Experiment No. 06

6.1 Experiment Name

Cascaded Single Phase and Three Phase H-Bridge Inverter using Simulink

6.2 Objectives

- To get familiarize with the Simulink platform and Simulink library
- To develop and study a cascaded single-phase H-bridge inverter using Simulink
- To use the Simulink platform to construct and analyze a cascaded three-phase H-bridge inverter.

6.3 Theory

Single phase and three phase H-bridge inverter

The inverter is a device that converts dc voltage to alternating current voltage and consists of four switches, whereas the half-bridge inverter requires two diodes and two switches connected in parallel. This can be constructed and cascaded into single and three phase inverters as desired.

The primary distinction between a single-phase and three-phase inverter is that a single-phase inverter can generate single-phase power from PV modules. It can also connect to single-phase equipment or the power grid. A three-phase, on the other hand, turns the DC input of solar panels into a three-phase AC output.

6.4 Apparatus

- Simulink

6.5 Simulink Block Diagram & Waveform

Cascaded Single-Phase H-bridge inverter

- **Block diagram**

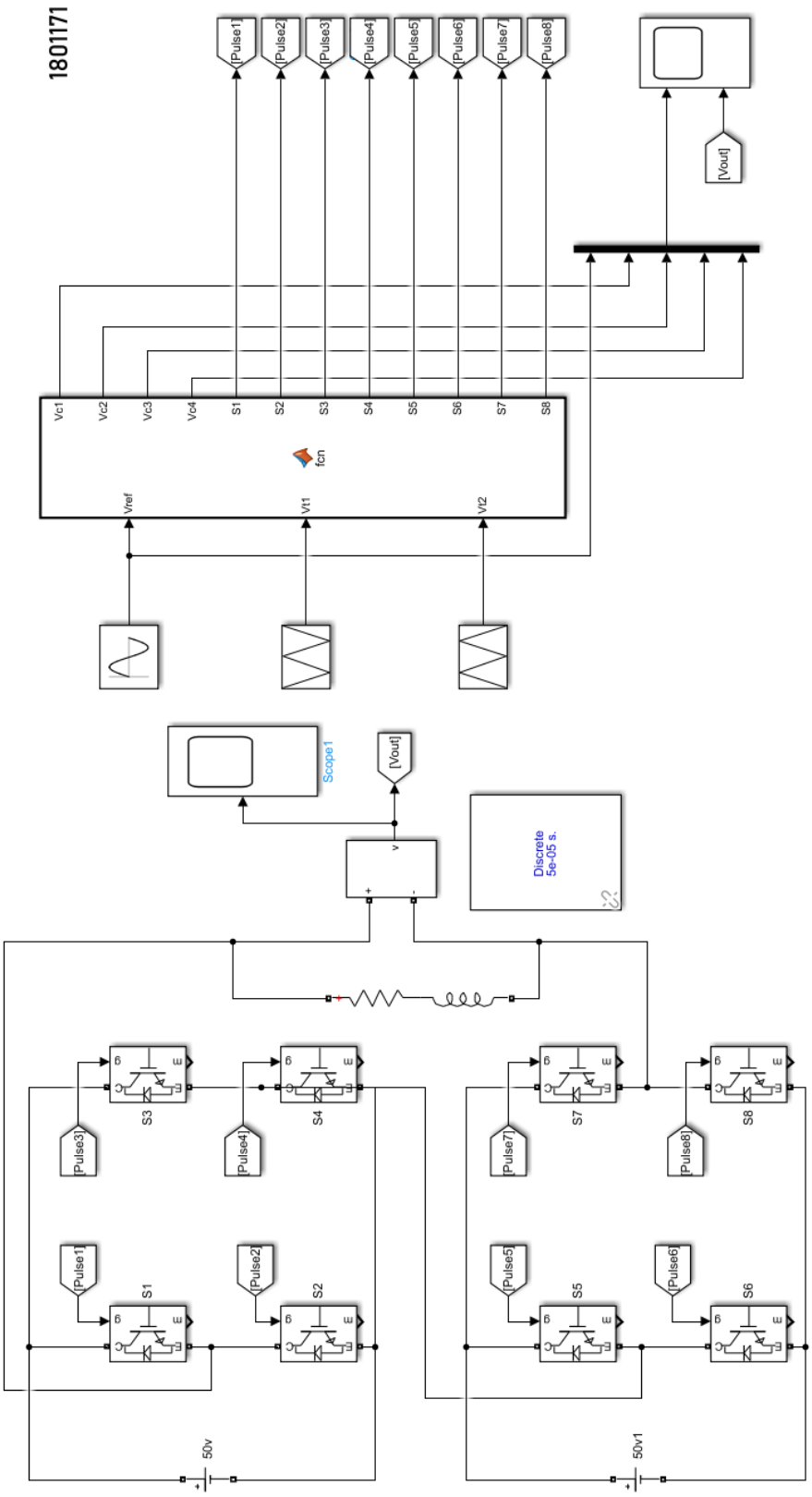


Fig. 6.1: Block diagram for Cascaded Single-Phase H-bridge inverter

- **Code for MATLAB function**

```
function [Vc1, Vc2, Vc3, Vc4, S1, S2, S3, S4, S5, S6, S7, S8] = fcn(Vref,
Vt1, Vt2)
Vc1 = (Vt1+1)*.25
Vc2 = .5+((Vt1+1)*.25)
Vc3 = (Vt2-1)*.25
Vc4 = -0.5+((Vt2-1)*.25)
if Vref>=0
if Vref>=0 && Vref<=0.5
    if  Vref>=Vc1
        S1=1; S2=0; S3=0; S4=1; S5=1; S6=0; S7=1; S8=0;
    else
        S1=1; S2=0; S3=1; S4=0; S5=1; S6=0; S7=1; S8=0;
    end
else Vref>0.5 && Vref<=1
     if  Vref>=Vc2
        S1=1; S2=0; S3=0; S4=1; S5=1; S6=0; S7=0; S8=1;
    else
       S1=1; S2=0; S3=0; S4=1; S5=1; S6=0; S7=1; S8=0;
     end
end

else
if Vref<0 && Vref>=-0.5
    if  Vref<=Vc3
        S1=0; S2=1; S3=1; S4=0; S5=1; S6=0; S7=1; S8=0;
    else
        S1=1; S2=0; S3=1; S4=0; S5=1; S6=0; S7=1; S8=0;
    end
else Vref<-0.5 && Vref>=-1
     if  Vref<=Vc4
        S1=0; S2=1; S3=1; S4=0; S5=0; S6=1; S7=1; S8=0;
    else
       S1=0; S2=1; S3=1; S4=0; S5=1; S6=0; S7=1; S8=0;
     end
end
end
end
```

- **Waveform**

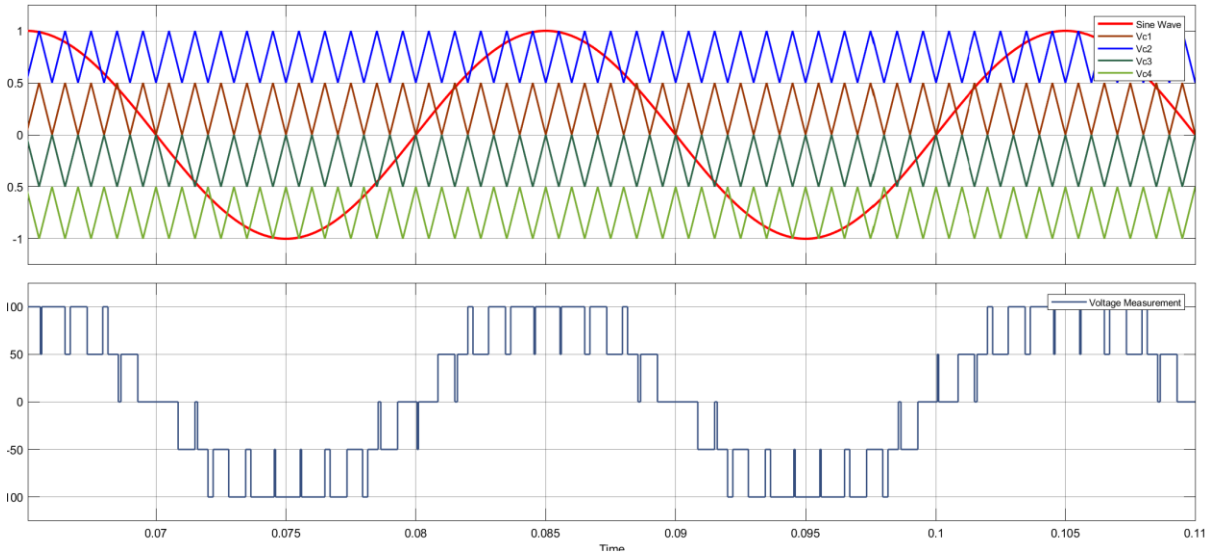


Fig. 6.2: Waveform for Cascaded Single-Phase H-bridge inverter

Three-phase H bridge inverter

- **Code for MATLAB function1**

```
function [Vc1,Vc2,Vc3,Vc4] = fcn(Vc)
Vc1 = (Vc+1)/4;
Vc2=Vc1+0.5;
Vc3= (Vc+1)/(-4);
Vc4=Vc3-0.5;
end
```

- **Code for MATLAB function2**

```
function [S1,S2,S3,S4,S5,S6,S7,S8]  = fcn(Vref,Vc1,Vc2,Vc3,Vc4)

if Vref >0
    if Vref>=0 && Vref<=0.5
        if Vref>=Vc1
            S1 =1; S2 =0; S3 =0; S4 =1; S5 =1; S6 =0; S7 =1; S8 =0;
        else
            S1 =1; S2 =0; S3 =1; S4 =0; S5 =1; S6 =0; S7 =1; S8 =0;
        end

    else
        if Vref>=Vc2
            S1 =1; S2 =0; S3 =0; S4 =1; S5 =1; S6 =0; S7 =0; S8 =1;
        else
            S1 =1; S2 =0; S3 =0; S4 =1; S5 =1; S6 =0; S7 =1; S8 =0;
        end
    end

else
    if Vref<=0 && Vref>=-0.5
        if Vref<=Vc3
            S1 =0; S2 =1; S3 =1; S4 =0; S5 =1; S6 =0; S7 =1; S8 =0;
        else
            S1 =0; S2 =1; S3 =0; S4 =1; S5 =0; S6 =1; S7 =0; S8 =1;
        end

    else
        if Vref<=Vc4
            S1 =0; S2 =1; S3 =1; S4 =0; S5 =0; S6 =1; S7 =1; S8 =0;
        else
            S1 =0; S2 =1; S3 =1; S4 =0; S5 =1; S6 =0; S7 =1; S8 =0;
        end
    end
end
end
```

- **Block diagram**

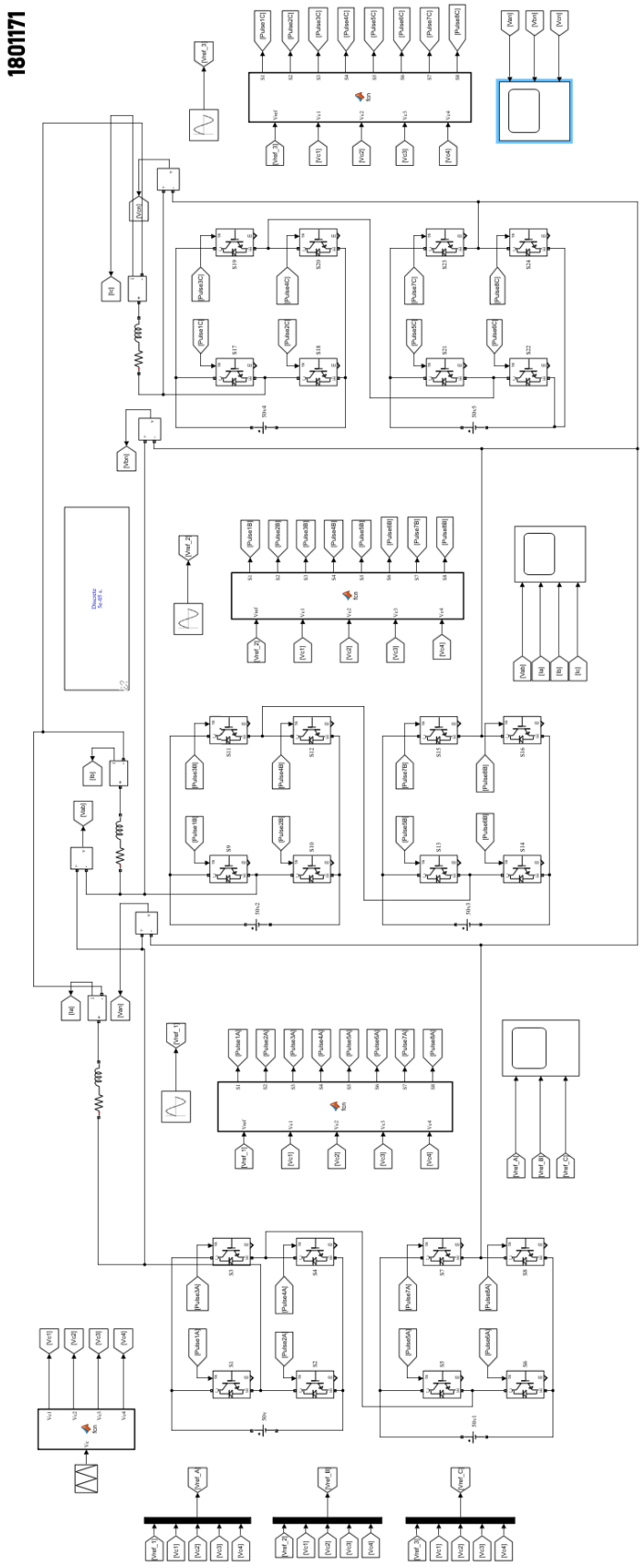
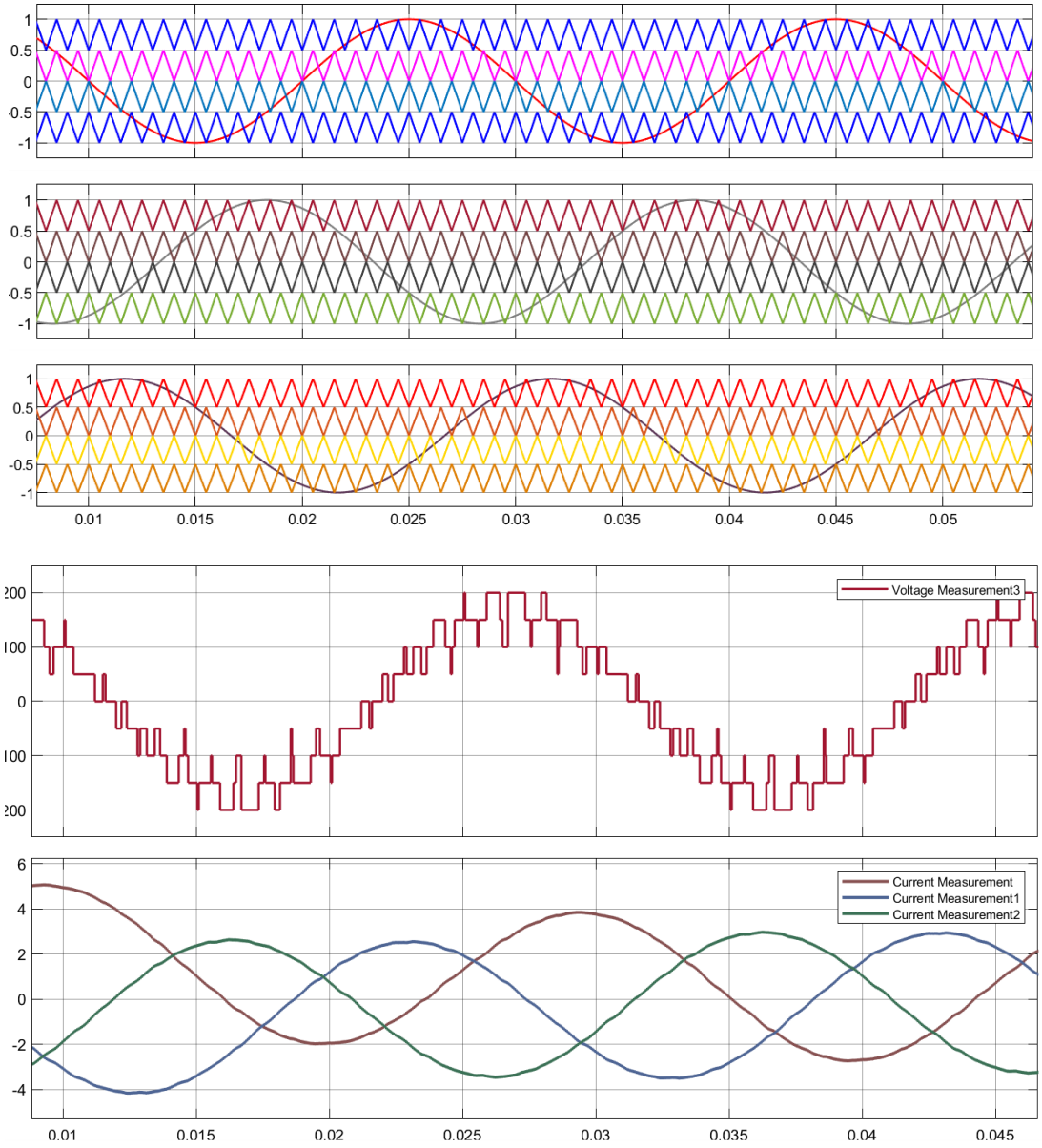


Fig. 6.3: Block diagram for Cascaded Single-Phase H-bridge inverter

- **Waveform**


Voltage Measurement3
Current Measurement
Current Measurement1
Current Measurement2

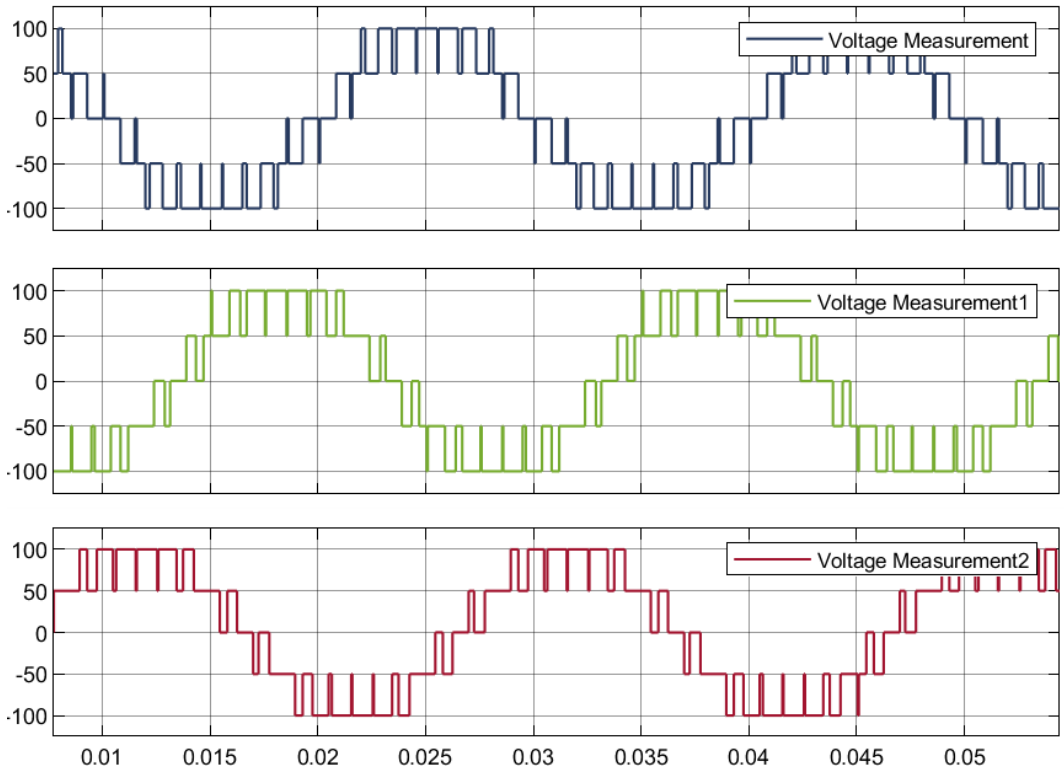


Fig. 6.4: Waveshape of PWM generators (Reference Voltages- Vref_A, Vref_B & Vref_C) , Phase Voltages (Van, Vbn & Vcn), Line Voltage (Vab) and Line Current (Ia) of Cascaded Three Phase H-Bridge Inverter Circuit

6.6 Discussion & Conclusion

This experiment thoroughly investigated cascaded single-phase and three-phase H-bridge inverters. RL load open loop was used to design single-phase and three-phase cascaded H-bridge inverter circuits. Four triangular waves of varying amplitudes were used to generate reference voltages. Three single-phase sources of equal amplitude shared a 120° phase shift in a three-phase cascaded inverter circuit. Finally, the experiment was carried out step by step, with each step carried out with honesty and care. As a result, the experiment is said to be a success.