

# MILESTONE 2 - TEST CASES

CIS 441/541 - PACEMAKER

GROUP 2

**Akshay Sriraman**

**Anupama Kumar**

**Chirag Shah**

**Shruthi Ashok Kumar**

The following test cases have been implemented in the function testMode\_(). To enter into this mode, press 't'. The details of the test scenario will be printed on the serial monitor and on the LCD panel.

## 1. To test a perfect heart :

**Objective :** Here, the heart model sends Asignal and Vsignal such that the timing constraints are satisfied. In other words, we wish to model a perfectly functioning heart and test the same.

**Expected result :** The pair of LEDs that represent Asignal and Vsignal blink one after the other, depicting a beating heart.

**Actual result :** It was observed that the pair of LEDs that represent Asignal and Vsignal blinked one after the other, depicting a normally beating heart. The trace for this test was printed on the serial port.

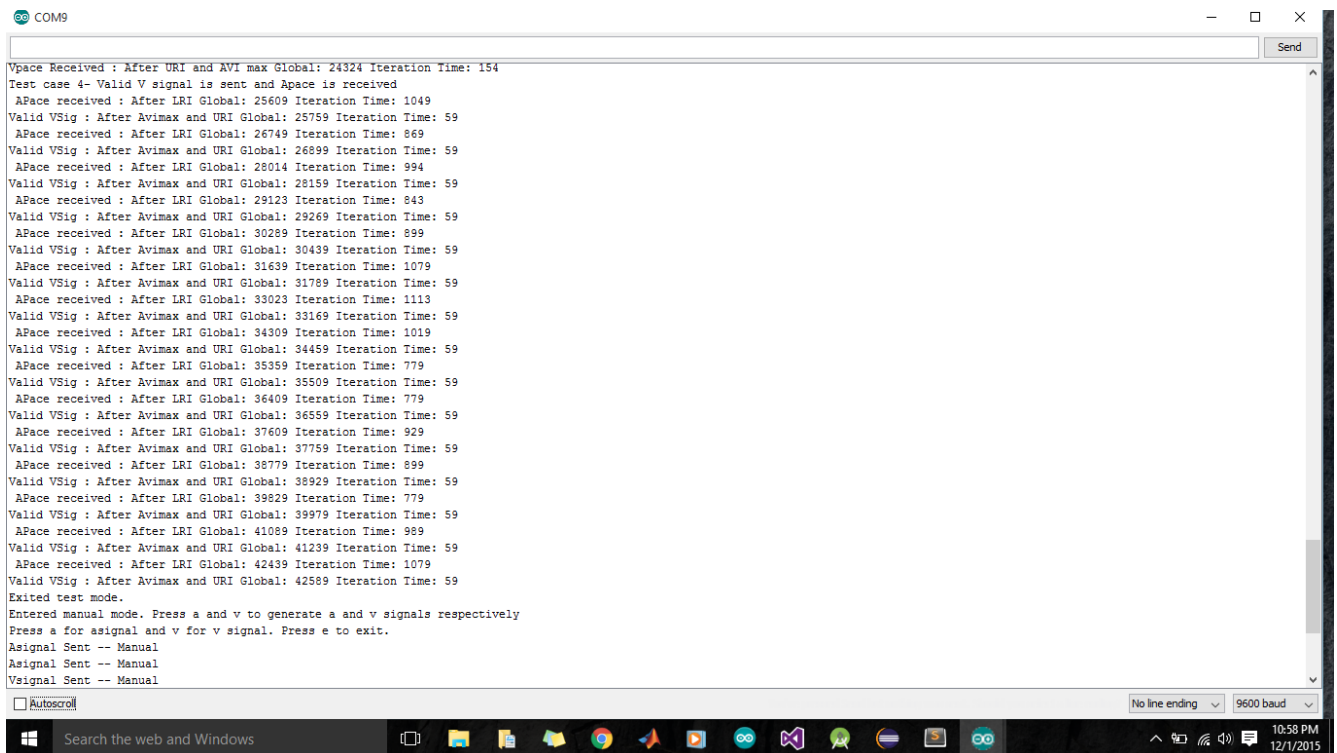


## 2. To test a dysfunctional heart :

**Objective :** Here, the heart stops generating Asignal and Vsignal. In other words, this models a complete heart shutdown.

**Expected result :** The pacemaker takes over and generates Apace and Vpace to keep the heart beating. This can be seen when the pair of LEDs that represents the pacemaker signals keeps blinking and the pair of LEDs that represents the heart does not blink at all.

**Actual result :** It was observed that the pacemaker steps in to generate pacing signals when it detects that no signals have been generated by the heart itself. The pair of LEDs that represents the pacemaker signals kept blinking and the pair of LEDs that represents the heart did not blink at all. The trace for this test was printed on the serial port.



```
COM9
Vpace Received : After URI and AVI max Global: 24324 Iteration Time: 154
Test case 4- Valid V signal is sent and Apace is received
APace received : After LRI Global: 25609 Iteration Time: 1049
Valid VSig : After Avimax and URI Global: 25759 Iteration Time: 59
APace received : After LRI Global: 26749 Iteration Time: 869
Valid VSig : After Avimax and URI Global: 26899 Iteration Time: 59
APace received : After LRI Global: 28014 Iteration Time: 994
Valid VSig : After Avimax and URI Global: 28159 Iteration Time: 59
APace received : After LRI Global: 29123 Iteration Time: 843
Valid VSig : After Avimax and URI Global: 29269 Iteration Time: 59
APace received : After LRI Global: 30289 Iteration Time: 899
Valid VSig : After Avimax and URI Global: 30439 Iteration Time: 59
APace received : After LRI Global: 31639 Iteration Time: 1079
Valid VSig : After Avimax and URI Global: 31789 Iteration Time: 59
APace received : After LRI Global: 33023 Iteration Time: 1113
Valid VSig : After Avimax and URI Global: 33169 Iteration Time: 59
APace received : After LRI Global: 34309 Iteration Time: 1019
Valid VSig : After Avimax and URI Global: 34459 Iteration Time: 59
APace received : After LRI Global: 35359 Iteration Time: 779
Valid VSig : After Avimax and URI Global: 35509 Iteration Time: 59
APace received : After LRI Global: 36409 Iteration Time: 779
Valid VSig : After Avimax and URI Global: 36559 Iteration Time: 59
APace received : After LRI Global: 37609 Iteration Time: 929
Valid VSig : After Avimax and URI Global: 37759 Iteration Time: 59
APace received : After LRI Global: 38779 Iteration Time: 899
Valid VSig : After Avimax and URI Global: 38929 Iteration Time: 59
APace received : After LRI Global: 39829 Iteration Time: 779
Valid VSig : After Avimax and URI Global: 39979 Iteration Time: 59
APace received : After LRI Global: 41089 Iteration Time: 989
Valid VSig : After Avimax and URI Global: 41239 Iteration Time: 59
APace received : After LRI Global: 42439 Iteration Time: 1079
Valid VSig : After Avimax and URI Global: 42589 Iteration Time: 59
Exited test mode.
Entered manual mode. Press a and v to generate a and v signals respectively
Press a for asignal and v for v signal. Press e to exit.
Asignal Sent -- Manual
Asignal Sent -- Manual
Vsignal Sent -- Manual
Autoscroll
No line ending 9600 baud
10:58 PM 12/1/2015
```

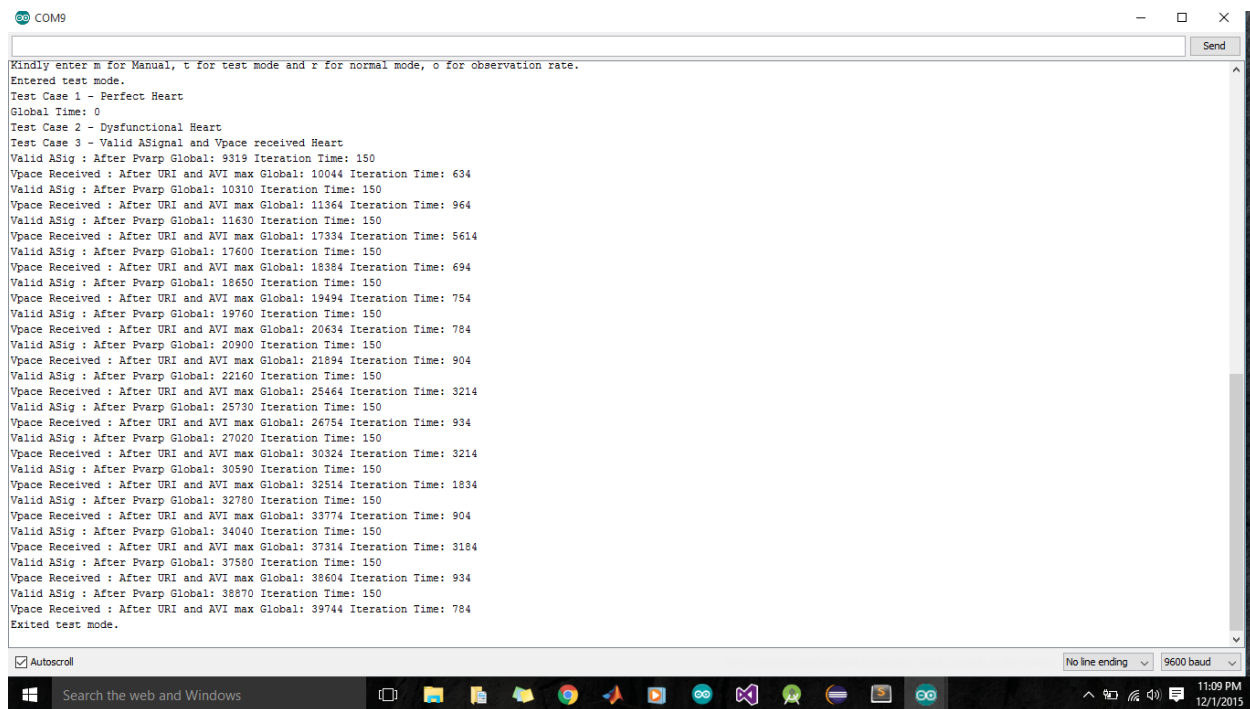
FIGURE 2(a) : TRACE OF THE HEART

### 3. To test that Vspace arrives correctly :

**Objective :** Under this testing scenario, we ensure that the heart model generates only Asignal. We test whether the pacemaker sends Vspace signal whenever it detects that Vsignal has not been generated.

**Expected result :** The red LED that depicts Asignal blinks alternately with the green LED that represents Vspace. Apart from these two LEDs, no other LED blinks as Vsignal and Apace are not generated.

**Actual result :** It was observed that the red LED (Asignal) and the green LED (Vspace) blink alternately. The trace for this test was printed on the serial port.



```
COM9
Kindly enter m for Manual, t for test mode and r for normal mode, o for observation rate.
Entered test mode.
Test Case 1 - Perfect Heart
Global Time: 0
Test Case 2 - Dysfunctional Heart
Test Case 3 - Valid ASignal and Vspace received Heart
Valid ASig : After Pvarp Global: 9319 Iteration Time: 150
Vspace Received : After URI and AVI max Global: 10044 Iteration Time: 634
Valid ASig : After Pvarp Global: 10310 Iteration Time: 150
Vspace Received : After URI and AVI max Global: 11364 Iteration Time: 964
Valid ASig : After Pvarp Global: 11630 Iteration Time: 150
Vspace Received : After URI and AVI max Global: 17334 Iteration Time: 5614
Valid ASig : After Pvarp Global: 17600 Iteration Time: 150
Vspace Received : After URI and AVI max Global: 18384 Iteration Time: 694
Valid ASig : After Pvarp Global: 18650 Iteration Time: 150
Vspace Received : After URI and AVI max Global: 19494 Iteration Time: 754
Valid ASig : After Pvarp Global: 19760 Iteration Time: 150
Vspace Received : After URI and AVI max Global: 20634 Iteration Time: 784
Valid ASig : After Pvarp Global: 20900 Iteration Time: 150
Vspace Received : After URI and AVI max Global: 21894 Iteration Time: 904
Valid ASig : After Pvarp Global: 22160 Iteration Time: 150
Vspace Received : After URI and AVI max Global: 25464 Iteration Time: 3214
Valid ASig : After Pvarp Global: 25730 Iteration Time: 150
Vspace Received : After URI and AVI max Global: 26754 Iteration Time: 934
Valid ASig : After Pvarp Global: 27020 Iteration Time: 150
Vspace Received : After URI and AVI max Global: 30324 Iteration Time: 3214
Valid ASig : After Pvarp Global: 30590 Iteration Time: 150
Vspace Received : After URI and AVI max Global: 32514 Iteration Time: 1834
Valid ASig : After Pvarp Global: 32780 Iteration Time: 150
Vspace Received : After URI and AVI max Global: 33774 Iteration Time: 904
Valid ASig : After Pvarp Global: 34040 Iteration Time: 150
Vspace Received : After URI and AVI max Global: 37314 Iteration Time: 3184
Valid ASig : After Pvarp Global: 37580 Iteration Time: 150
Vspace Received : After URI and AVI max Global: 38604 Iteration Time: 934
Valid ASig : After Pvarp Global: 38870 Iteration Time: 150
Vspace Received : After URI and AVI max Global: 39744 Iteration Time: 784
Exited test mode.
Autoscroll
No line ending
9600 baud
11:09 PM
12/1/2015
```

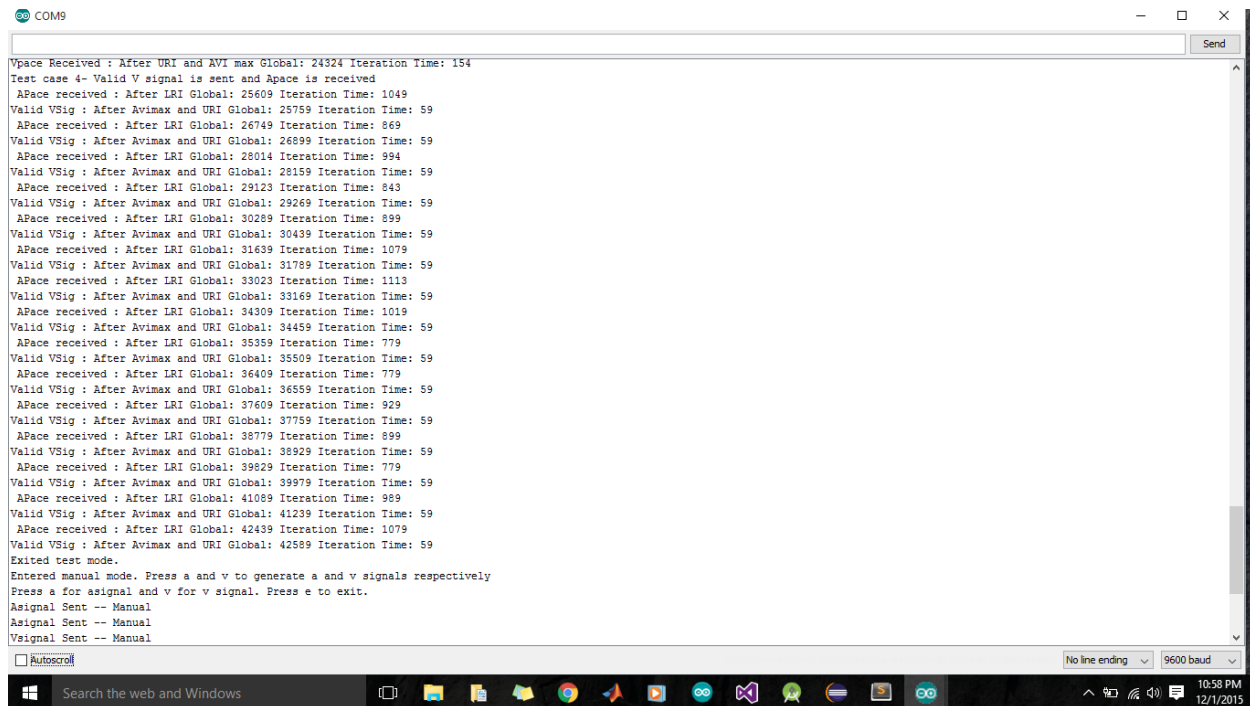
FIGURE 3(a) : TRACE OF THE HEART

### 4. To test that Apace arrives correctly :

**Objective :** Under this testing scenario, we ensure that the heart model generates only Vsignal. We test whether the pacemaker sends Apace signal whenever it detects that Asignal has not been generated.

**Expected result :** The green LED that depicts Vsignal blinks alternately with the red LED that represents Apace. Apart from these two LEDs, no other LED blinks as Asignal and Vpace are not generated.

**Actual result :** It was observed that the red LED (Apace) and the green LED (Vsignal) blink alternately. The trace for this test was printed on the serial port.



```
COM9
Vspace Received : After URI and XVI max Global: 24324 Iteration Time: 154
Test case 4- Valid V signal is sent and Apace is received
Apace received : After LRI Global: 25609 Iteration Time: 1049
Valid Vsig : After Avimax and URI Global: 25759 Iteration Time: 59
Apace received : After LRI Global: 26749 Iteration Time: 869
Valid Vsig : After Avimax and URI Global: 26899 Iteration Time: 59
Apace received : After LRI Global: 28014 Iteration Time: 994
Valid Vsig : After Avimax and URI Global: 28159 Iteration Time: 59
Apace received : After LRI Global: 29123 Iteration Time: 843
Valid Vsig : After Avimax and URI Global: 29269 Iteration Time: 59
Apace received : After LRI Global: 30289 Iteration Time: 899
Valid Vsig : After Avimax and URI Global: 30439 Iteration Time: 59
Apace received : After LRI Global: 31639 Iteration Time: 1079
Valid Vsig : After Avimax and URI Global: 31789 Iteration Time: 59
Apace received : After LRI Global: 33023 Iteration Time: 1113
Valid Vsig : After Avimax and URI Global: 33169 Iteration Time: 59
Apace received : After LRI Global: 34309 Iteration Time: 1019
Valid Vsig : After Avimax and URI Global: 34459 Iteration Time: 59
Apace received : After LRI Global: 35359 Iteration Time: 779
Valid Vsig : After Avimax and URI Global: 35509 Iteration Time: 59
Apace received : After LRI Global: 36409 Iteration Time: 779
Valid Vsig : After Avimax and URI Global: 36559 Iteration Time: 59
Apace received : After LRI Global: 37609 Iteration Time: 929
Valid Vsig : After Avimax and URI Global: 37759 Iteration Time: 59
Apace received : After LRI Global: 38779 Iteration Time: 899
Valid Vsig : After Avimax and URI Global: 38929 Iteration Time: 59
Apace received : After LRI Global: 39829 Iteration Time: 779
Valid Vsig : After Avimax and URI Global: 39979 Iteration Time: 59
Apace received : After LRI Global: 41089 Iteration Time: 989
Valid Vsig : After Avimax and URI Global: 41239 Iteration Time: 59
Apace received : After LRI Global: 42439 Iteration Time: 1079
Valid Vsig : After Avimax and URI Global: 42589 Iteration Time: 59
Exited test mode.
Entered manual mode. Press a and v to generate a and v signals respectively
Press a for a signal and v for v signal. Press e to exit.
Asignal Sent -- Manual
Asignal Sent -- Manual
Vsignal Sent -- Manual
```

FIGURE 4(a) : TRACE OF THE HEART

## 5. To test for alarm functionalities :

**Objective :** When the heart rate falls dangerously low and the pacemaker is unable to pace the heart, then the system needs to sound an alarm. This test case works with the assumption that the pacemaker has failed and is unable to save the slowing heart. An alarm is needed for this extreme situation.

**Expected Result :** The buzzer starts to ring when the heart starts to fail.

**Actual Result :** It was observed that the buzzer connected to the pacemaker mbed starts to sound an alarm when the heart failed and the pacemaker was unable to revive the heart.