# Examples 3 - Elementary Signals

## Contents



Lecturer: Set up MATLAB

```
clear all
format compact
```

To accompany [Unit 2.3: Elementary Signals](#).

Follow along at [cpjobling.github.io/eg-150-textbook/signals_and_systems/elementary_signals/examples3](#)

# Plot the Unit Step

```
syms t
u0(t) = heaviside(t); % allows us to type u0(t) in our formulae
A = 2; T = 2; % we need numerical values to get a successful plot
fplot(A*u0(t),'LineWidth',2),title('Unit
step'),subtitle(texlabel('Au_0(t)')),grid,xlabel('t')
```

# 3.1: Other forms of unit step

**MATLAB Example**

We will solve this example by hand and then give the solution in the MATLAB lab.

Use the MATLAB functions `subplot`, `heaviside` and `fplot` to reproduce Fig. 22.

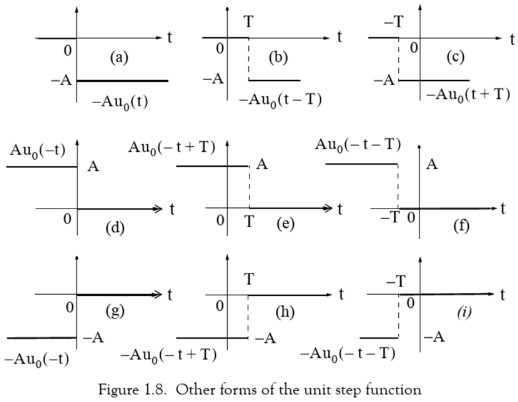



*Fig. 22* Other forms of unit step function (Figure 1.8 [Karris, 2012])

We've done the first row for you.

a). $-Au_0(t)$

```
sgtitle('Other forms of the unit step function');
subplot(331)
fplot(-A*u0(t)),title(['a) ',texlabel('-
A*u_0(t)')]),grid,xlabel('t')
```

b). $-A(t-T)$

```
subplot(332)
fplot(-A*u0(t - T)),title(['b) ',texlabel('-A*u_0(t-
T)')]),grid,xlabel('t')
```

c). $-A(t+T)$

```
subplot(333)
fplot(-A*u0(t + T)),title(['c) ',texlabel('-
A*u_0(t+T)')]),xlabel('t')
```

d). $Au_0(-t)$

e). $Au_0(-t+T)$

f). $Au_0(-t-T)$

g). $-Au_0(-t)$

h). $-Au_0(-t+T)$

i). $-Au_0(-t-T)$

The result should look like Fig. 23.

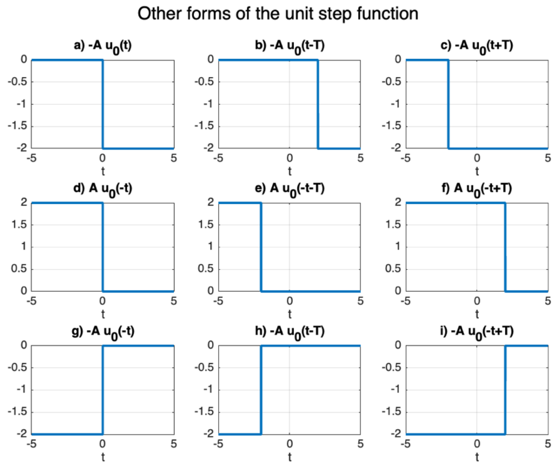



*Fig. 23* Other forms of unit step function (Figure 1.8 [Karris, 2012]) reproduced in MATLAB

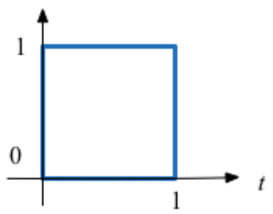
## 3.2: Synthesis of Signals from Unit Step

**MATLAB Example**

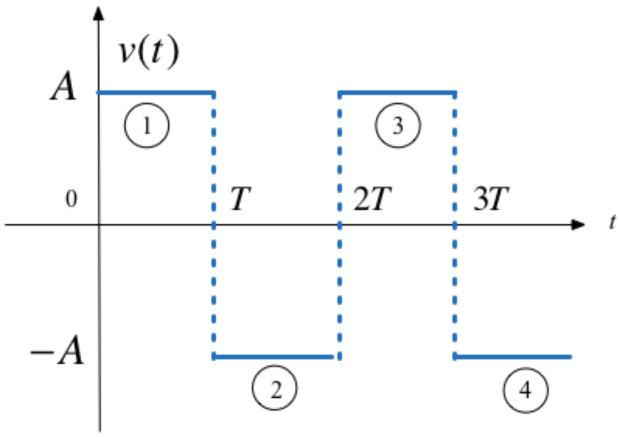
We will solve this example by hand and then give the solution in the MATLAB lab.

Unit step functions can be used to represent other time-varying functions such as rectangular pulses, square waves and triangular pulses.

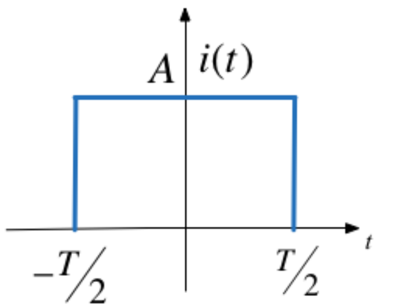
### a) Synthesize Rectangular Pulse



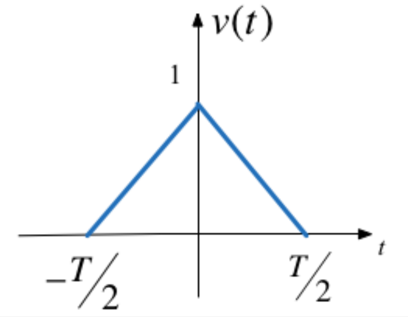
## b) Synthesize Square Wave




## c) Synthesize Symmetric Rectangular Pulse



### d) Synthesize Symmetric Triangular Pulse




## Example 3.3: Important properties of the delta function

> **MATLAB Example**
>
> We will solve this example by hand and then give the solution in the MATLAB lab.

See the accompanying notes.

Evaluate the following expressions

a) $3t^4\delta(t-1)$

b)

$$\int_{-\infty}^{\infty} t\delta(t-2)dt$$

$$t^2\delta'(t-3)$$

## Example 3.4

**MATLAB Example**

We will solve this example by hand and then give the solution in the MATLAB lab.

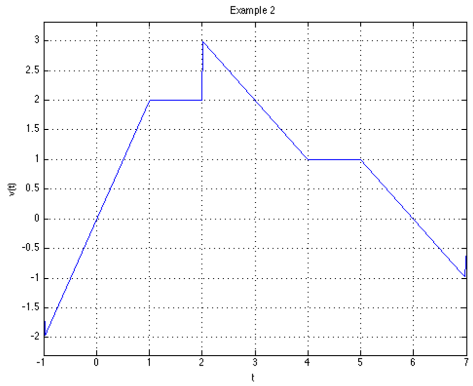



*Fig. 24* Signal to be symthesized for Example 3.6

a) Express the voltage waveform $v(t)$ shown in Fig. 24 as a sum of unit step functions for the time interval $-1 < t < 7$ s

b) Using the result of 3.6(a), compute the derivative of $v(t)$ and sketch its waveform.

# Lab Work

In the second lab we will solve the examples indicated in these examples.