SYS-6581 Simulink and Testing

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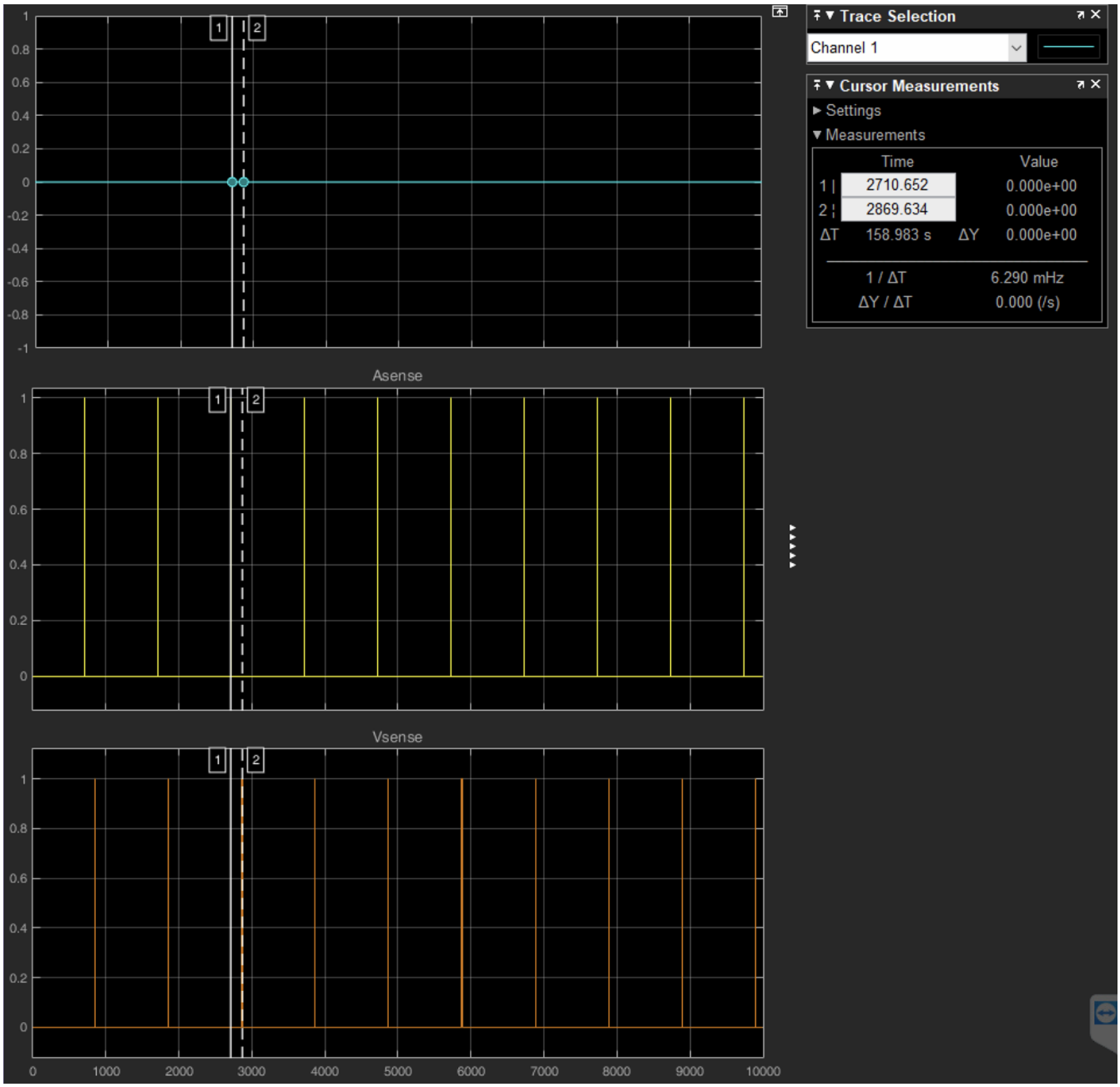
5 Heart Modeling

5.1 Heart Modeling

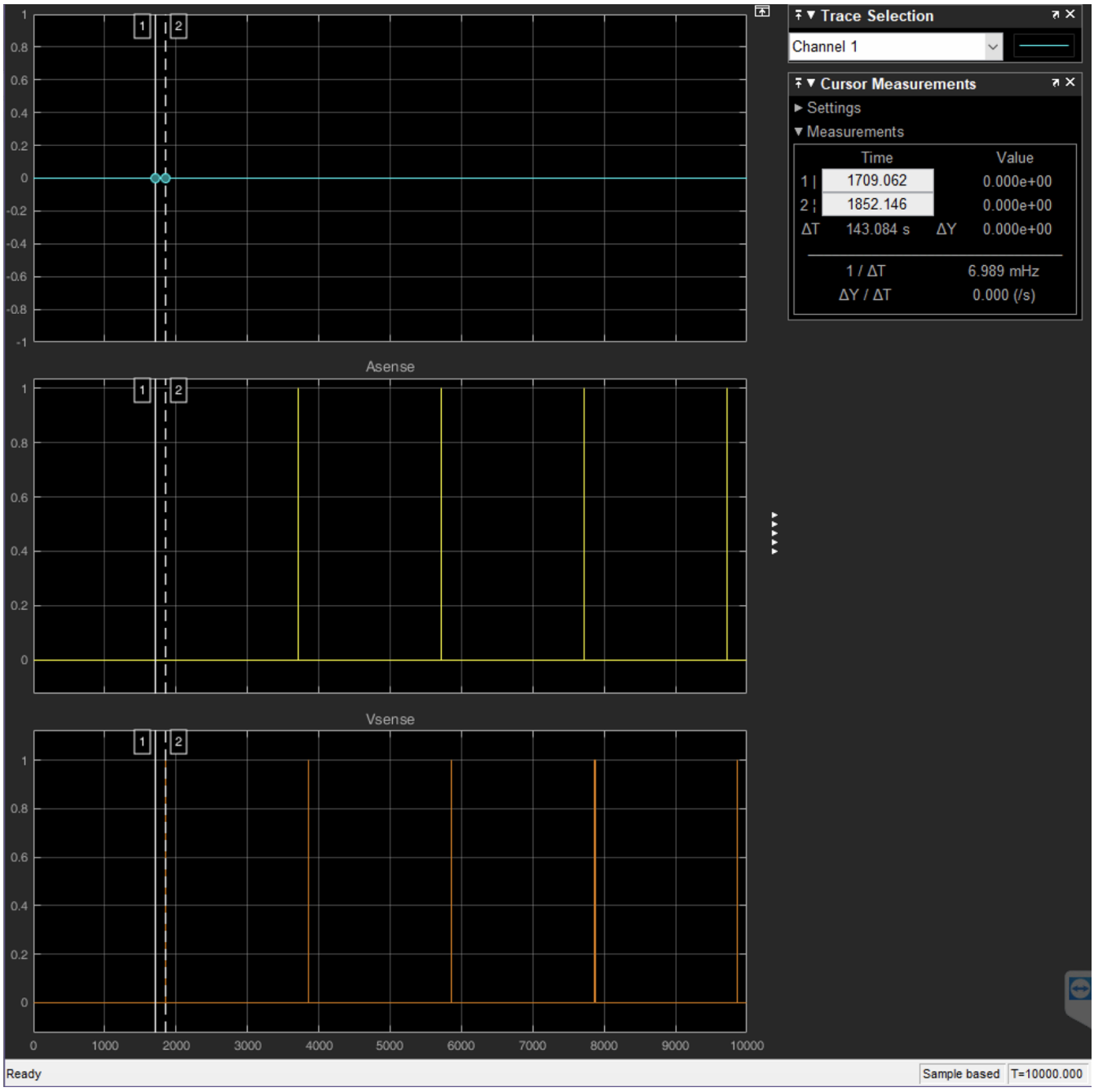
5.1.1 Normal Sinus Rhythm

(a) NPN, total of 10 beats in 10 seconds.



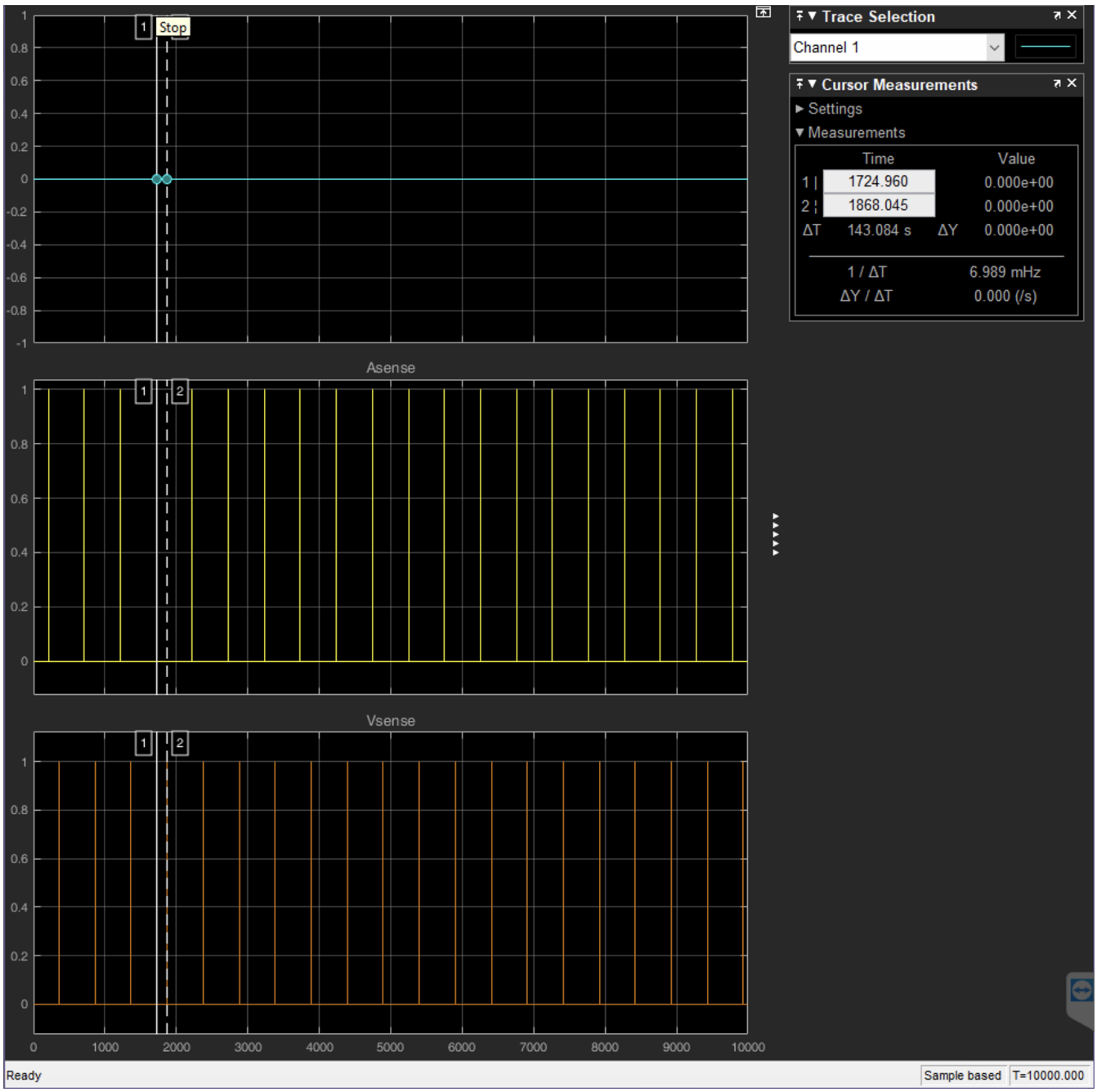
5.1.2 Sinus Bradycardia

(a) 30 bpm, total of 5 beats in 10 seconds.



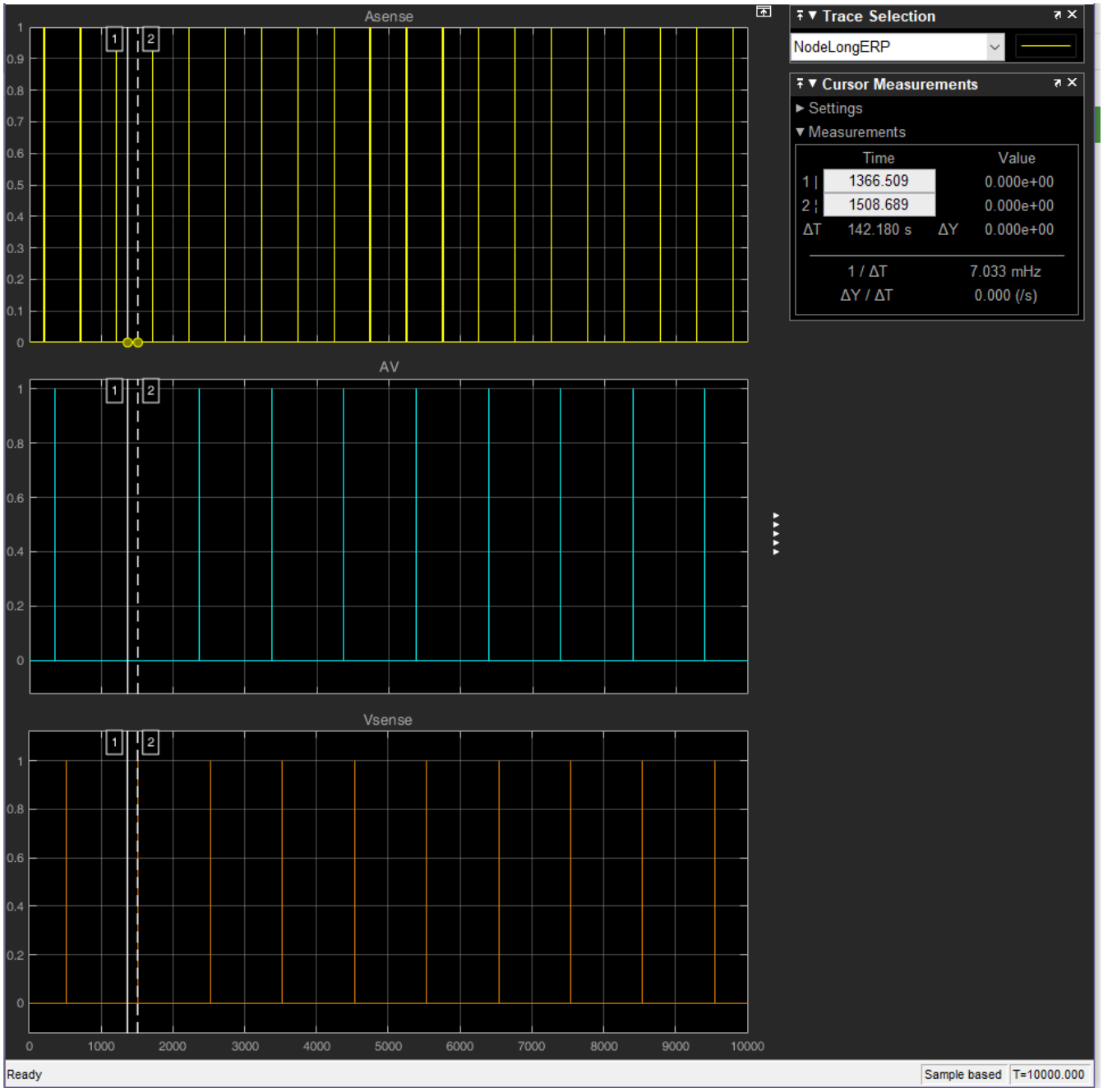
5.1.3 Sinus Tachycardia

(a) 60 bpm, total of 20 beats in 10 seconds.


Stop
Asense
Vsense
Trace Selection
Channel 1
Cursor Measurements
Settings
Measurements
Time
Value
1 1724.960 0.000e+00
2 1868.045 0.000e+00
ΔT 143.084 s ΔY 0.000e+00
1 / ΔT 6.989 mHz
ΔY / ΔT 0.000 (/s)
Ready
Sample based
T=10000.000

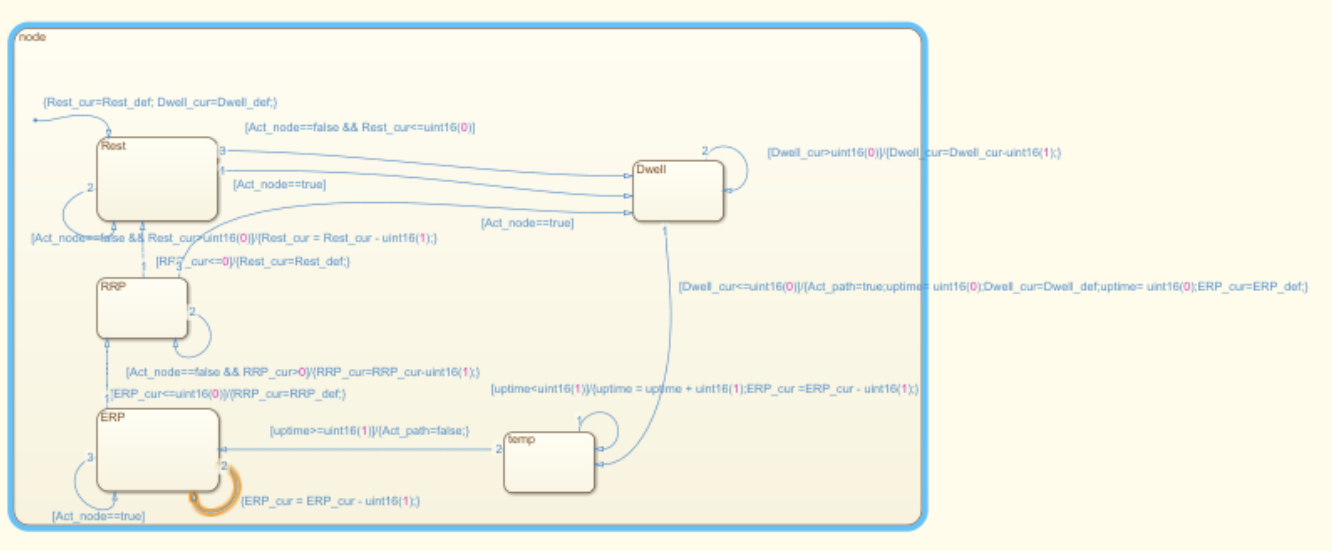
5.1.4 AV Block

(a) NPNPN.

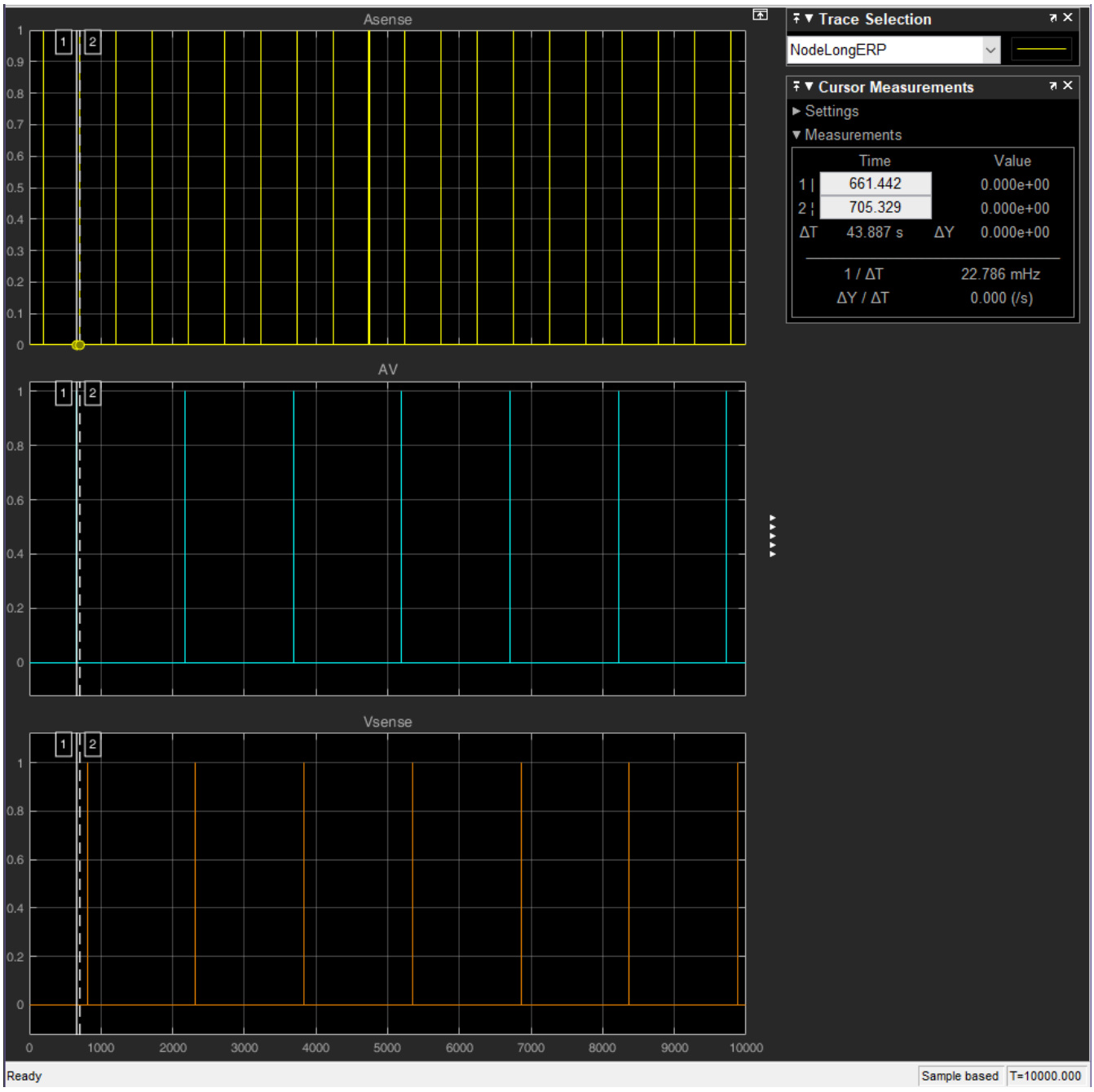


5.1.5 AV Delay

(a) Adding the dwell images

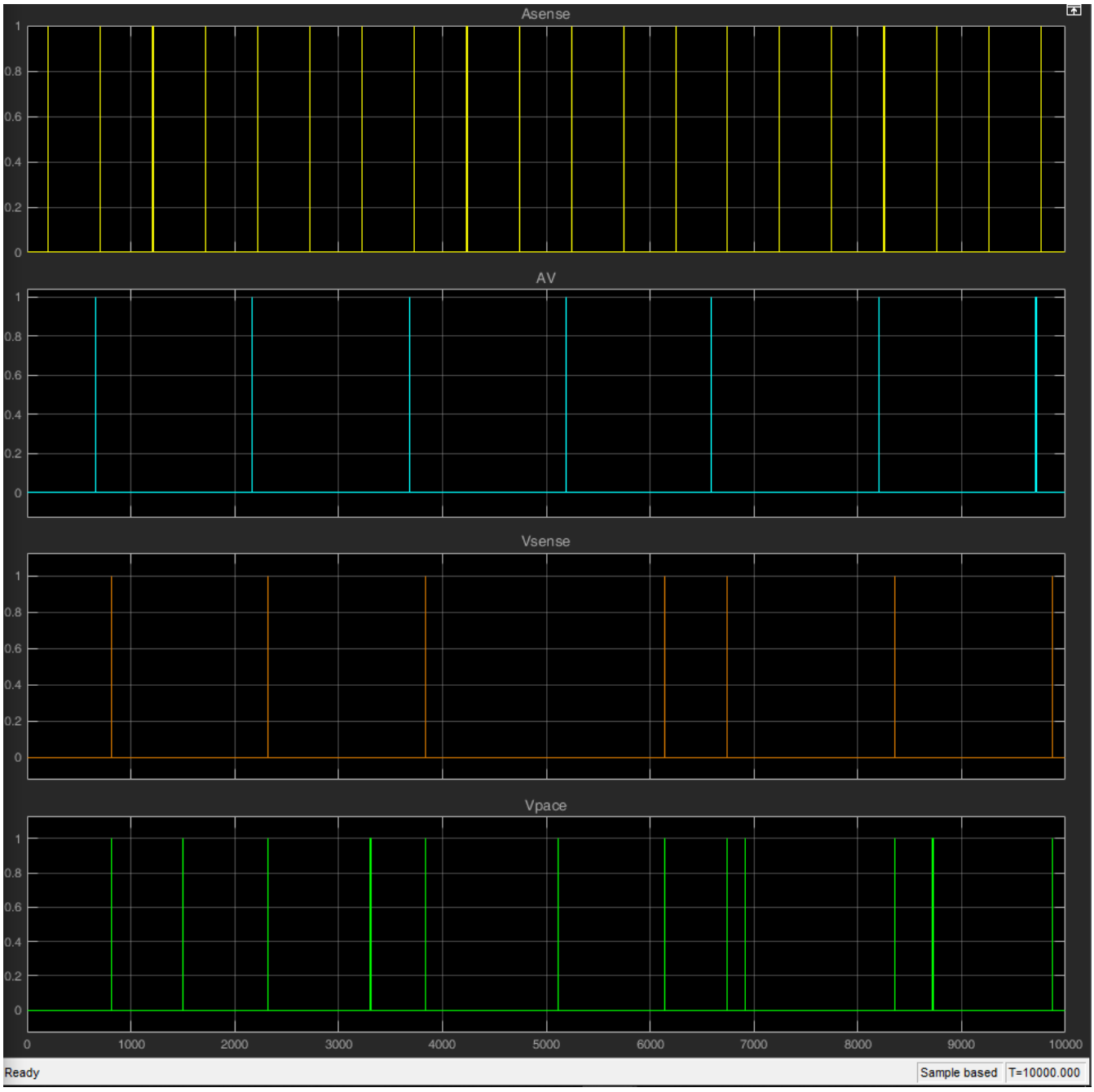


(b) Scope


Asense
AV
Vsense
Trace Selection
NodeLongERP
Cursor Measurements
Settings
Measurements
Time
Value
1
661.442
0.000e+00
2
705.329
0.000e+00
ΔT
43.887 s
ΔY
0.000e+00
1 / ΔT
22.786 mHz
ΔY / ΔT
0.000 (/s)
Ready
Sample based
T=10000.000

5.1.6 Premature Ventricula Complex

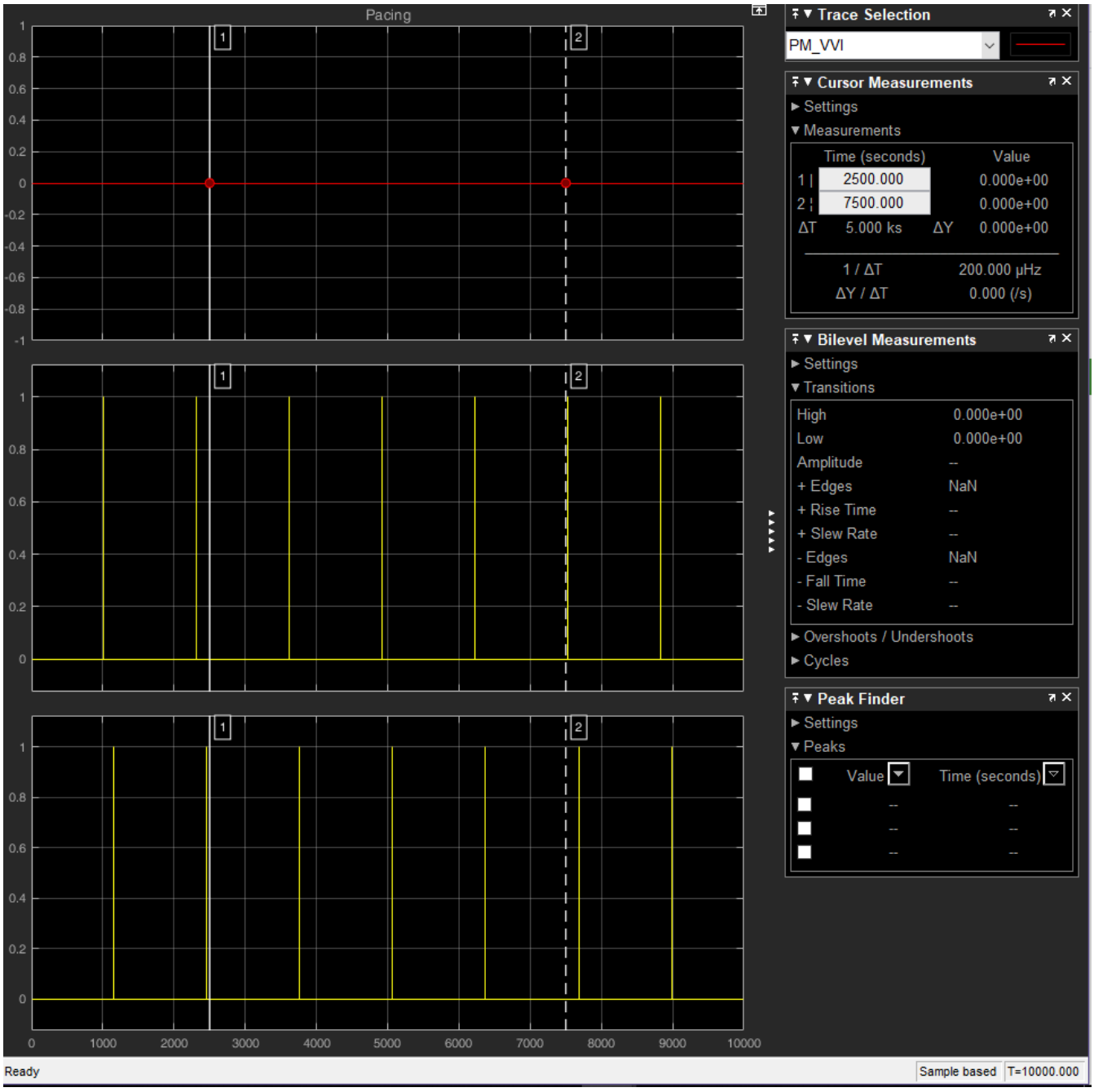
(a) PVC, also known as Rhythm HiJack, is a ventricular event that is triggered spontaneously. (Lec-11,pg 26).


Asense
AV
Vsense
Vpace
0
0.2
0.4
0.6
0.8
1
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
Ready
Sample based
T=10000.000

5.2 Pacemaker Model Simulink

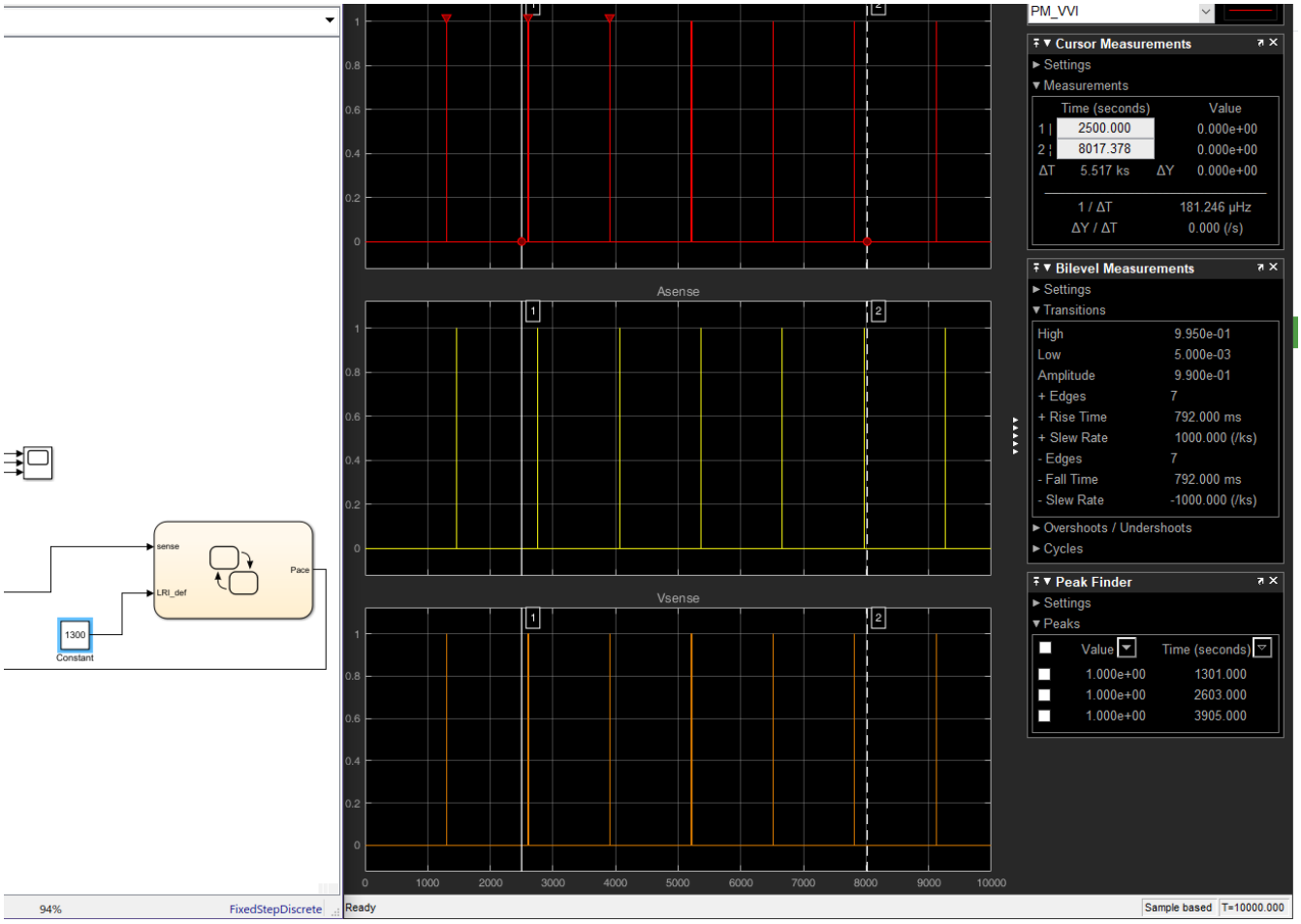
5.2.1 Observer VVI pacemaker

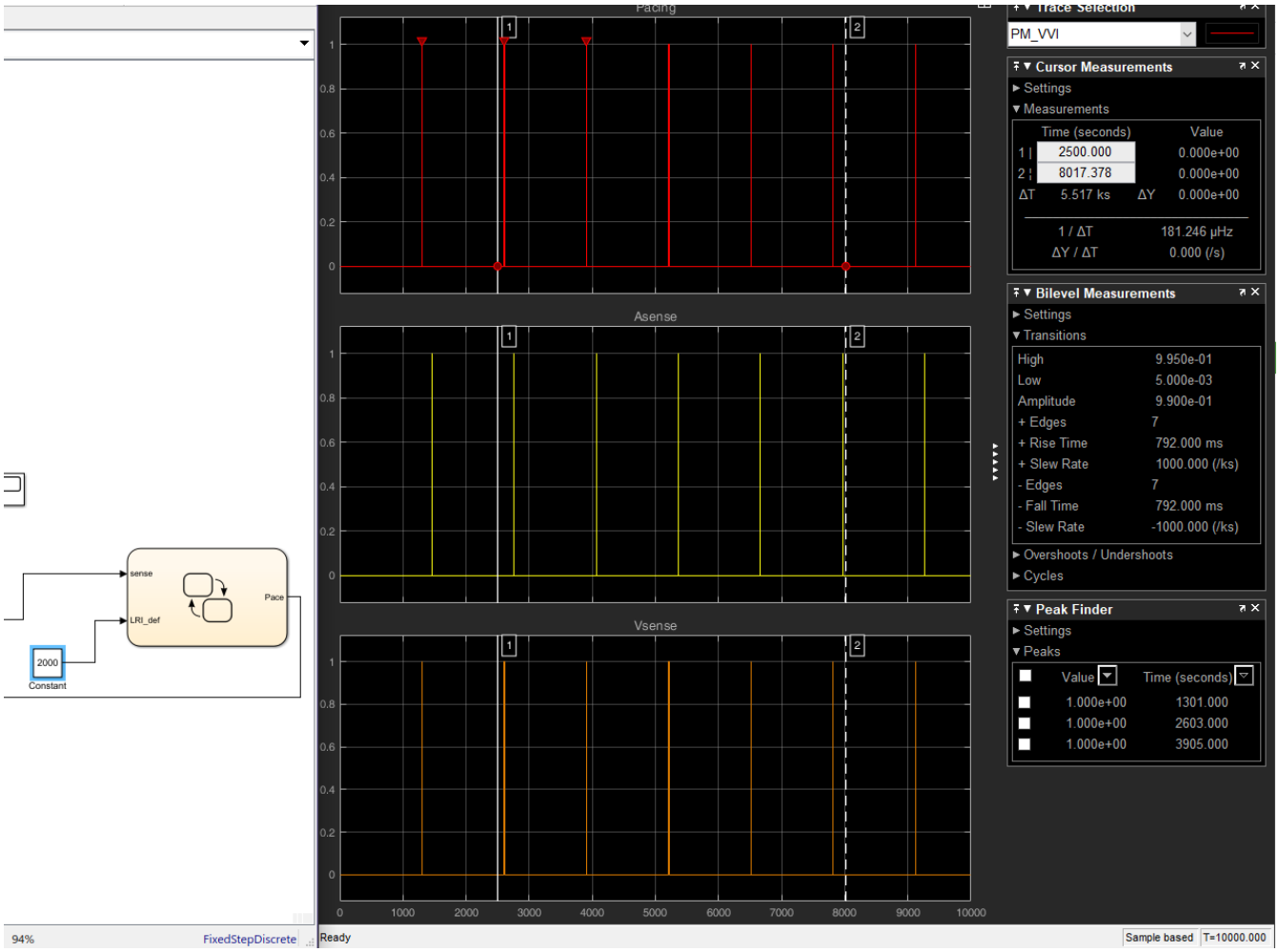
(a) I do not see the PM pacing, probably because the Lower Rate Interval of $1300 = A_{rest} + A_{erp}$


Pacing
Trace Selection
PM_VVI
Cursor Measurements
Settings
Measurements
Time (seconds)
Value
1
2500.000
0.000e+00
2
7500.000
0.000e+00
ΔT
5.000 ks
ΔY
0.000e+00
1 / ΔT
200.000 µHz
ΔY / ΔT
0.000 (/s)
Bilevel Measurements
Settings
Transitions
High
0.000e+00
Low
0.000e+00
Amplitude
--
+ Edges
NaN
+ Rise Time
--
+ Slew Rate
--
- Edges
NaN
- Fall Time
--
- Slew Rate
--
Overshoots / Undershoots
Cycles
Peak Finder
Settings
Peaks
Value
Time (seconds)
Ready
Sample based
T=10000.000

5.2.2 Debugging the VVI

(a) The PM fires and triggers the V node in place of the delayed A signal to trigger the V node on time. Likely any setting above the atrium 1800ms fire will not trigger the pacemaker correctly.





5.2.3 Maintaining the minimum heart rate

(a) Definitions: where AEI = atrial escape interval, PVARP = postventricula atrial refractory period, AVI = Atrioventricular interval, TARP = Total Atrial Refractory Period, and LRI = Lower Rate Interval.

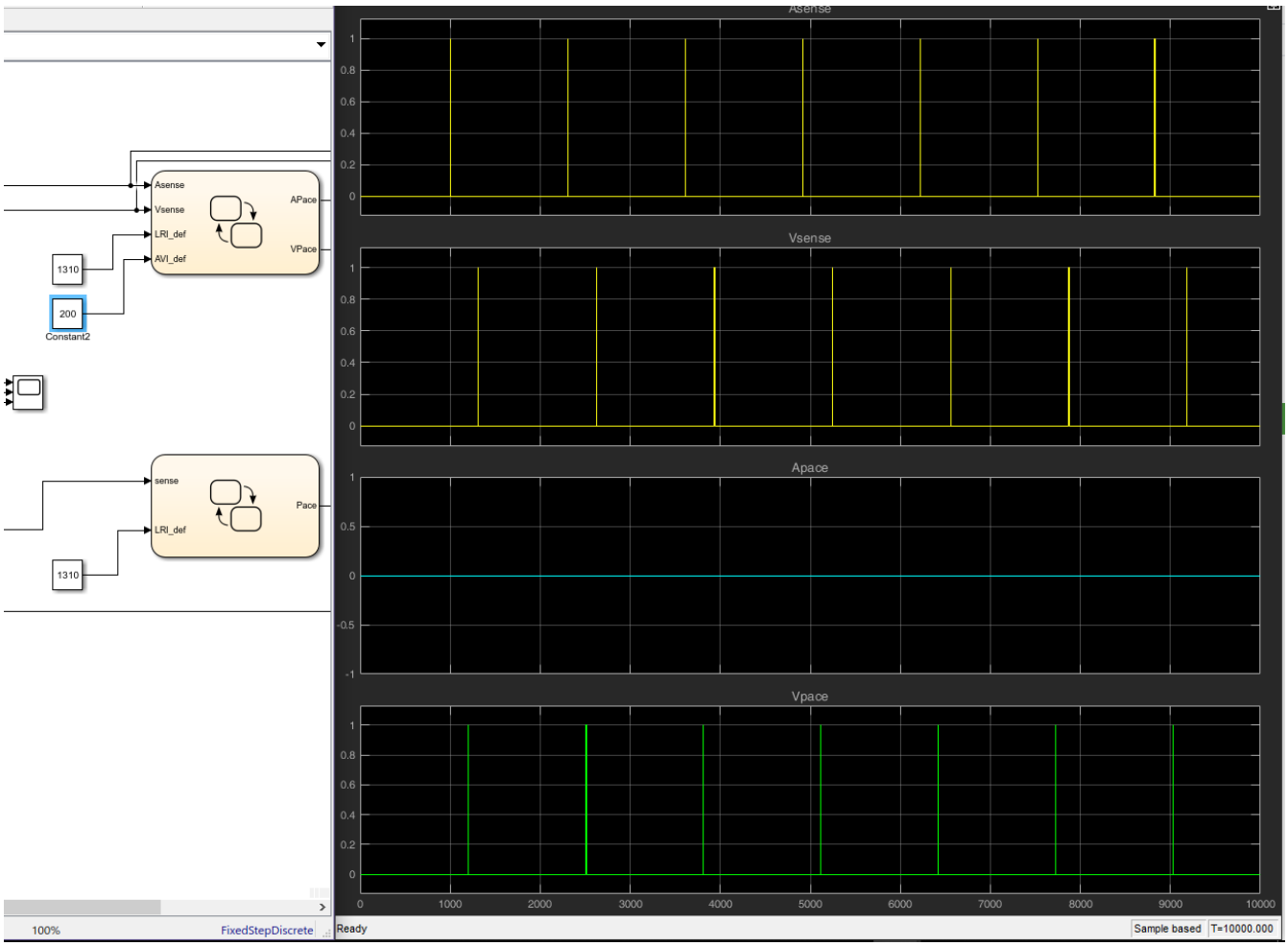
(b)

$$LRI = AEI + AVI = 1000 + 300 = 1300$$

,

(c)

$$AVI = TARP - PVARP = 650 - (300 + 150) = 200$$


Asense
Vsense
LRI_def
AVI_def
APace
VPace
1310
200
Constant2
sense
LRI_def
Pace
1310
Asense
Vsense
Apace
Vpace
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
100%
FixedStepDiscrete
Ready
Sample based
T=10000.000