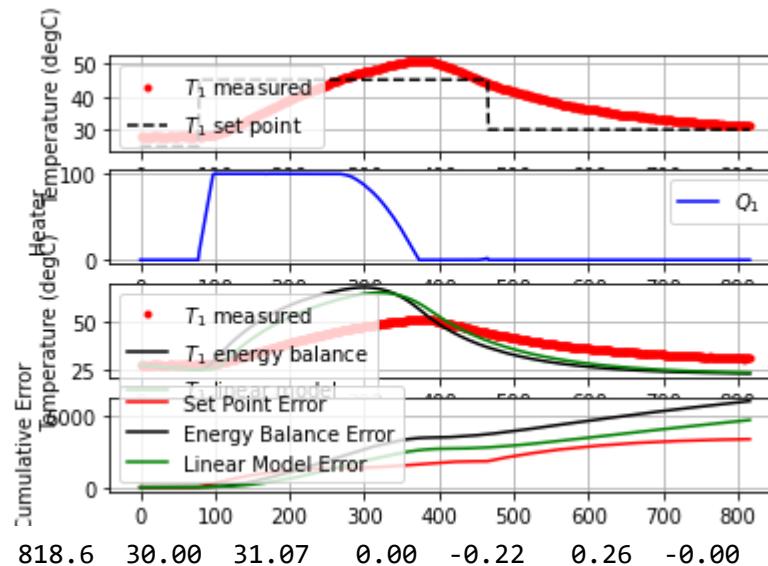
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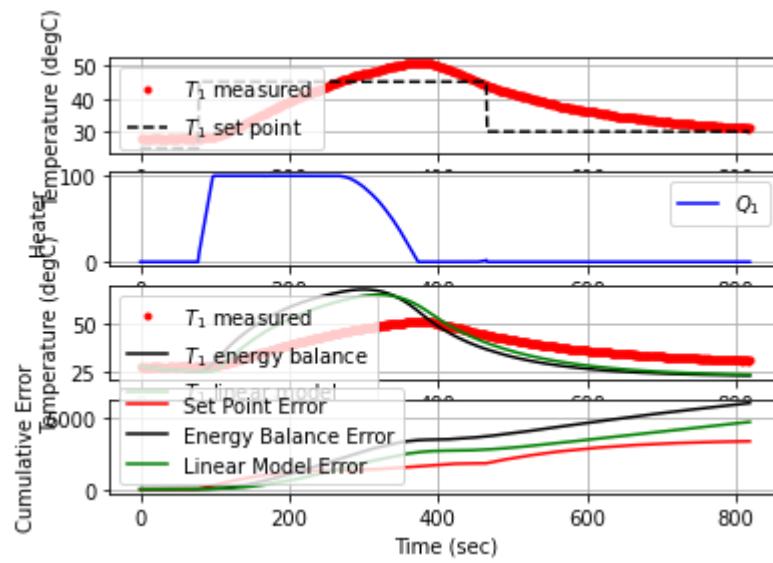


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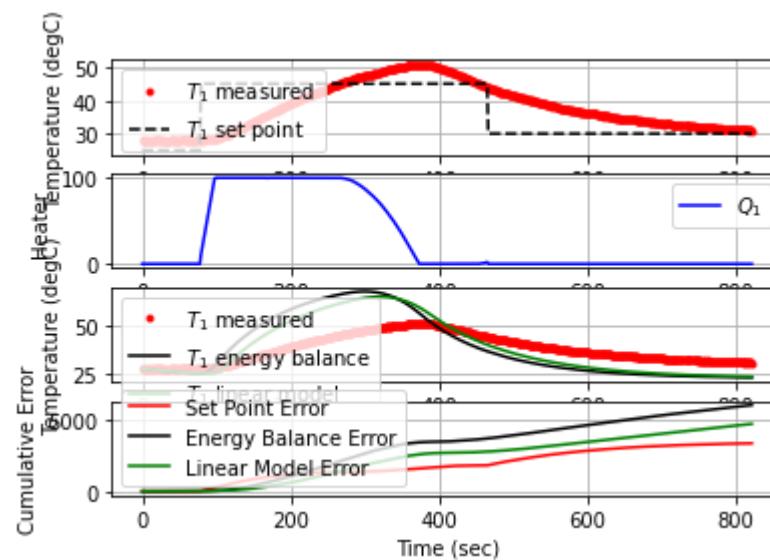
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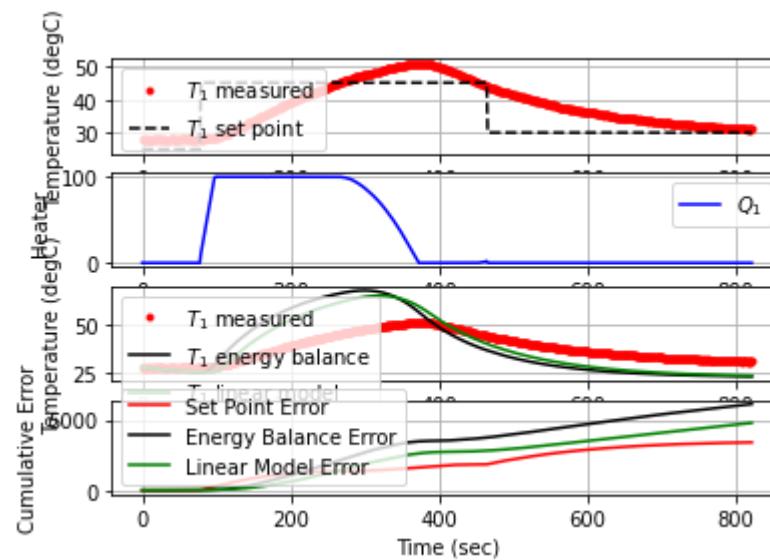


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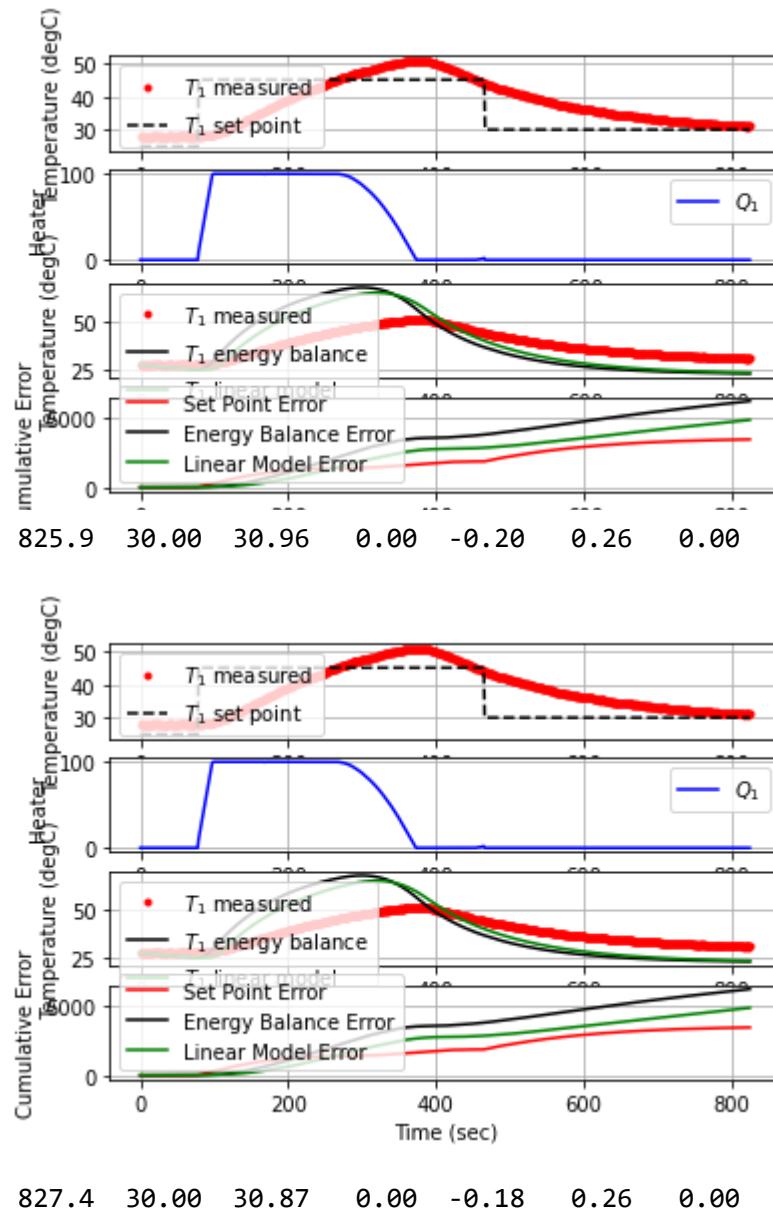
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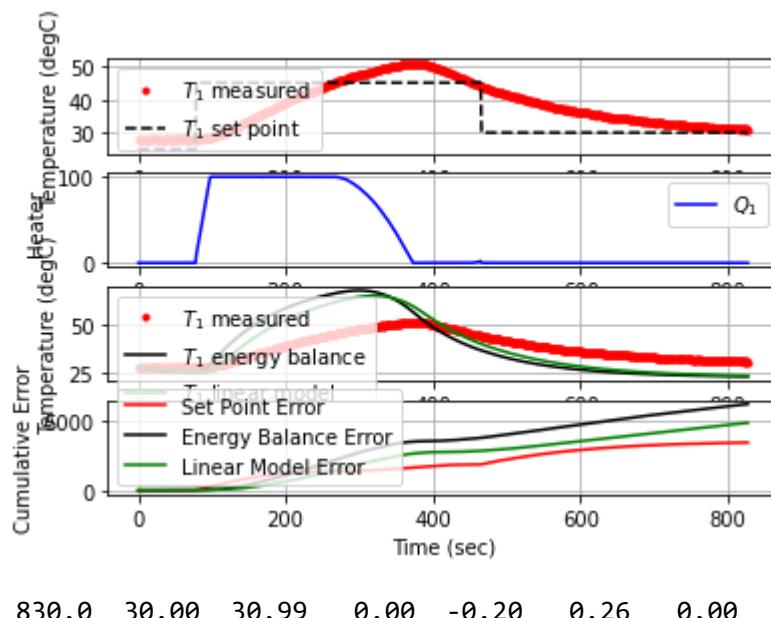
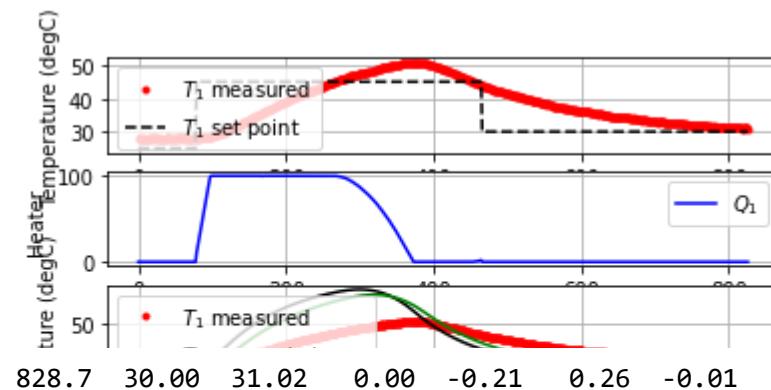


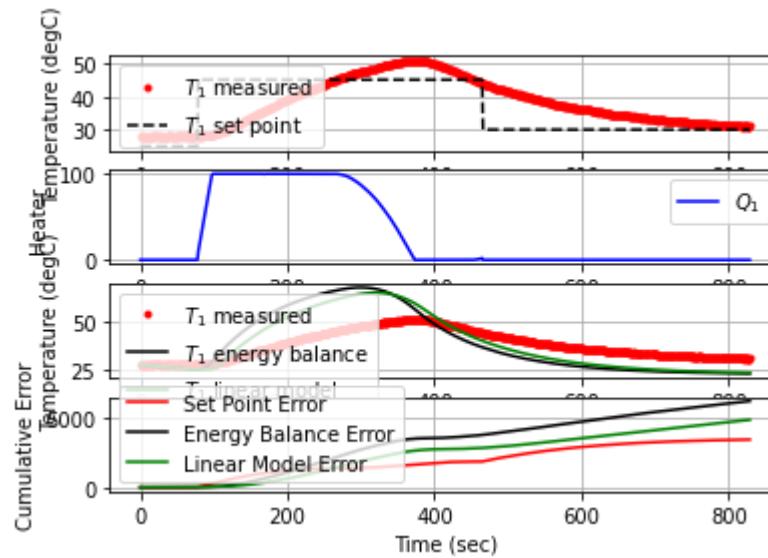
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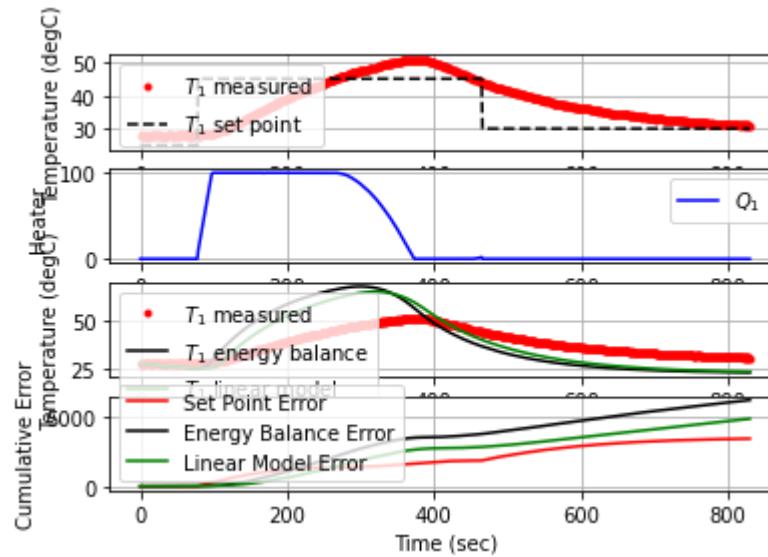
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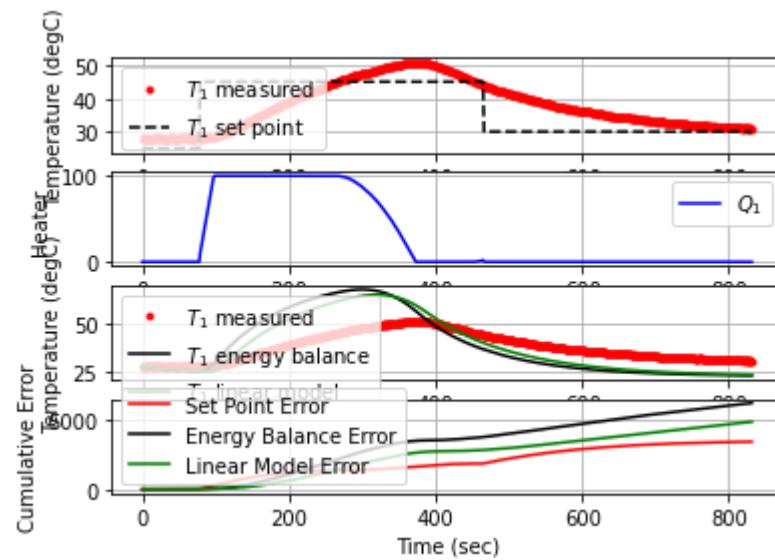




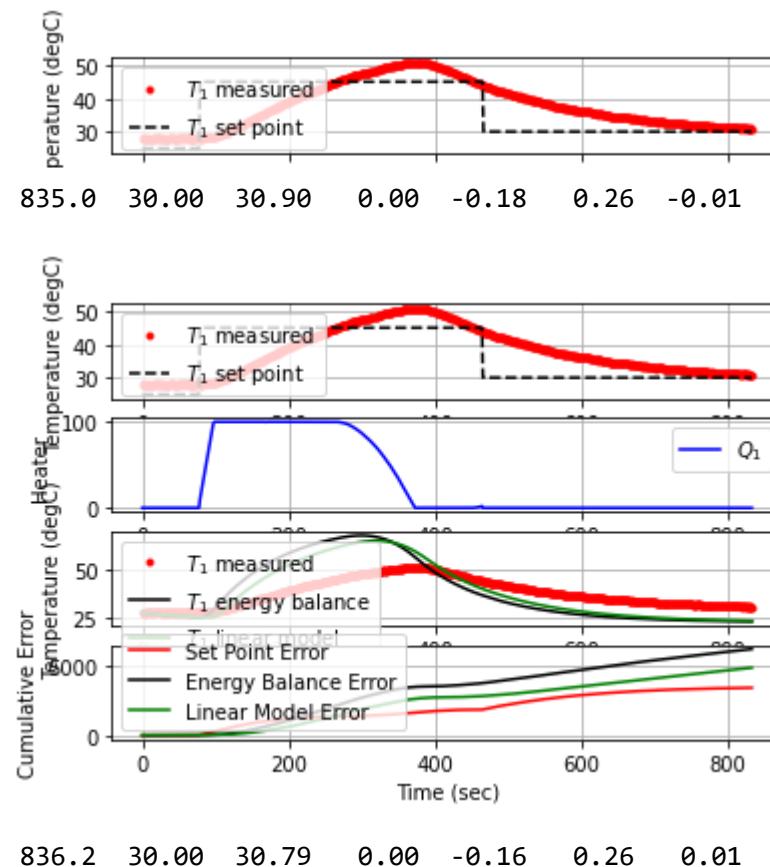
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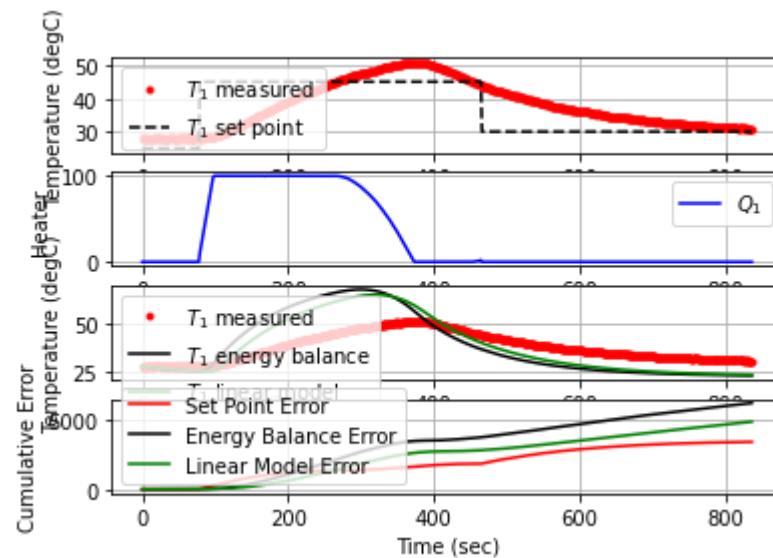


833.8 30.00 30.81 0.00 -0.17 0.26 0.00

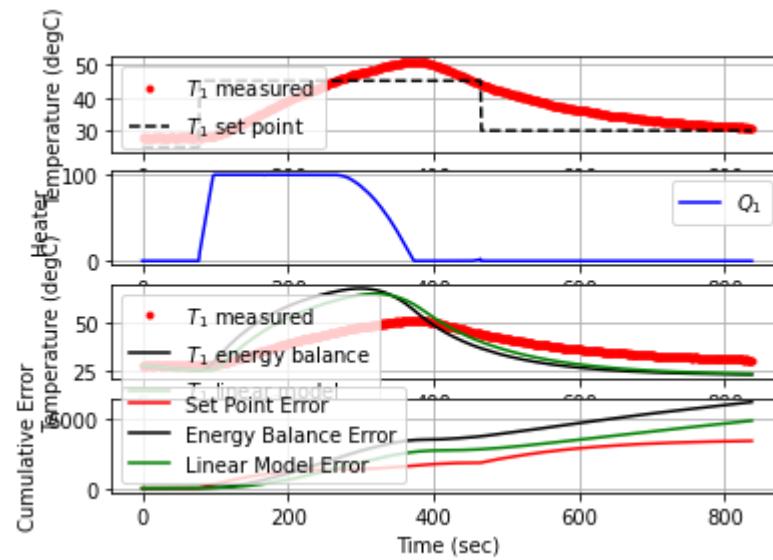


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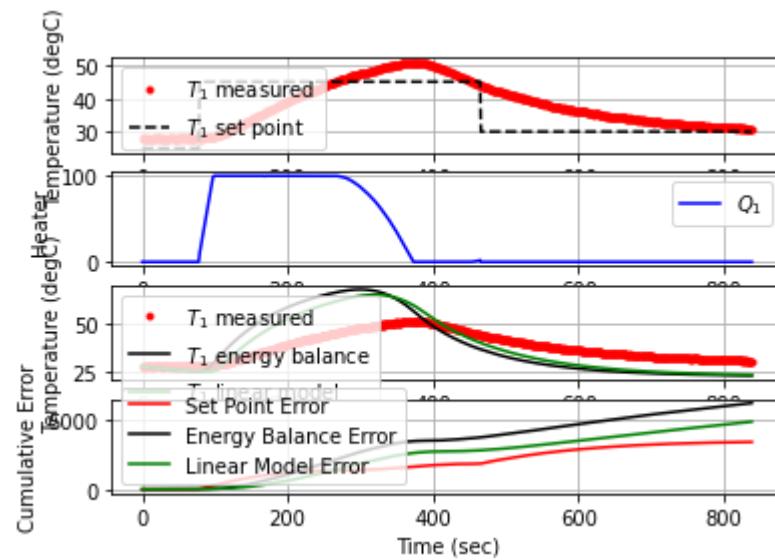
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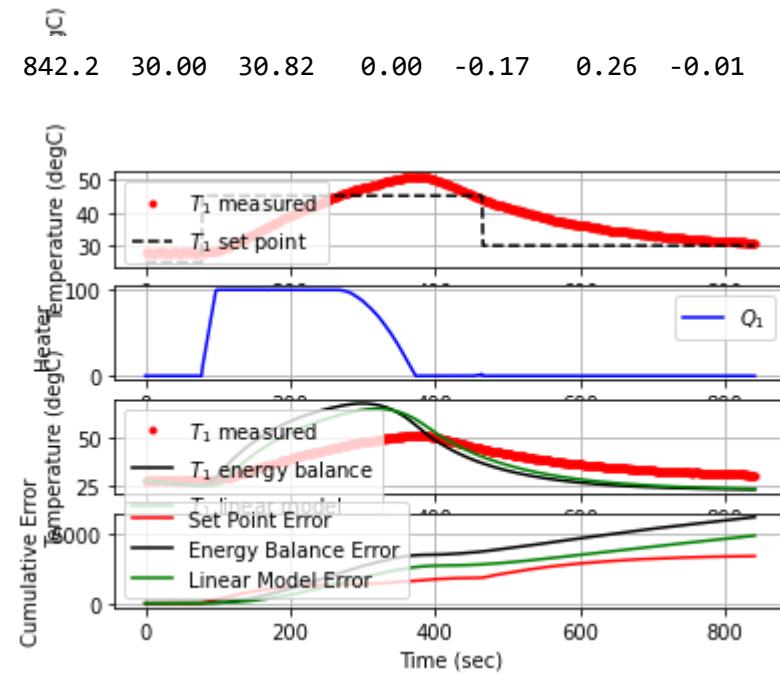
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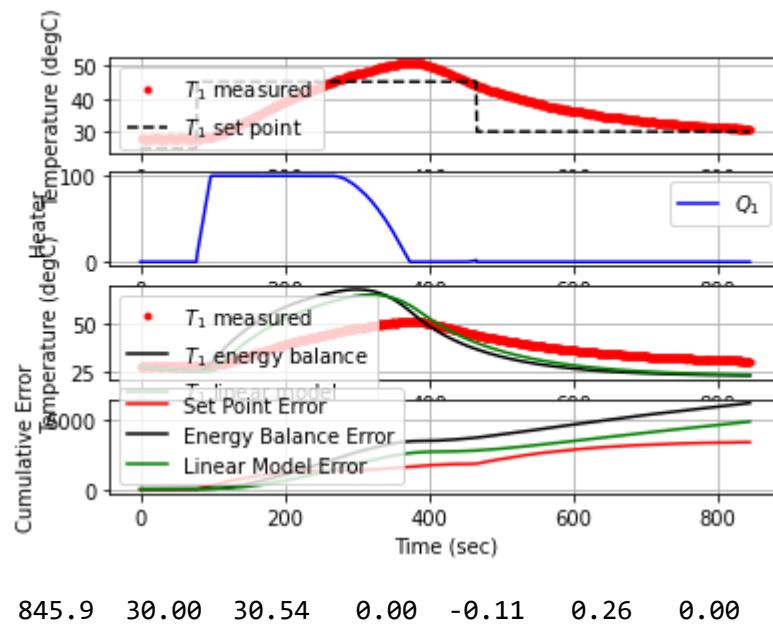
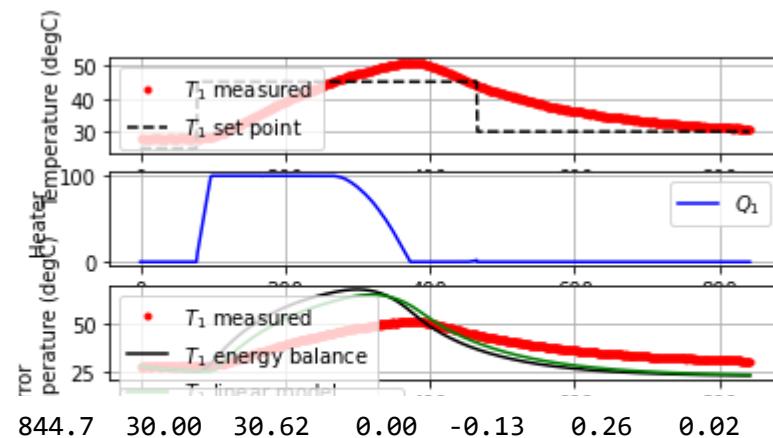
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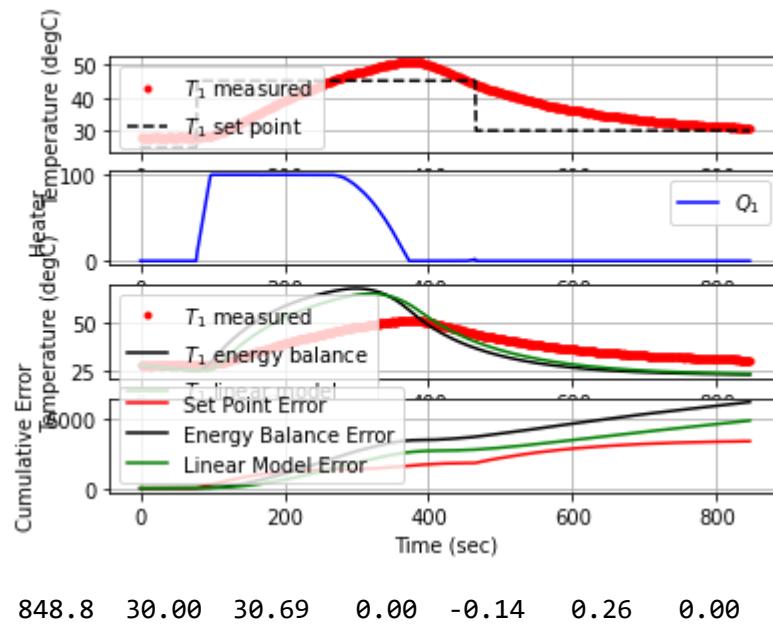
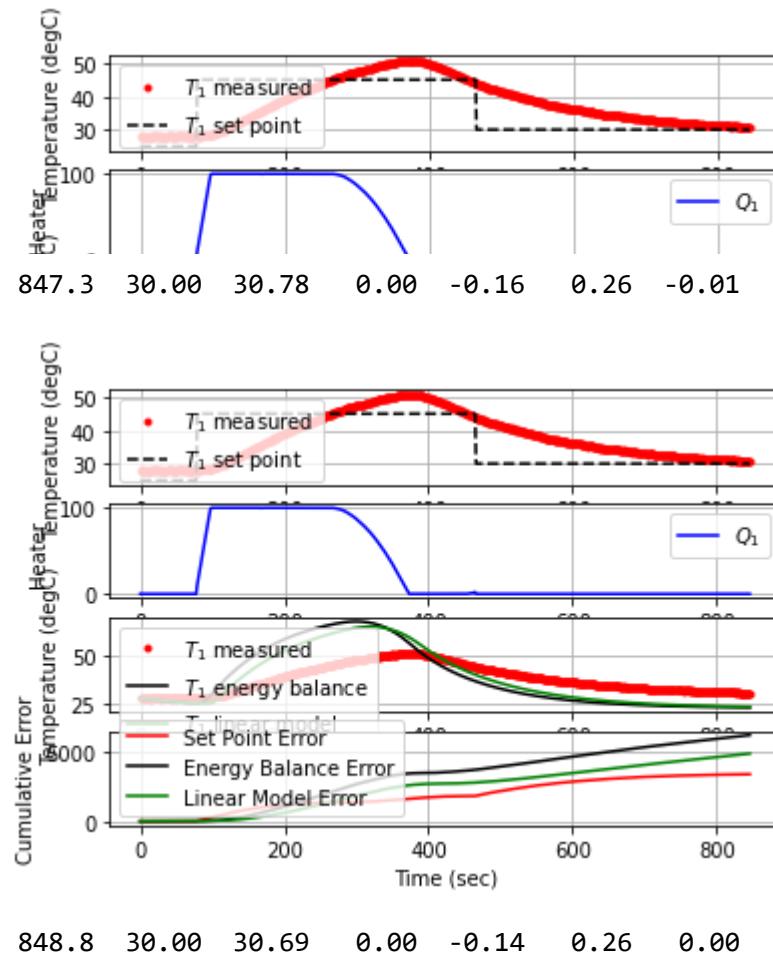


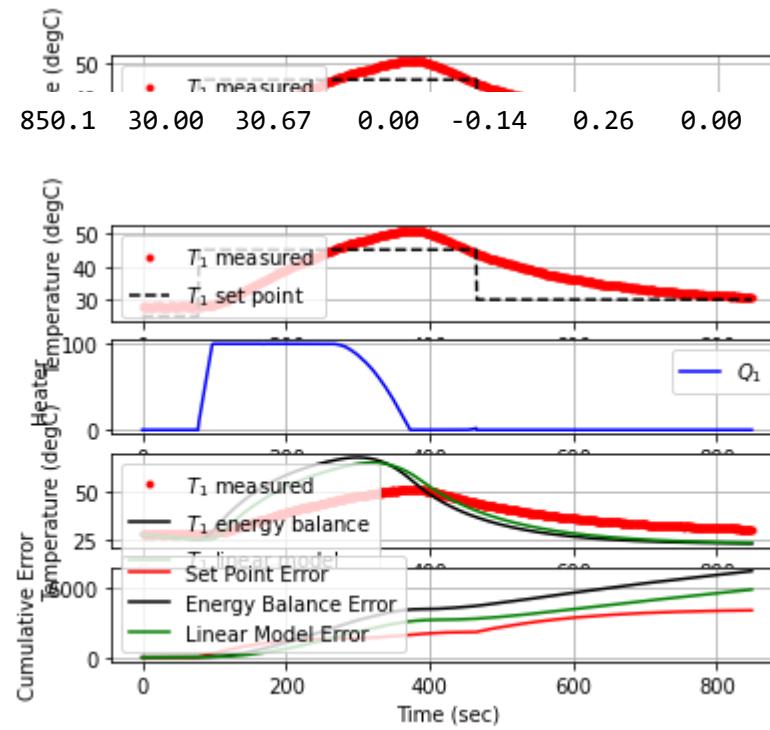
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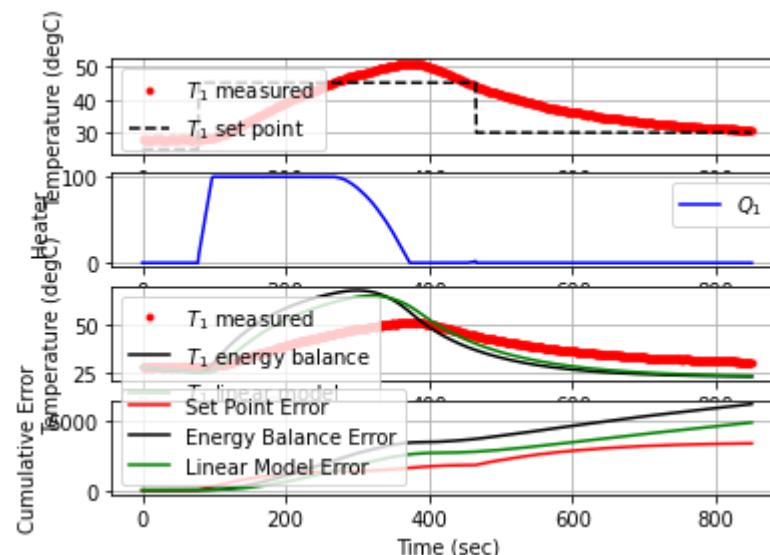
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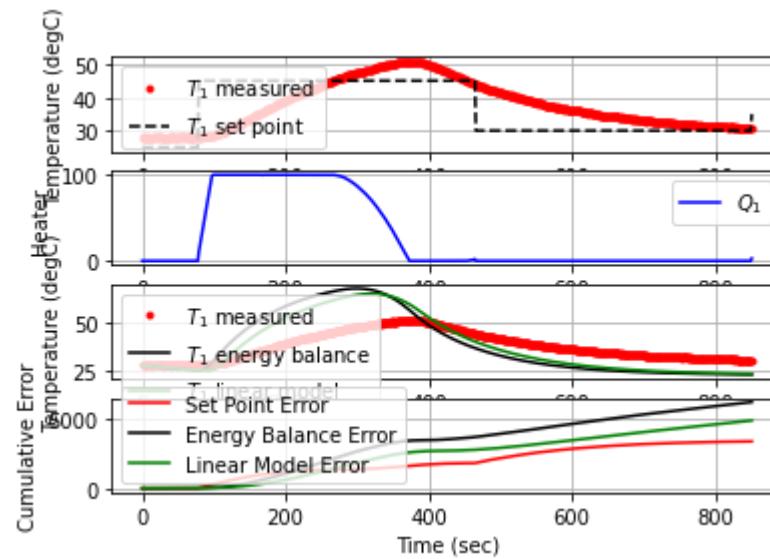




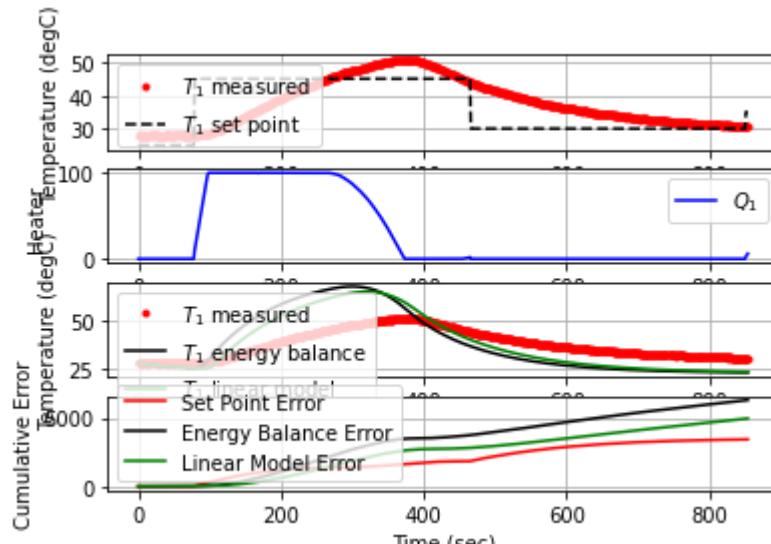
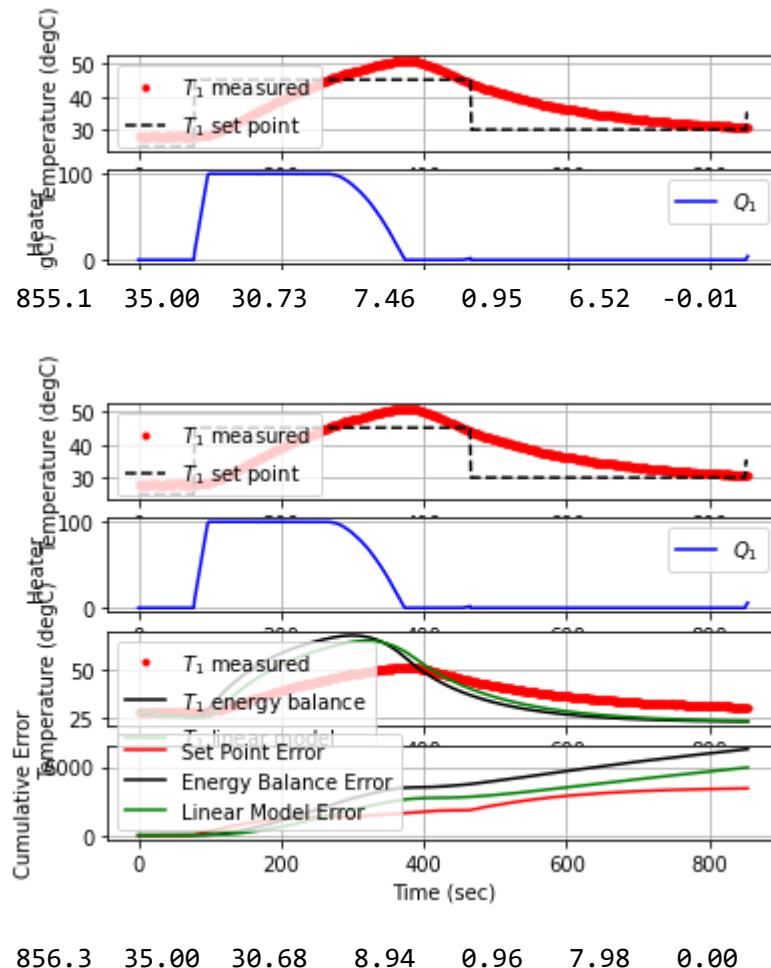
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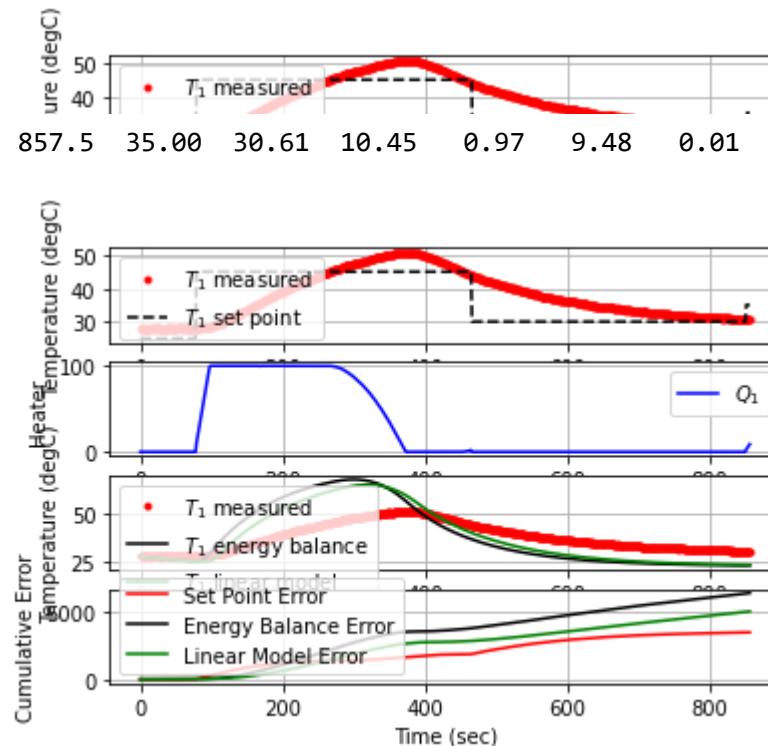
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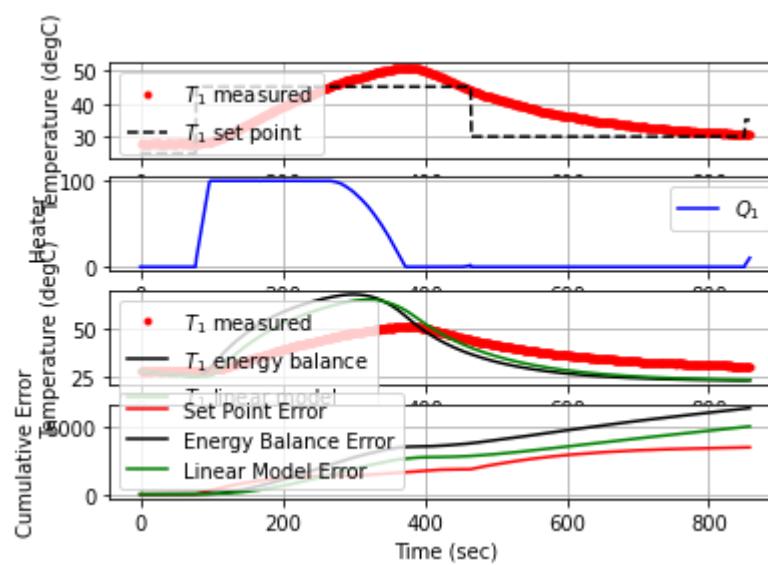
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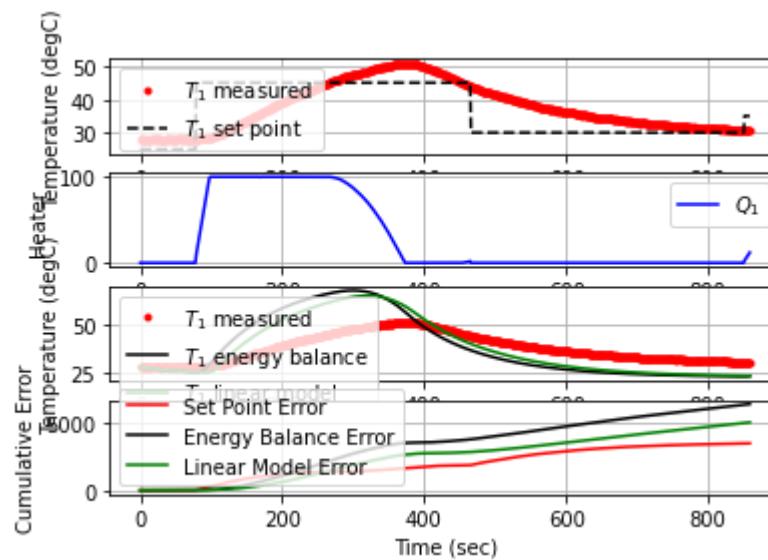
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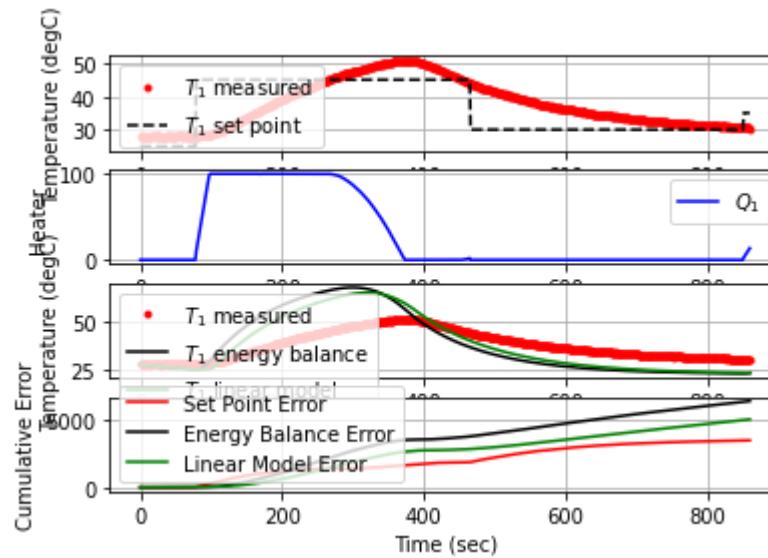
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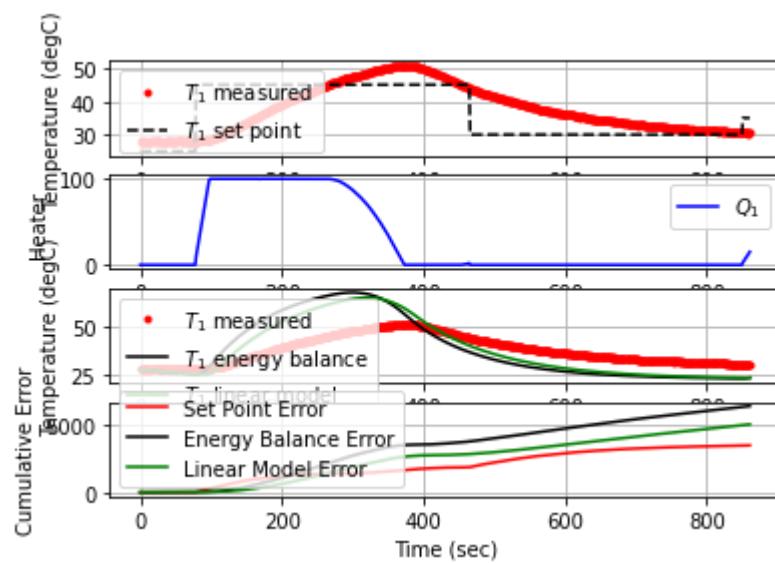
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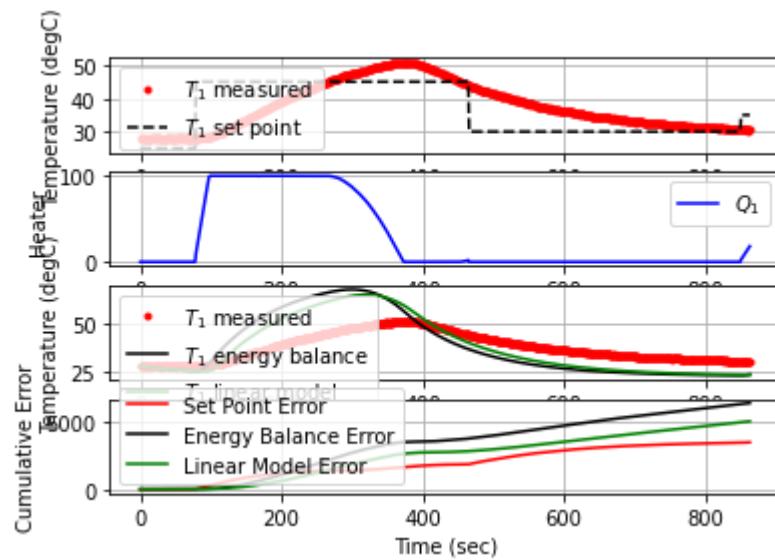
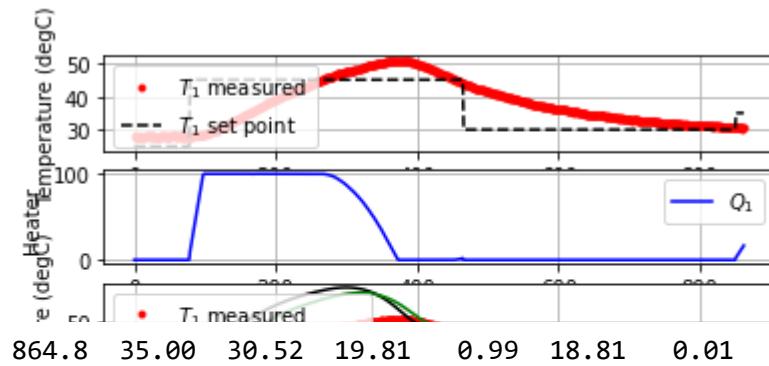
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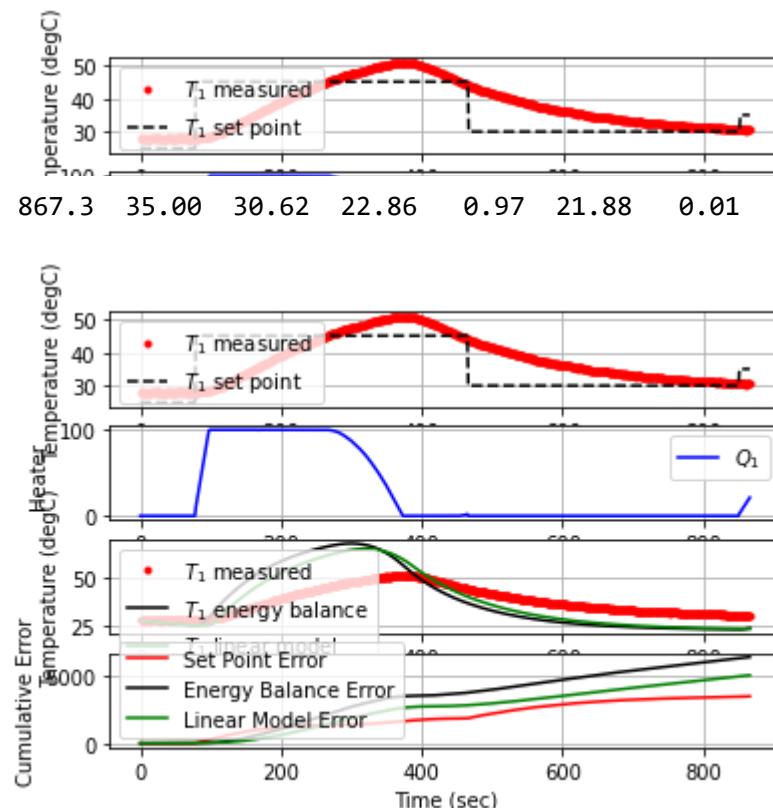
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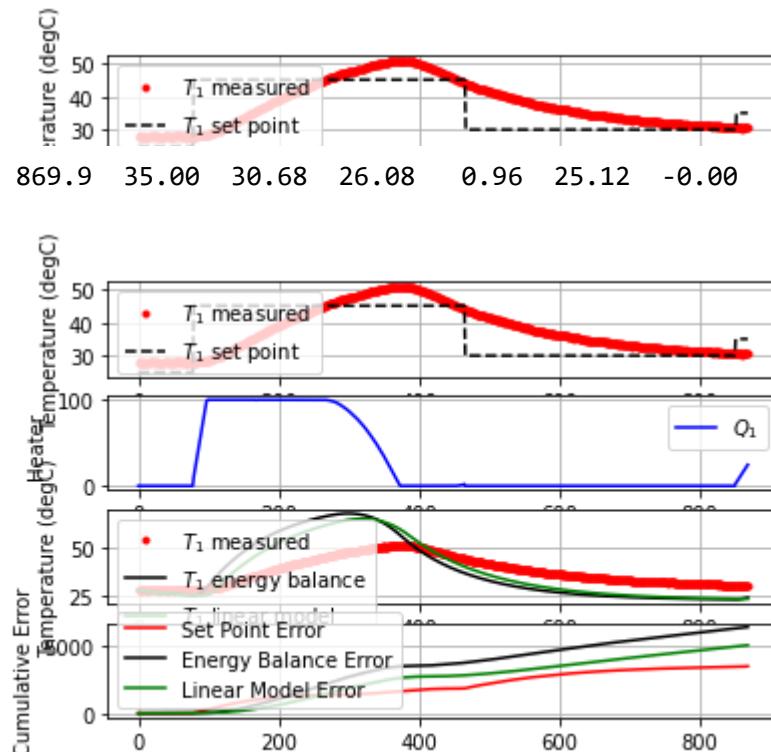
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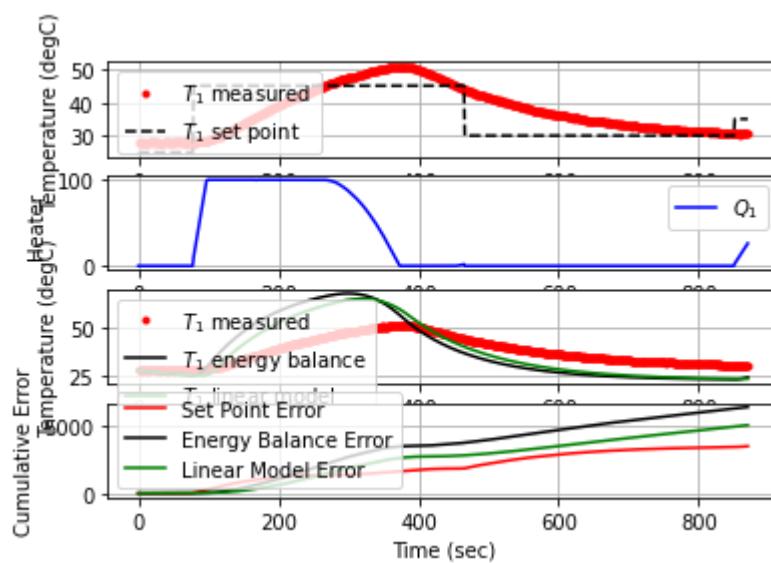
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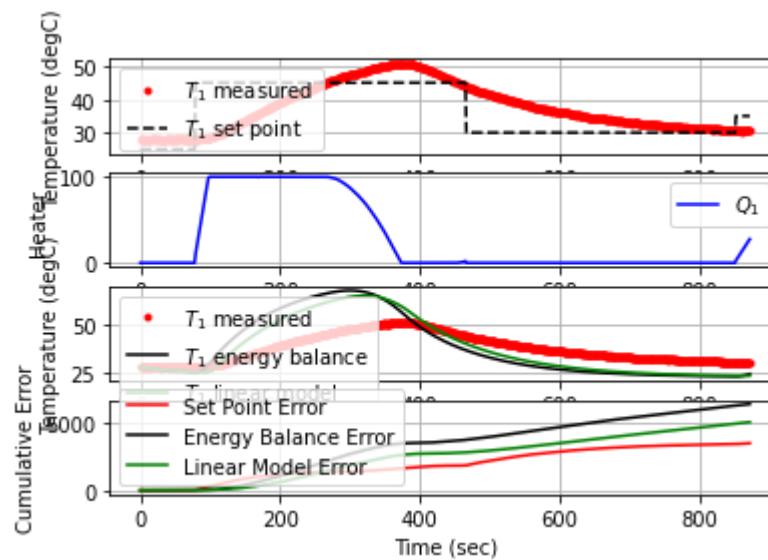
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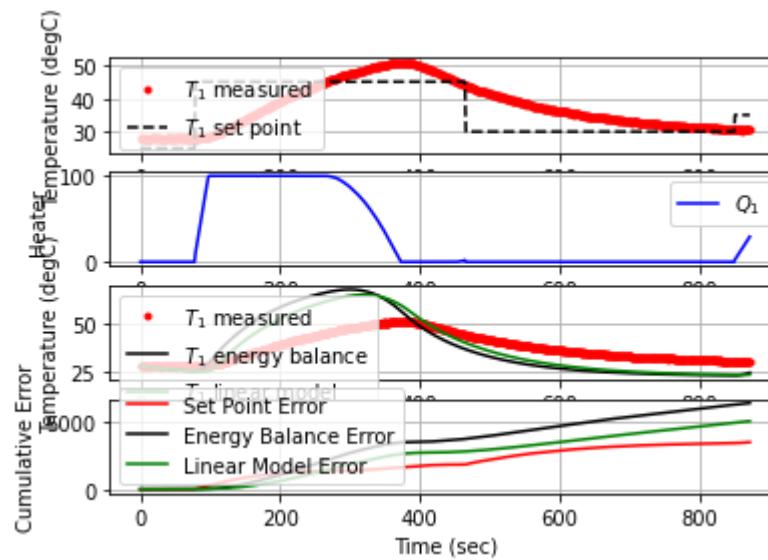
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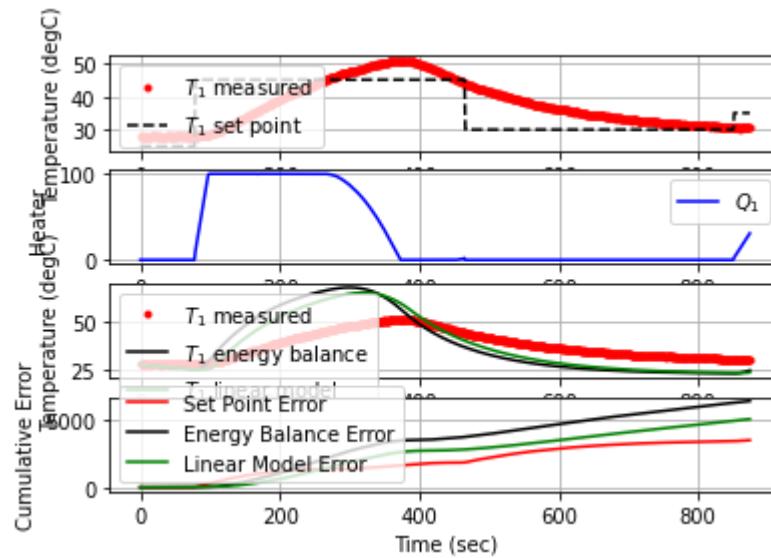
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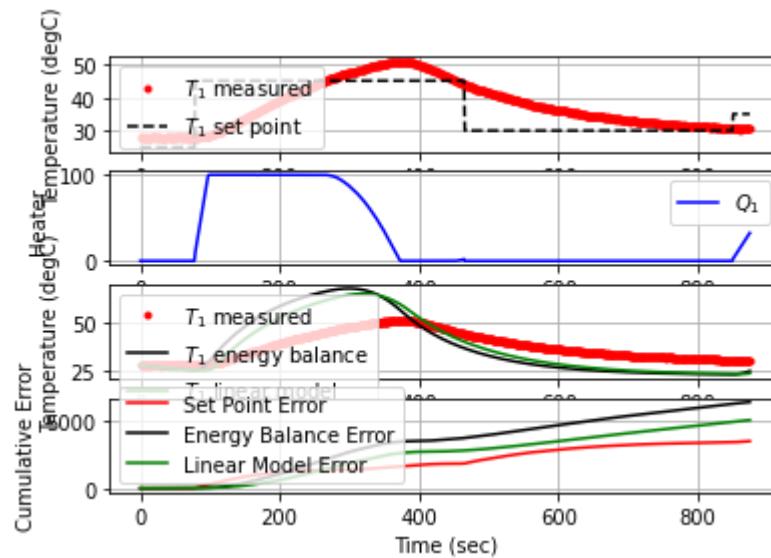
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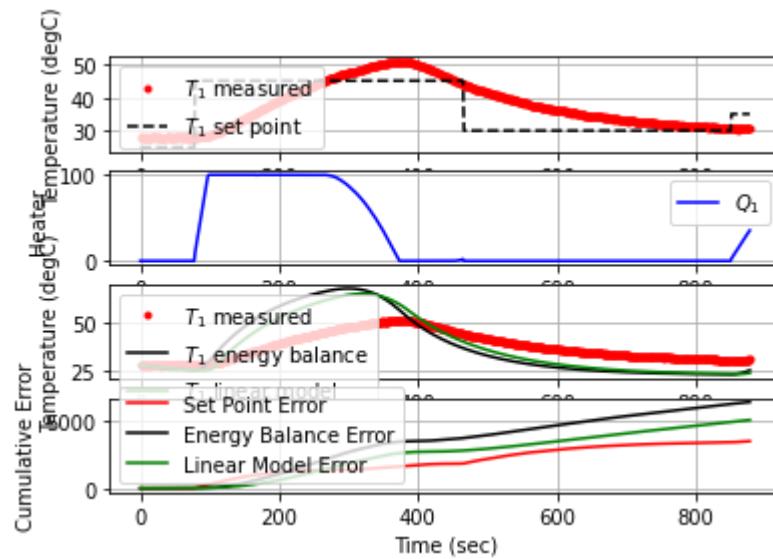
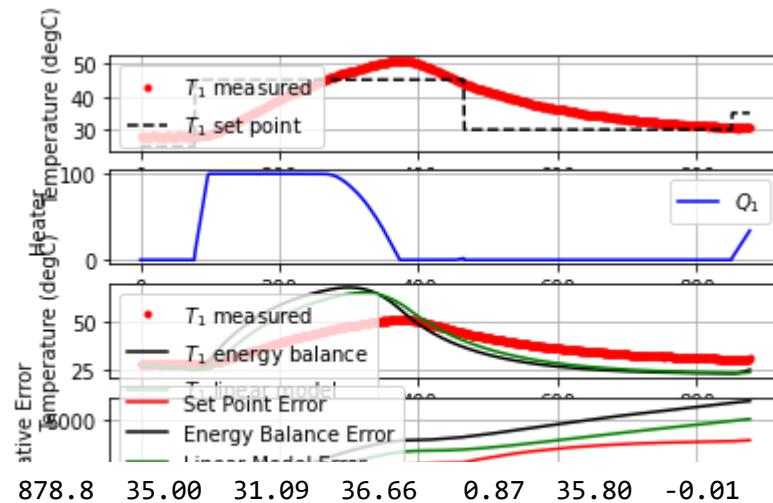
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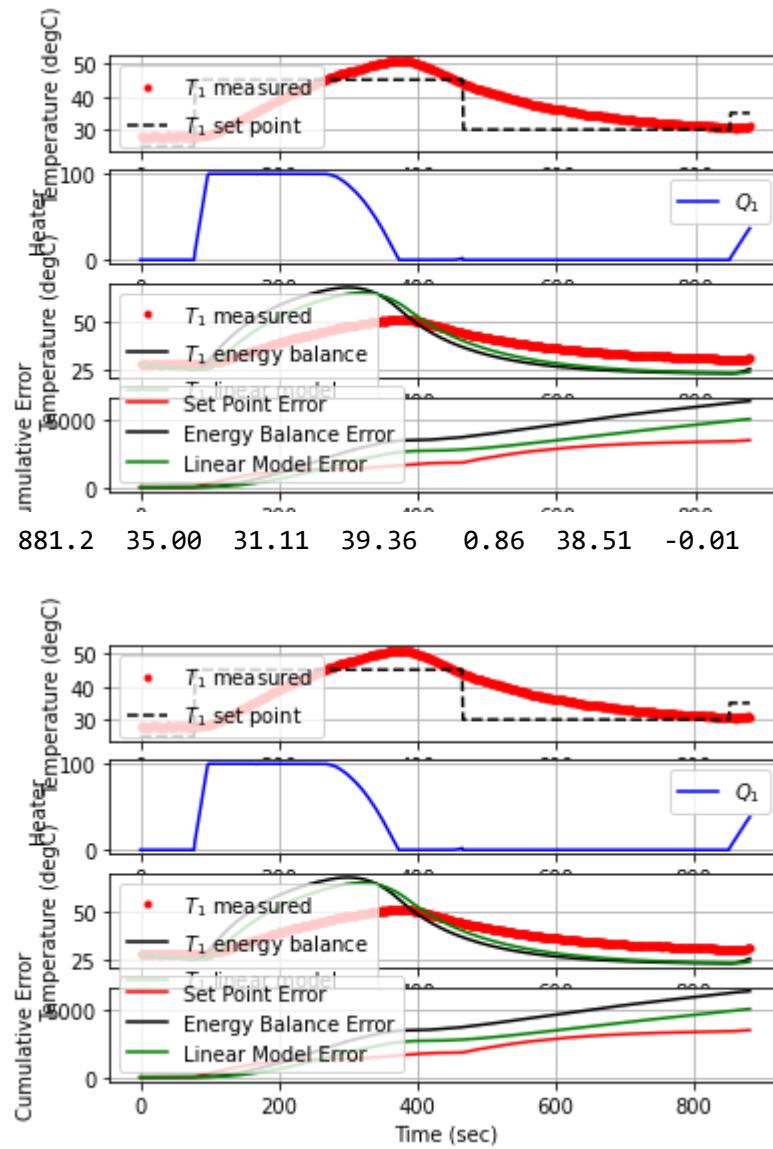


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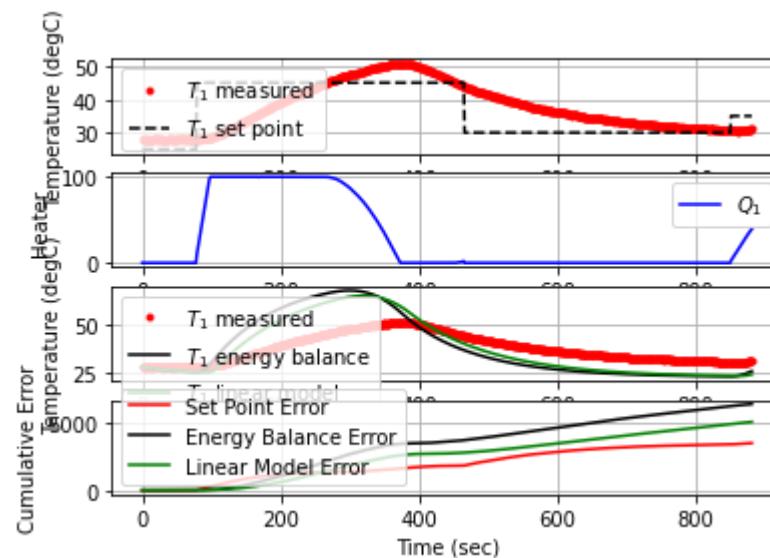


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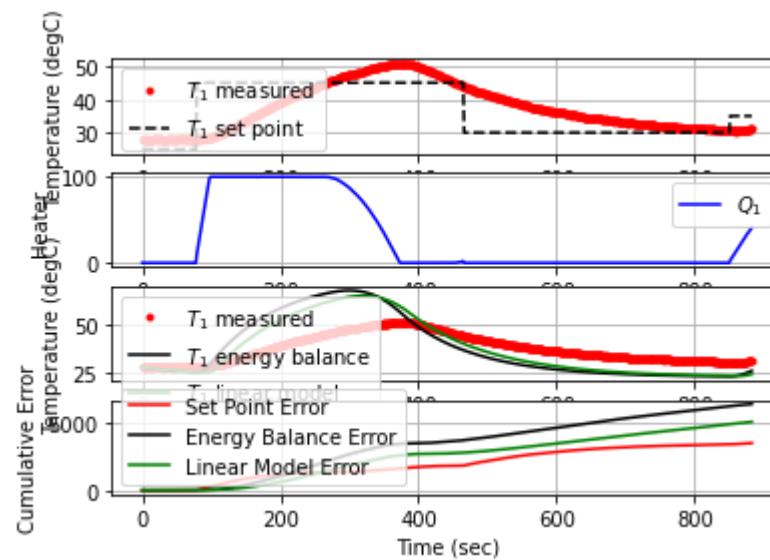




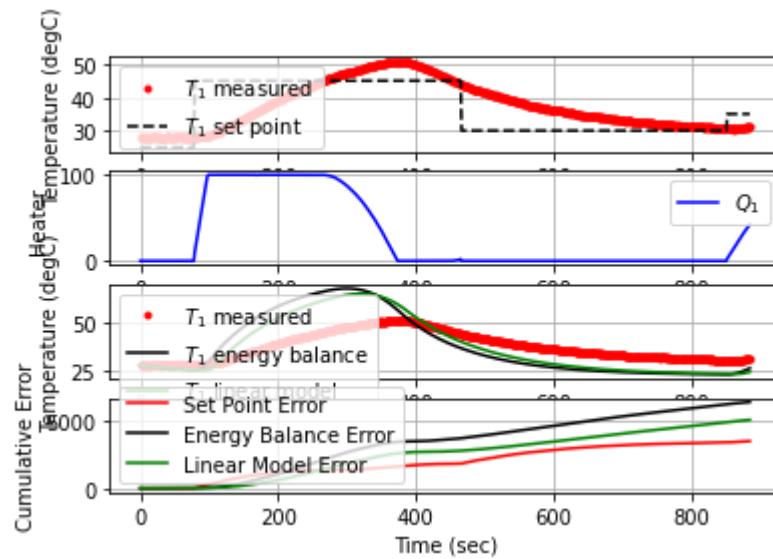
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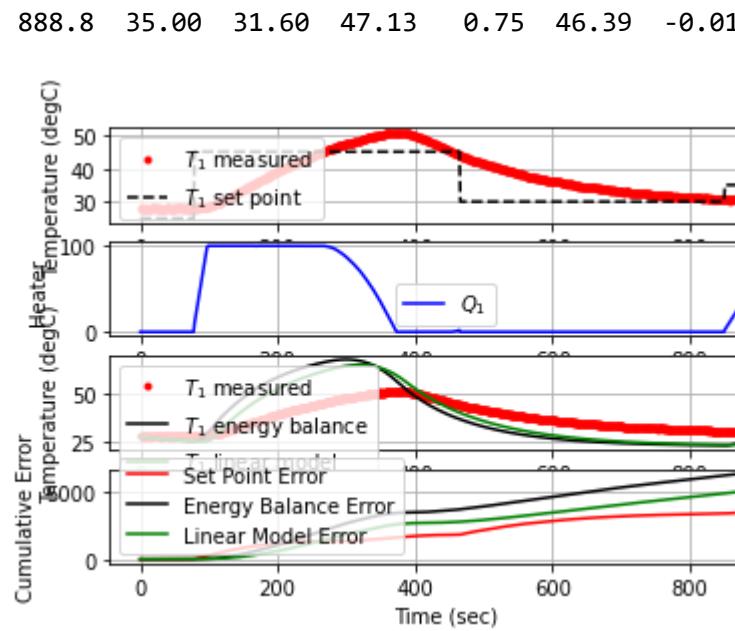
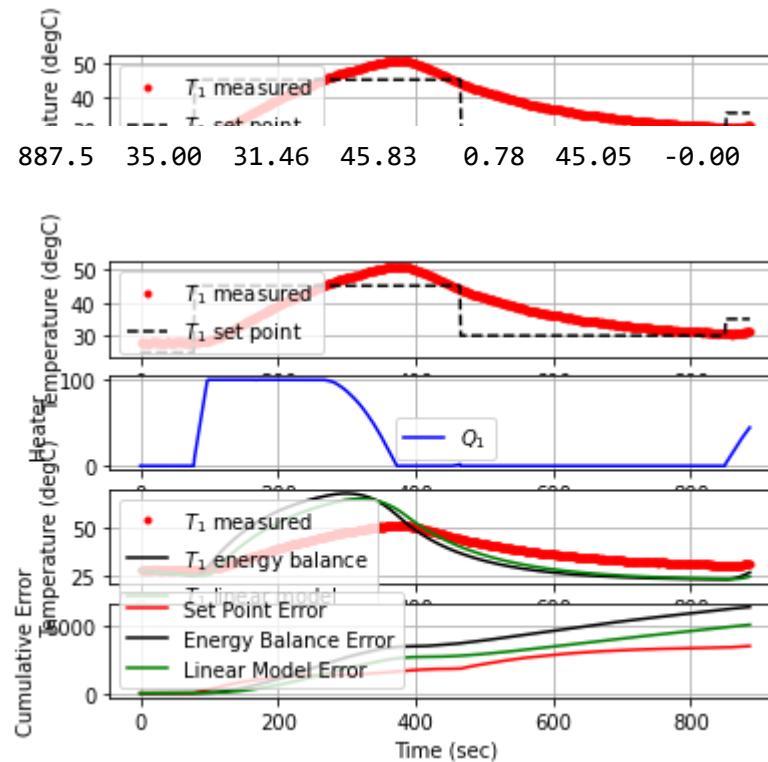
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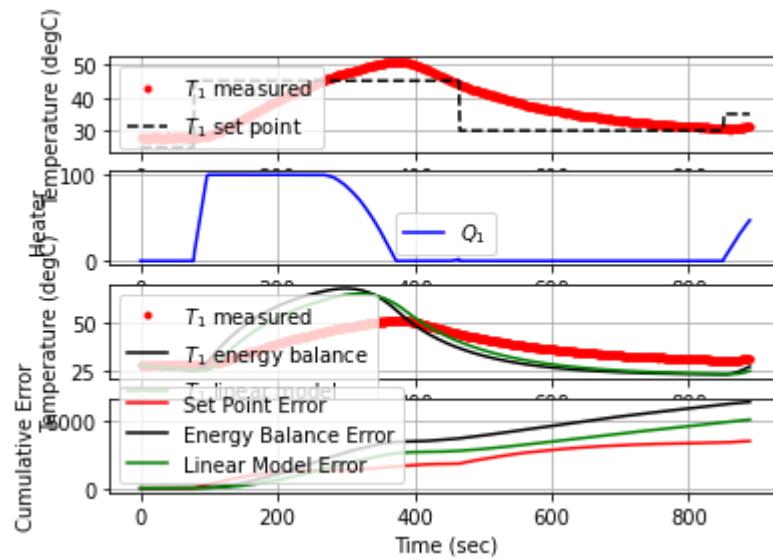
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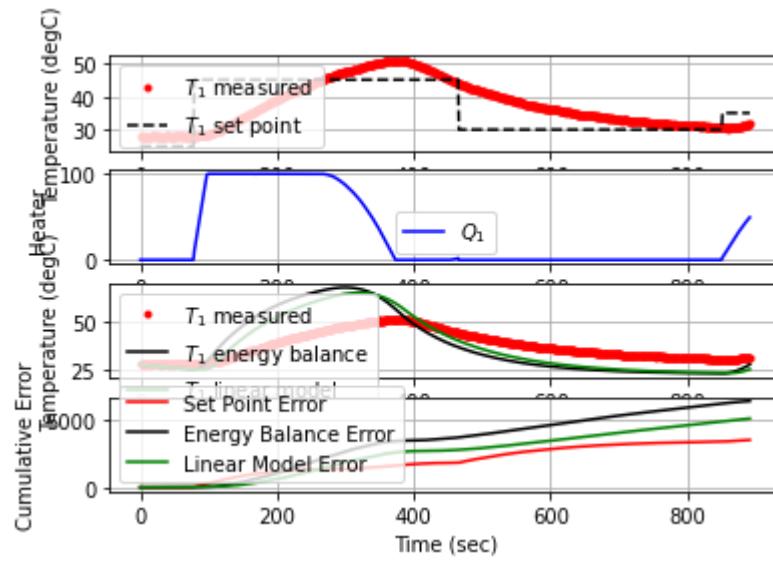
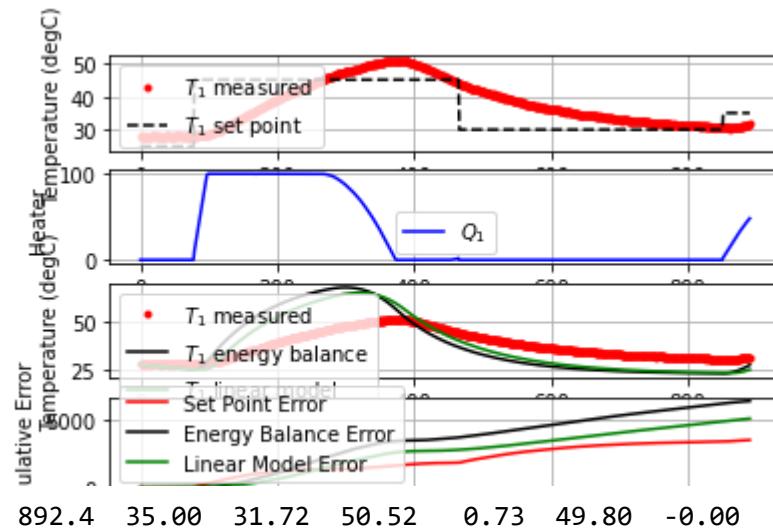
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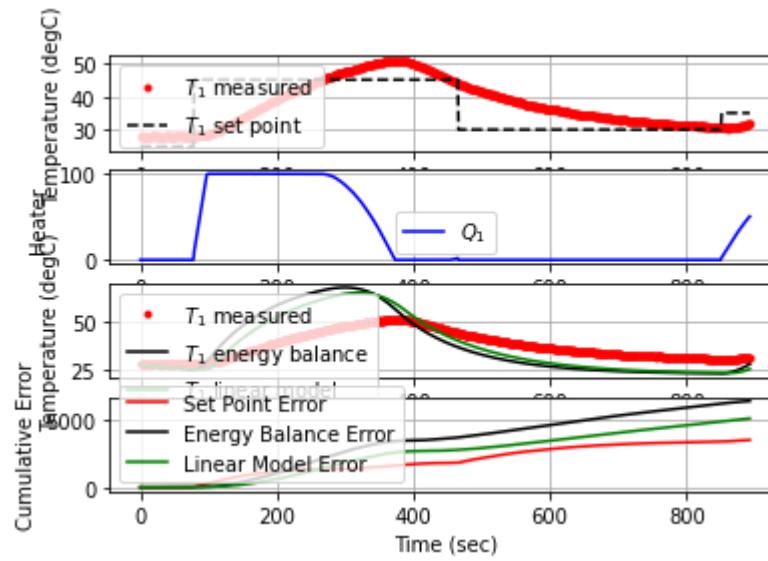


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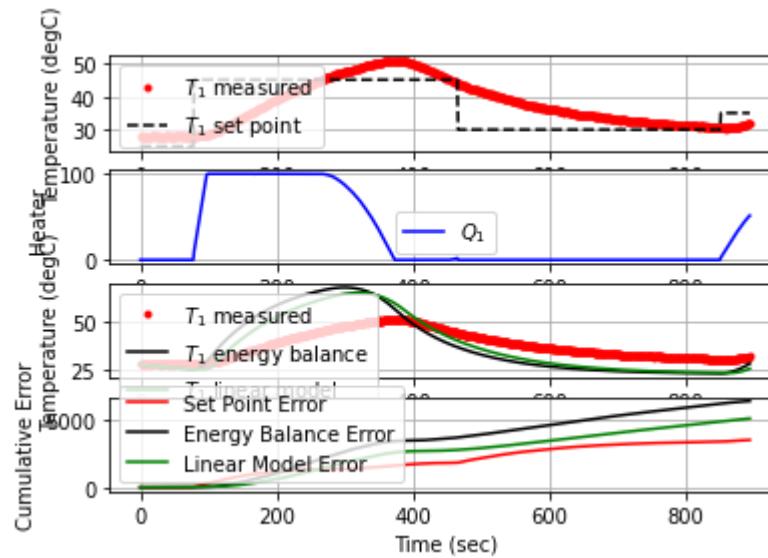


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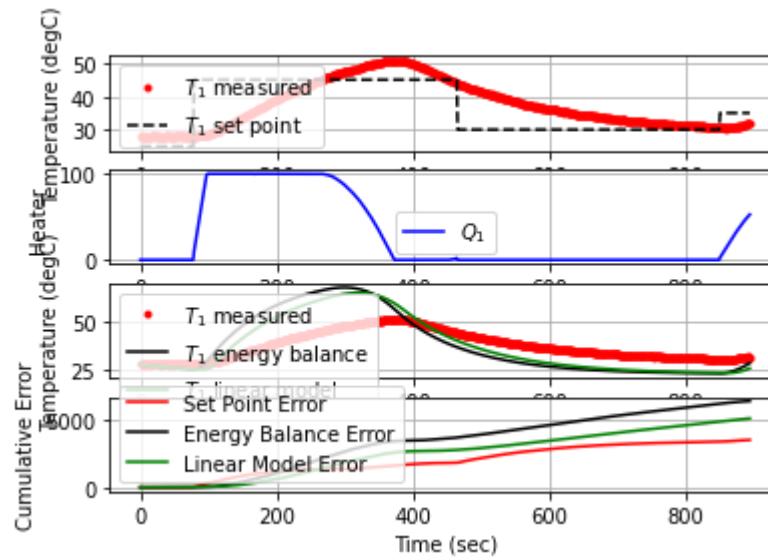




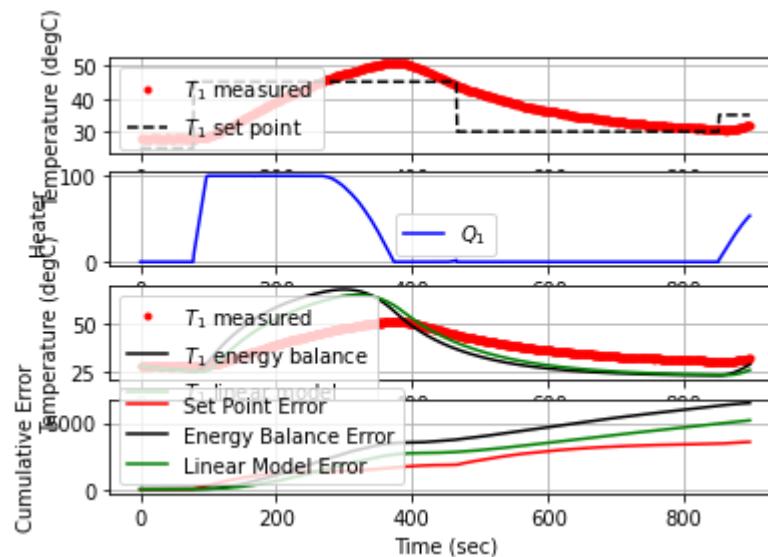
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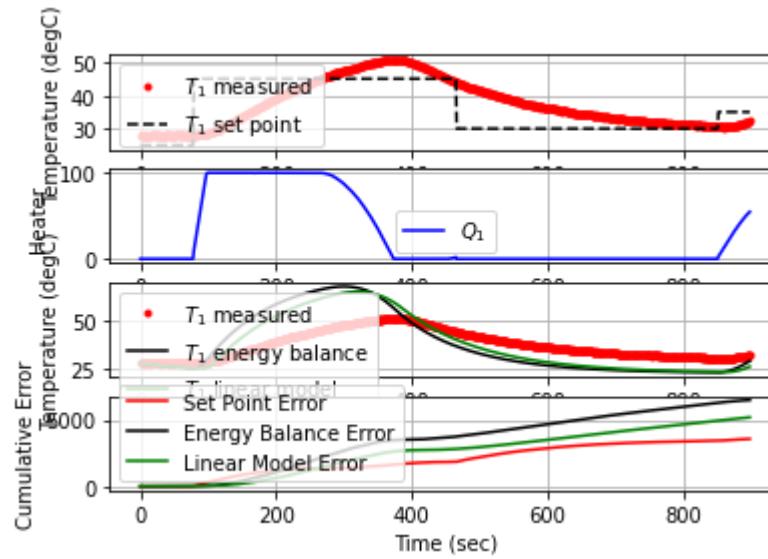
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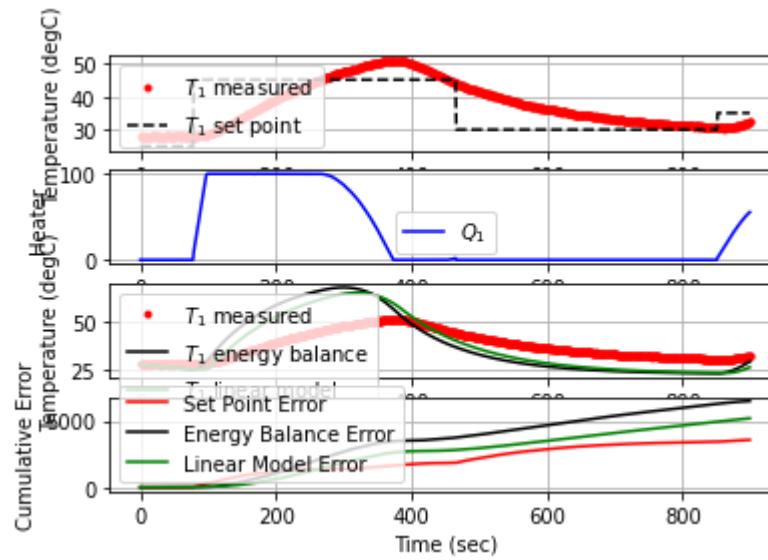
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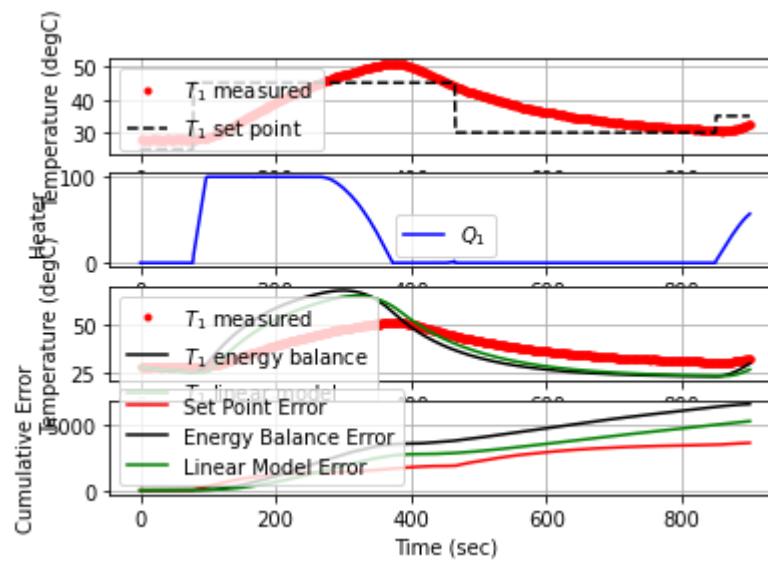
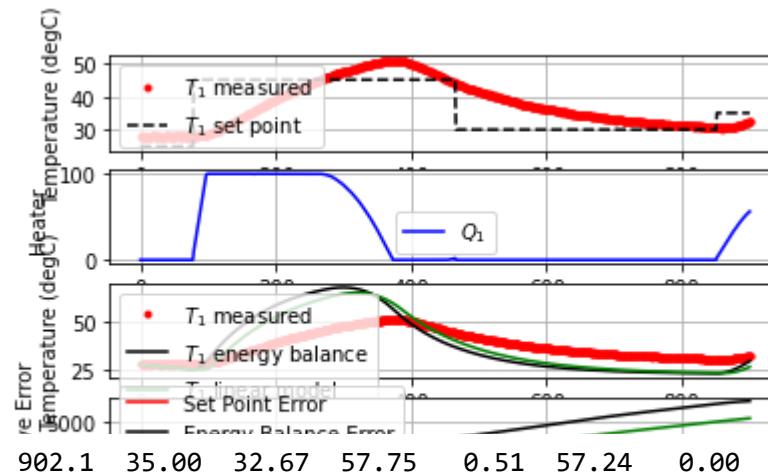
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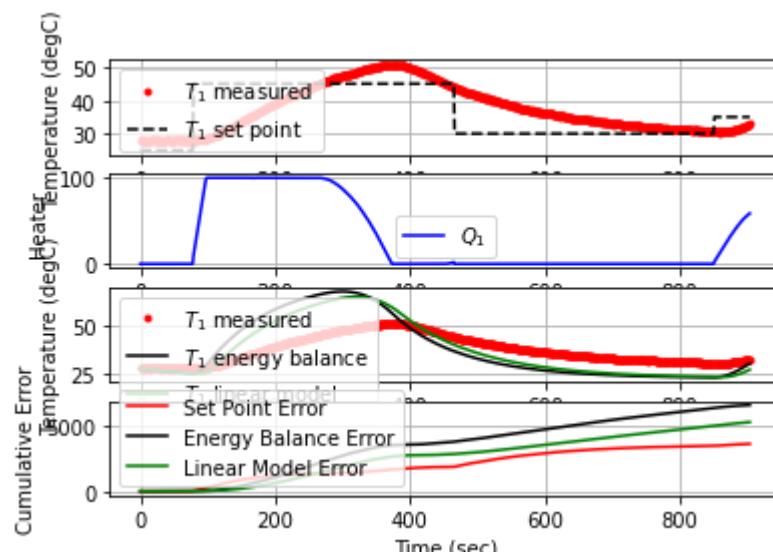
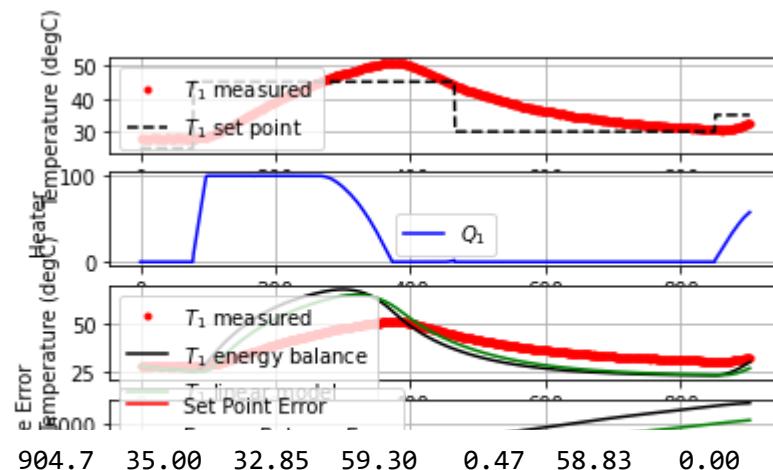
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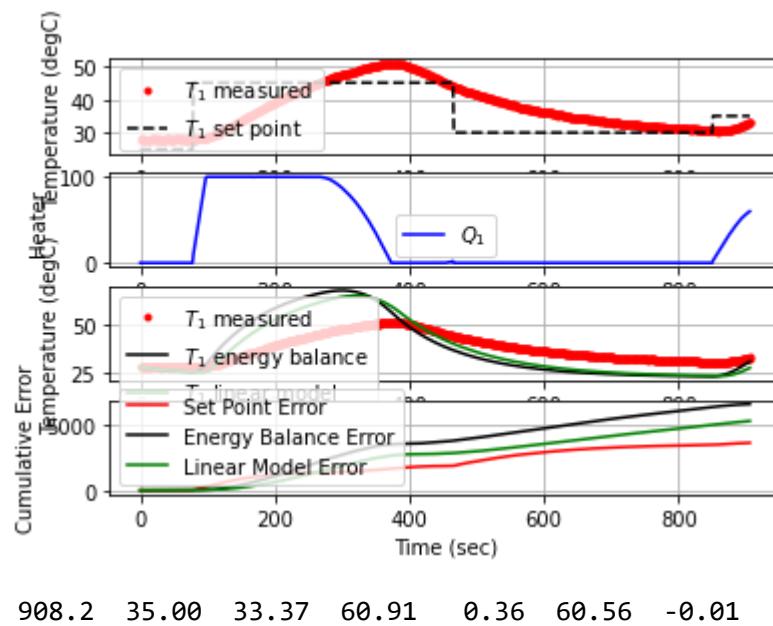
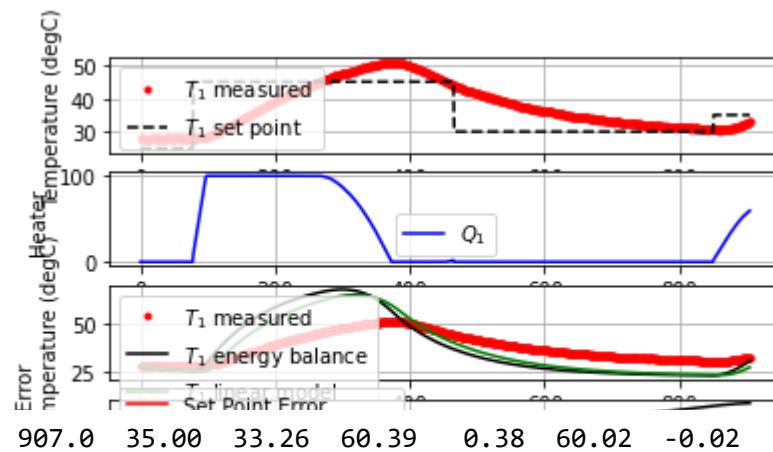
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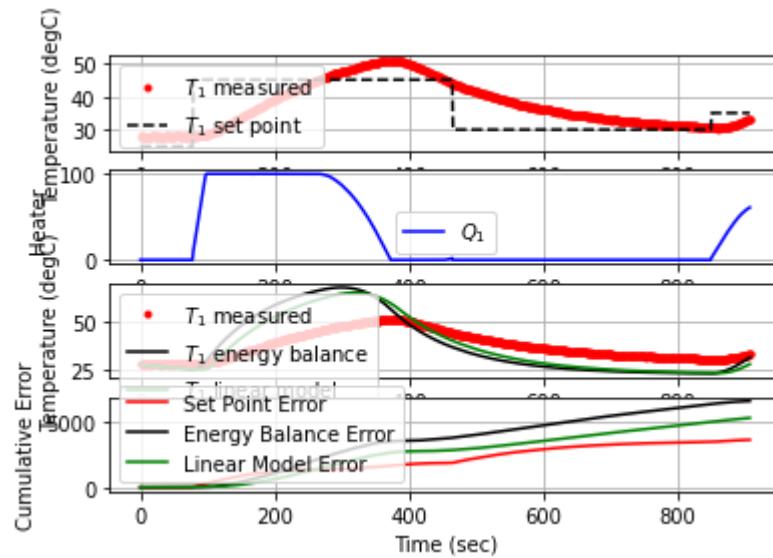
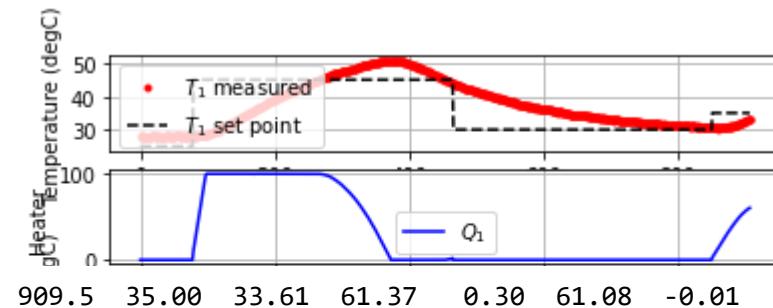


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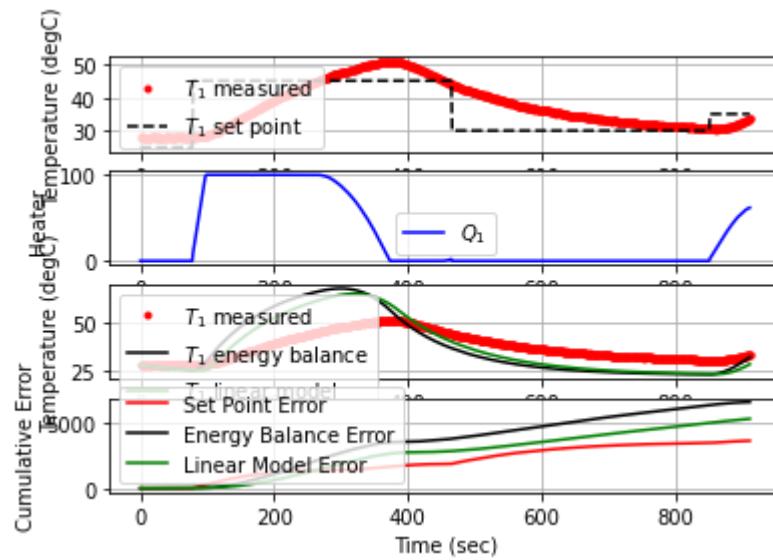
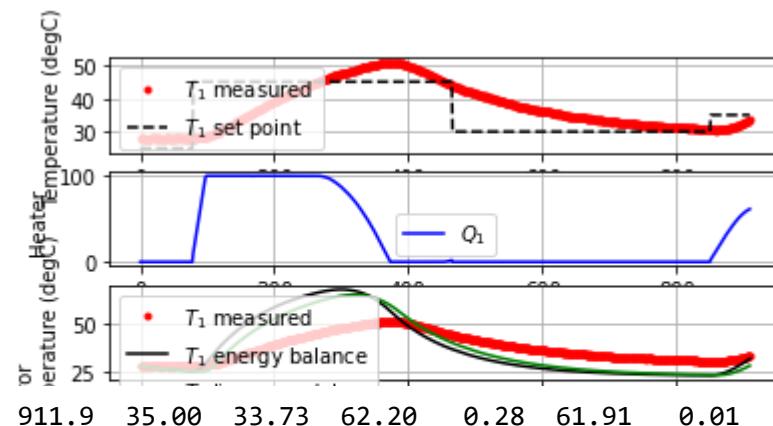


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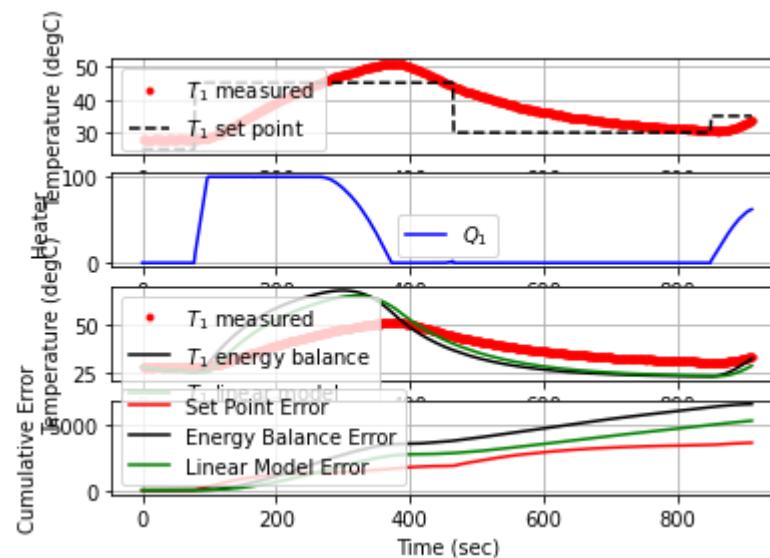




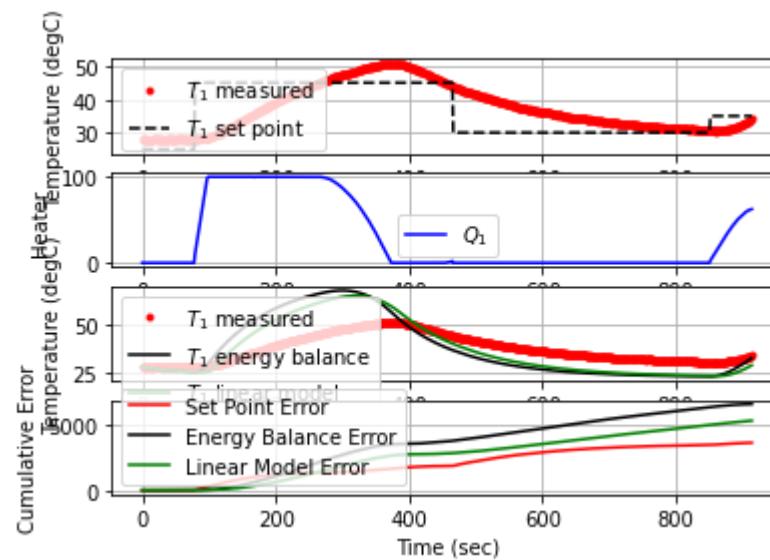
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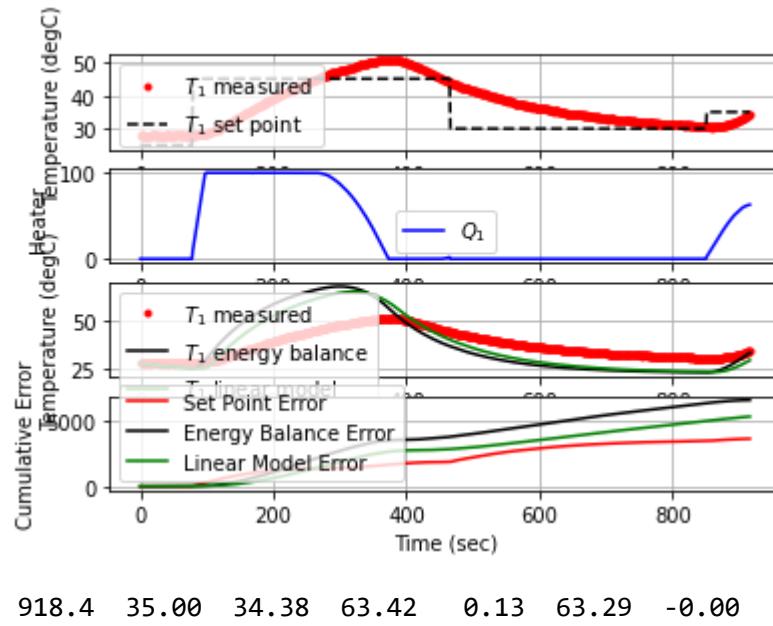
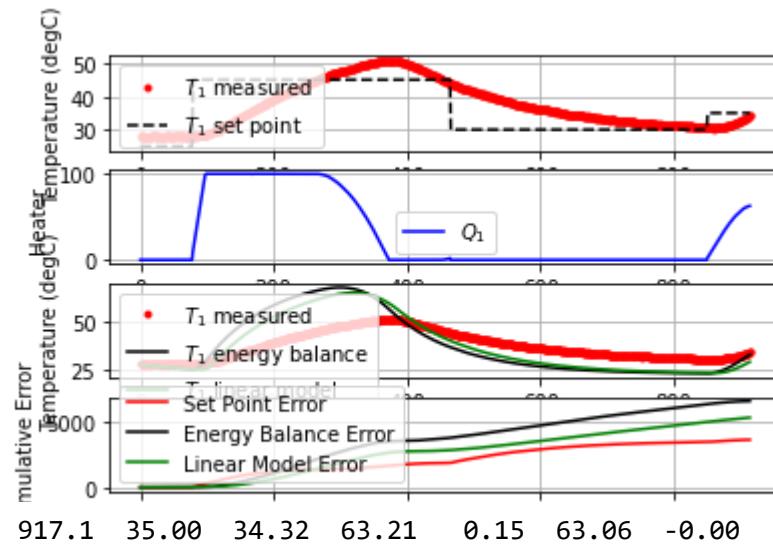
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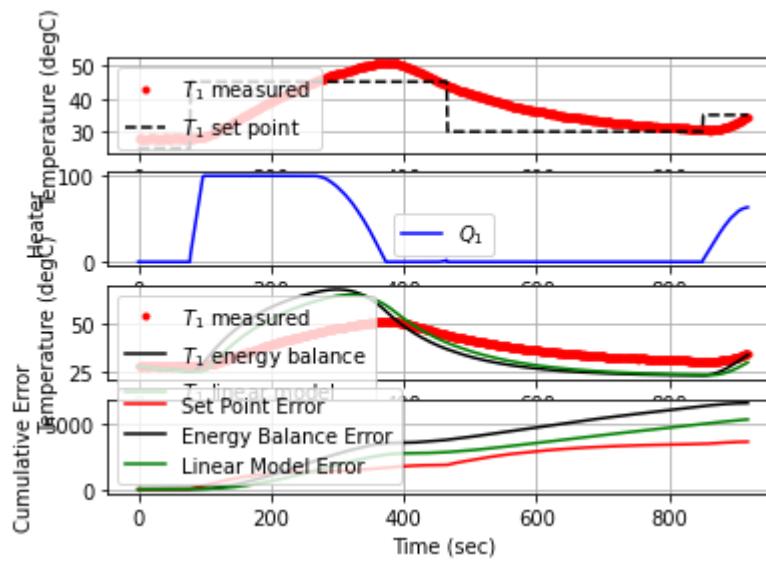
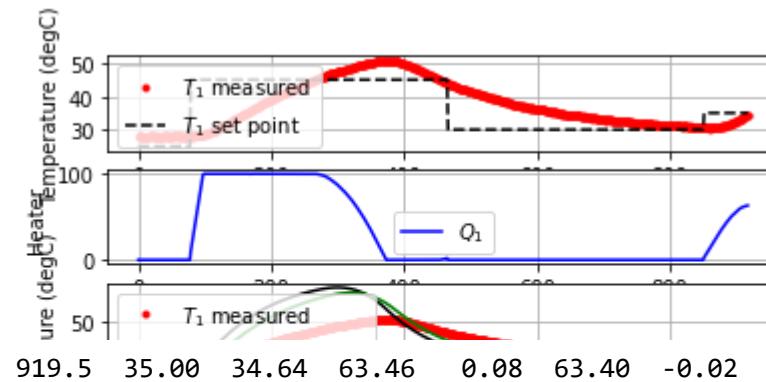


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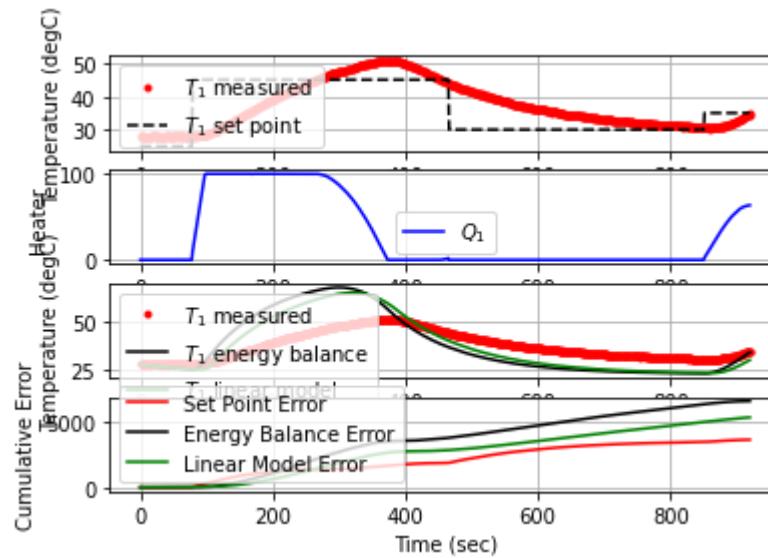


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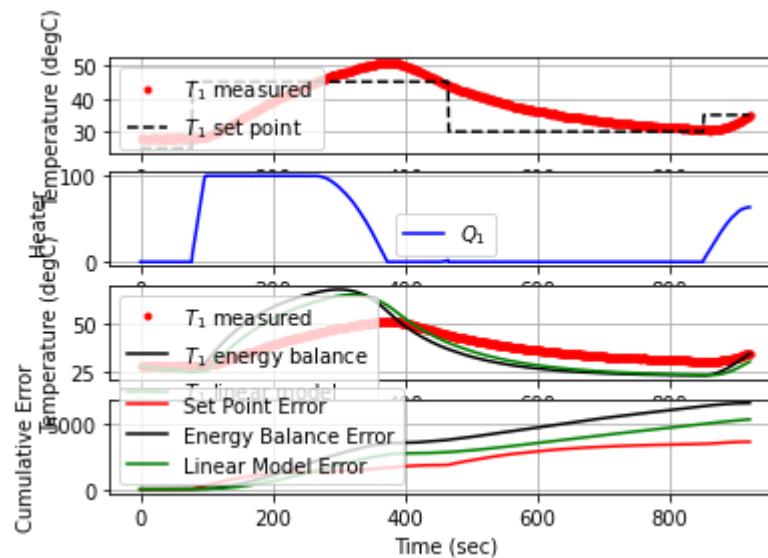




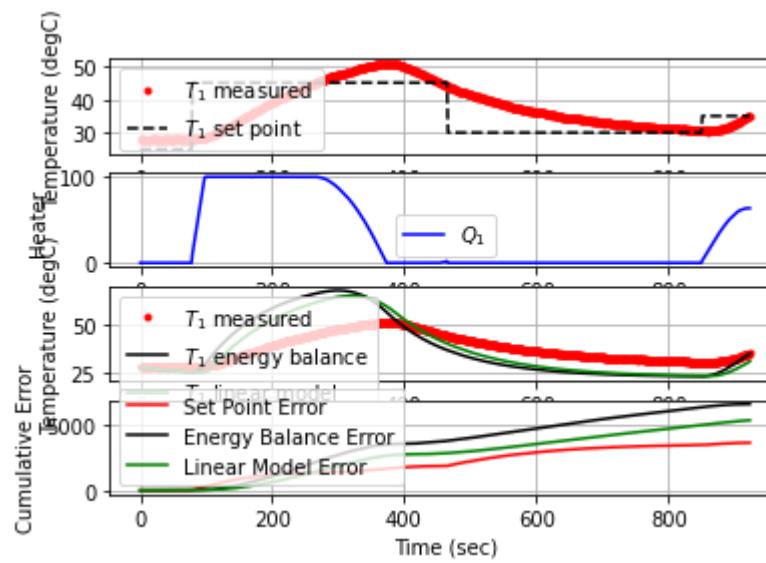
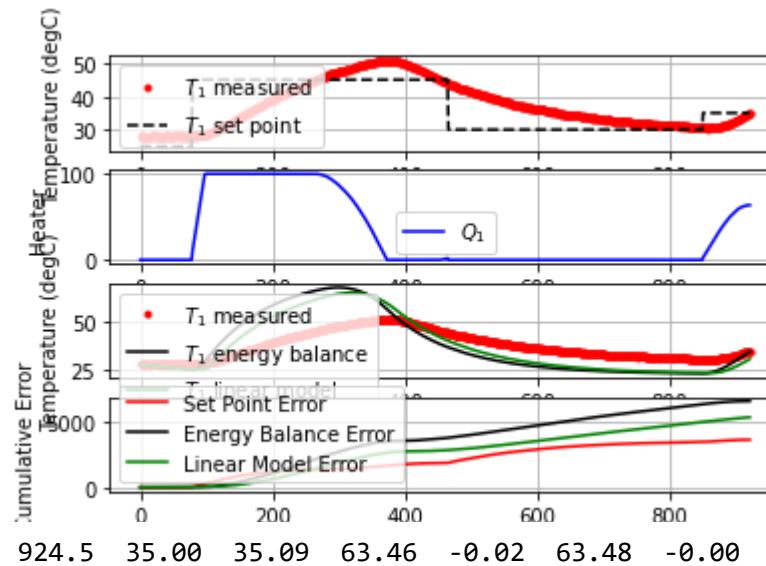
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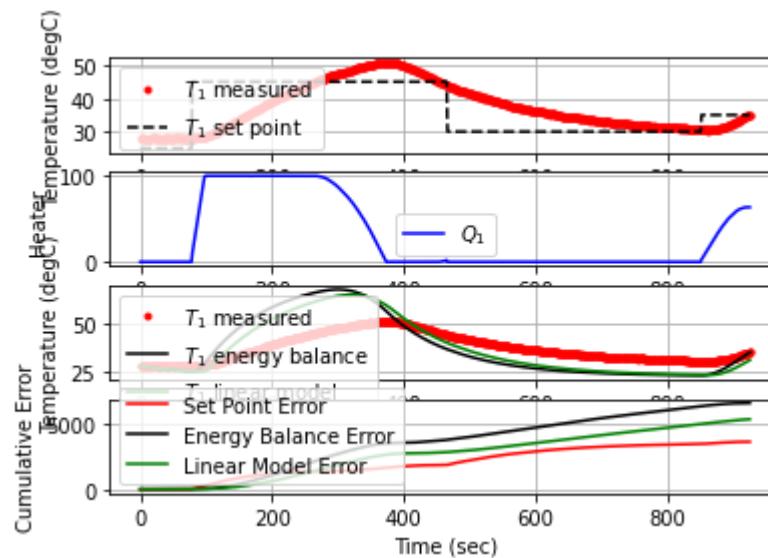
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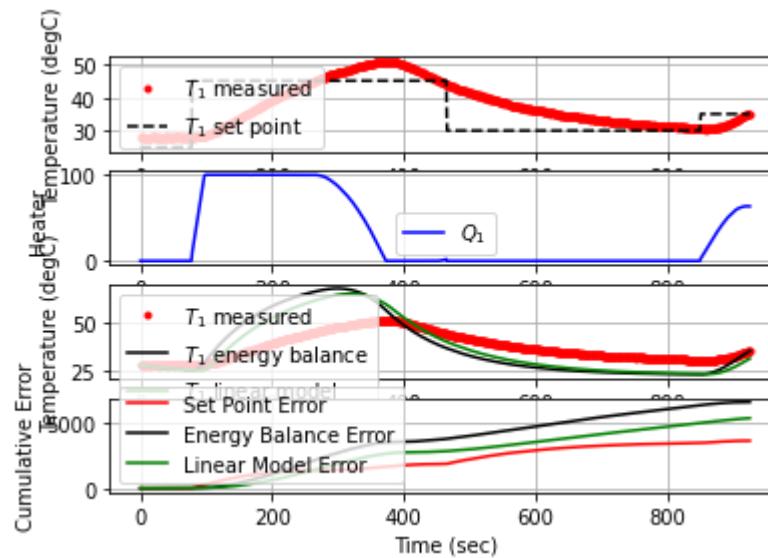
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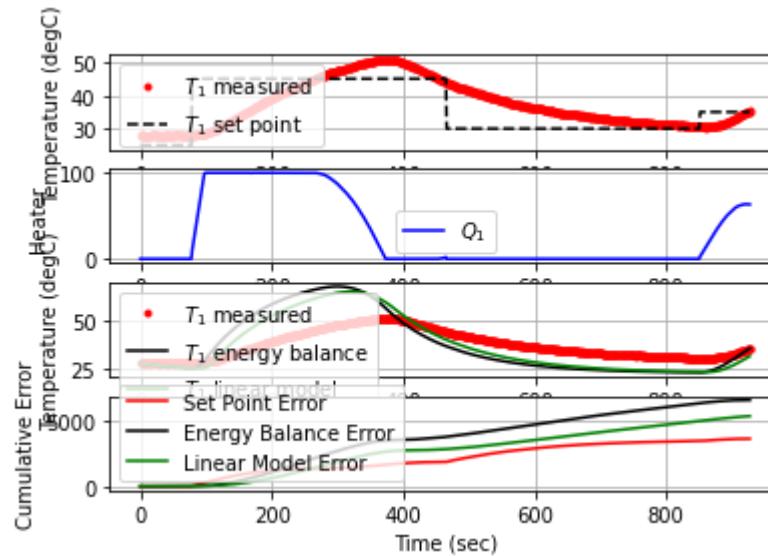
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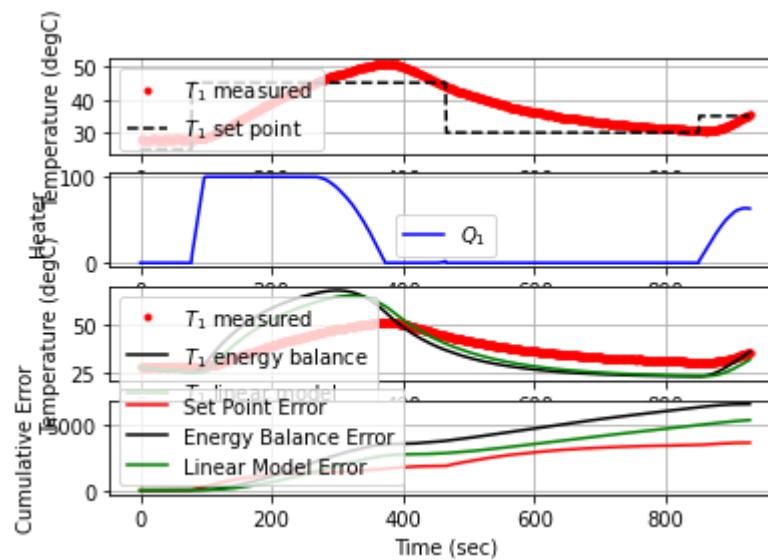
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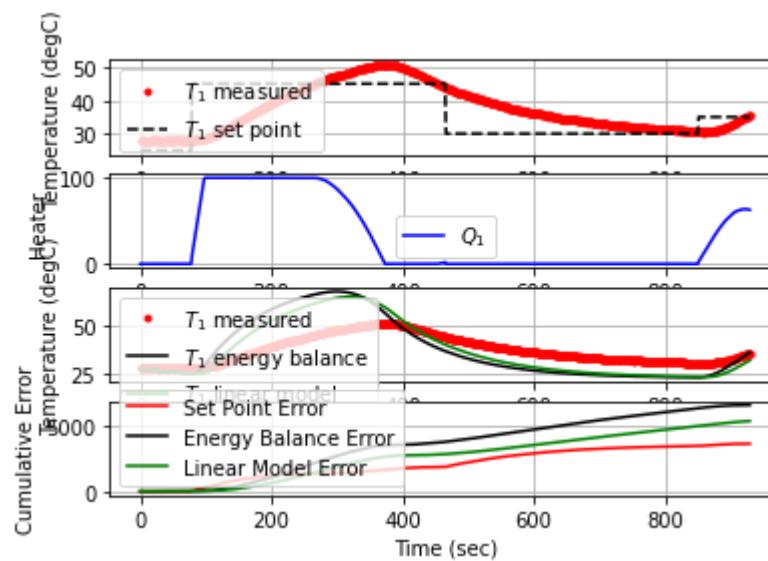
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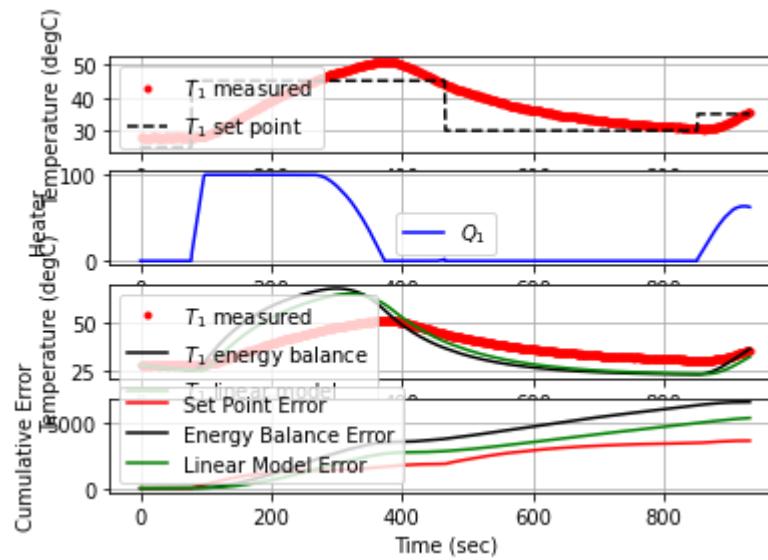
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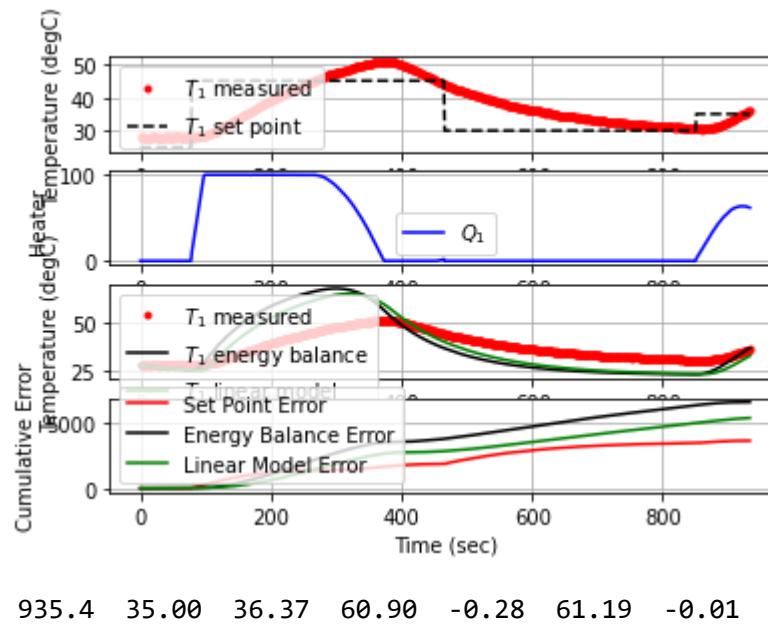
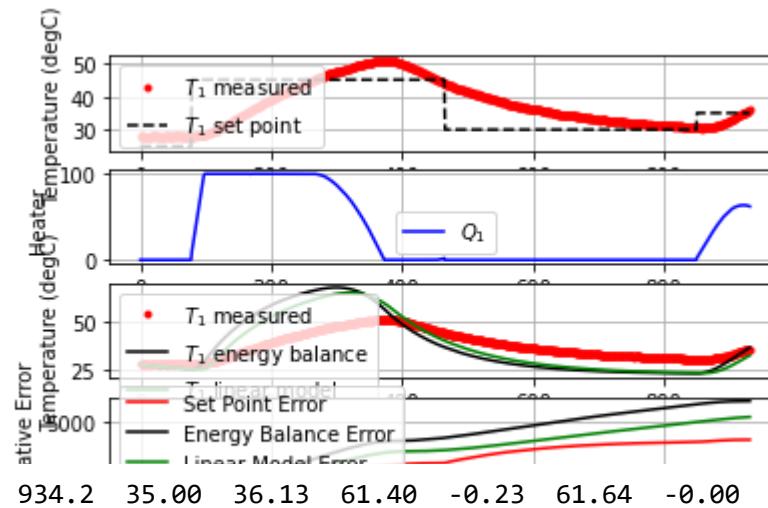
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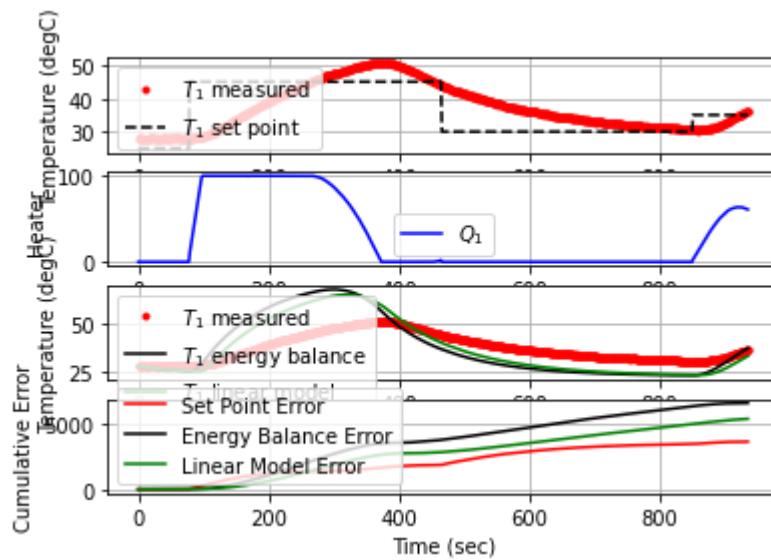
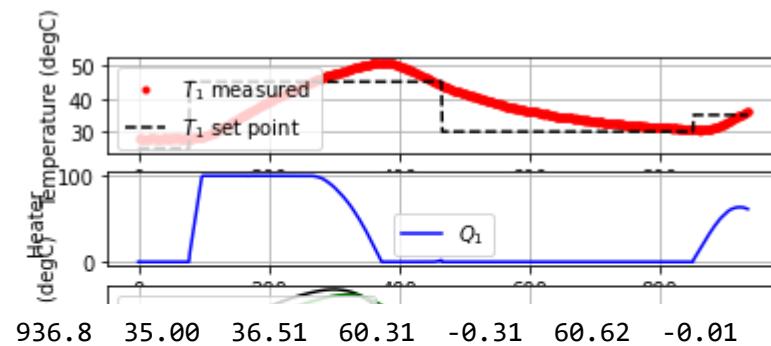


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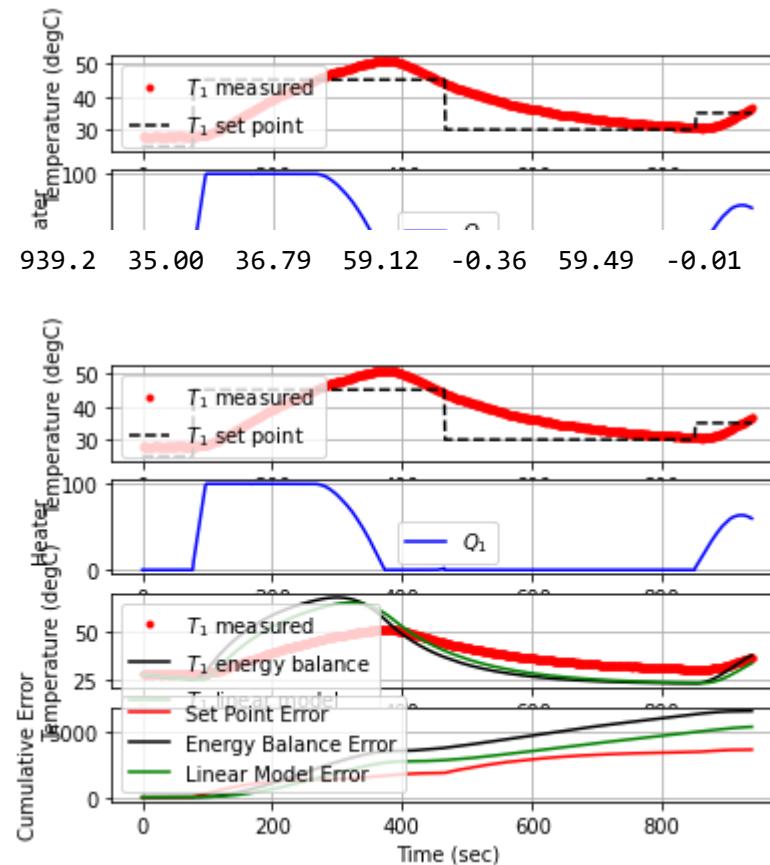


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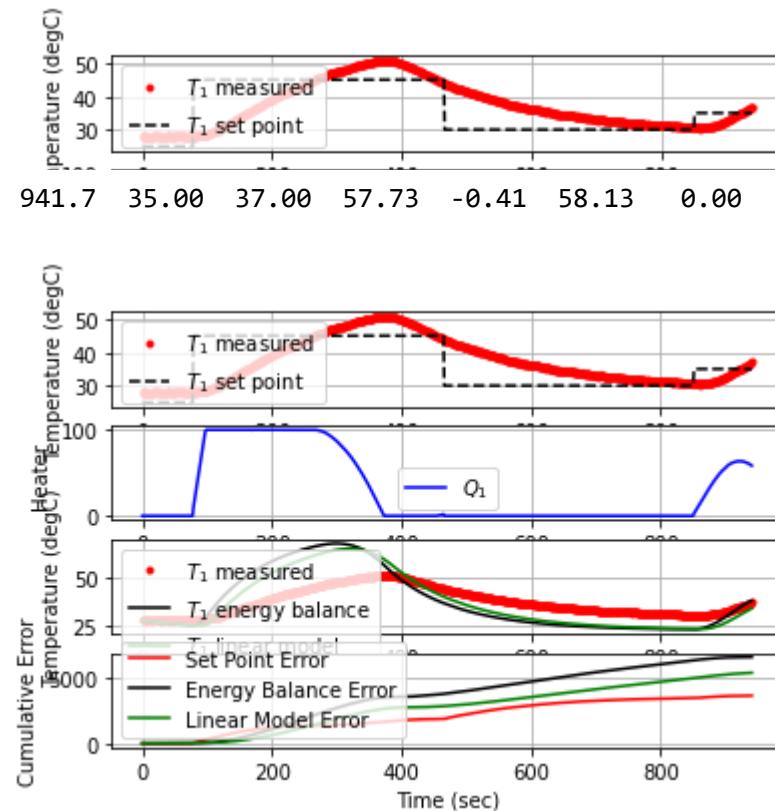




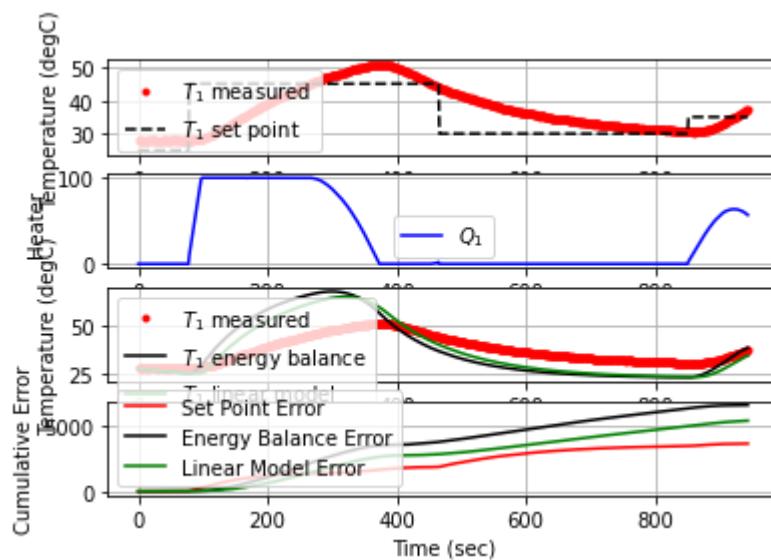
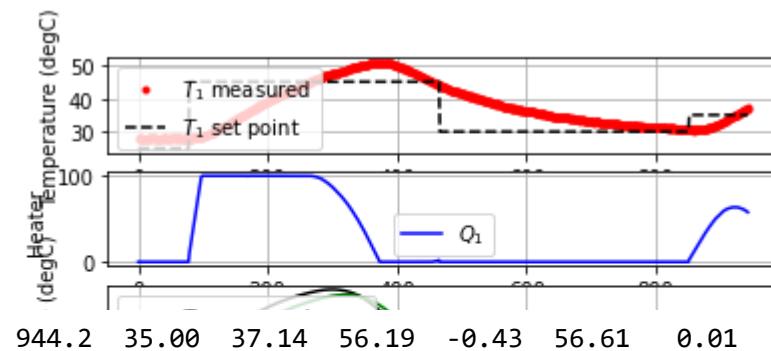
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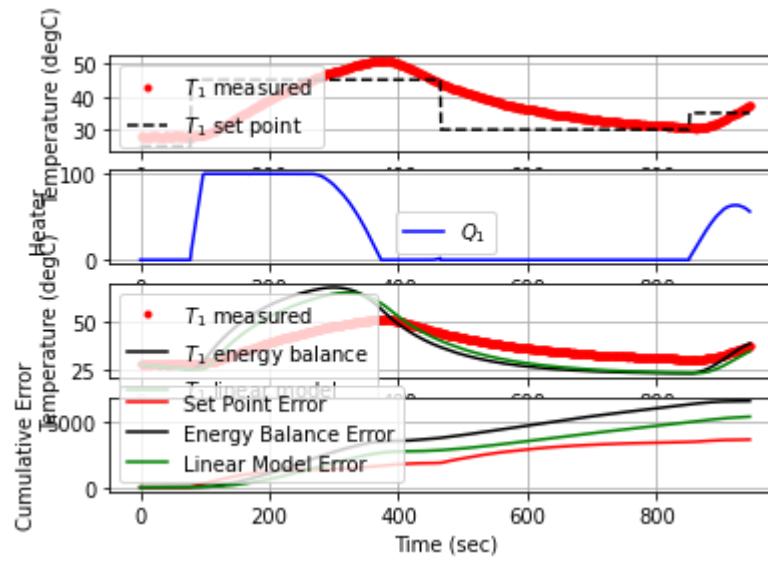
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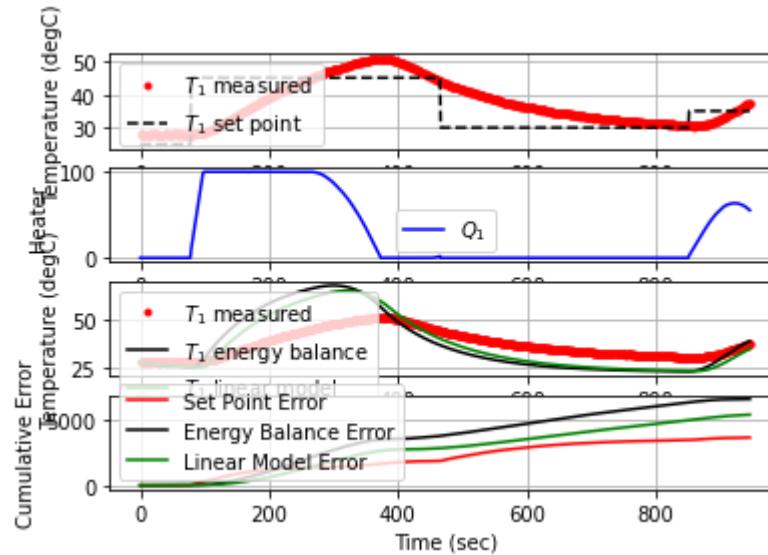
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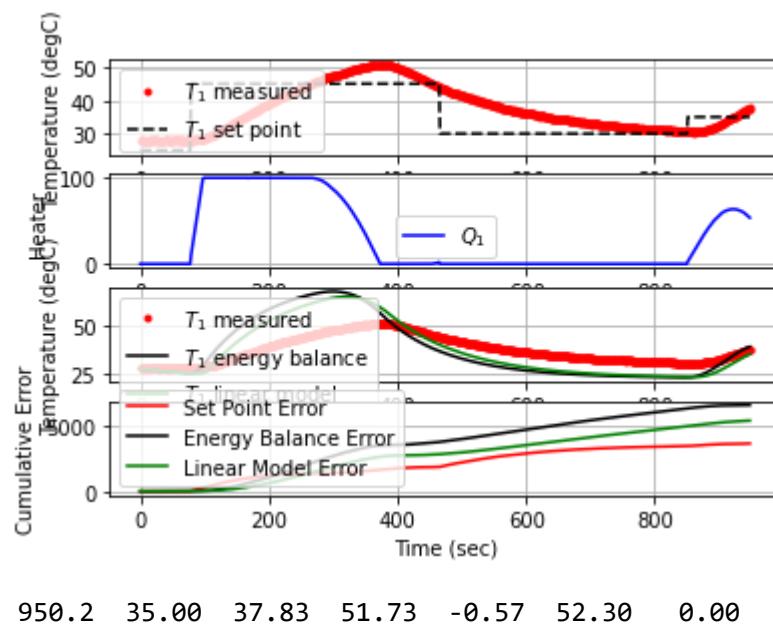
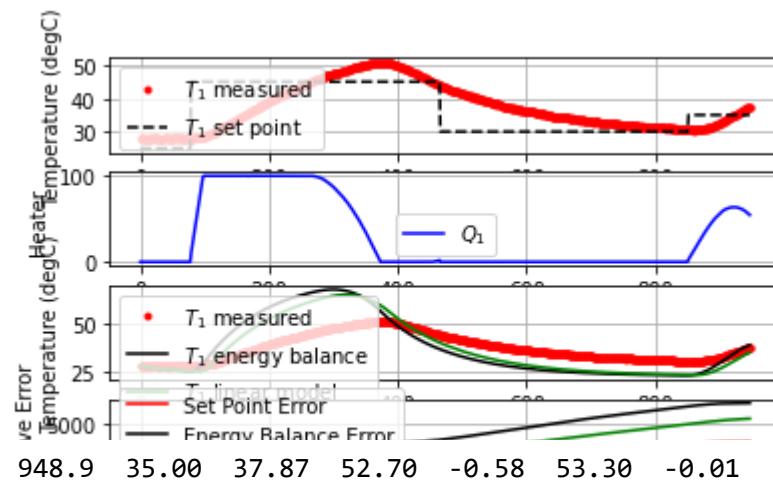
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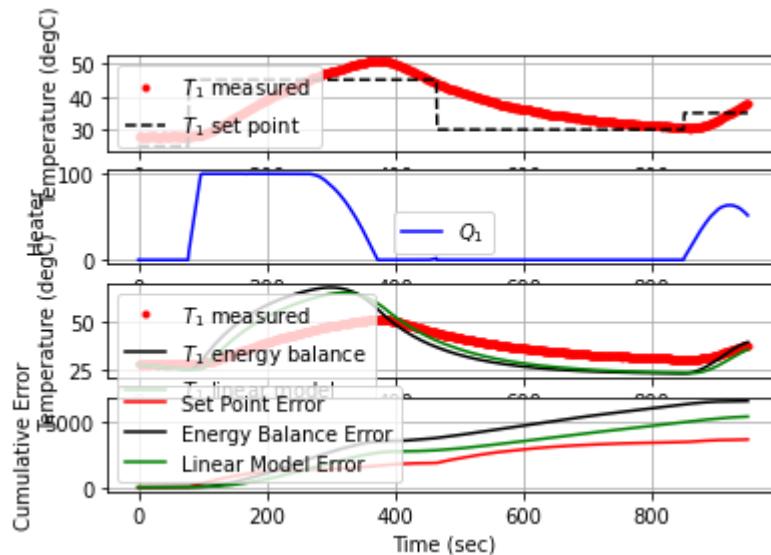
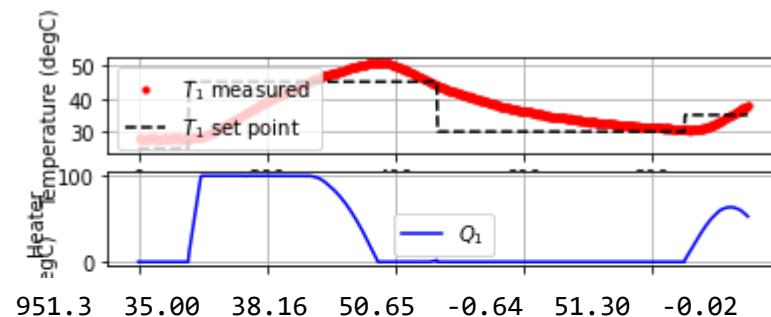


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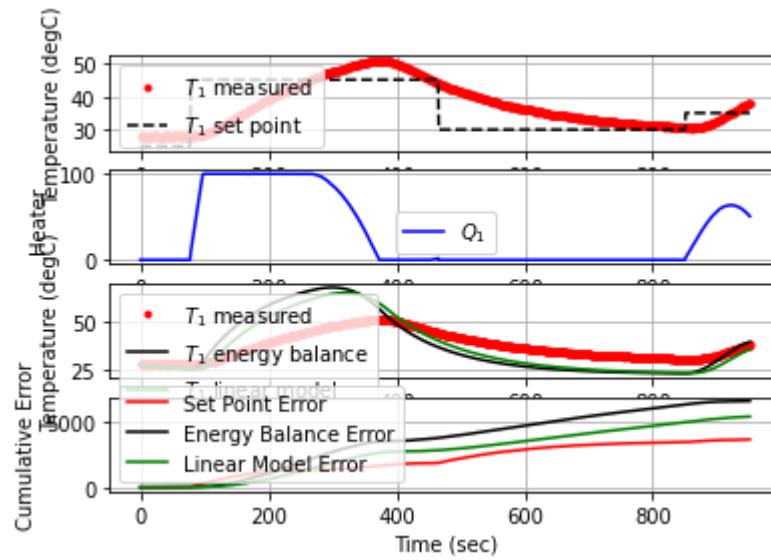


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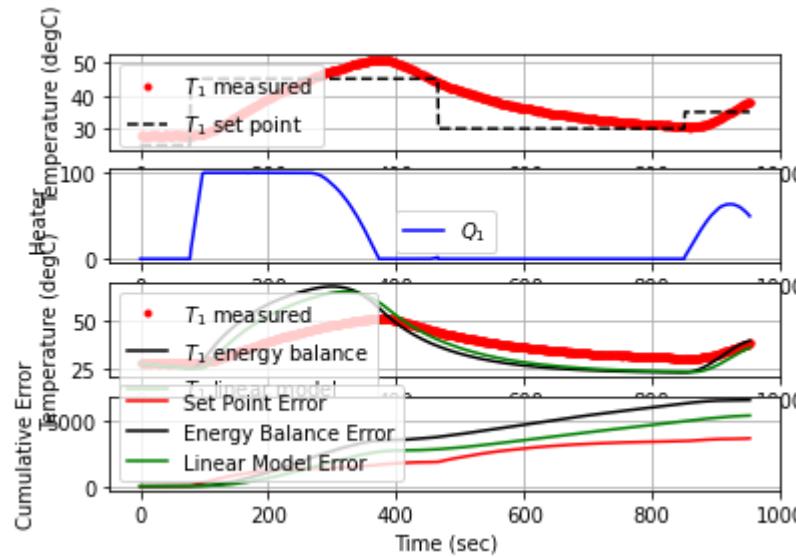




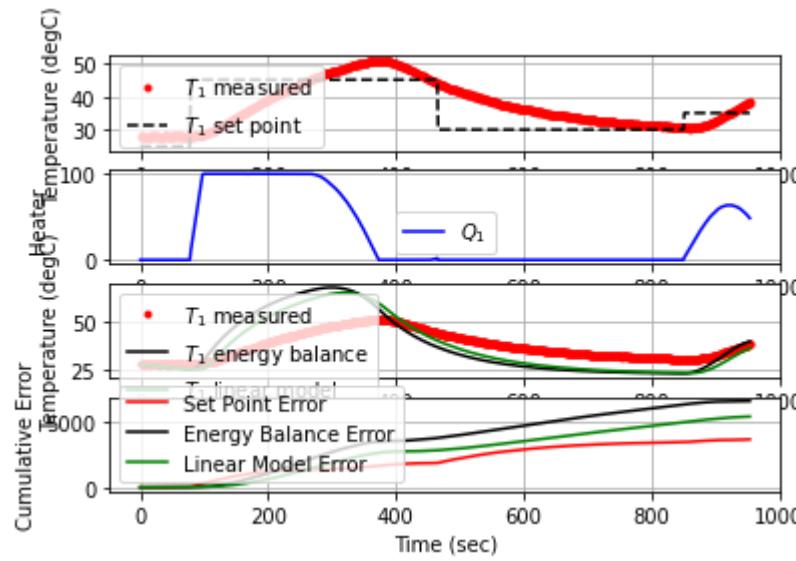
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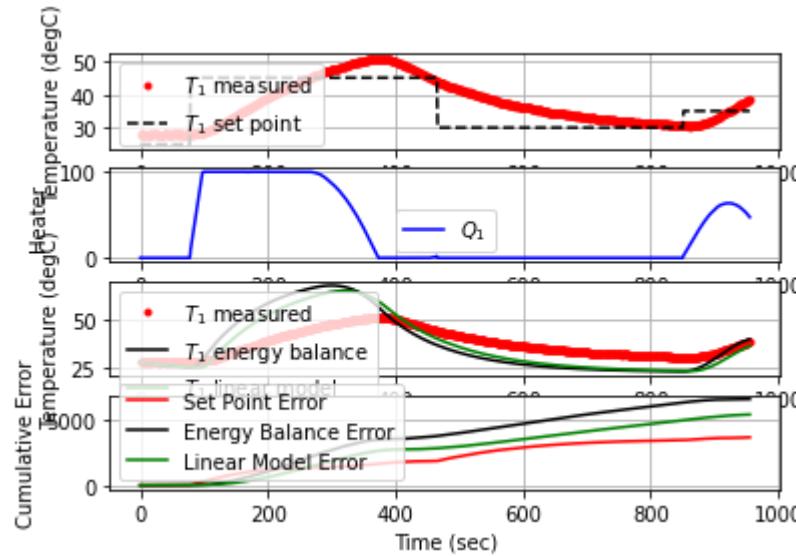
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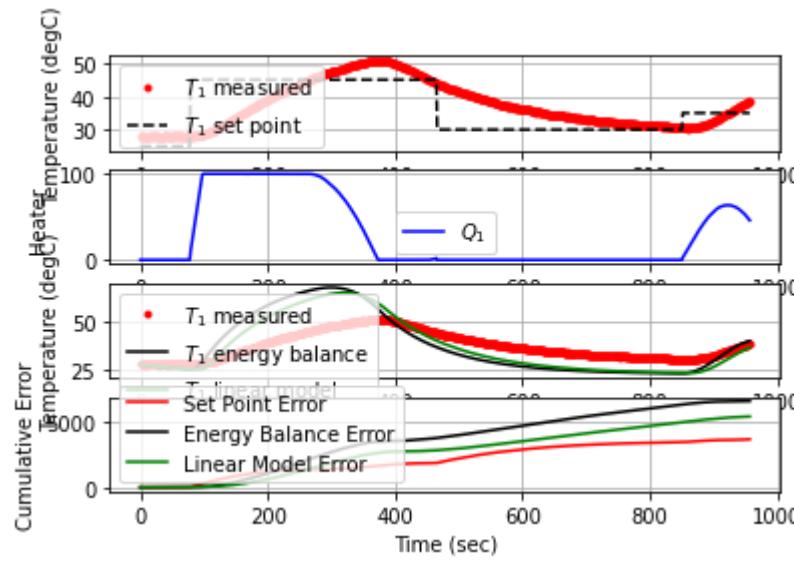
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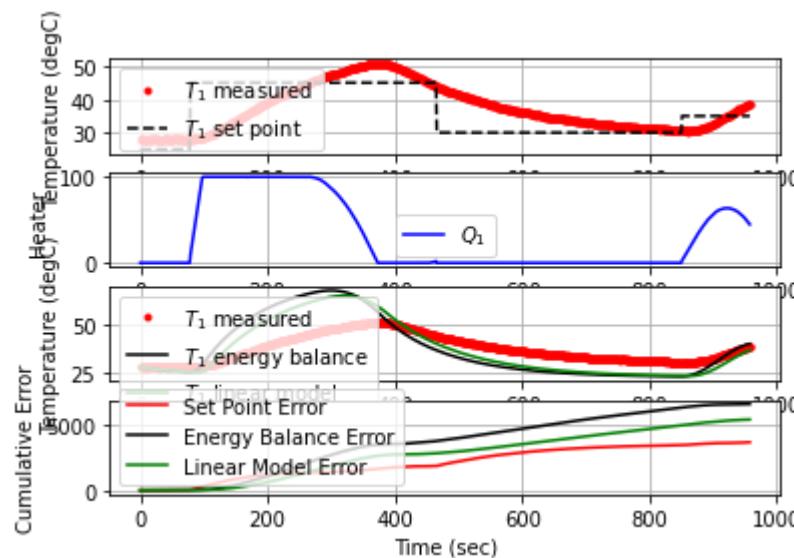
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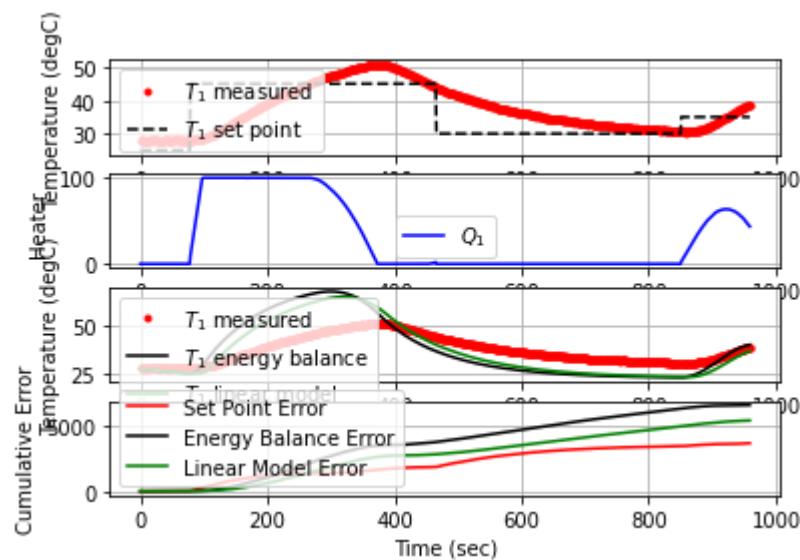
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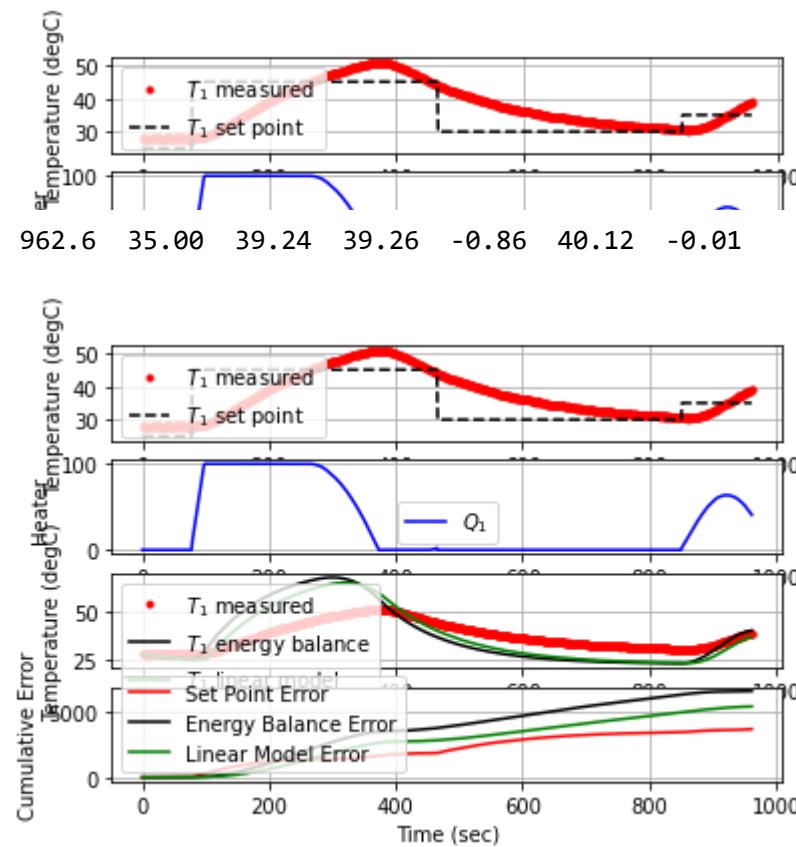
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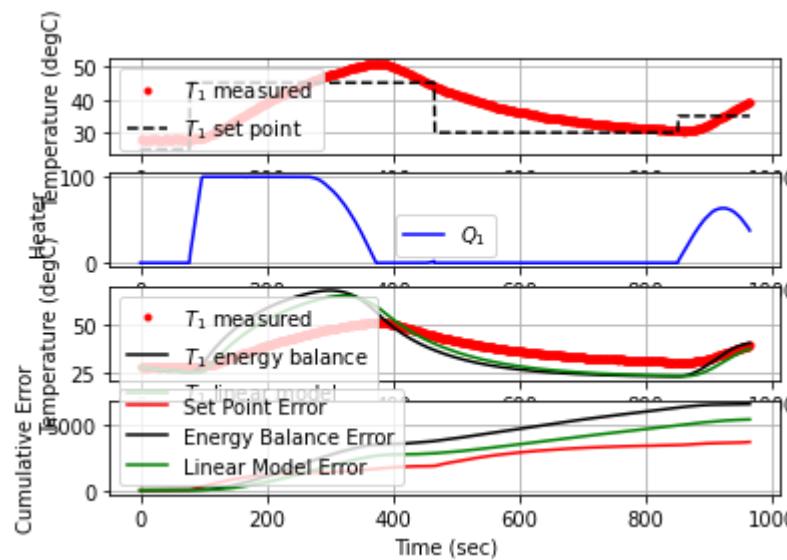
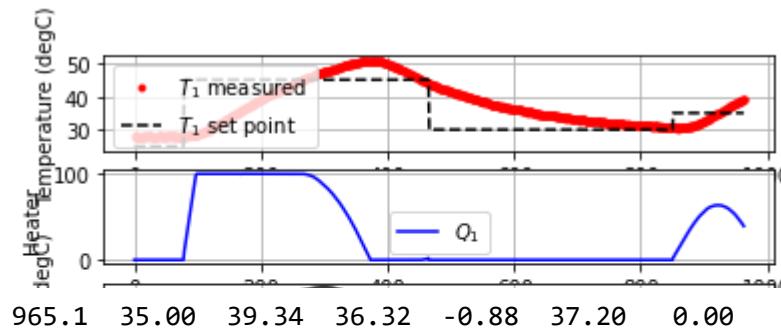
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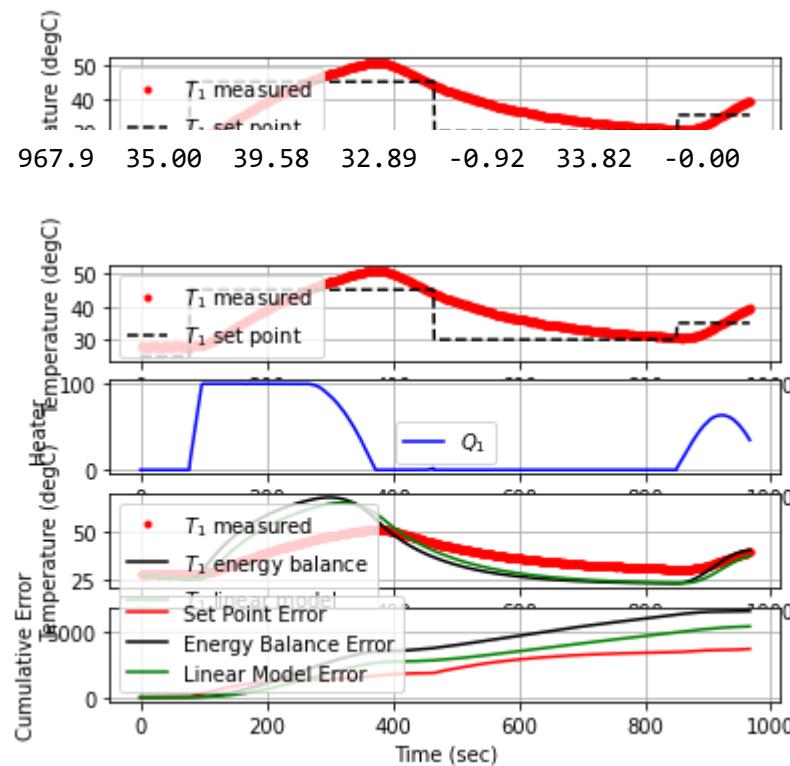
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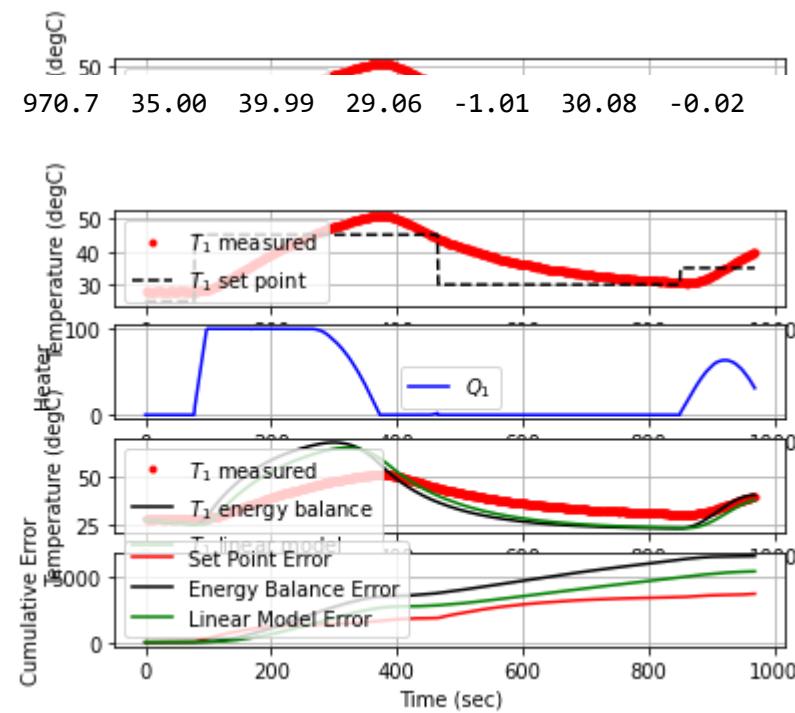
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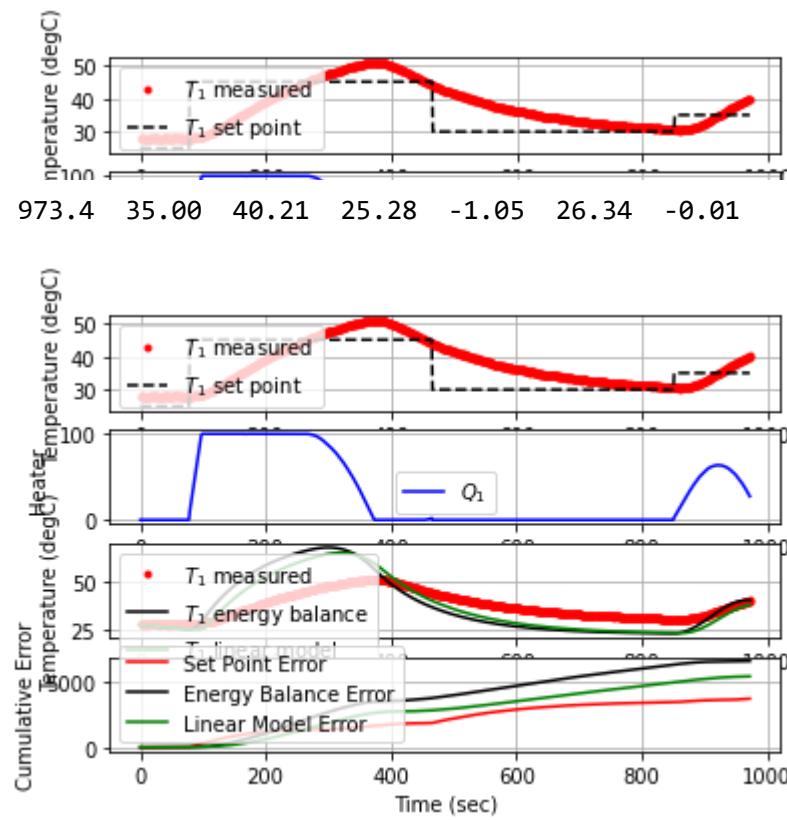
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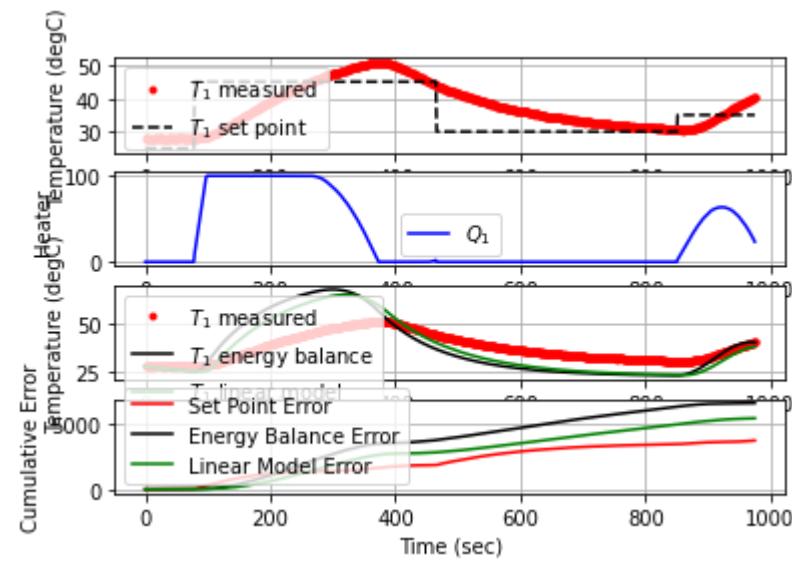
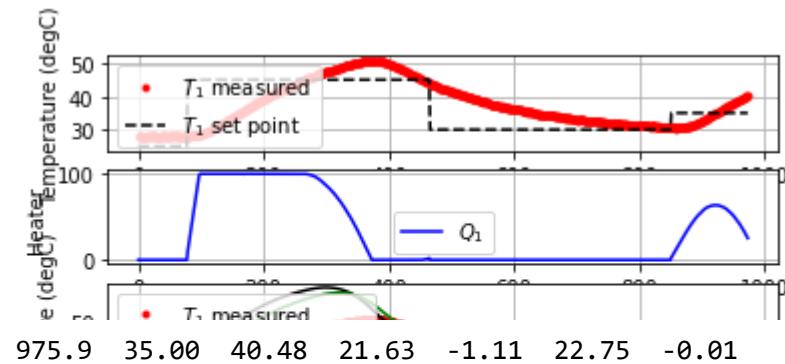
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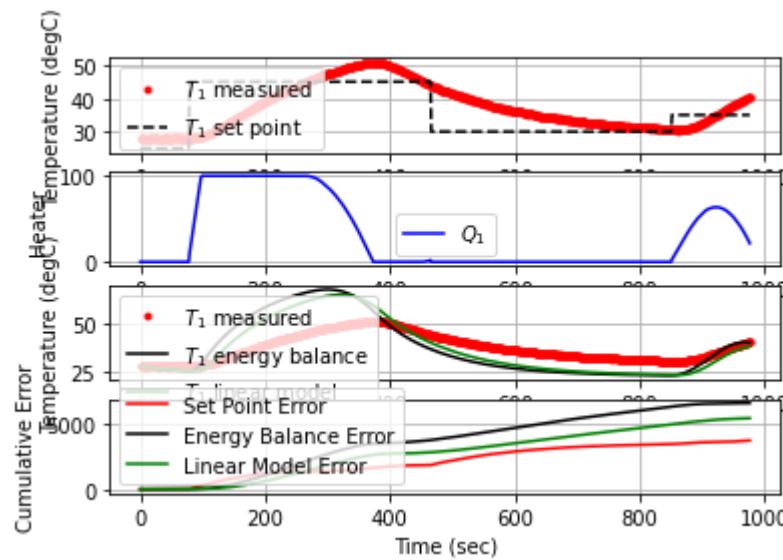


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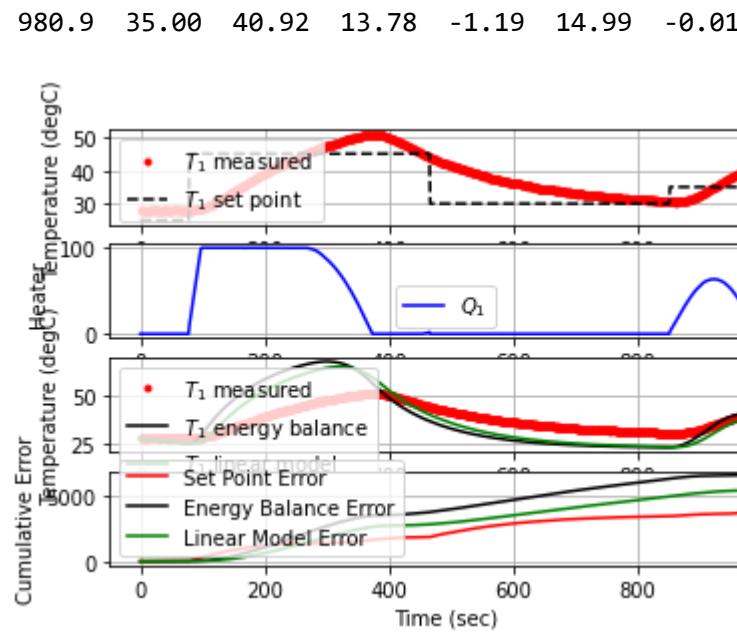
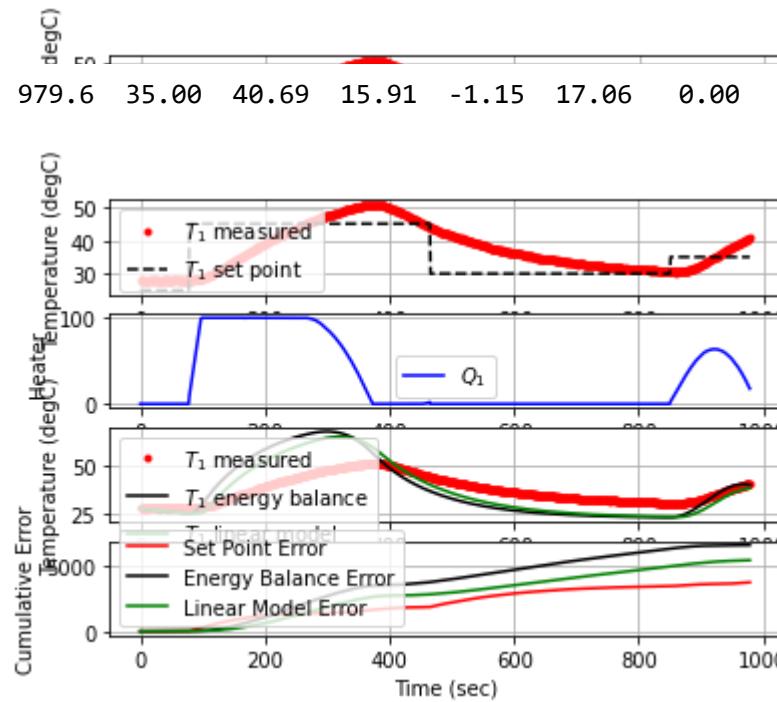


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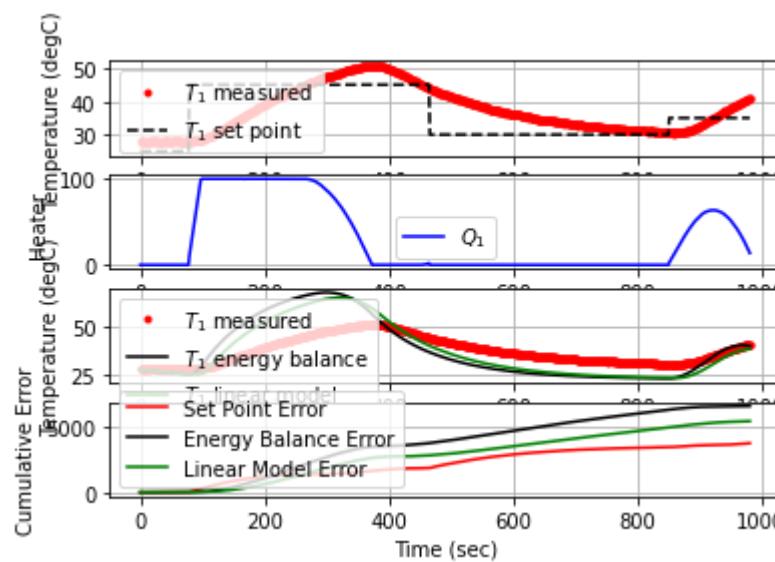




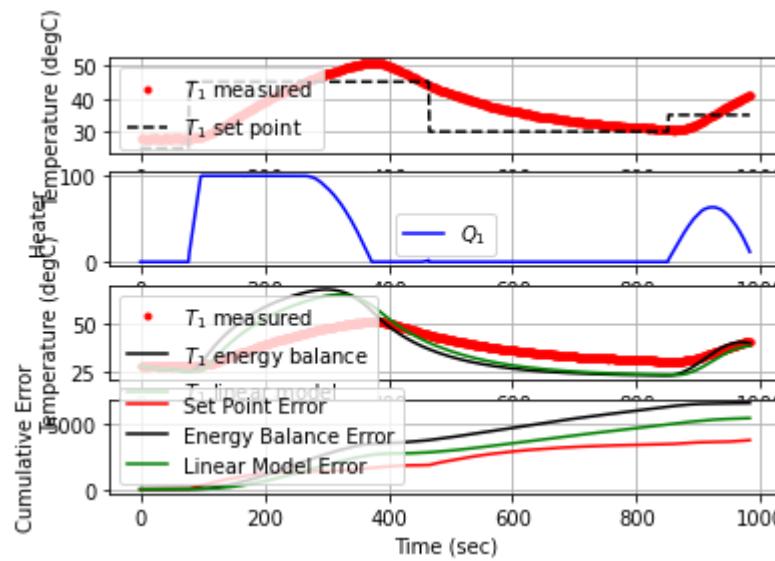
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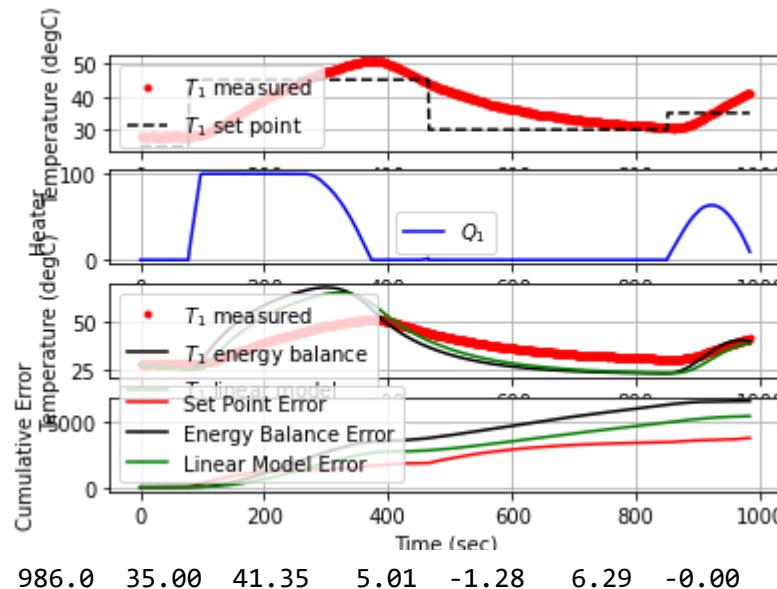
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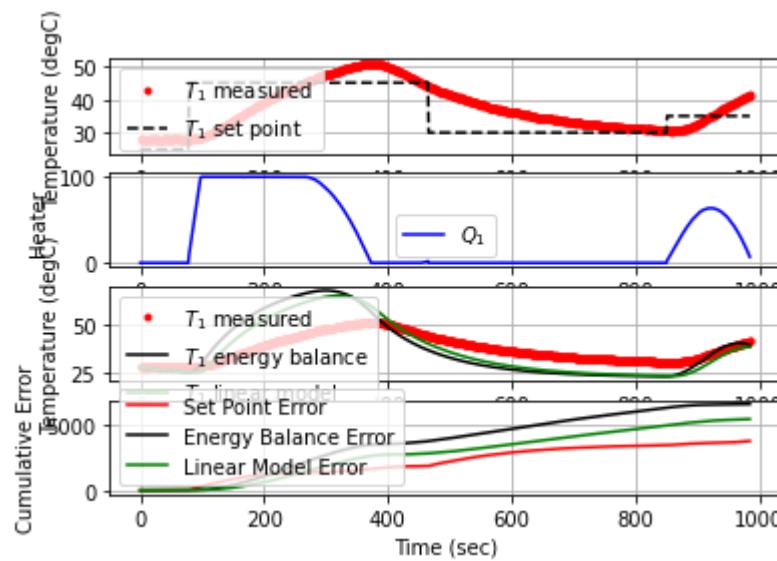
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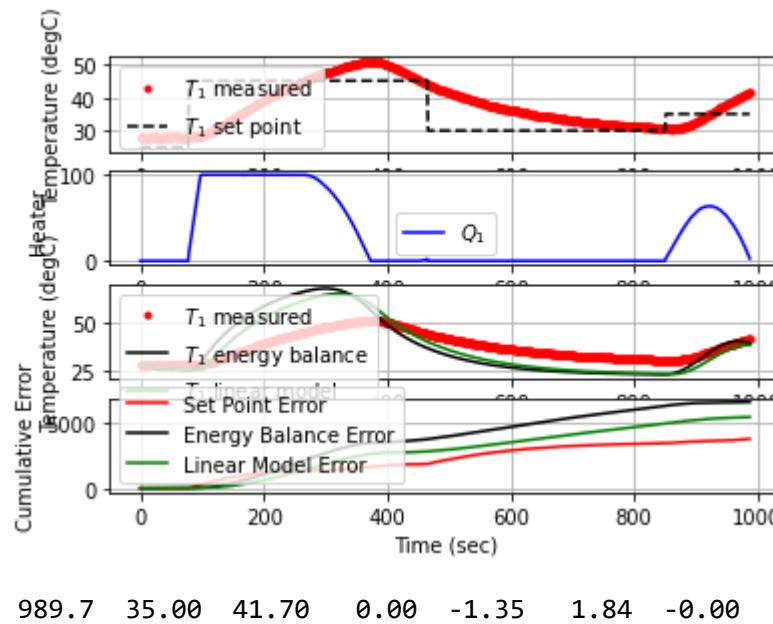
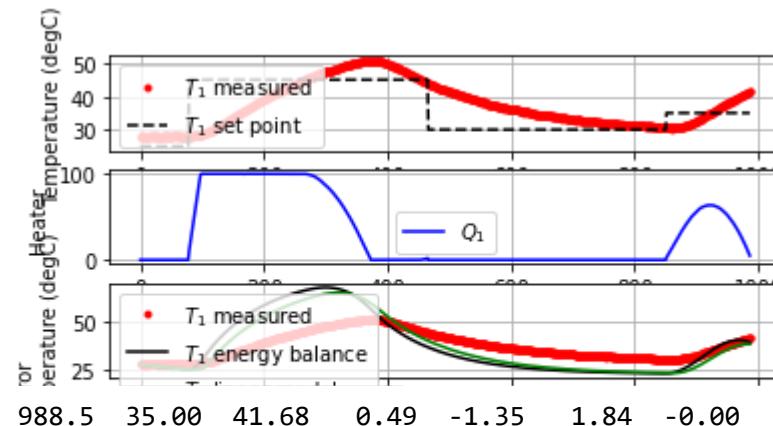
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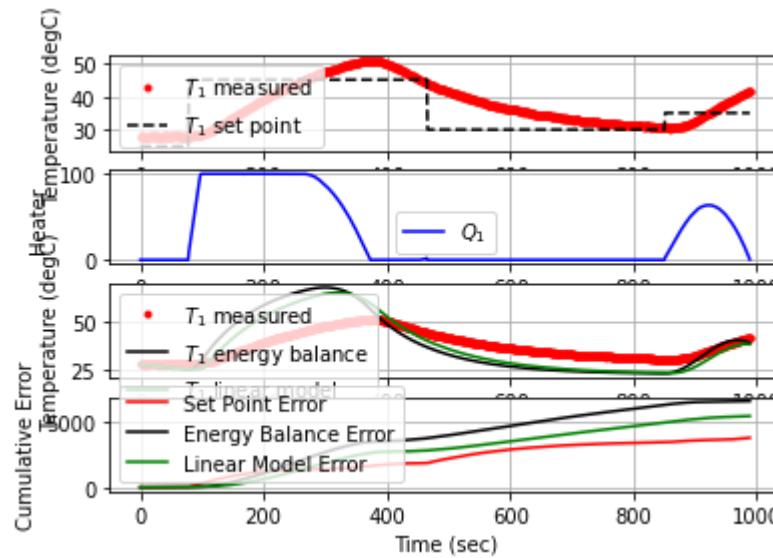


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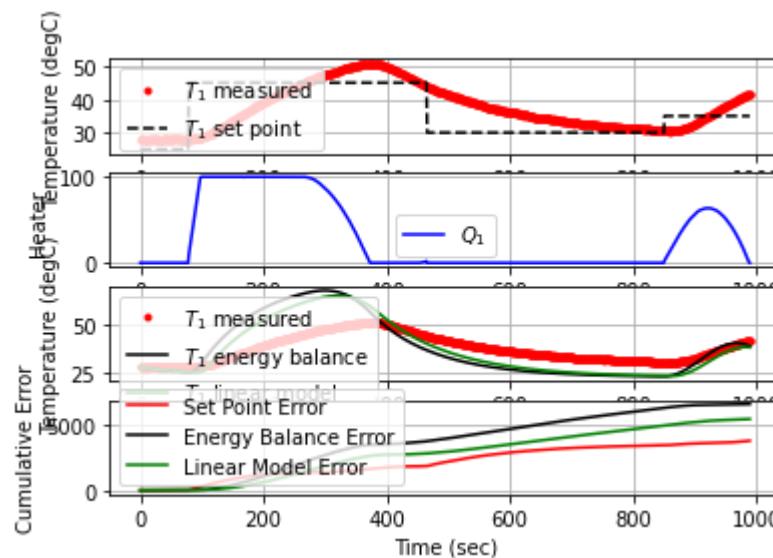


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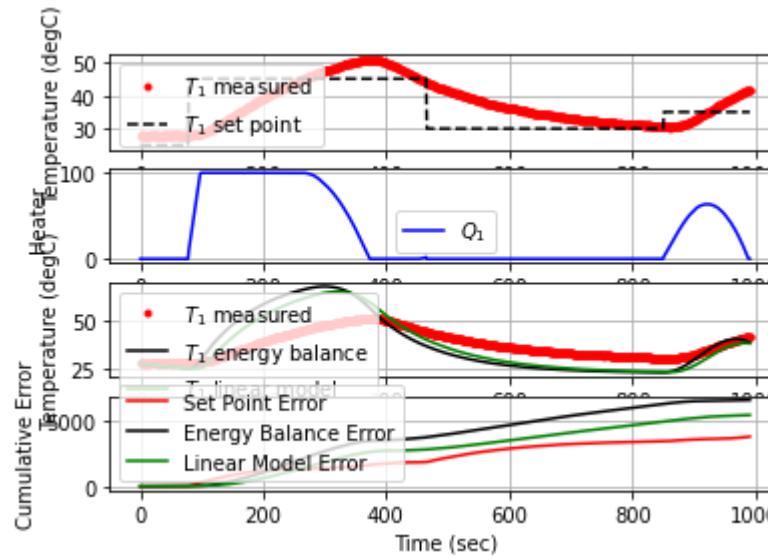




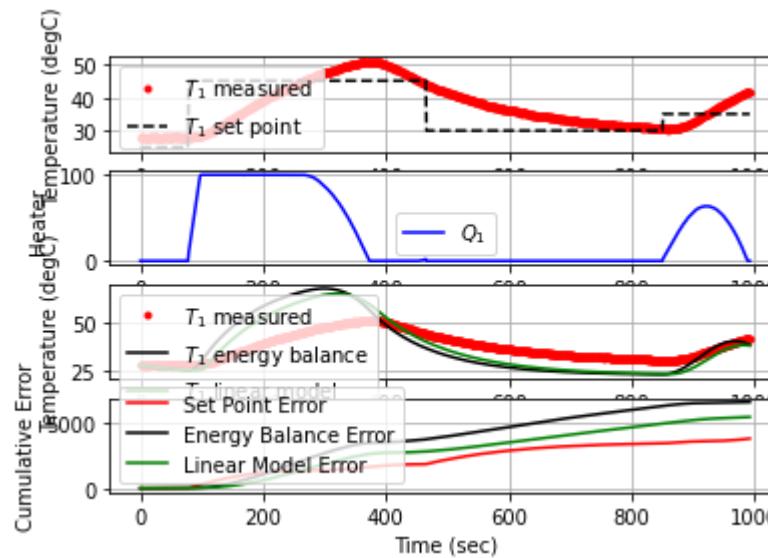
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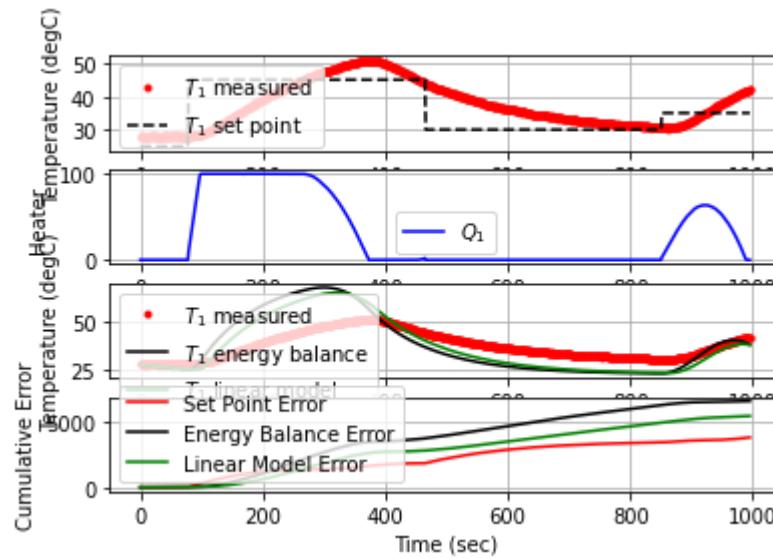
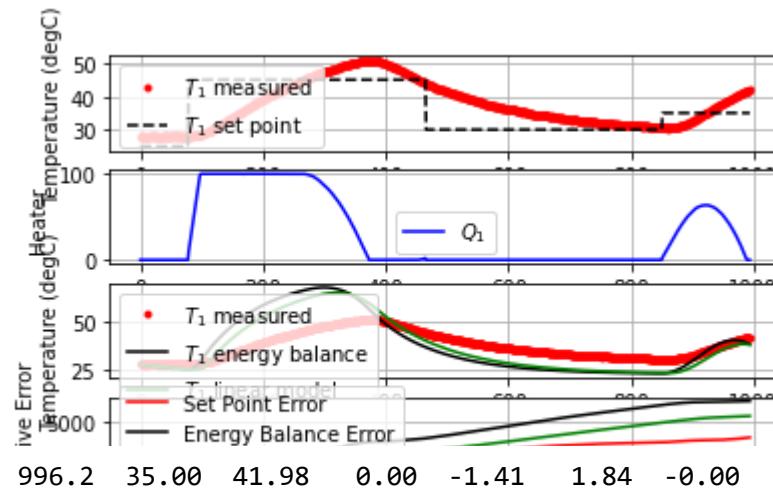
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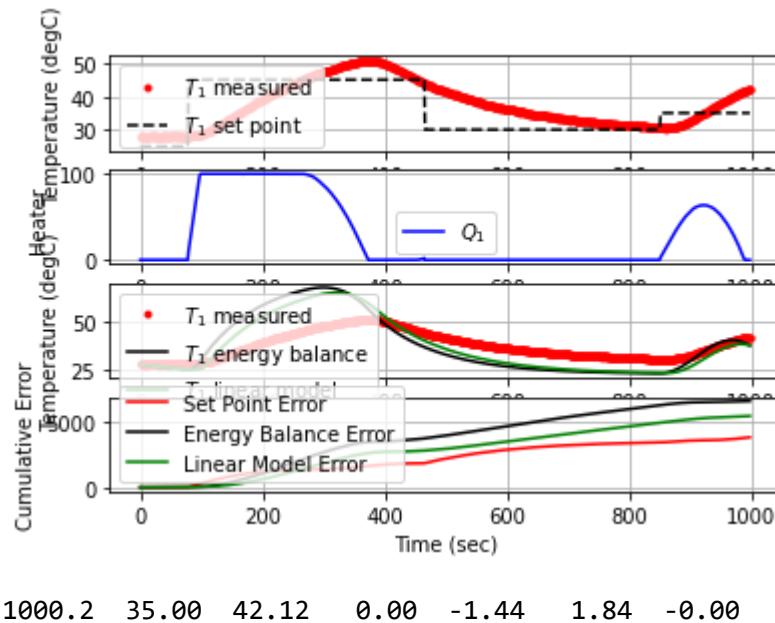
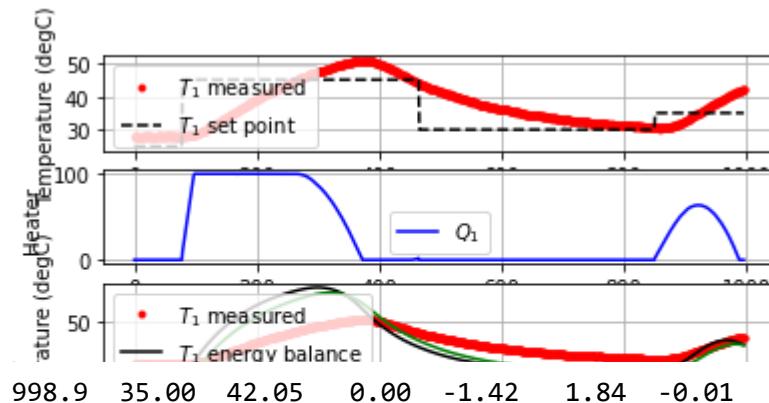


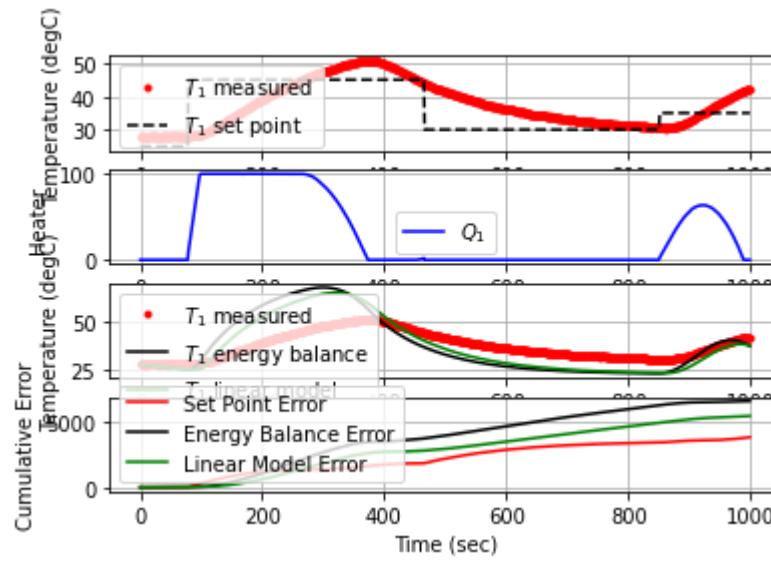
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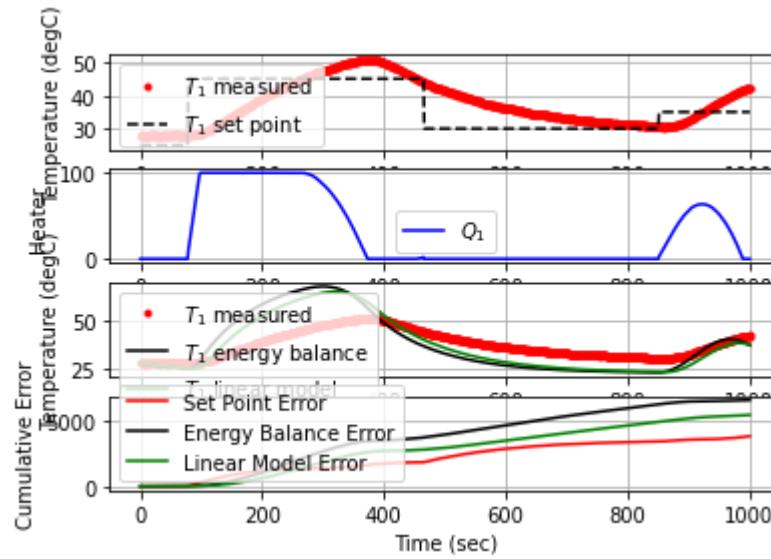
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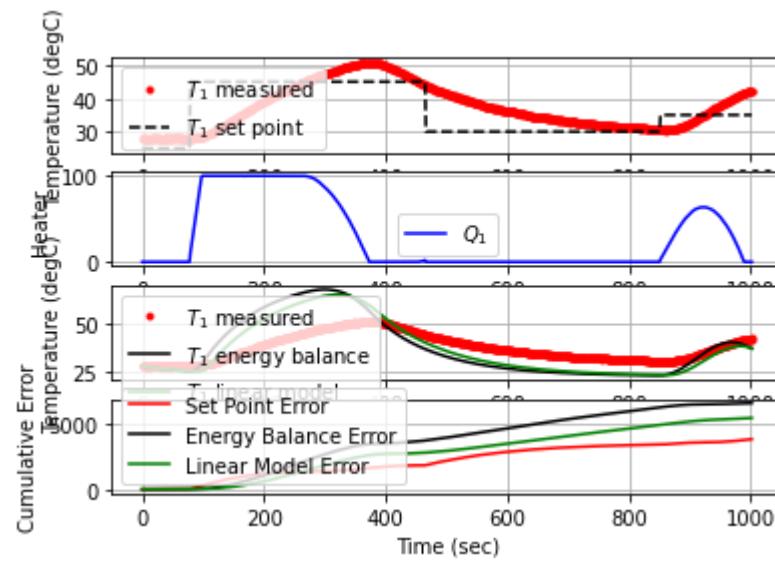




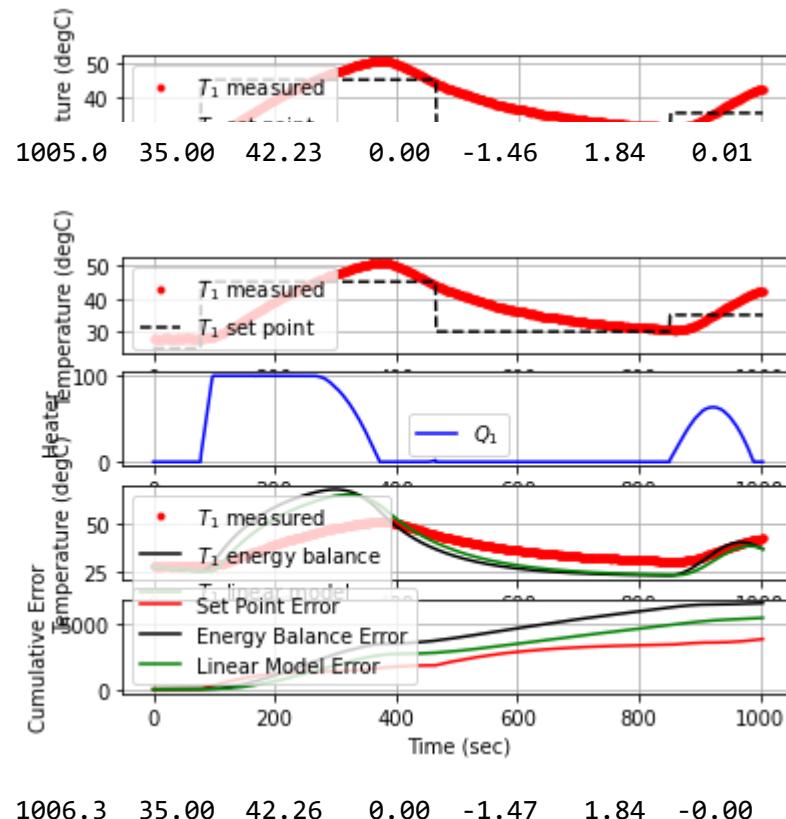
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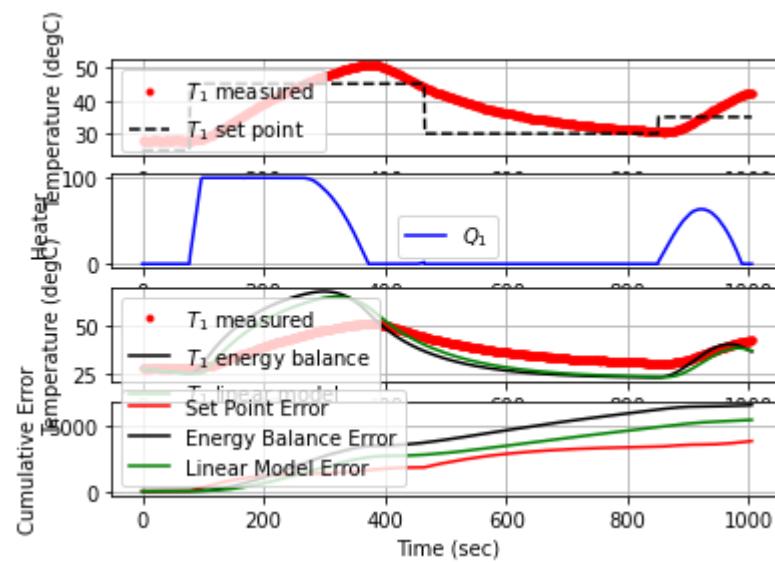
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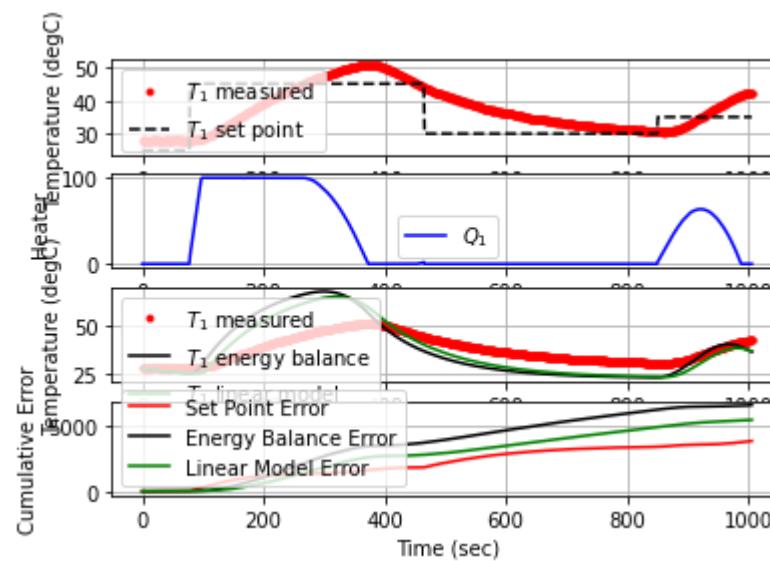
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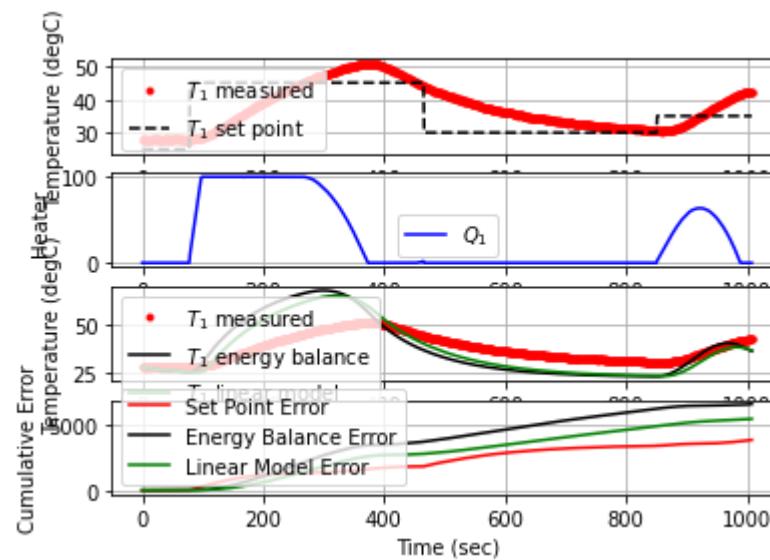
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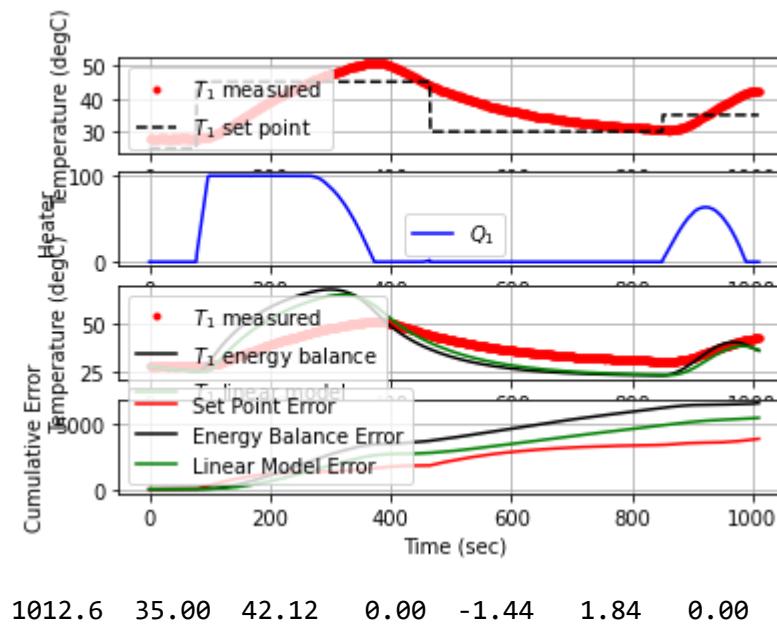
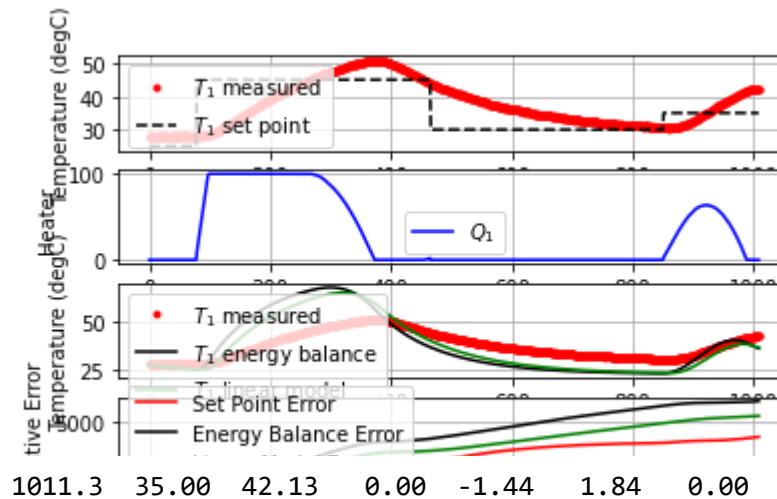
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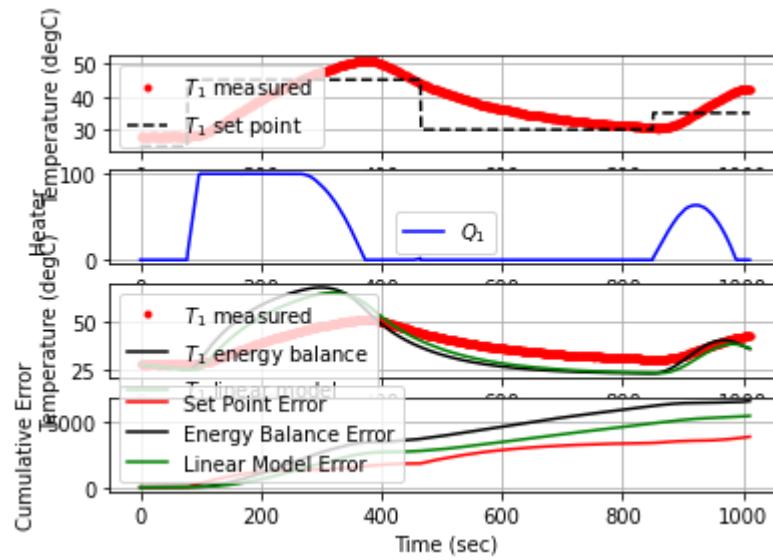


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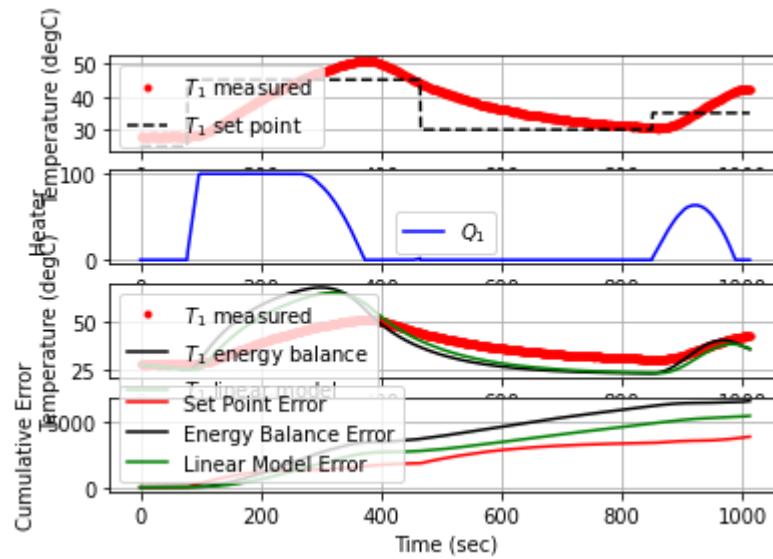


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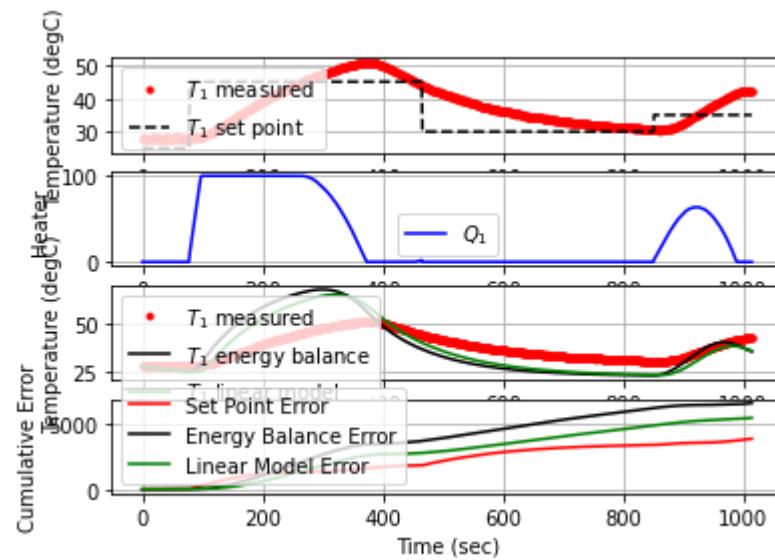




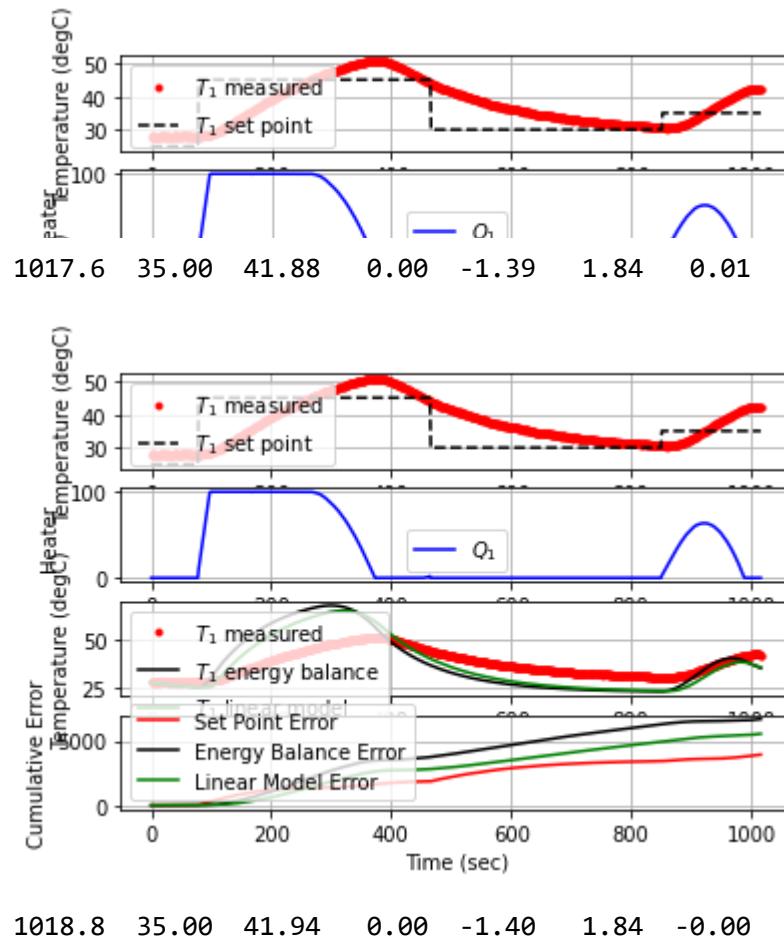
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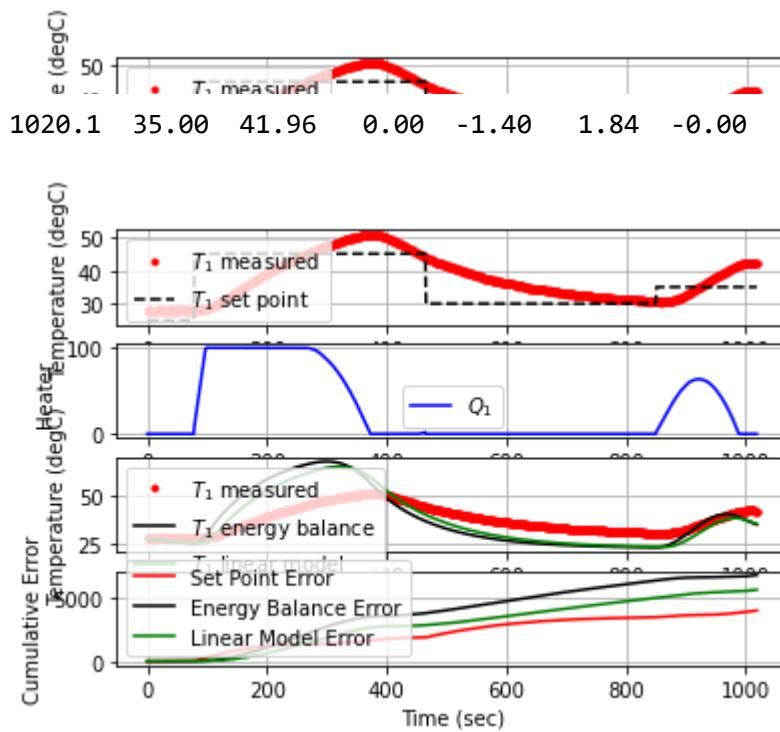


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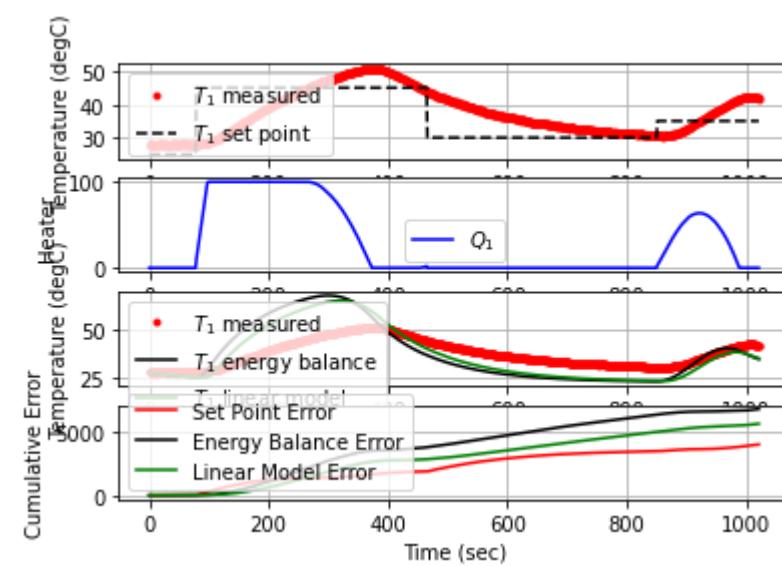
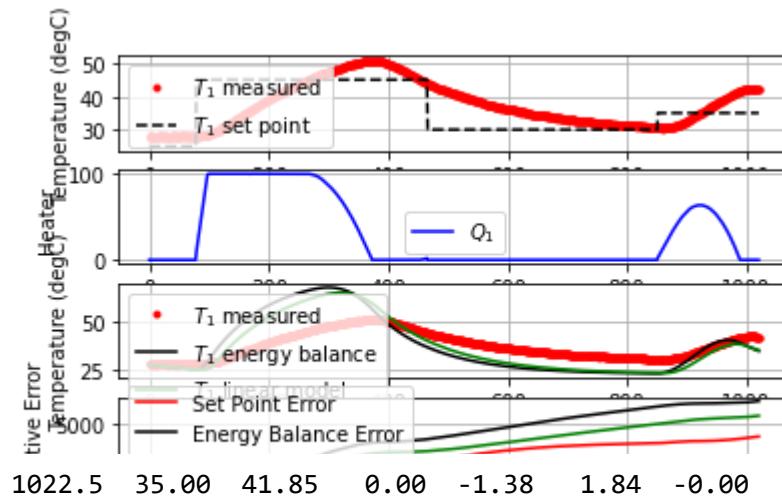


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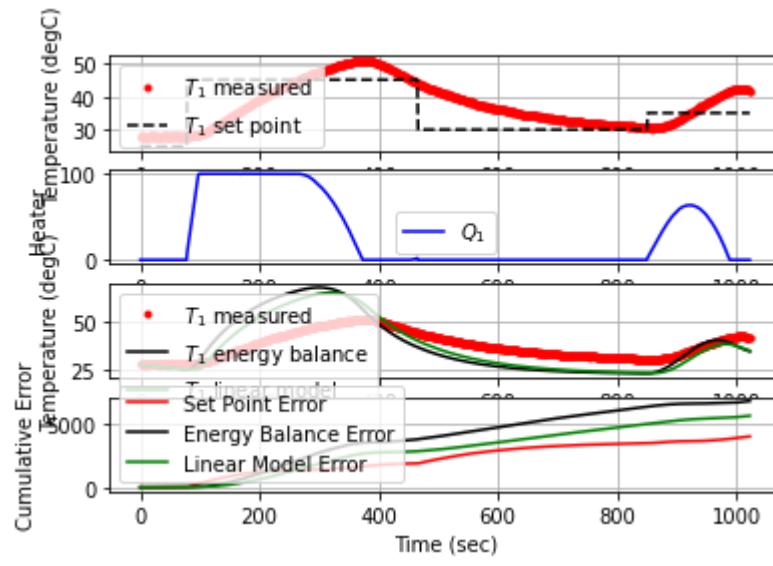




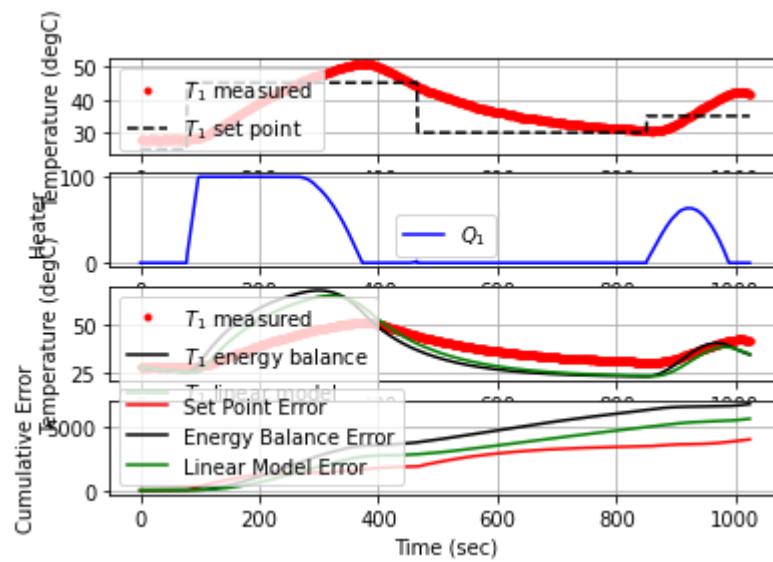
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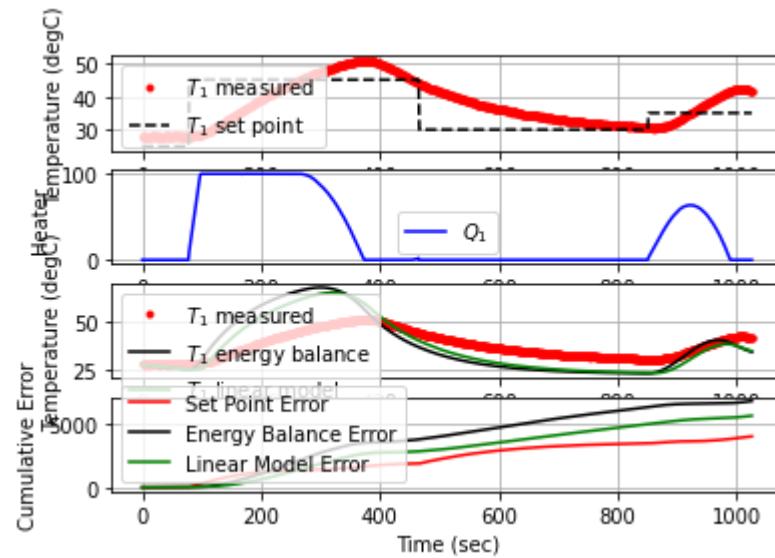
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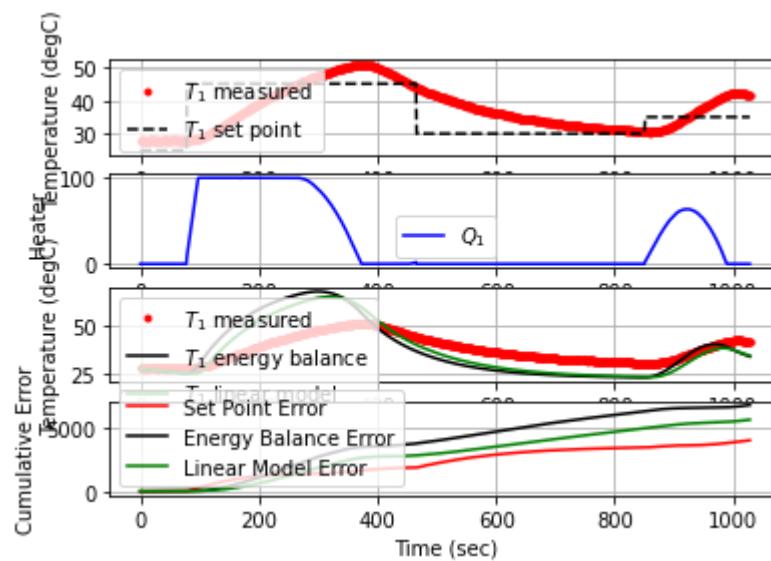


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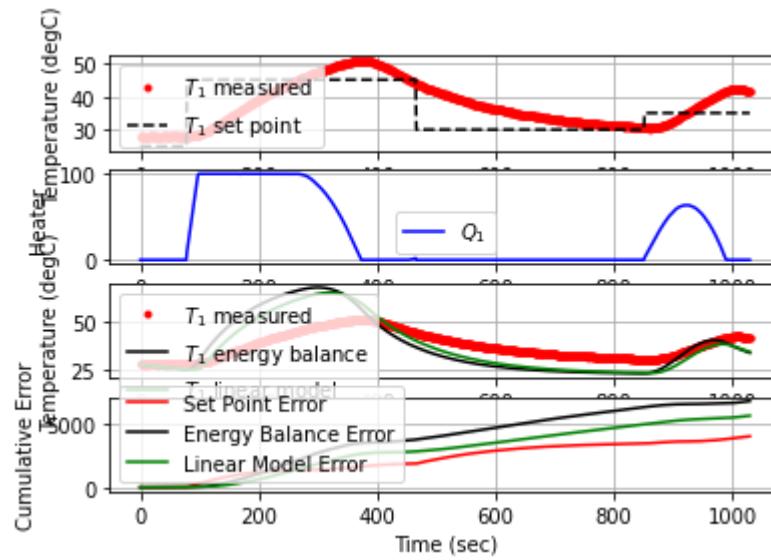


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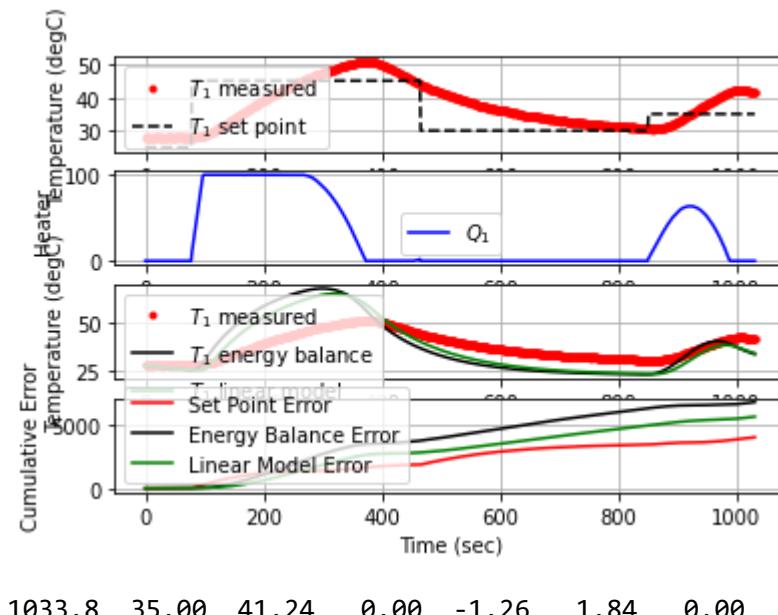
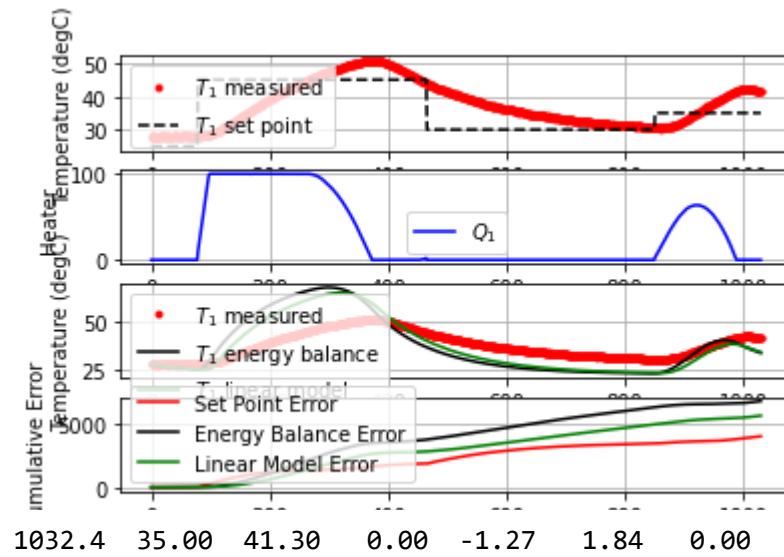
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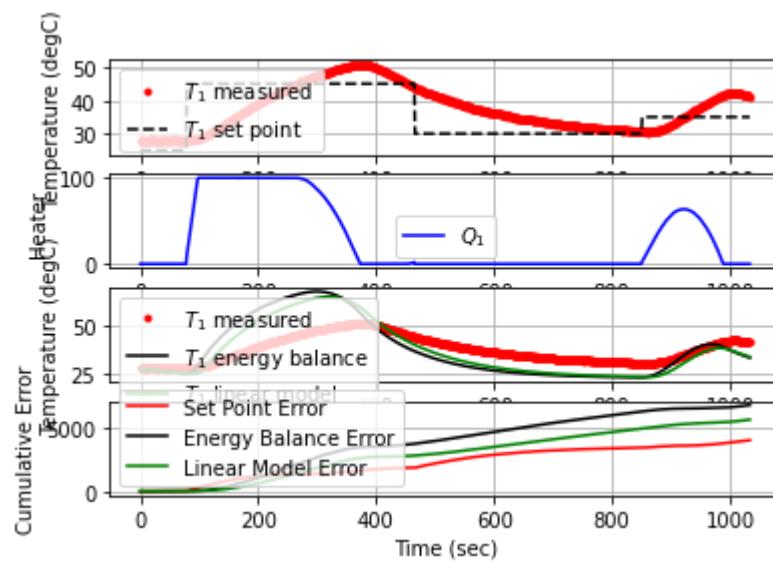
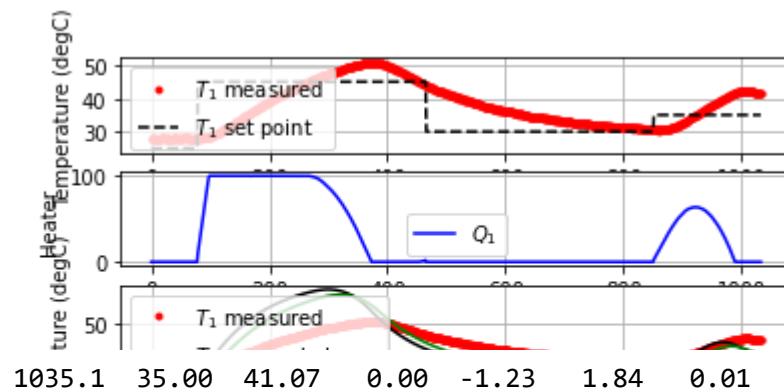


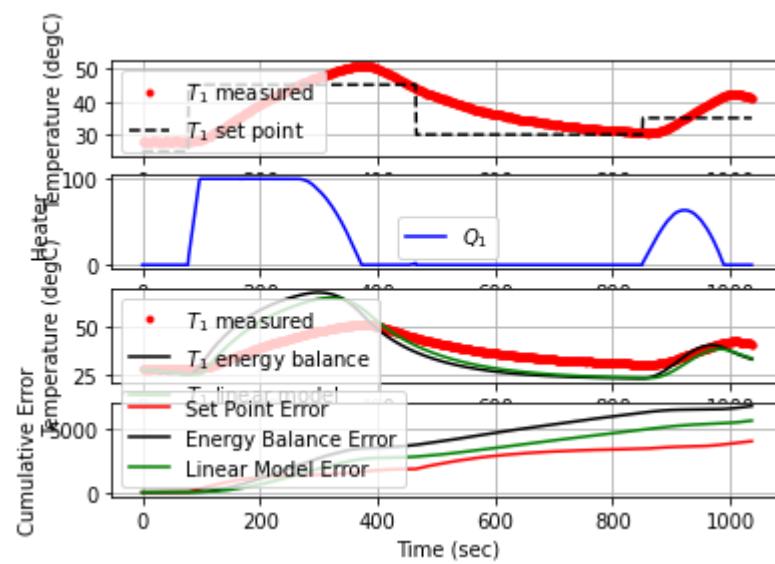
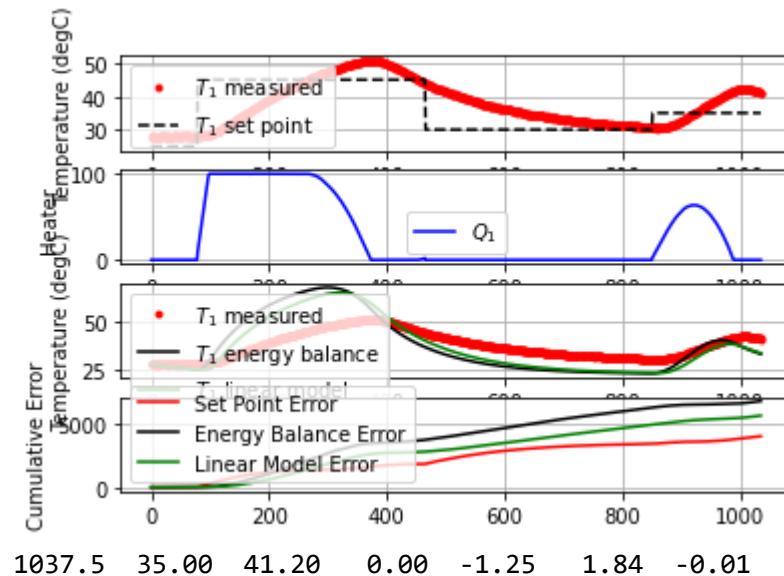
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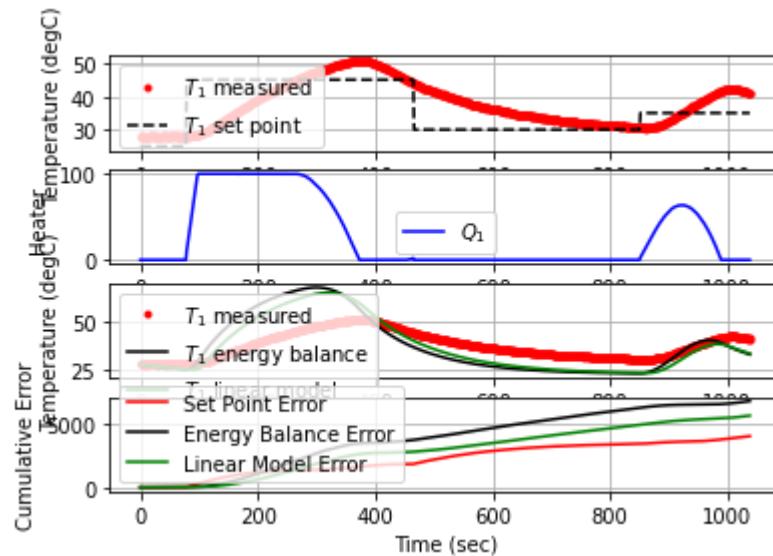
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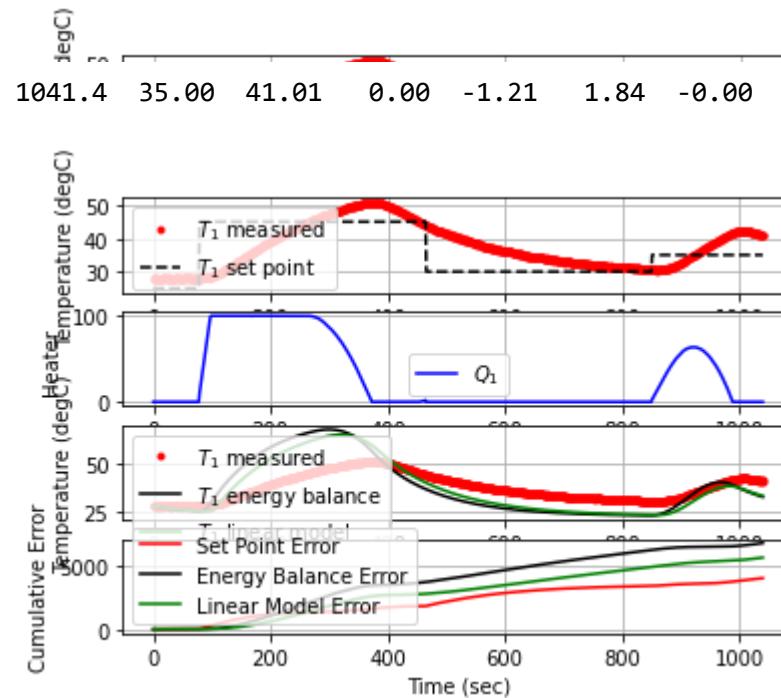




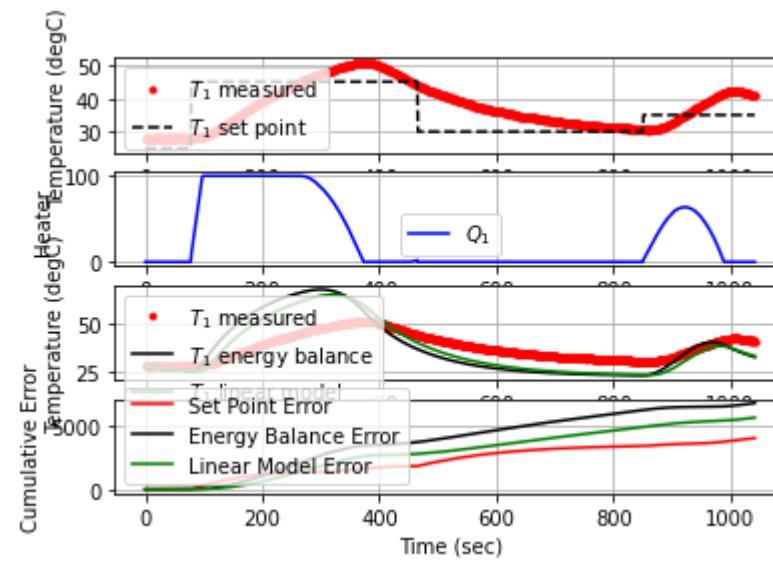
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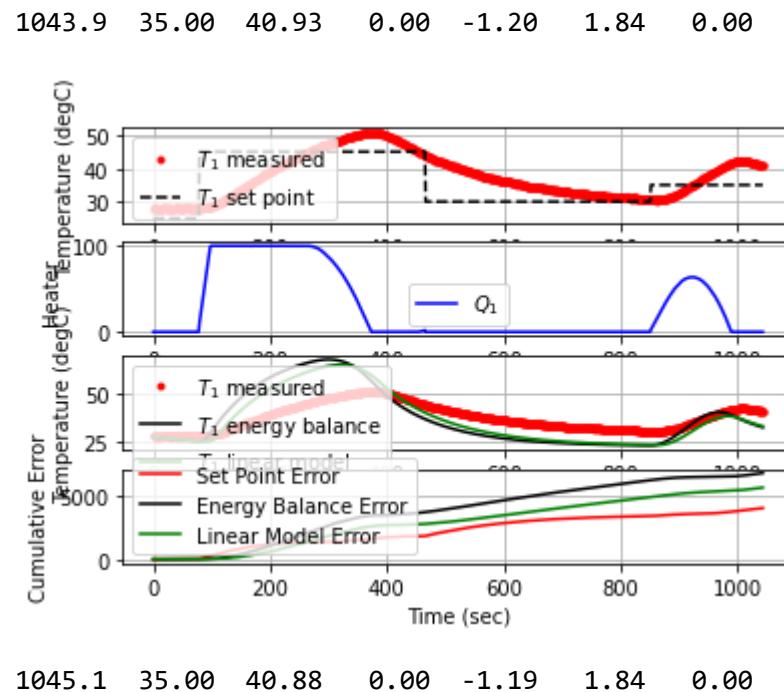


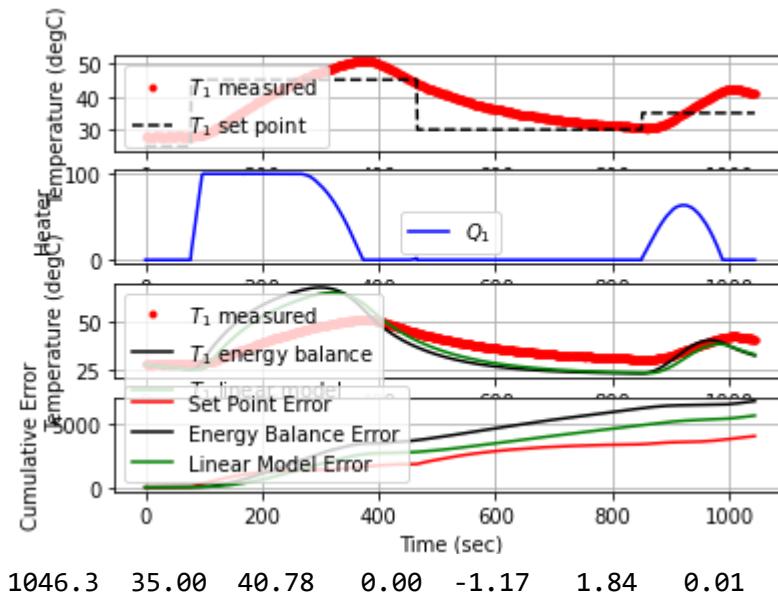
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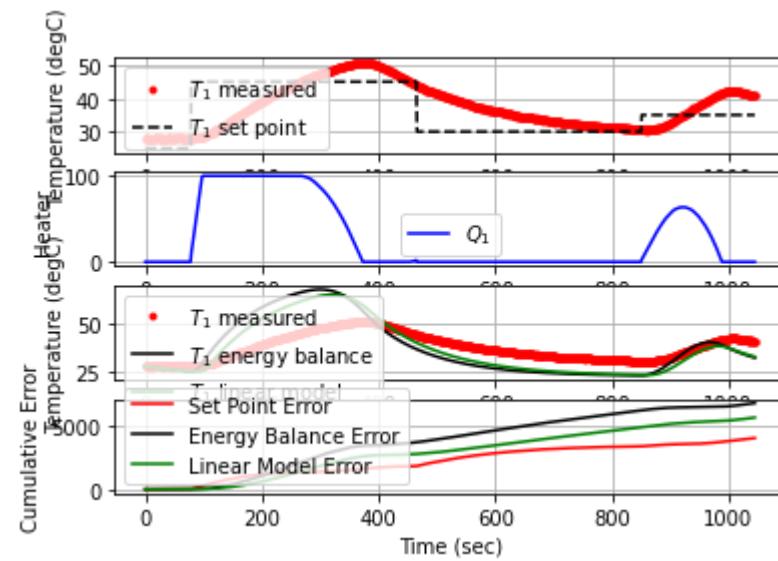
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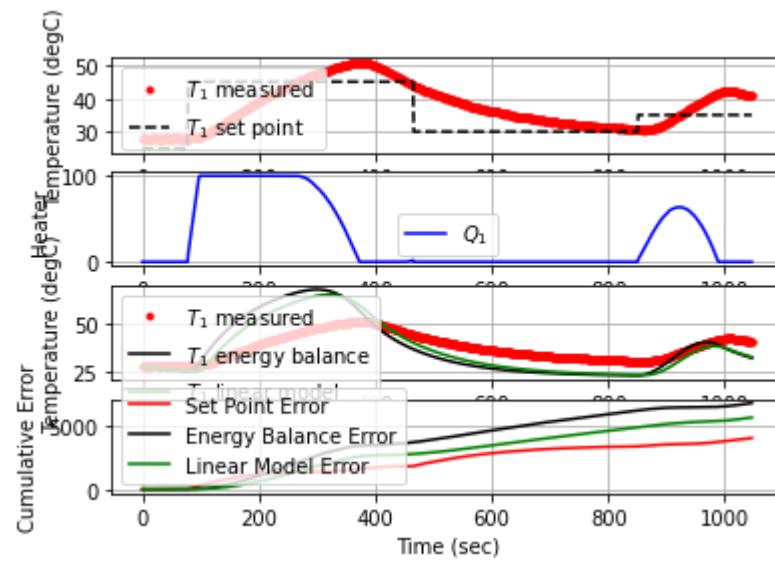




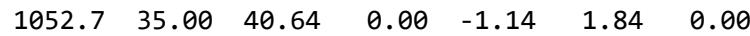
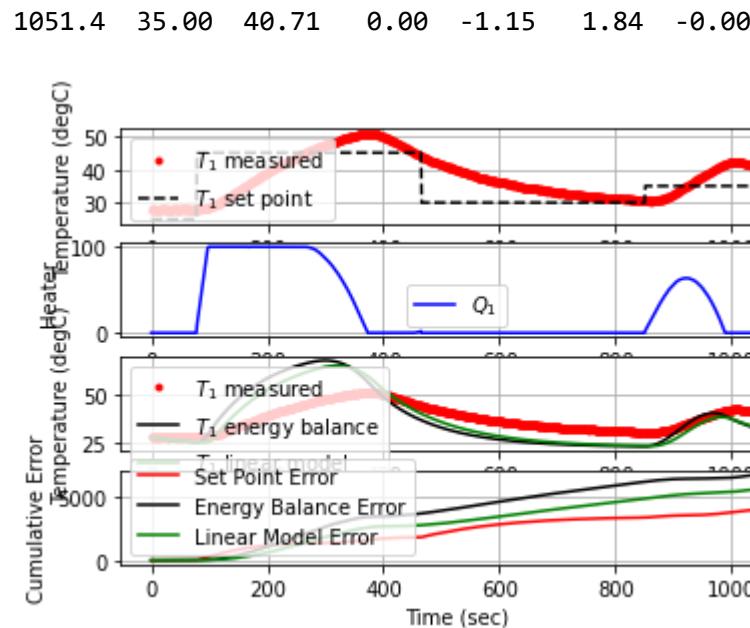
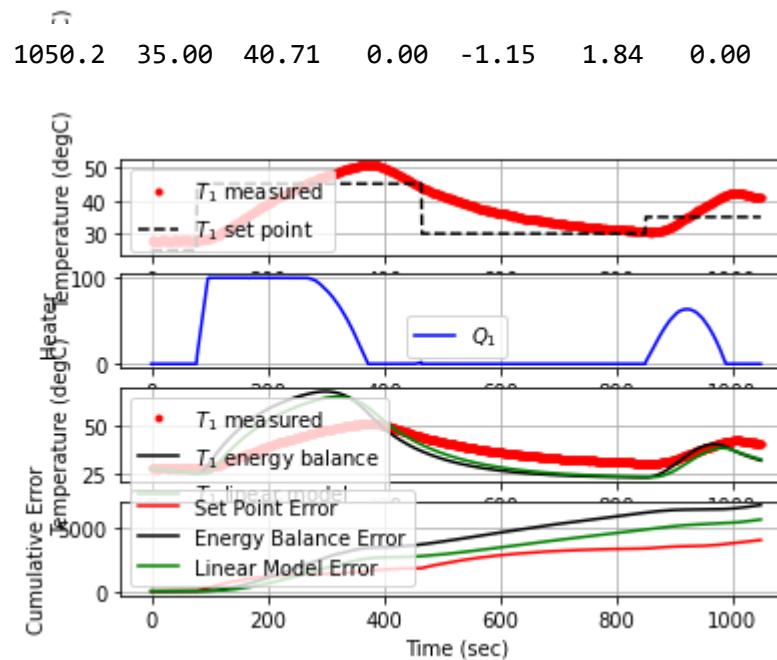
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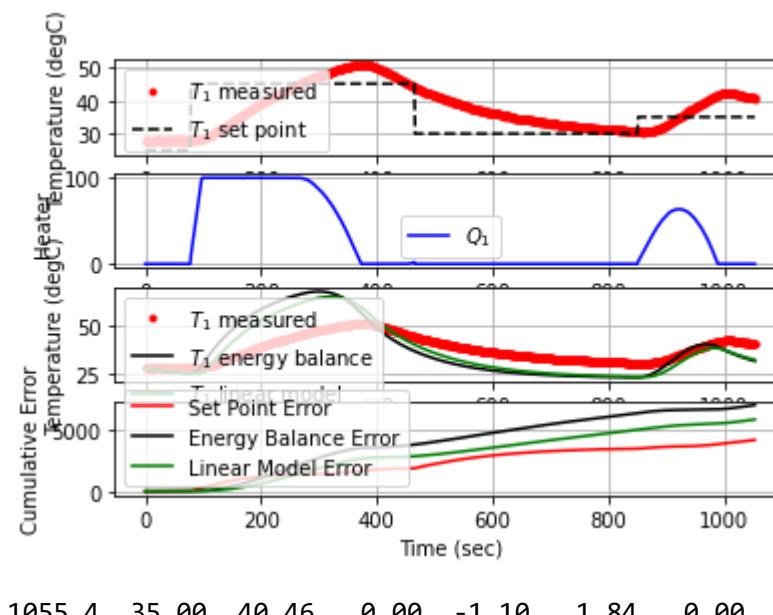
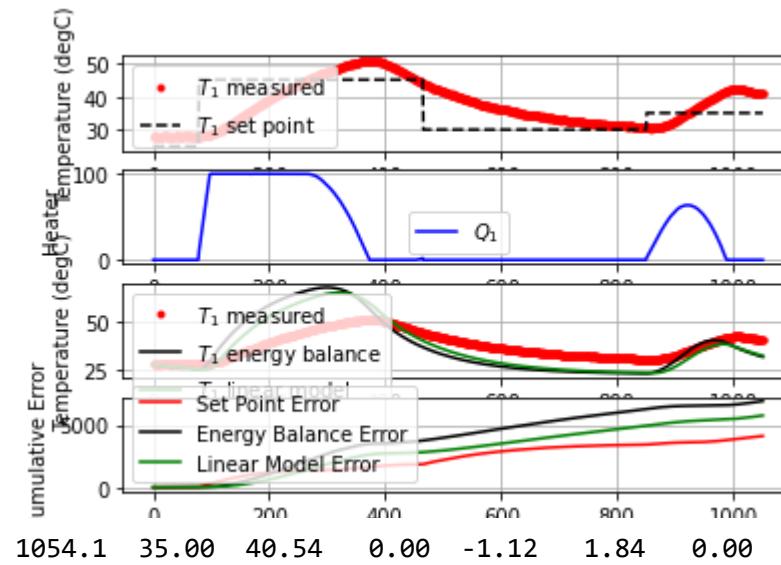


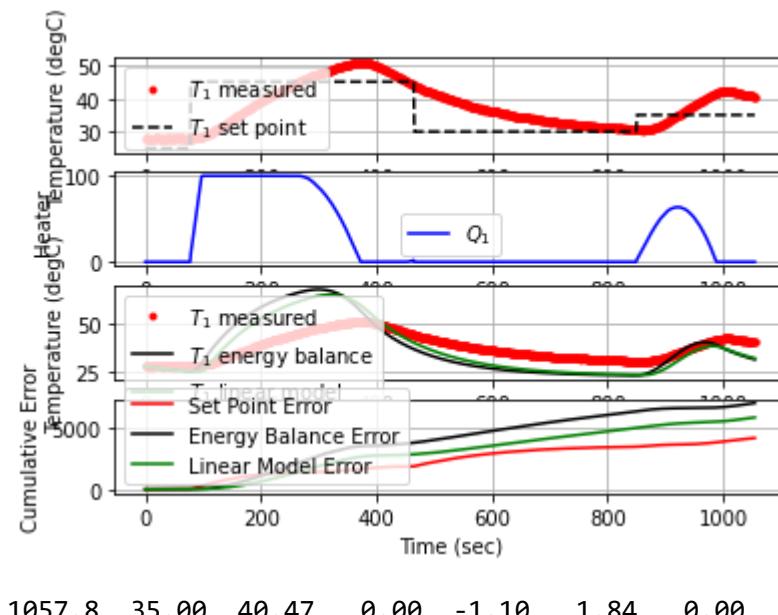
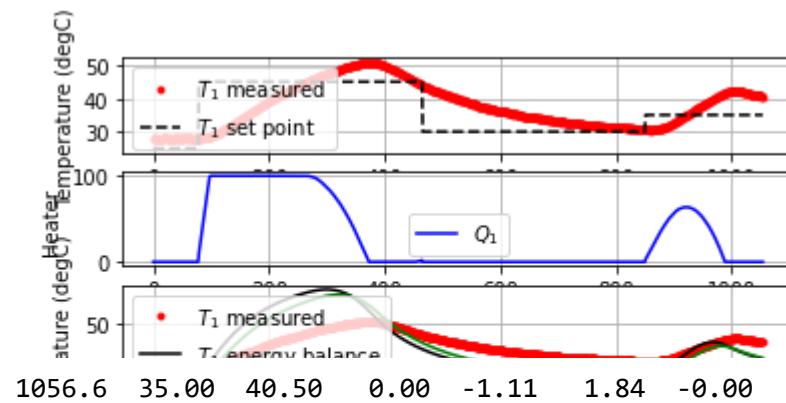
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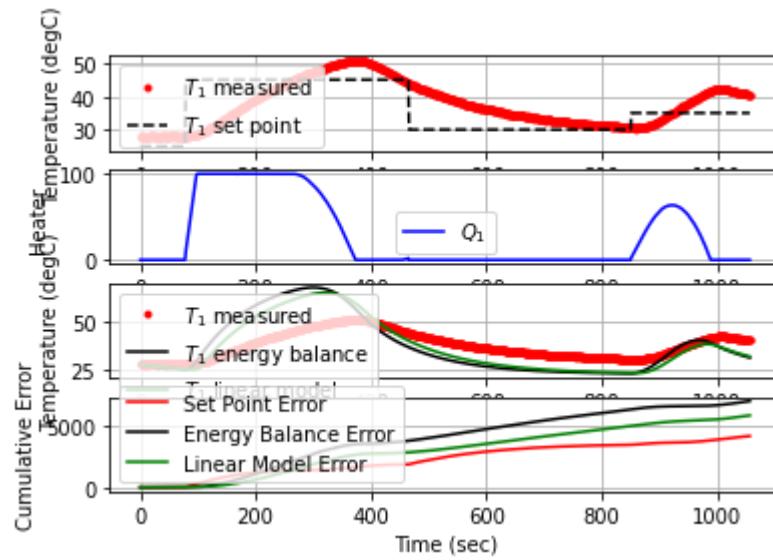


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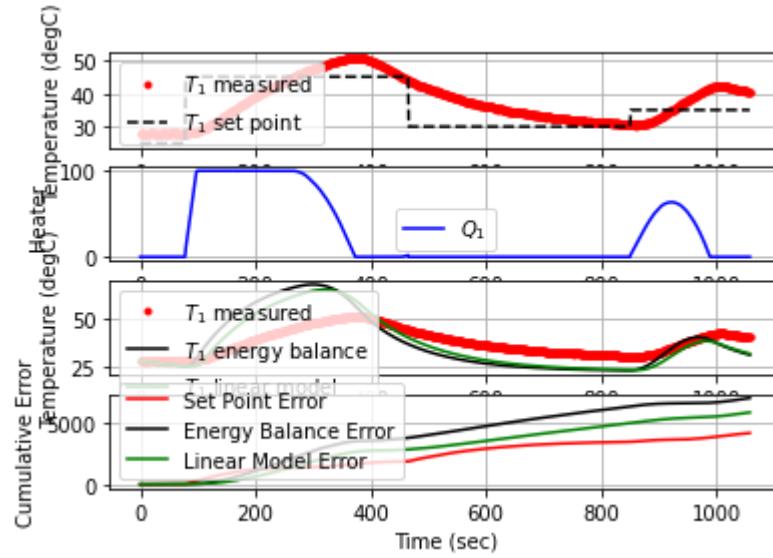




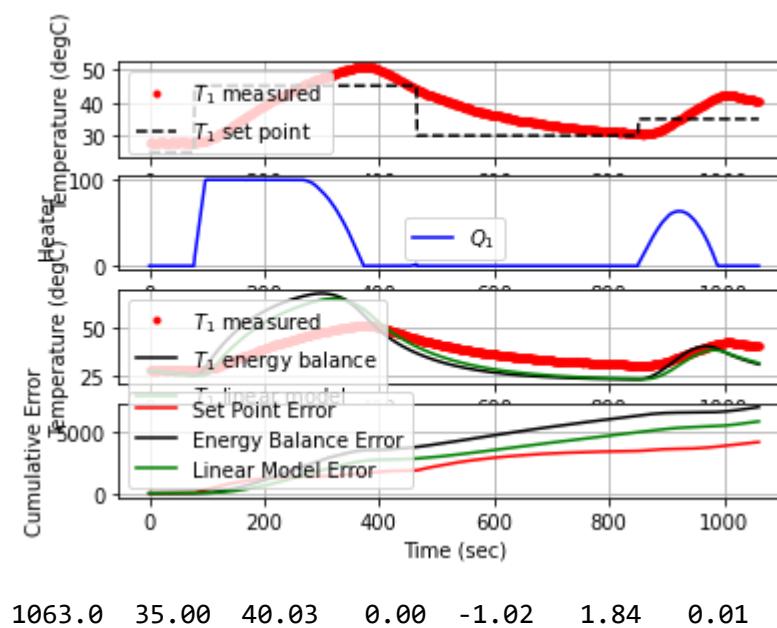
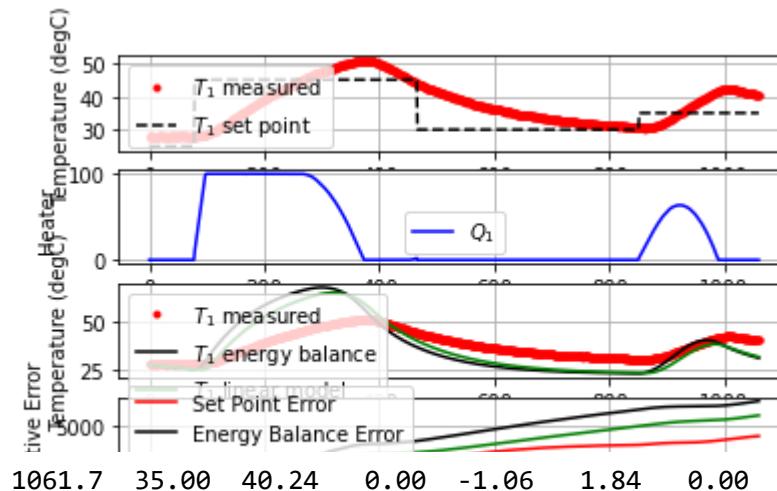


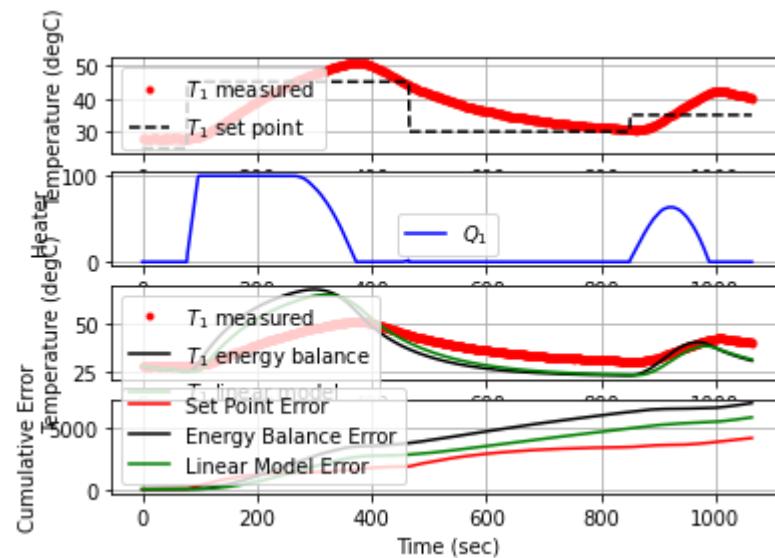
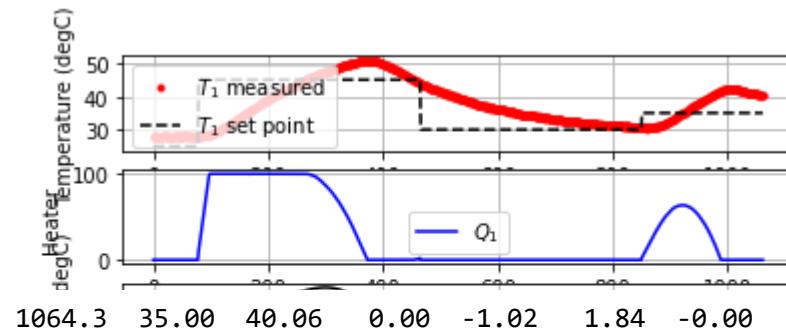


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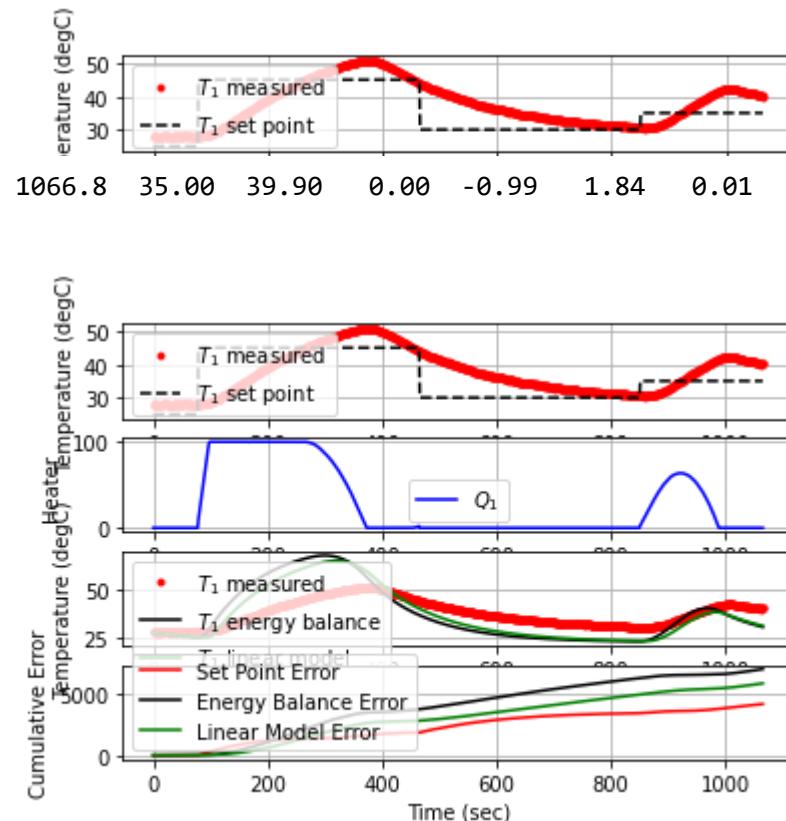


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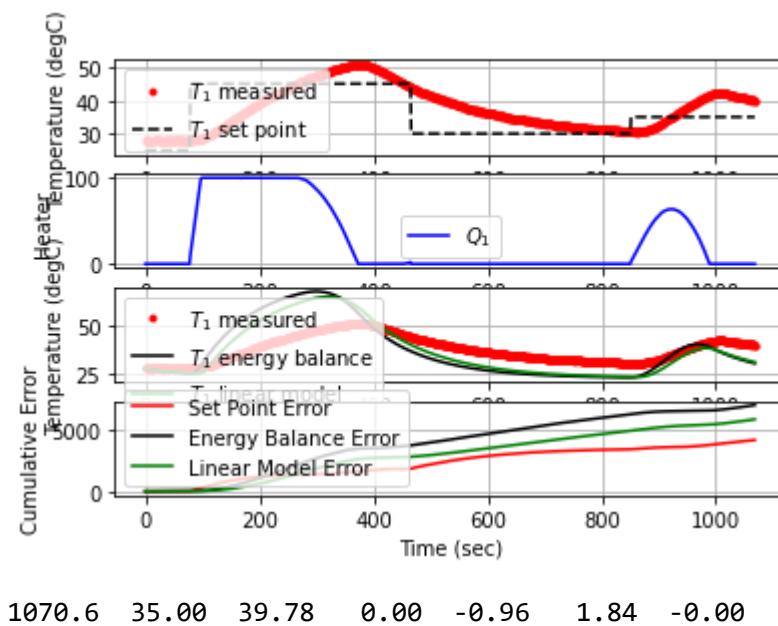
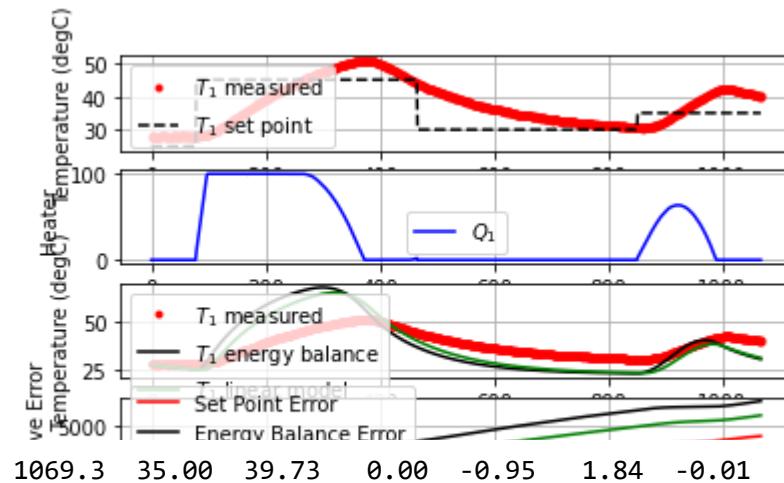


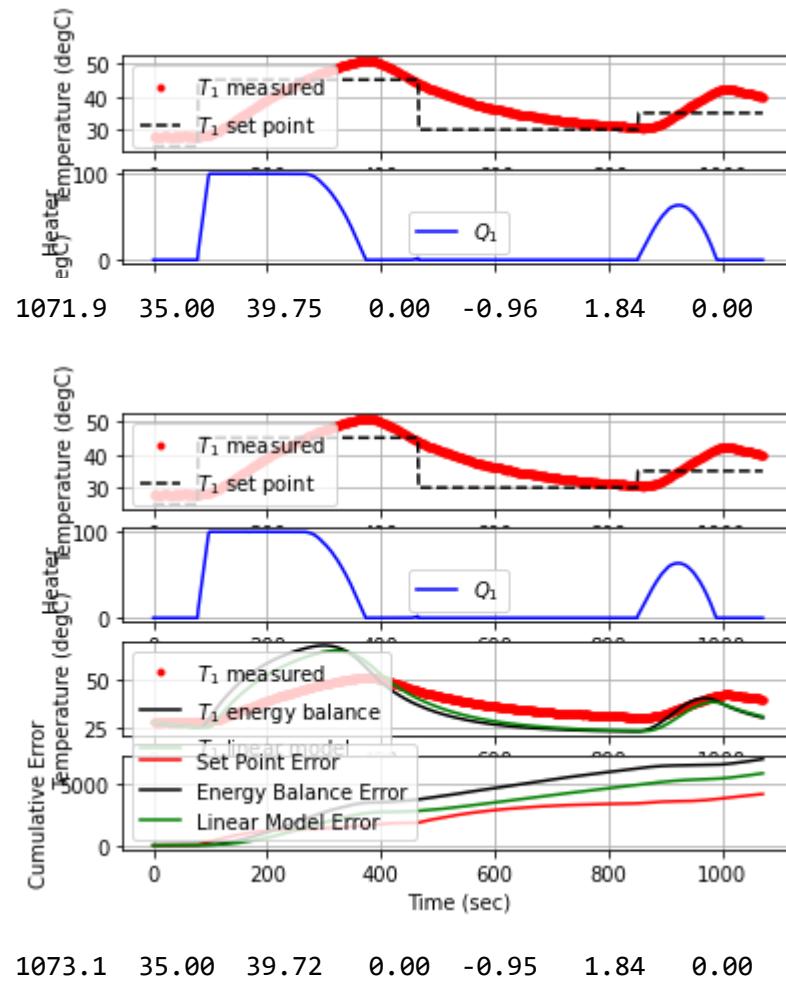


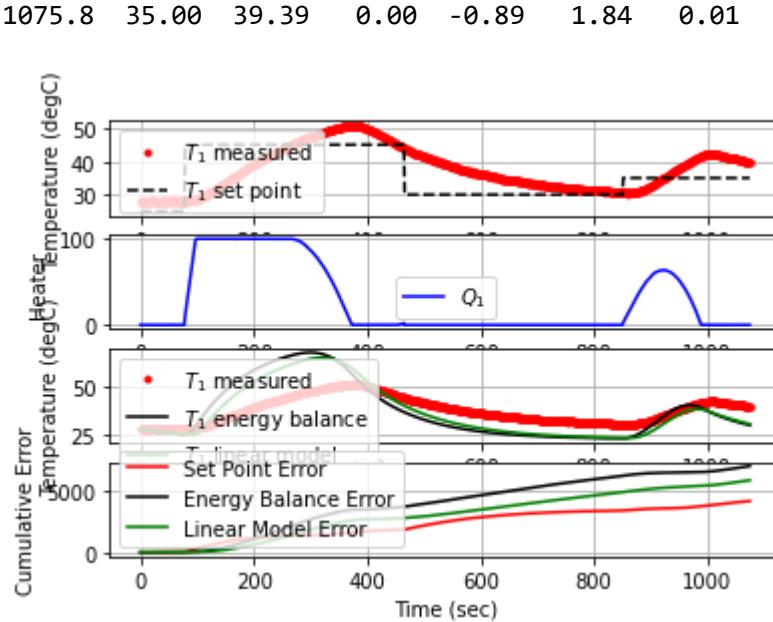
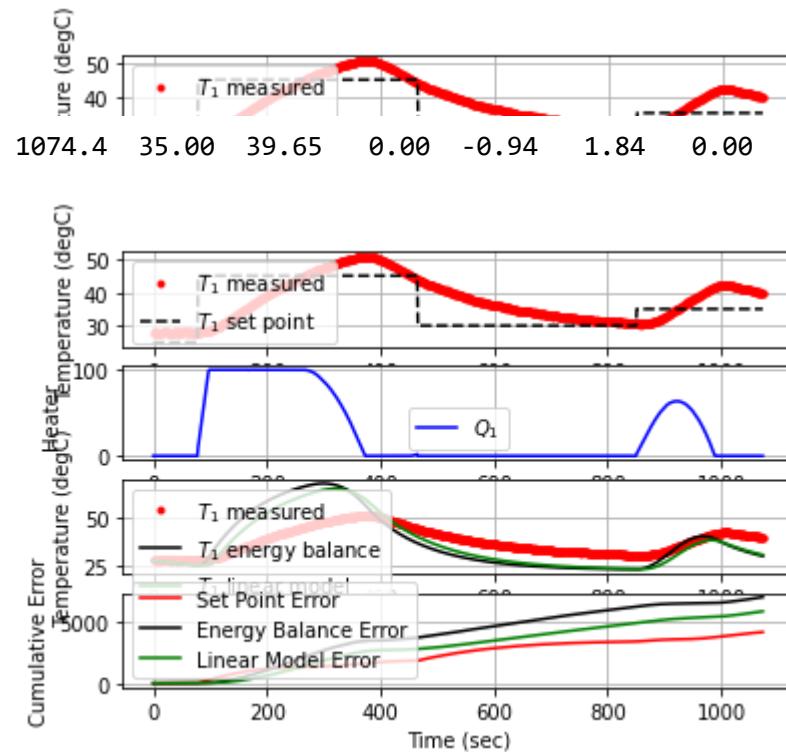
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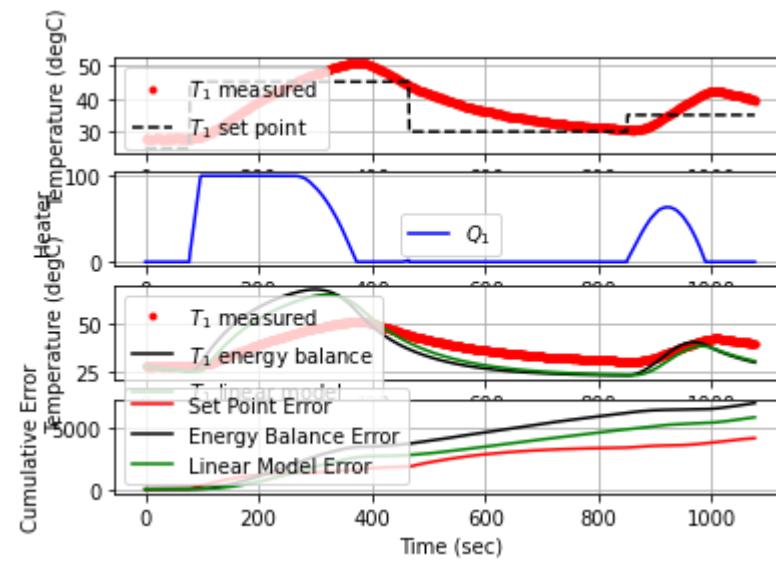
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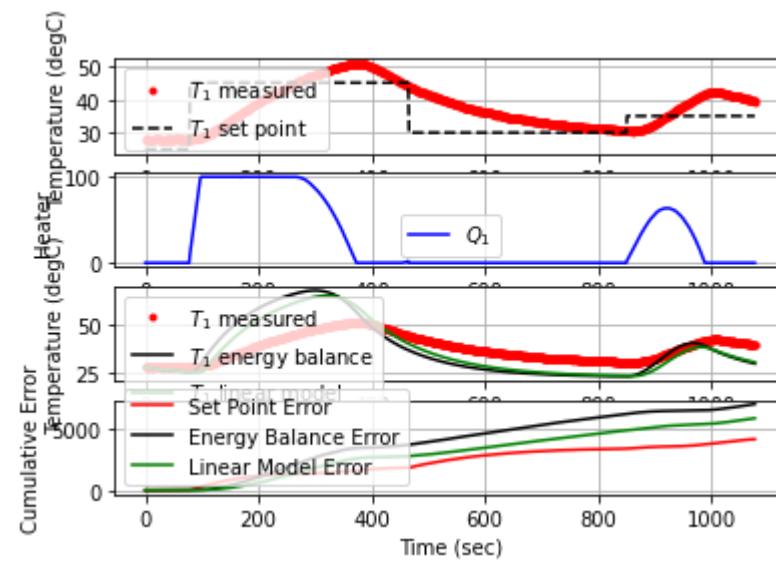




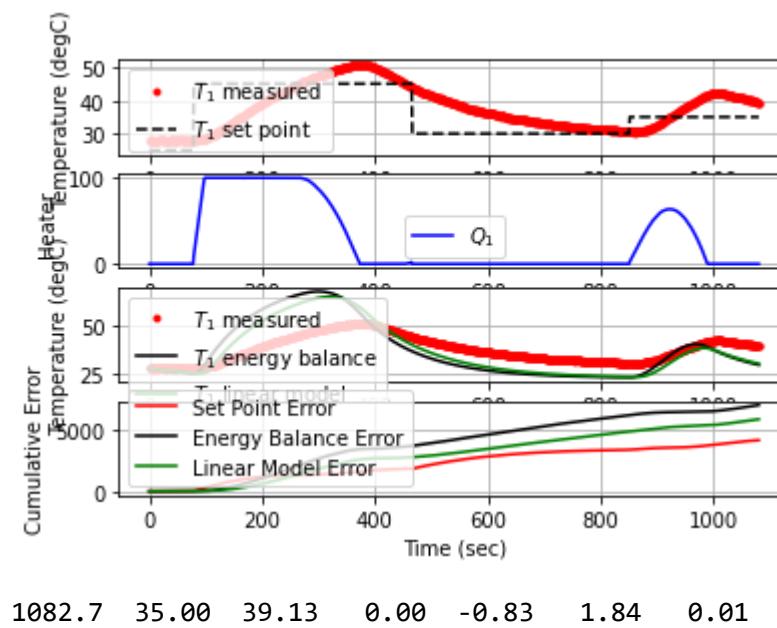
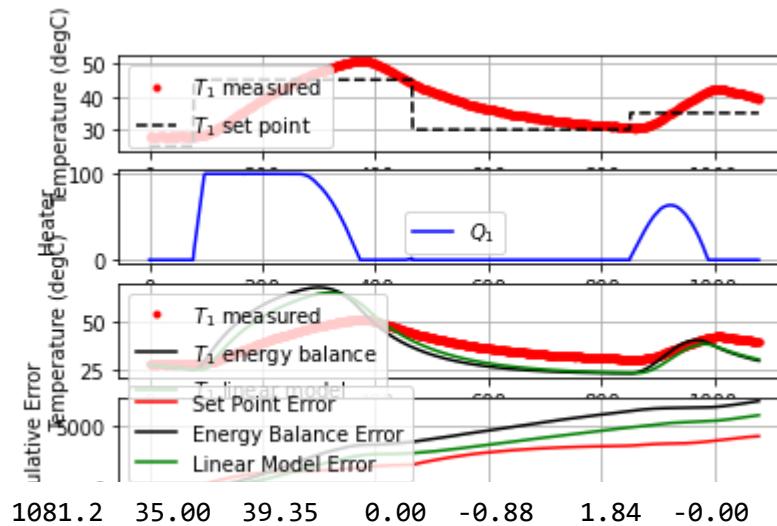
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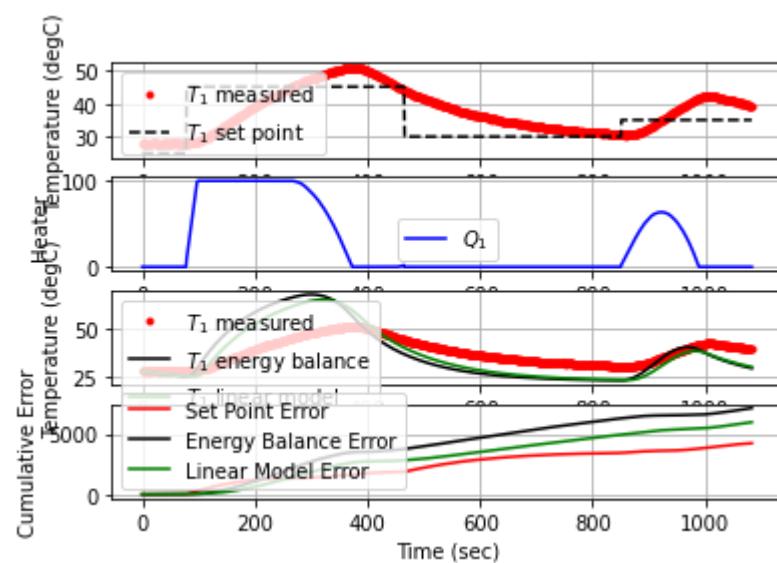
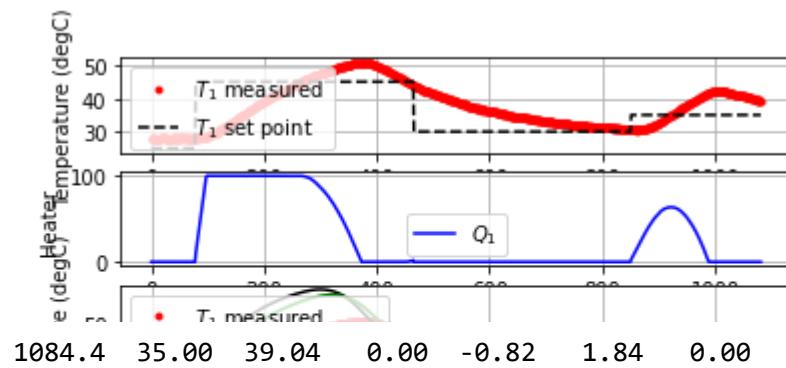


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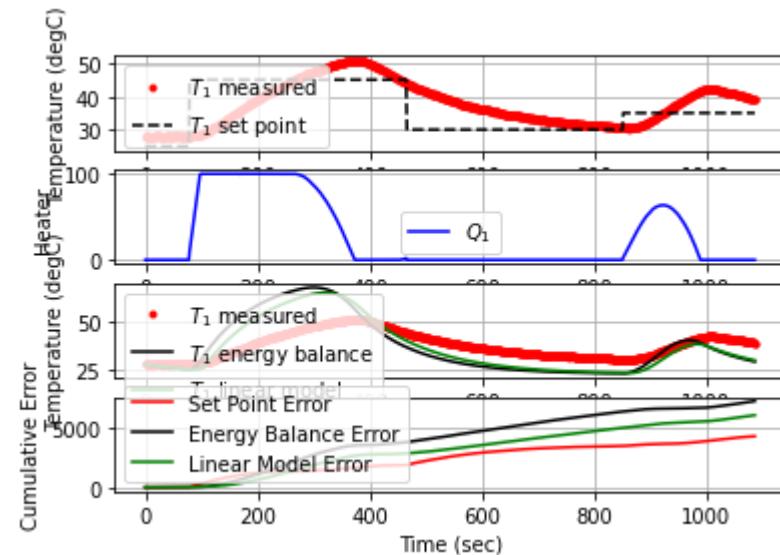
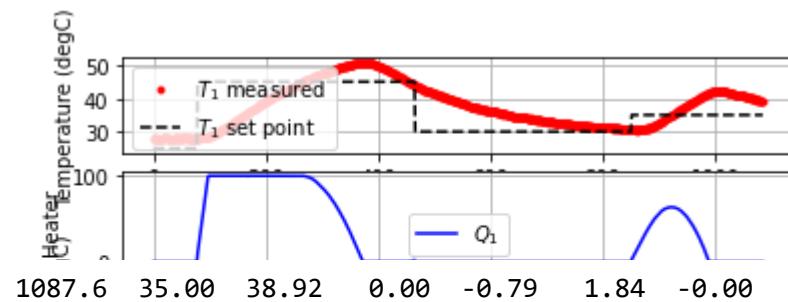


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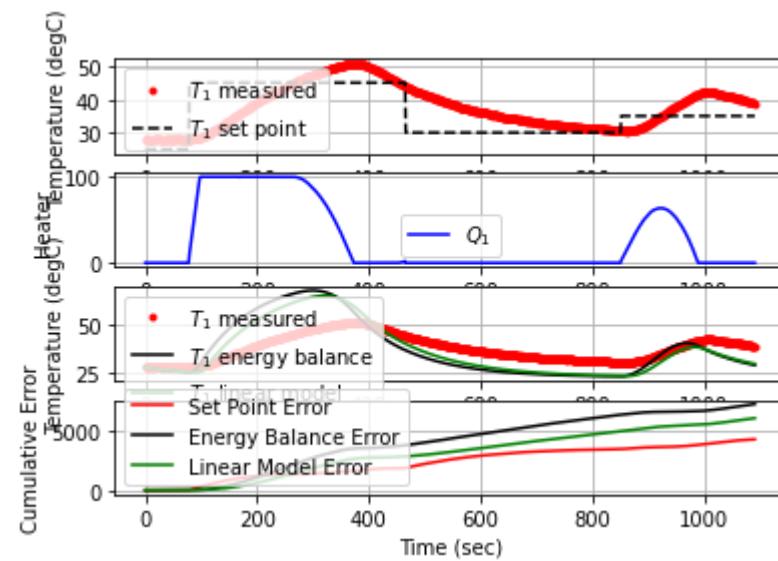
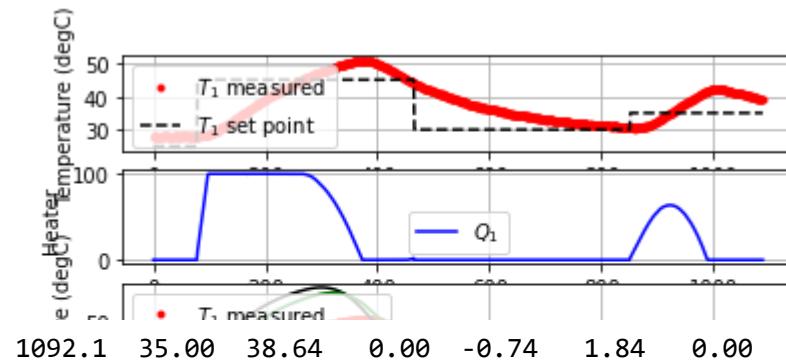


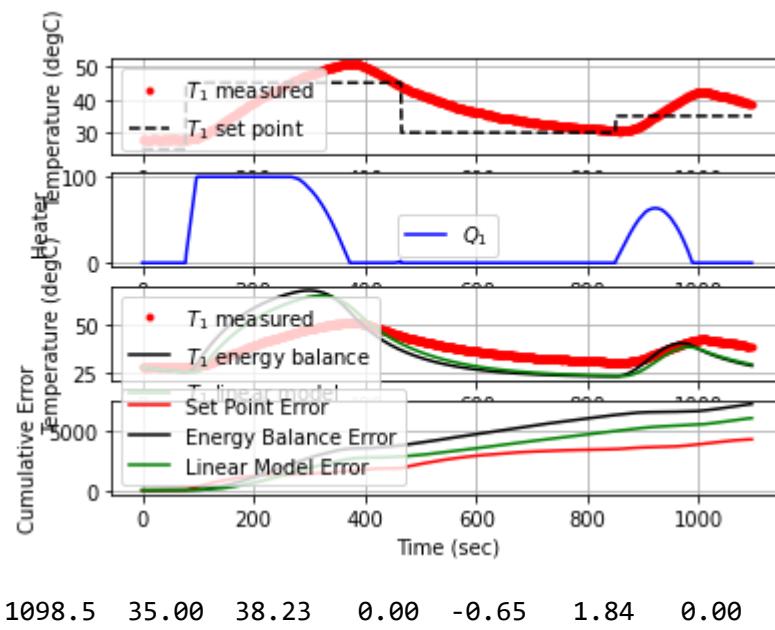
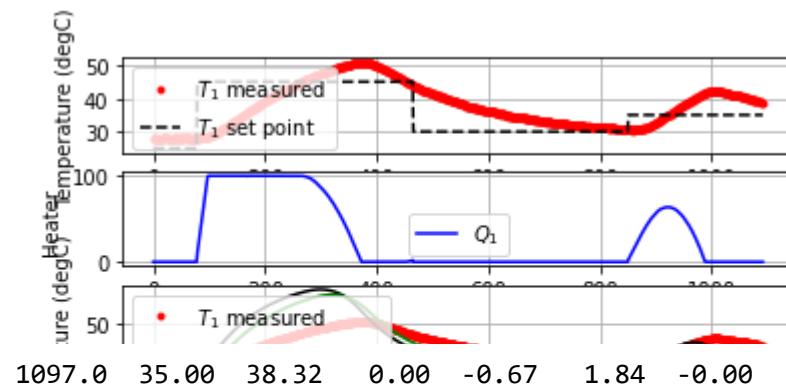


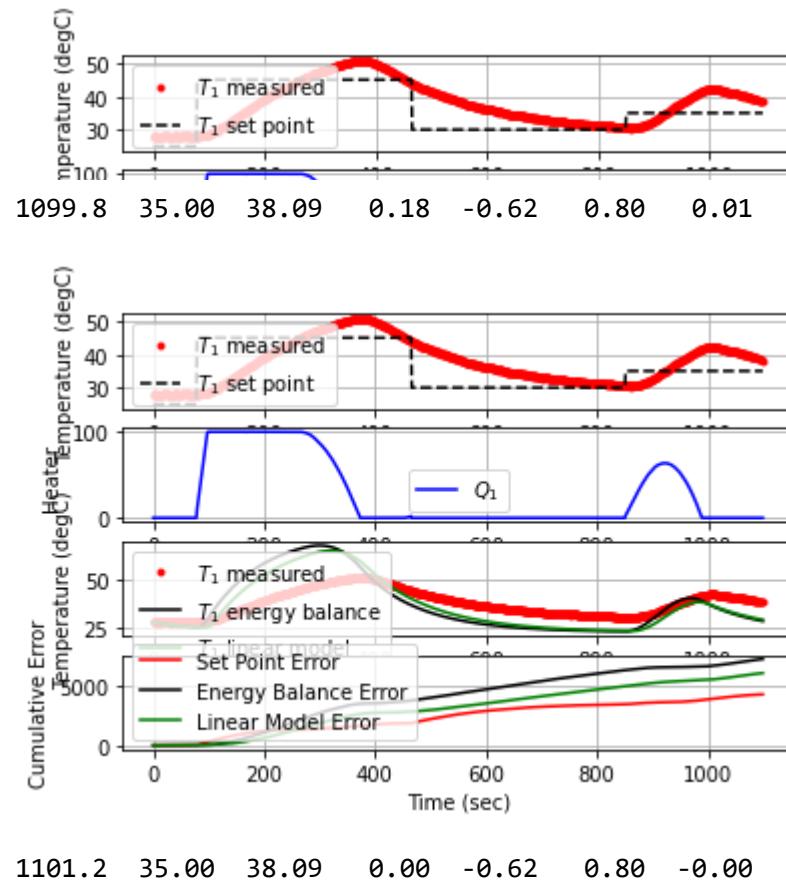
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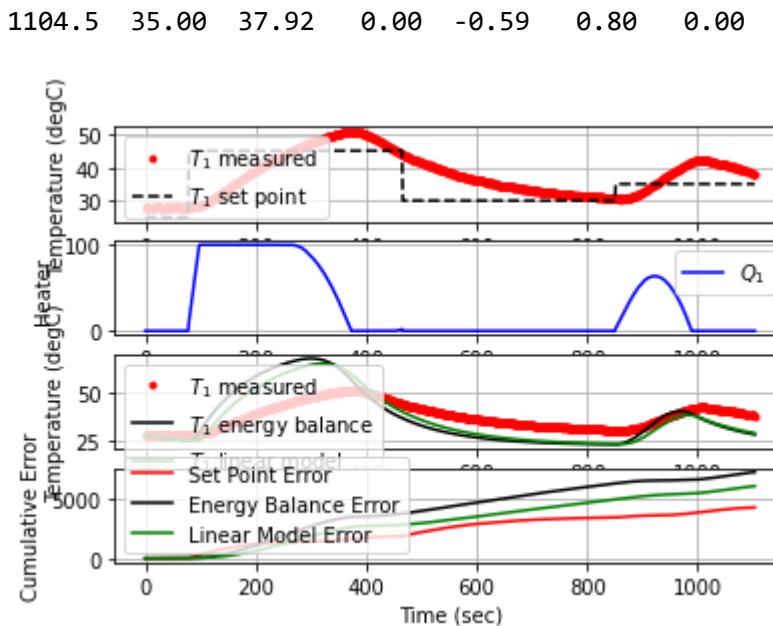
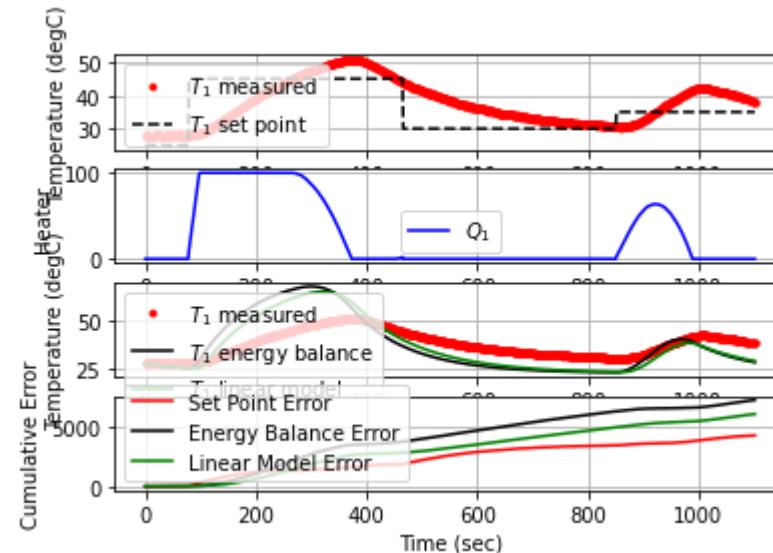
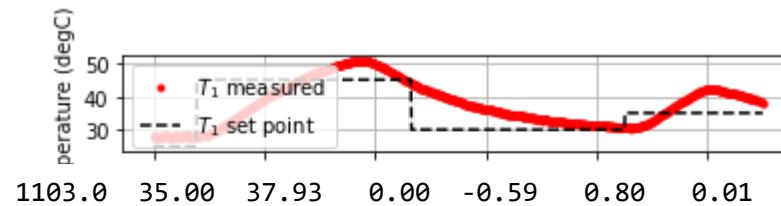


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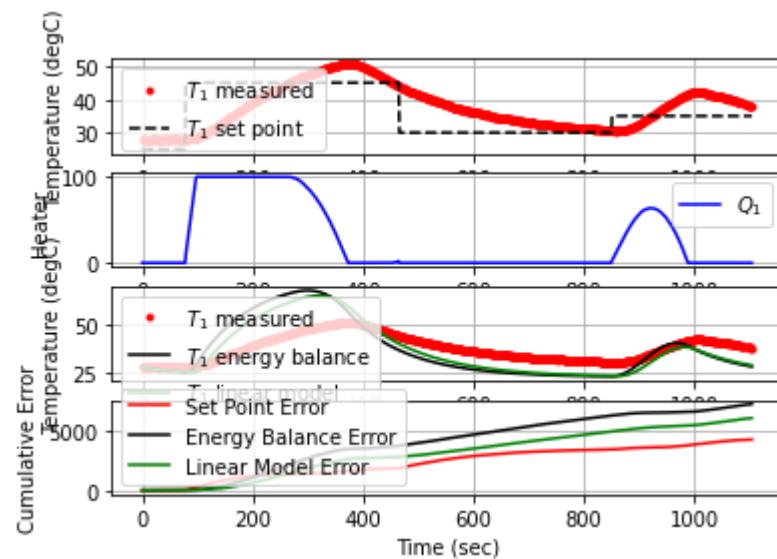




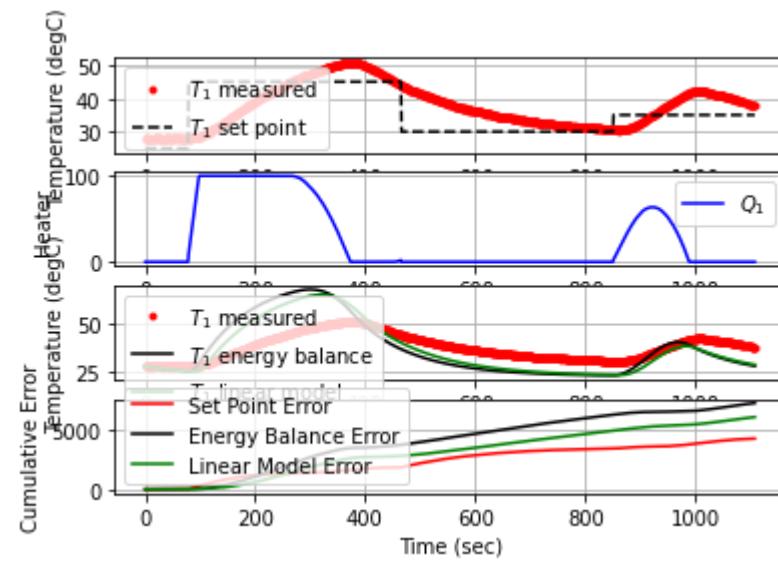
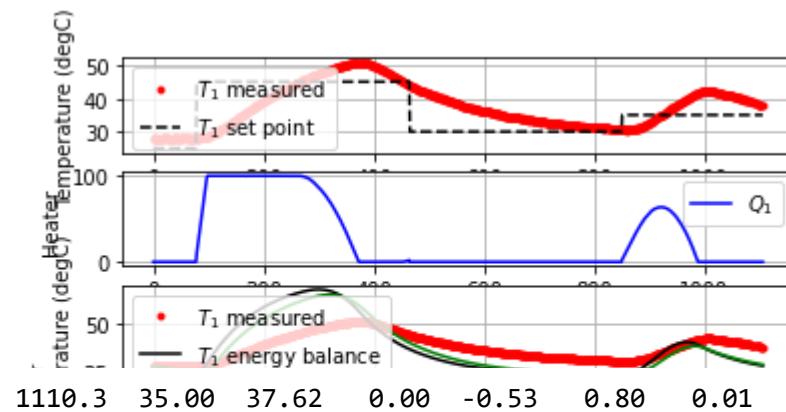




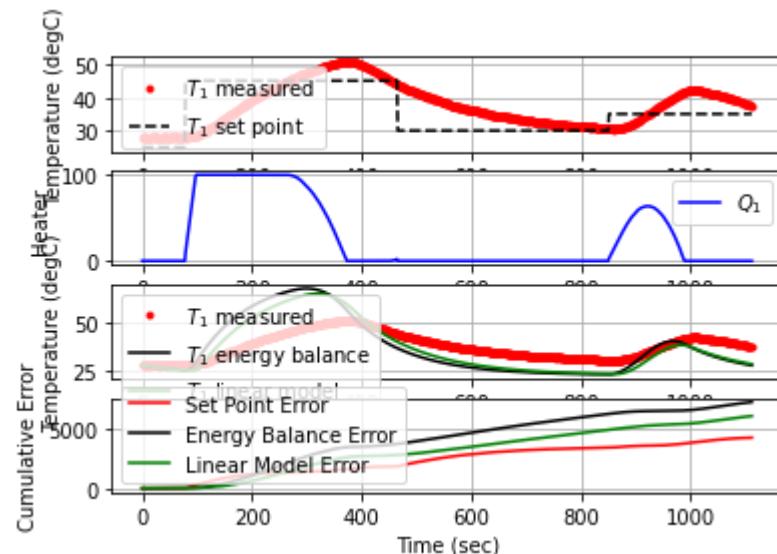
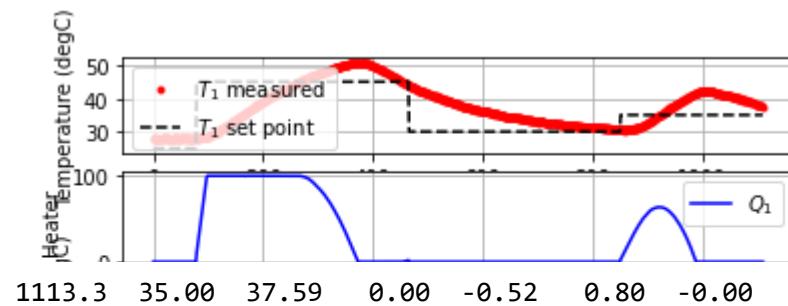
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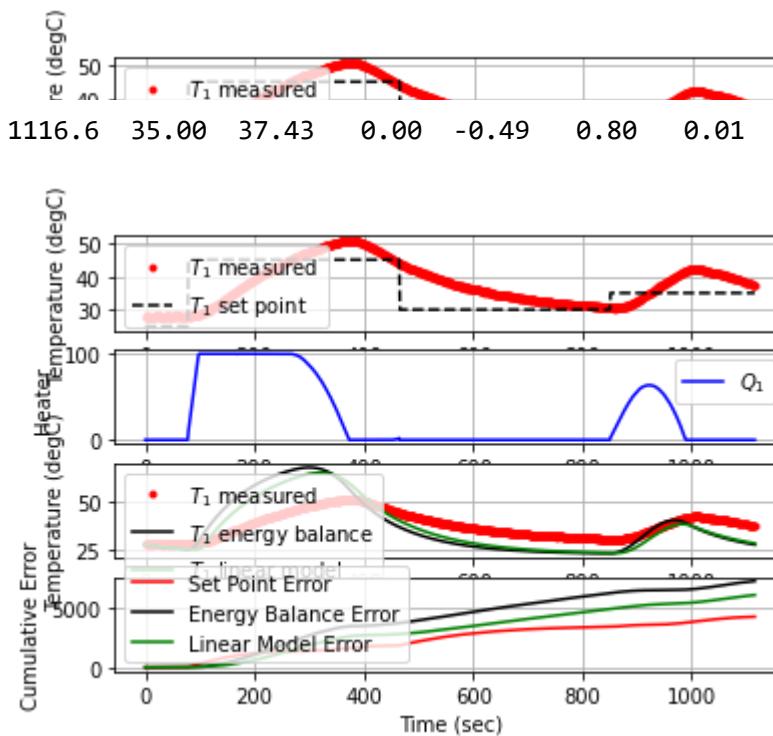
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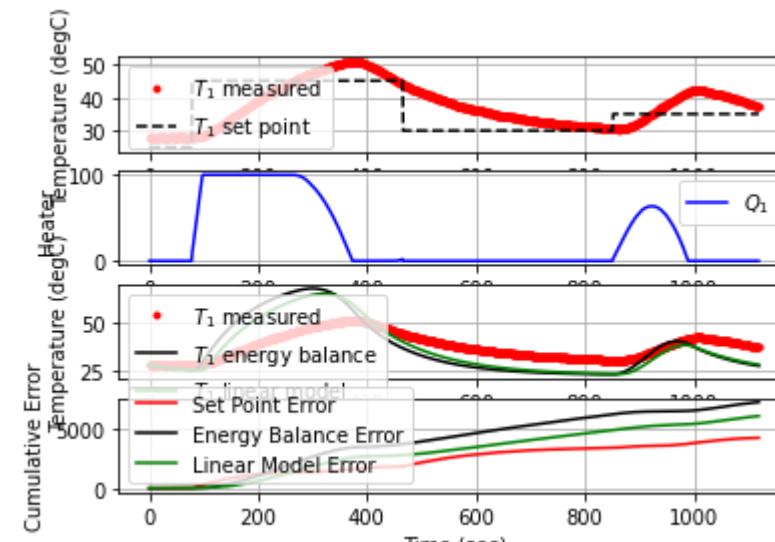
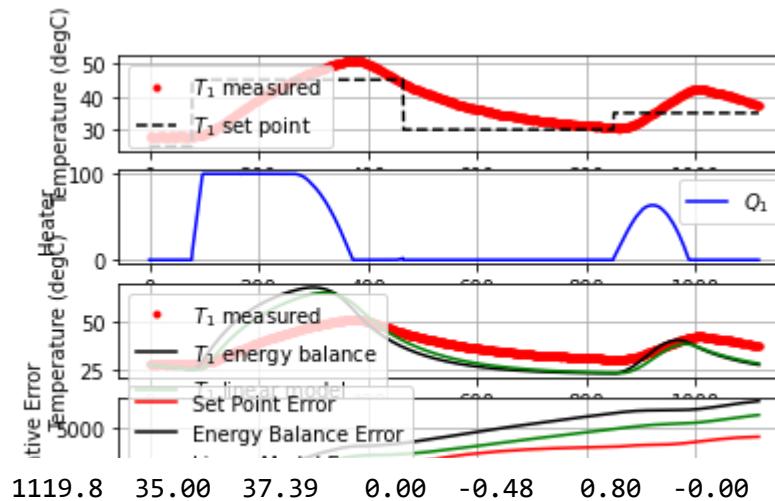
1111.8 35.00 37.53 0.00 -0.51 0.80 0.00

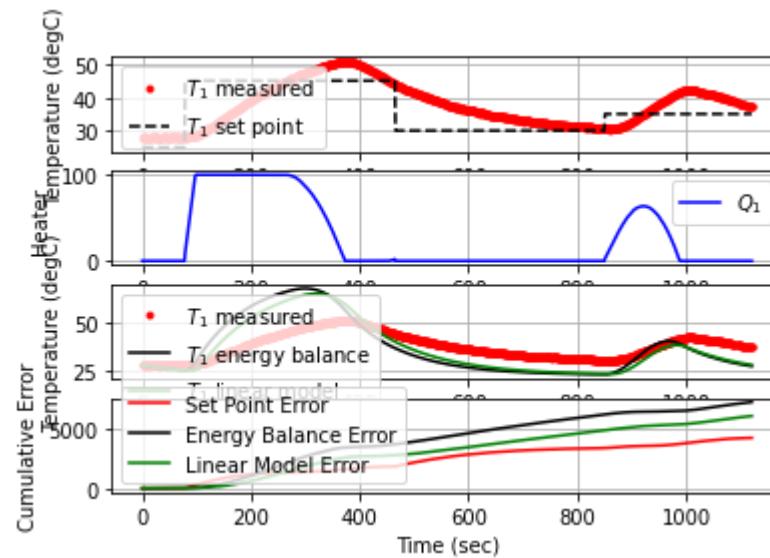
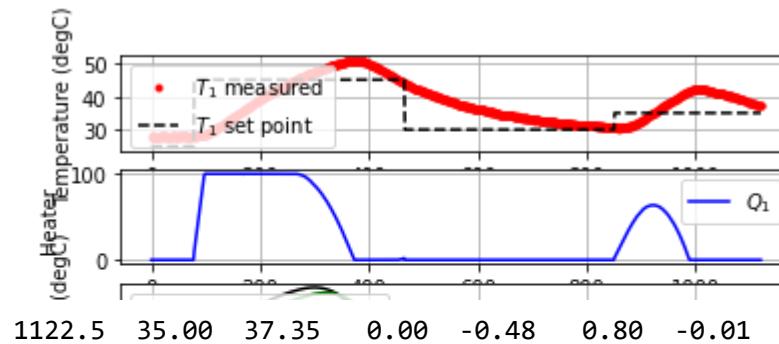


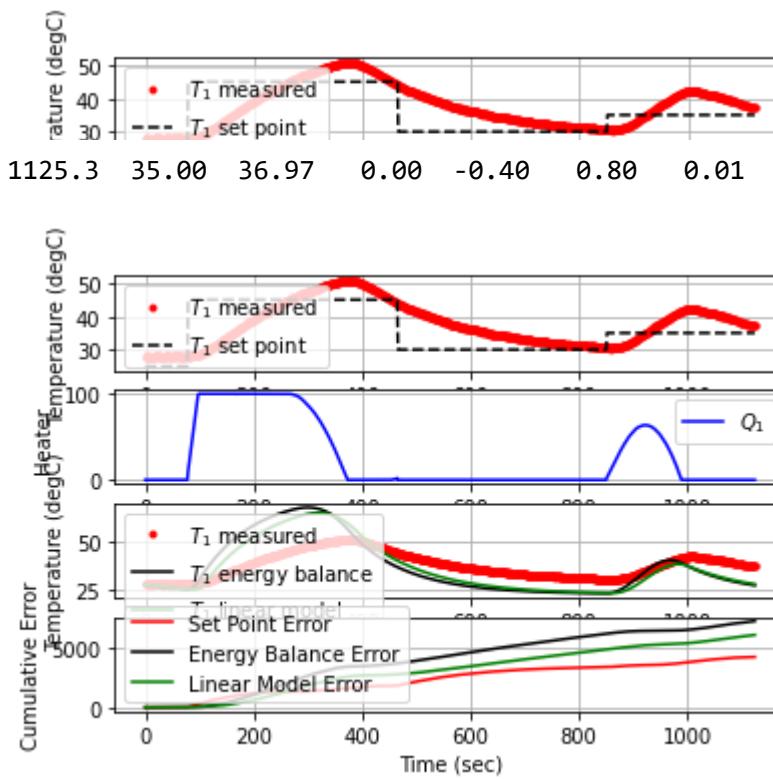
1115.2 35.00 37.59 0.00 -0.52 0.80 -0.00



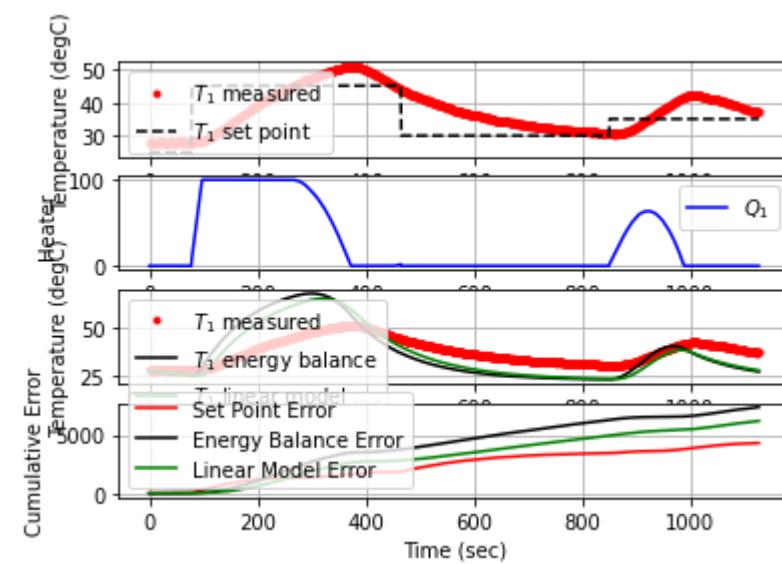
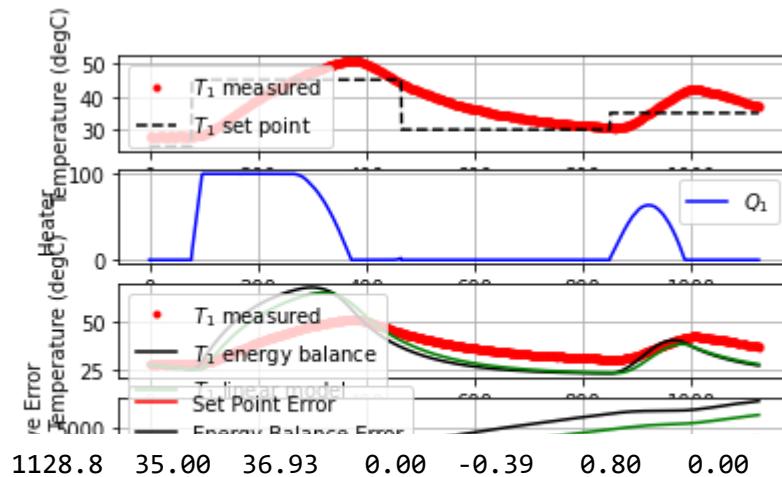
1118.4 35.00 37.38 0.00 -0.48 0.80 0.00



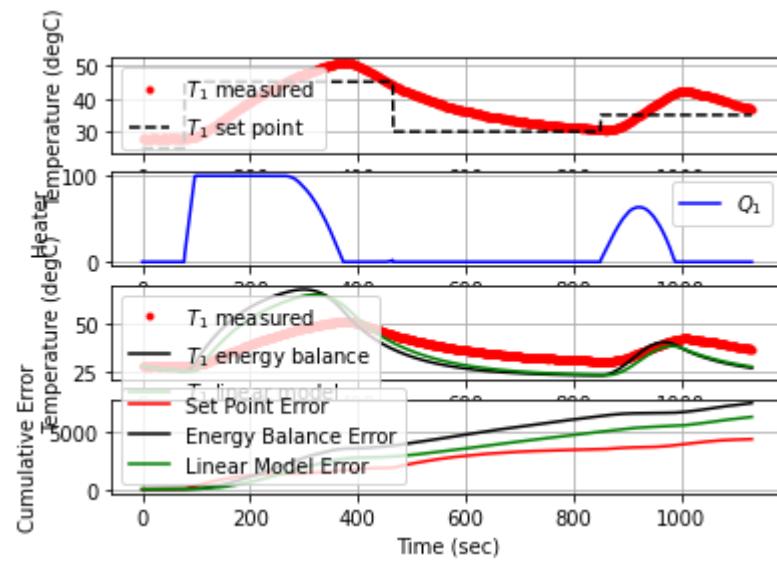
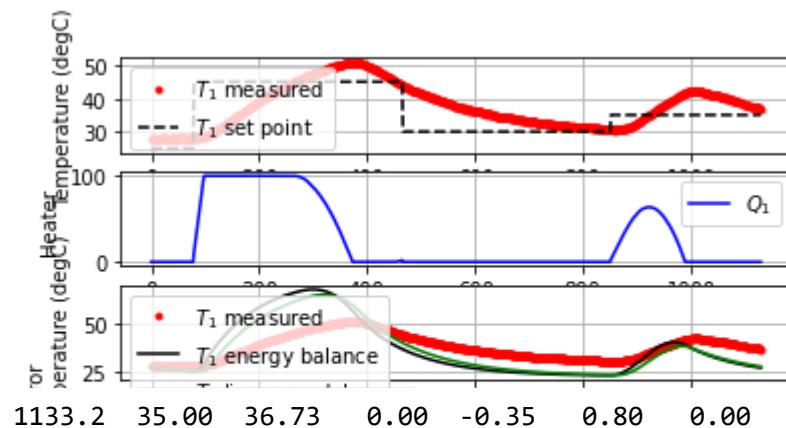




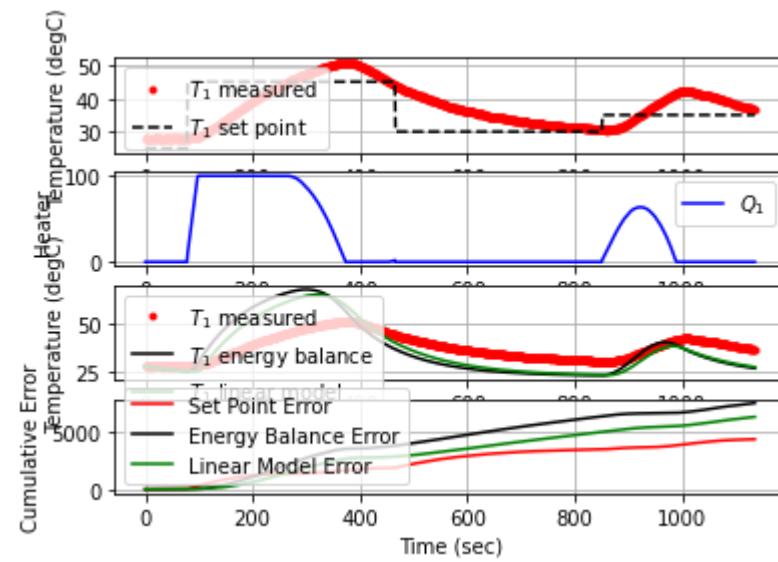
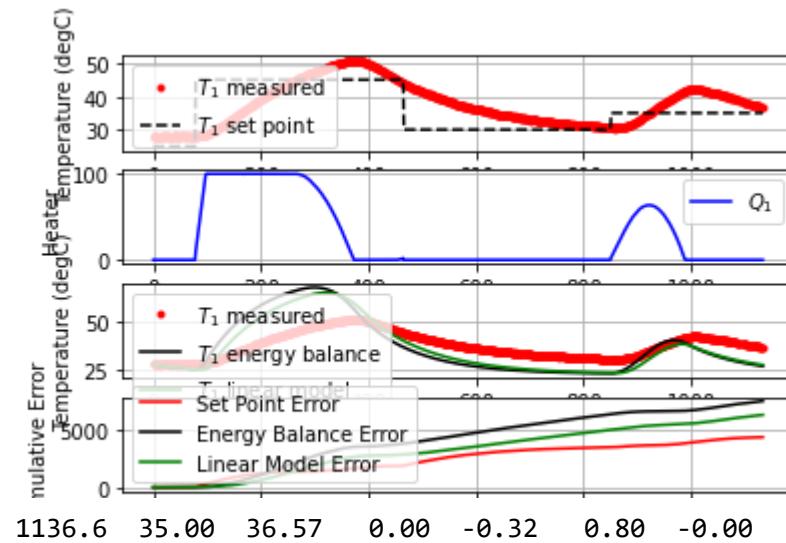
1126.8 35.00 37.06 0.00 -0.42 0.80 -0.00

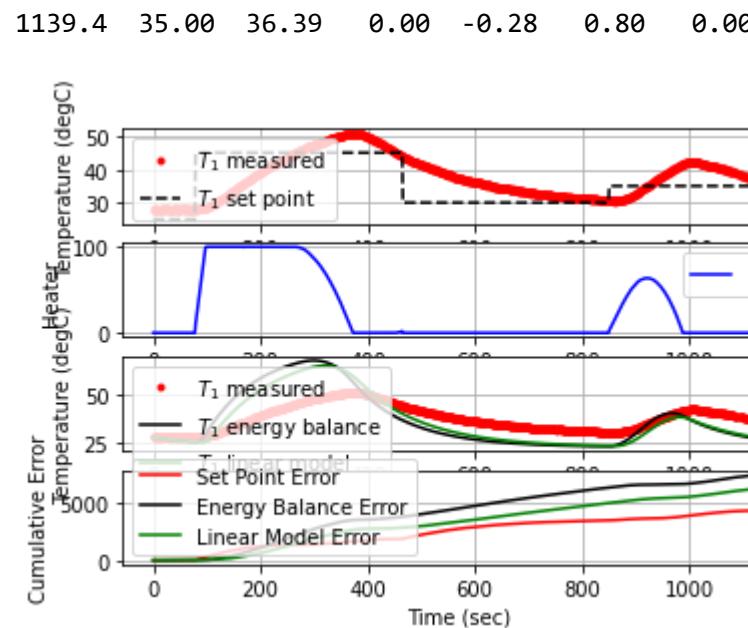
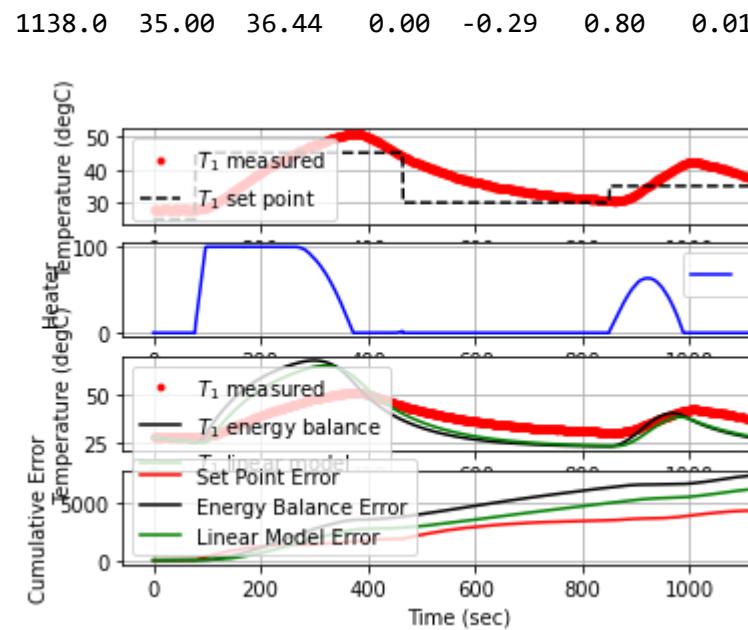


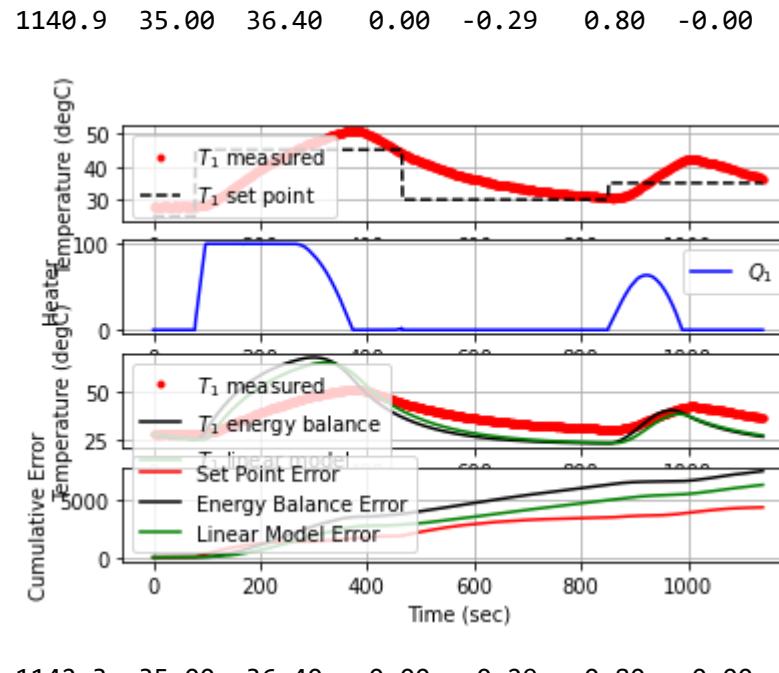
1131.1 35.00 36.85 0.00 -0.38 0.80 0.00



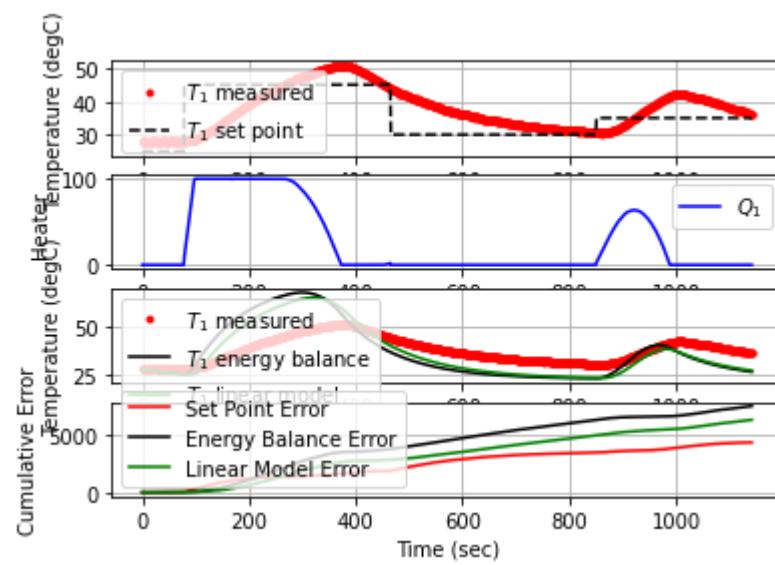
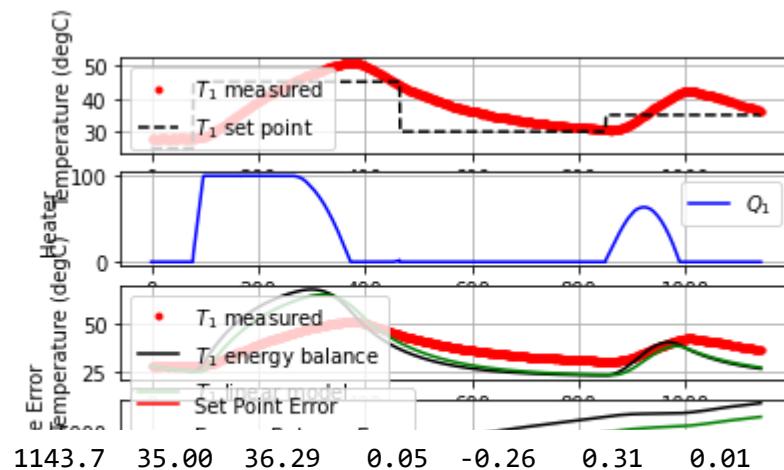
1135.0 35.00 36.56 0.00 -0.32 0.80 0.01



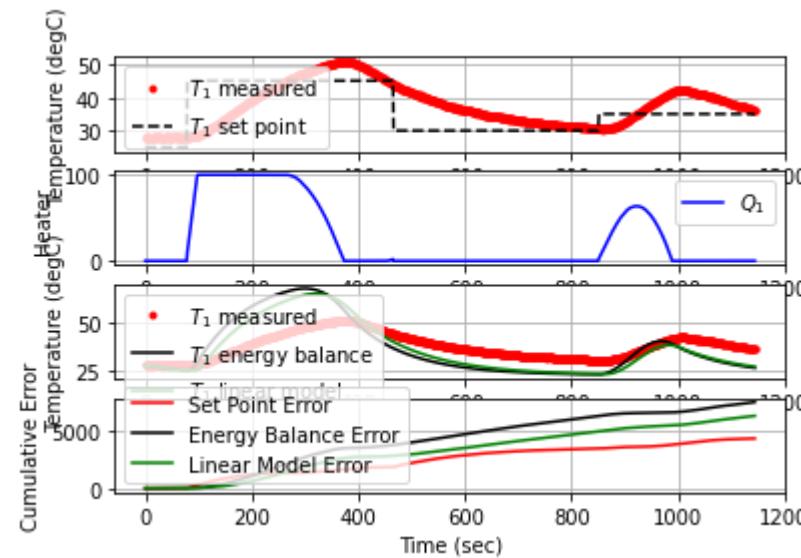




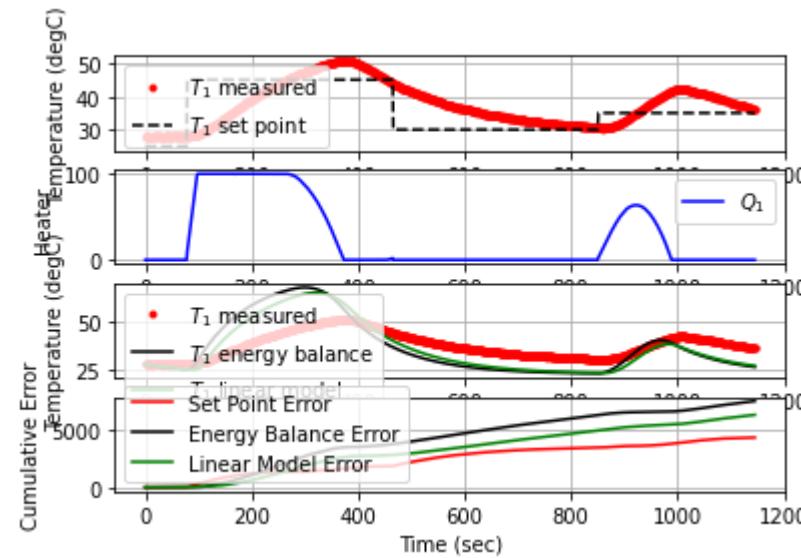
1142.3 35.00 36.40 0.00 -0.29 0.80 -0.00



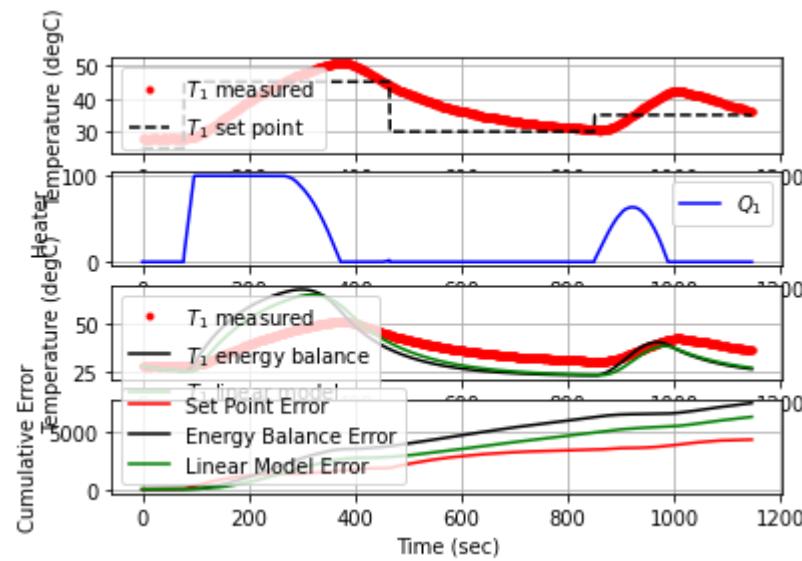
1145.1 35.00 36.25 0.00 -0.26 0.31 0.00



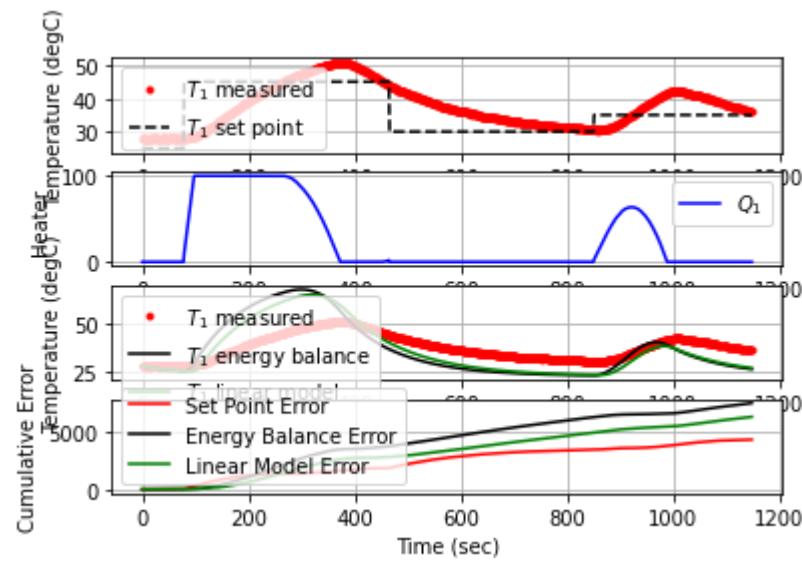
1146.6 35.00 36.29 0.00 -0.26 0.31 -0.00



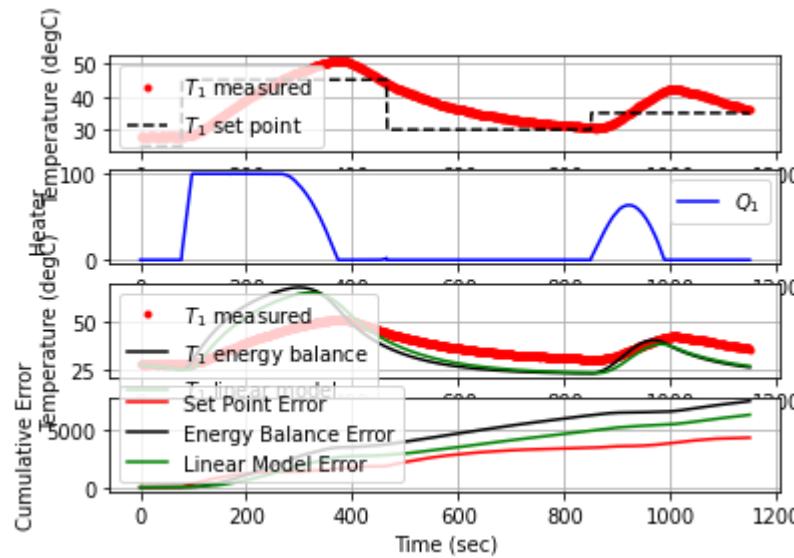
1148.4 35.00 36.14 0.00 -0.23 0.31 0.01



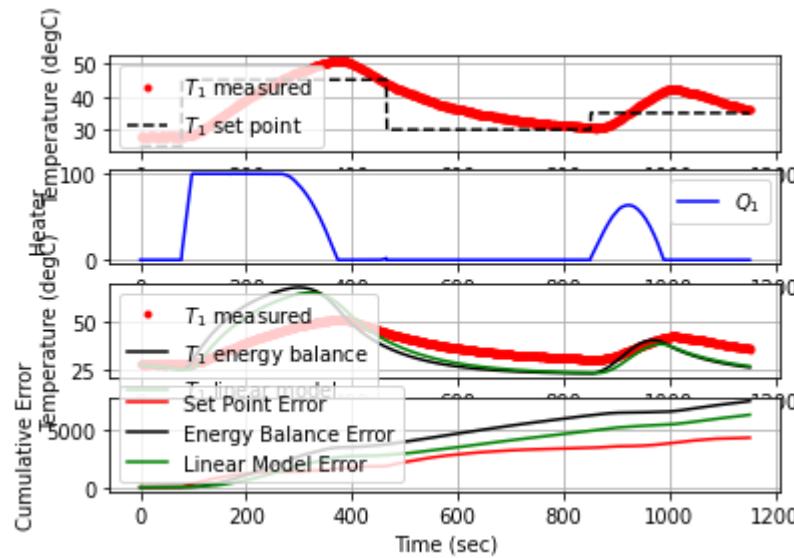
1150.0 35.00 35.97 0.00 -0.20 0.31 0.01



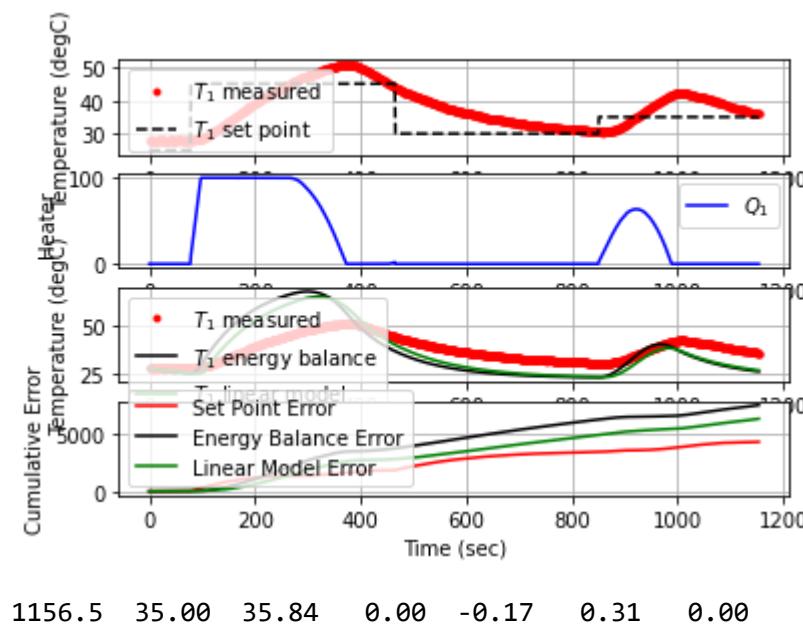
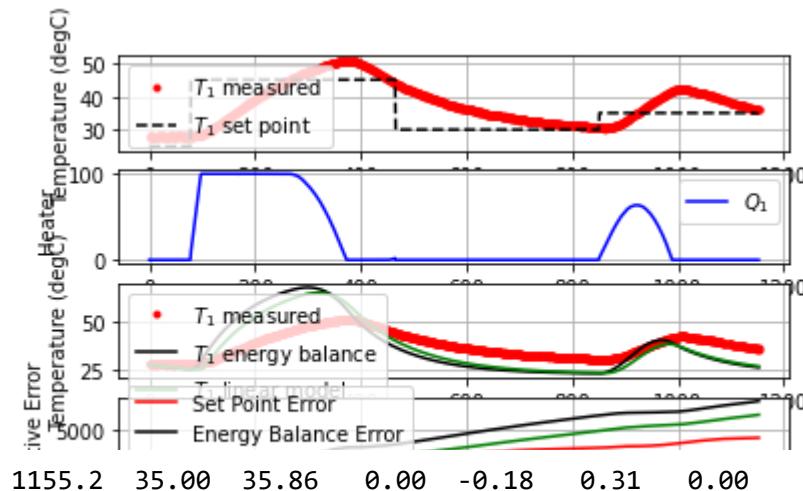
1151.3 35.00 36.12 0.00 -0.23 0.31 -0.01

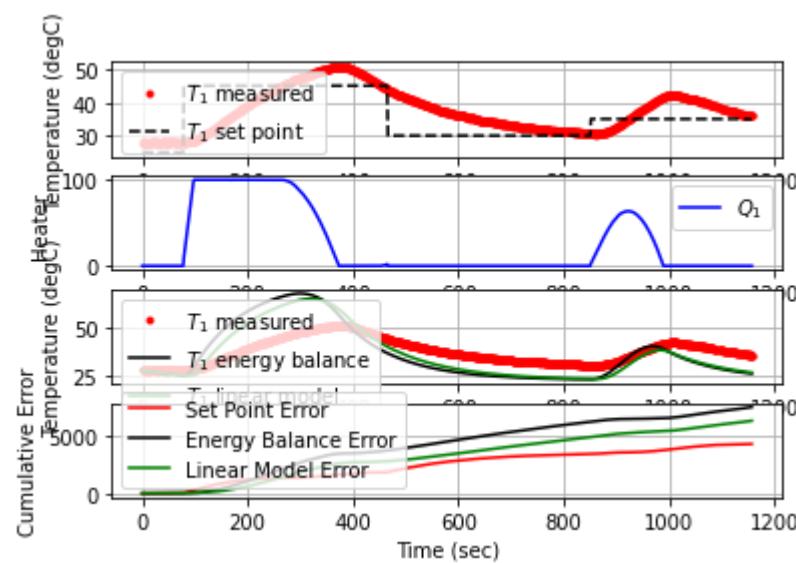
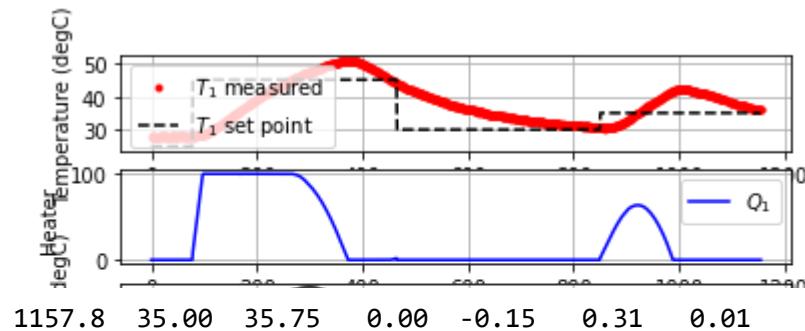


1152.5 35.00 35.86 0.00 -0.18 0.31 0.02

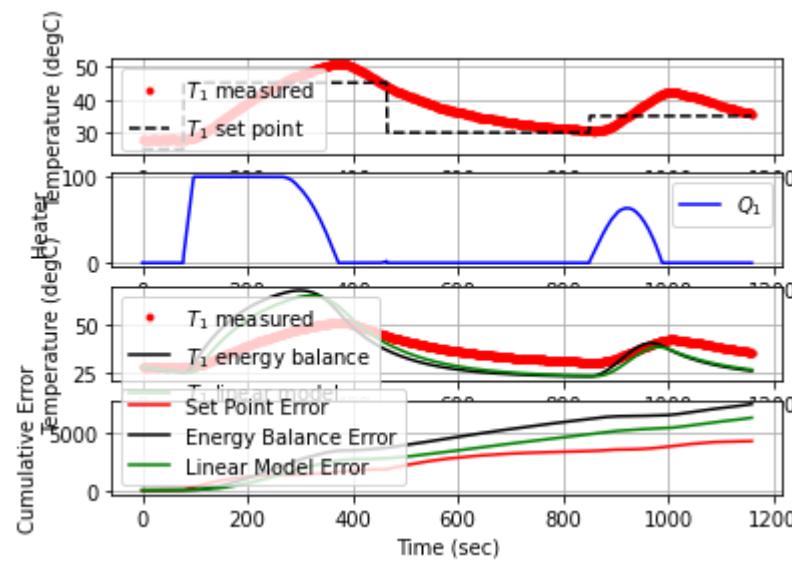
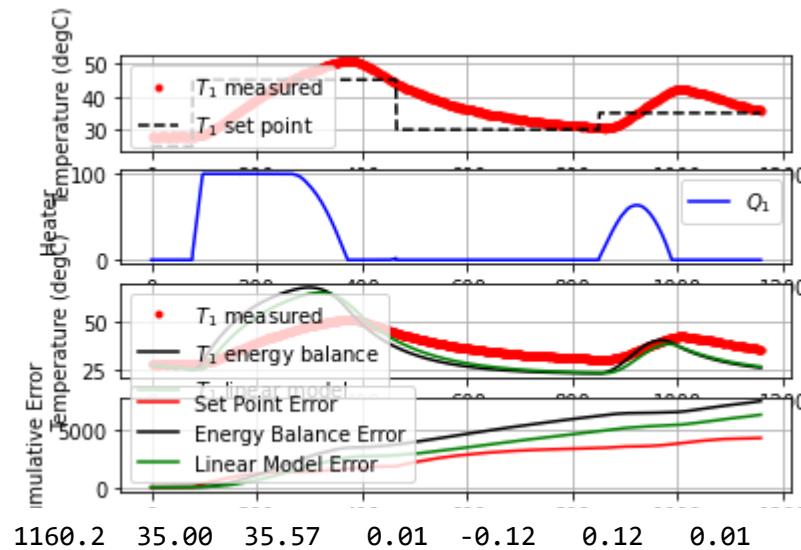


1153.9 35.00 35.94 0.00 -0.19 0.31 -0.00

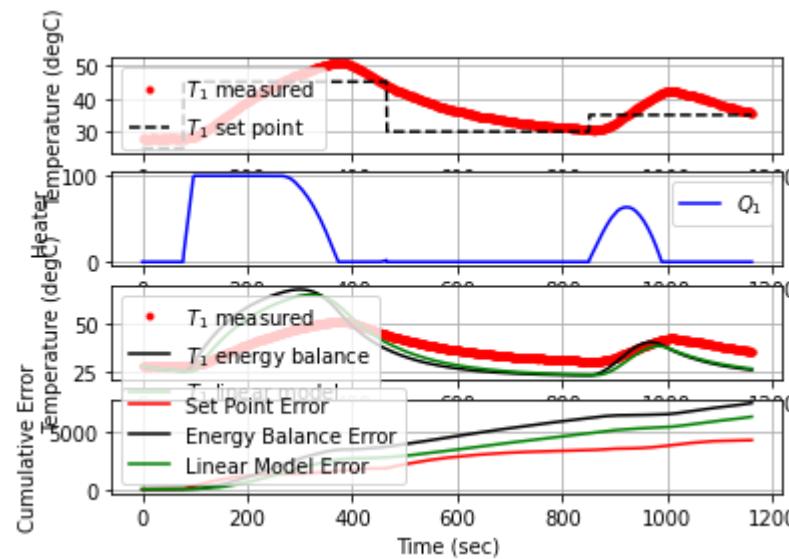




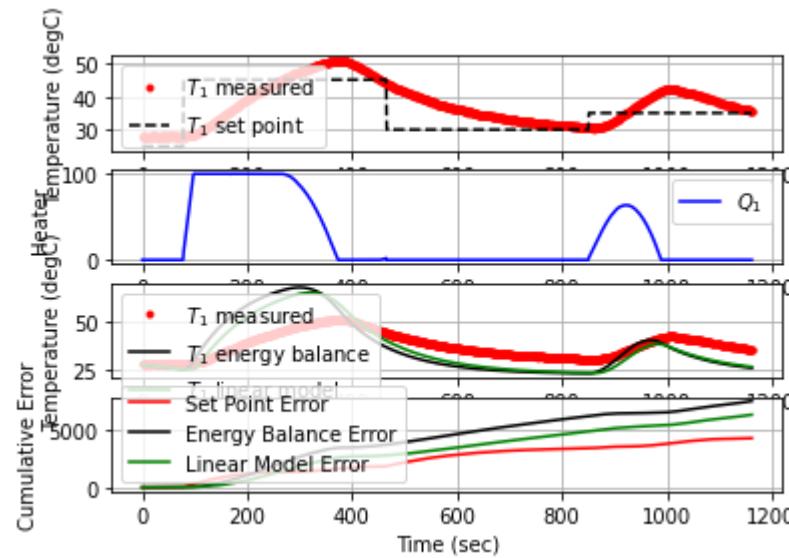
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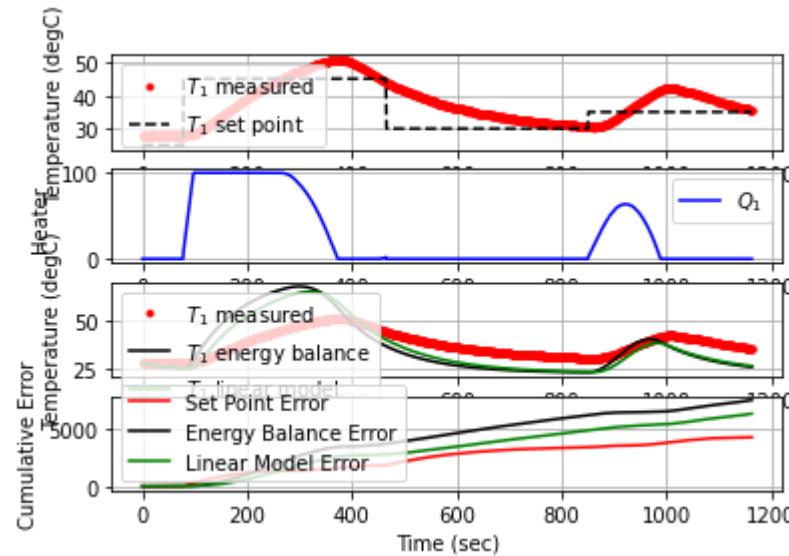
1161.6 35.00 35.66 0.00 -0.14 0.12 -0.00



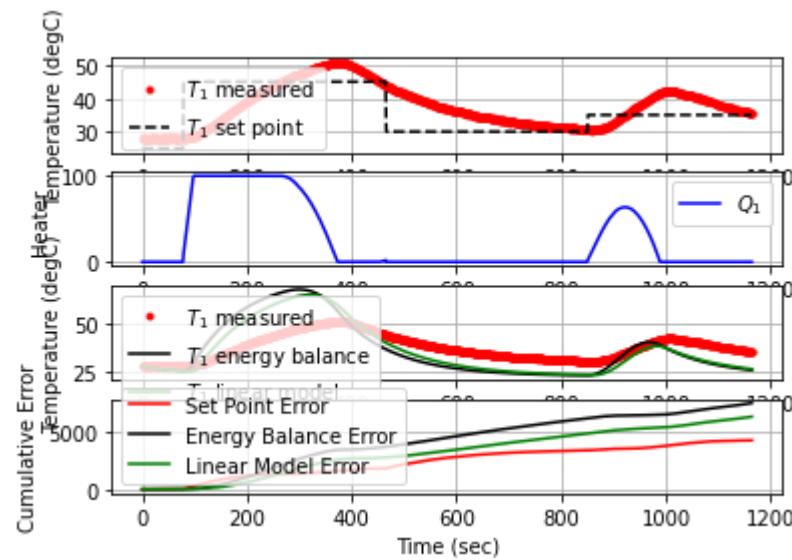
1162.9 35.00 35.60 0.00 -0.12 0.12 0.00



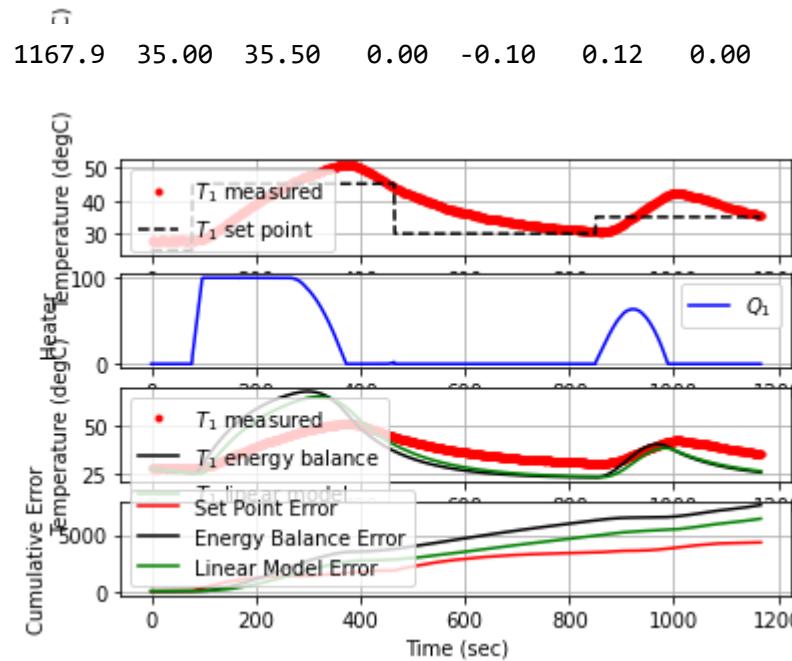
1164.1 35.00 35.58 0.00 -0.12 0.12 0.00



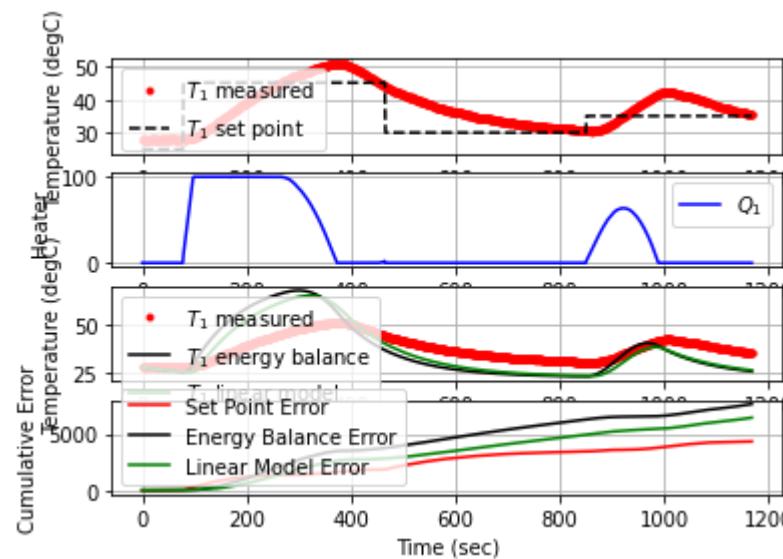
1165.3 35.00 35.54 0.00 -0.11 0.12 0.00



1166.6 35.00 35.51 0.00 -0.11 0.12 0.00



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 [ ]: