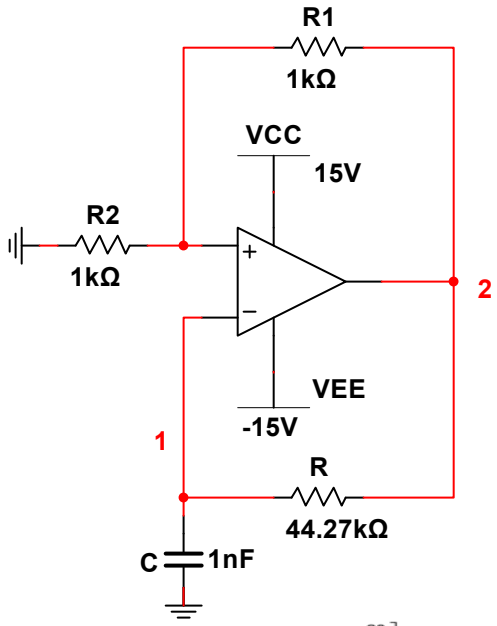


# Single Op Amp

# Relaxation Oscillator

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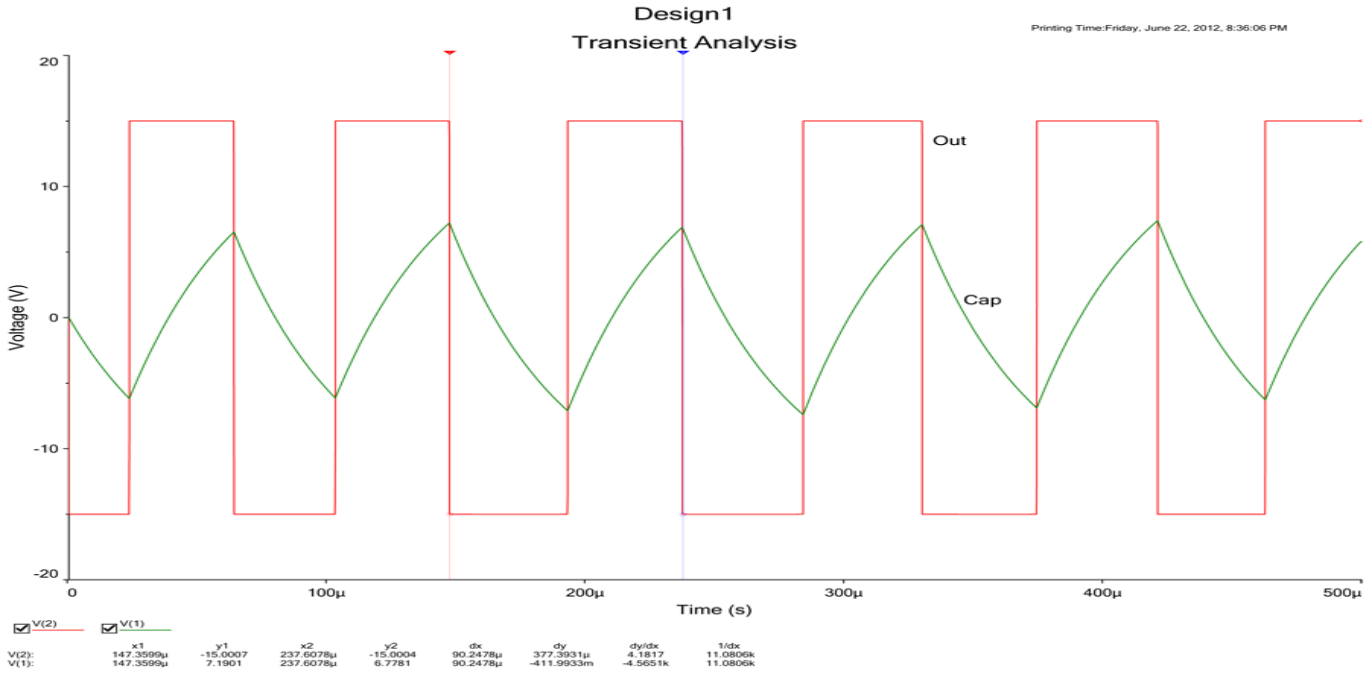

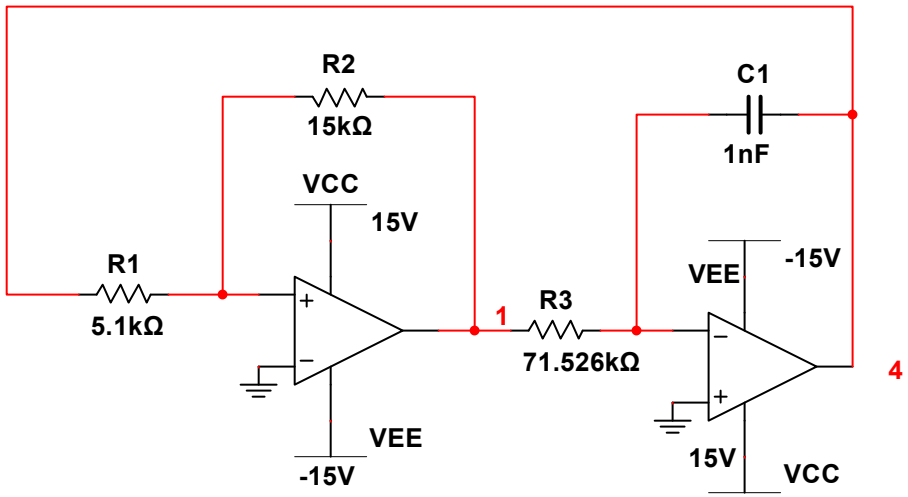


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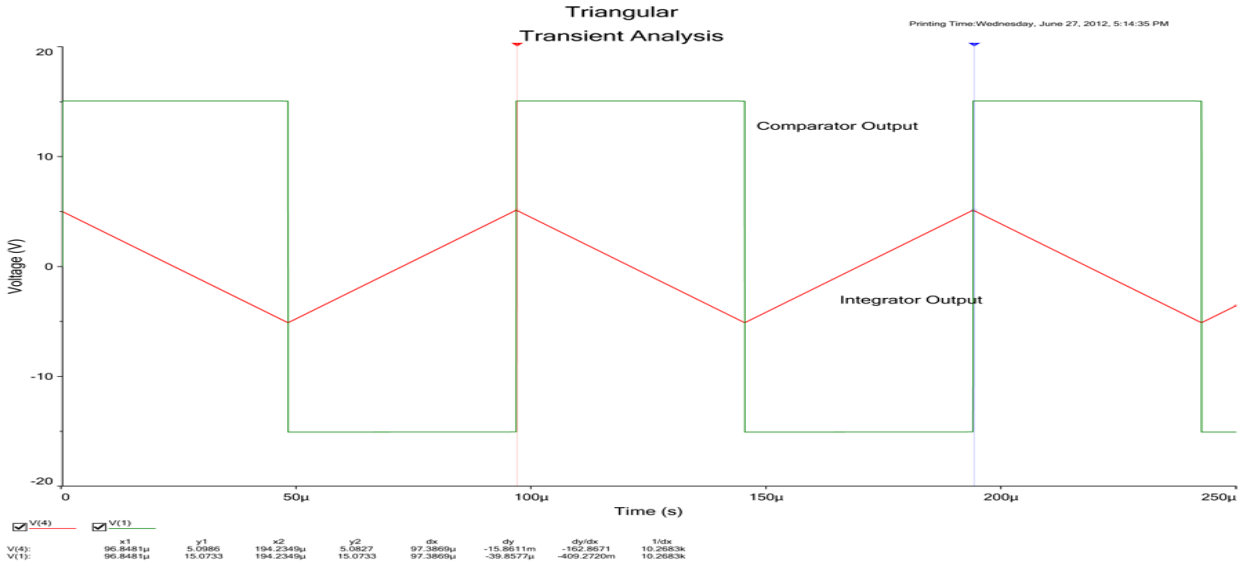
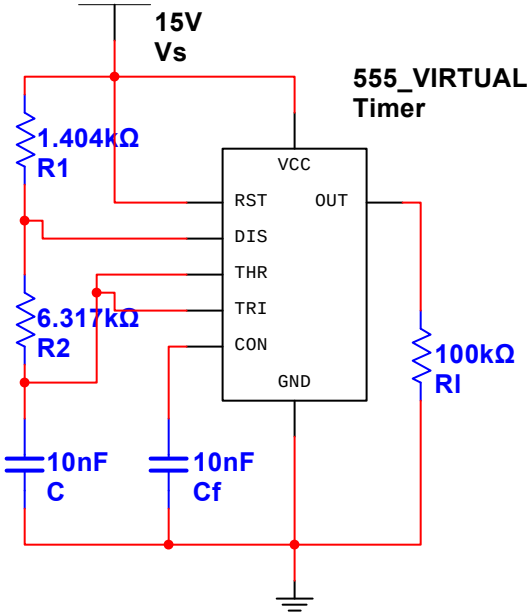
Schmitt Trigger Comparator

Integrator



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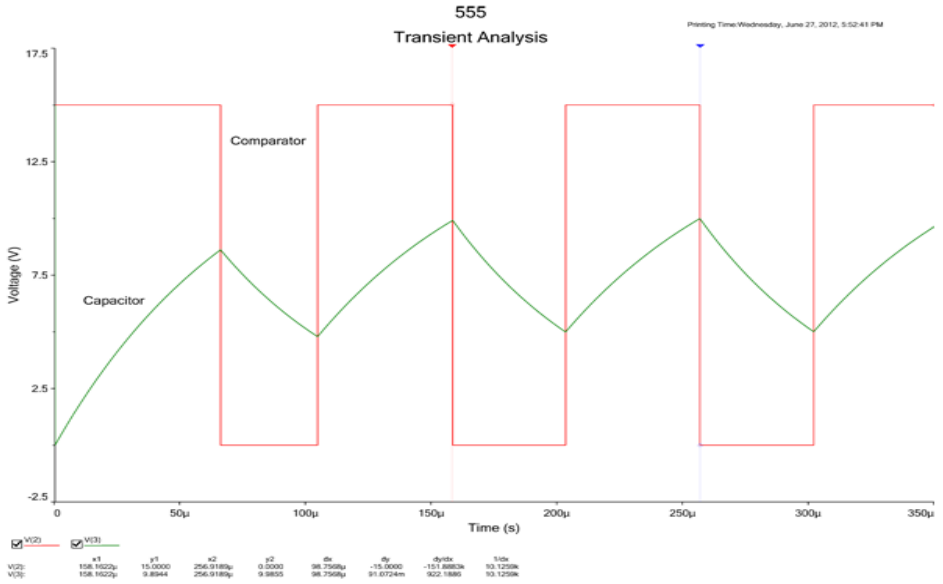
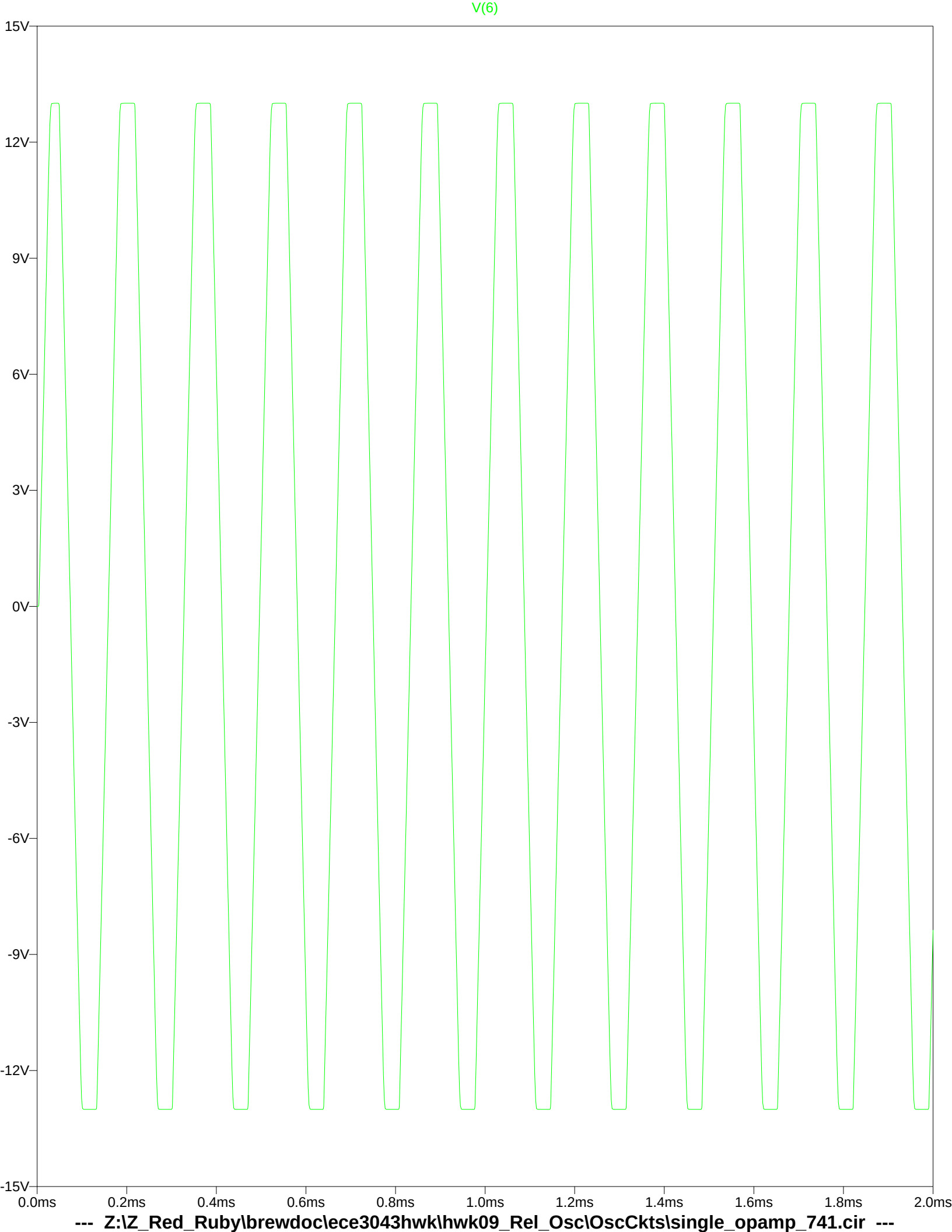
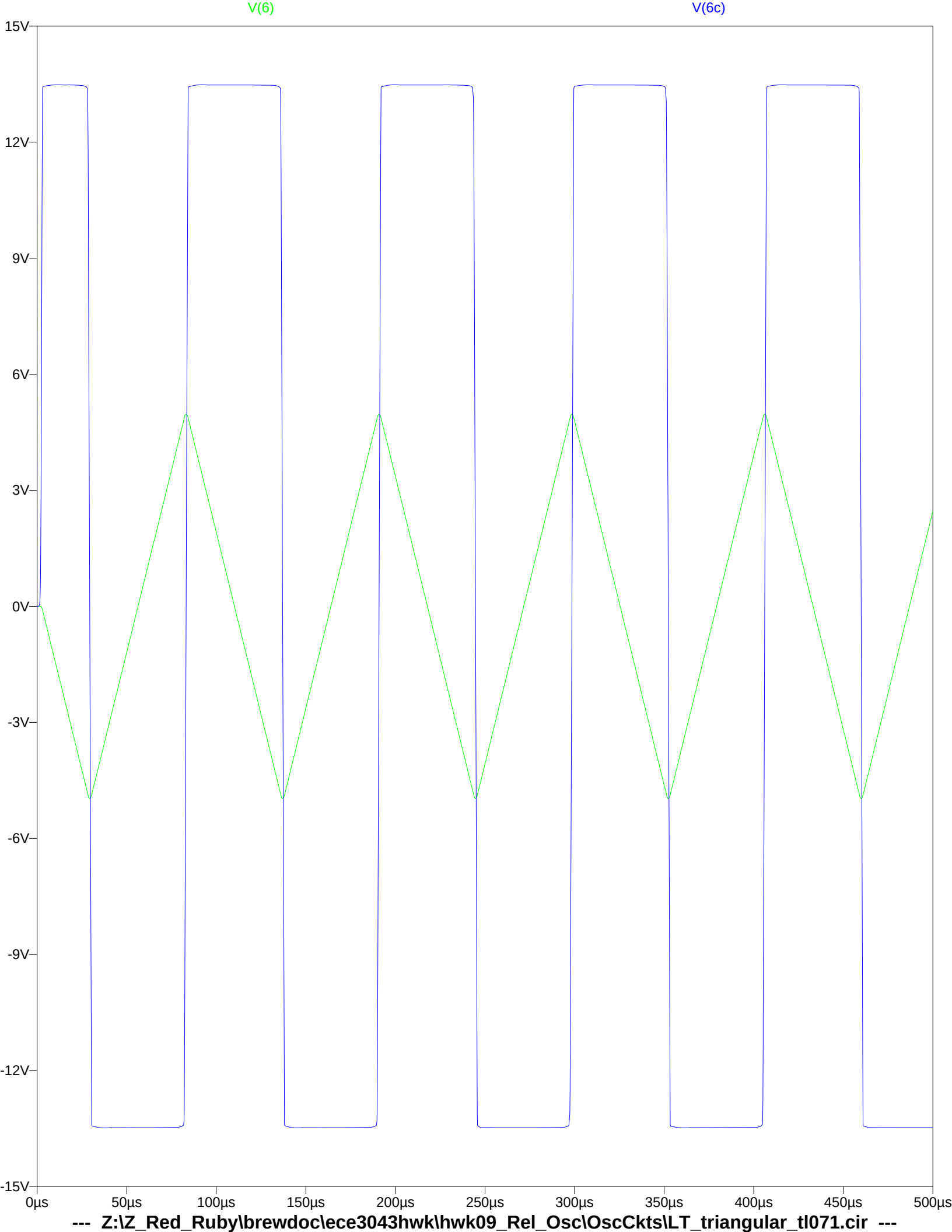



V(6)
15V
12V
9V
6V
3V
0V
-3V
-6V
-9V
-12V
-15V
0.0ms
0.2ms
0.4ms
0.6ms
0.8ms
1.0ms
1.2ms
1.4ms
1.6ms
1.8ms
2.0ms
--- Z:\Z_Red_Ruby\brewdoc\ece3043hwk\hwk09_Rel_Osc\OscCkts\single_opamp_741.cir ---

```
Single OpAmp Oscillator
C 2 0 1n IC=0
R 2 6 44.27k
R1 6 3 1k
R2 3 0 1k
X0A 3 2 7 4 6 XUA741
VCC 7 0 DC 15
VEE 4 0 DC -15
*Sngl GenPurpose OpAmp pkgIP8 3,2,7,4,6
..SUBCKT XUA741 1 2 3 4 5
C1 11 12 4.664E-12
C2 6 7 20E-12
DC 5 53 DX
DE 54 5 DX
DLP 90 91 DX
DLN 92 90 DX
DP 4 3 DX
BGND 99 0 V=V(3)*.5 + V(4)*.5
BB 7 99 I=I(VB)*10.61E6 - I(VC)*10E6 + I(VE)*10E6 +
+ I(VLP)*10E6 - I(VLN)*10E6
GA 6 0 11 12 137.7E-6
GCM 0 6 10 99 2.574E-9
IEE 10 4 DC 10.16E-6
HLIM 90 0 VLIM 1K
Q1 11 2 13 QX
Q2 12 1 14 QX
R2 6 9 100E3
RC1 3 11 7.957E3
RC2 3 12 7.957E3
RE1 13 10 2.74E3
RE2 14 10 2.74E3
REE 10 99 19.69E6
RO1 8 5 150
RO2 7 99 150
RP 3 4 18.11E3
VB 9 0 DC 0
VC 3 53 DC 2.6
VE 54 4 DC 2.6
VLIM 7 8 DC 0
VLP 91 0 DC 25
VLN 0 92 DC 25
..MODEL DX D(IS=800E-18)
..MODEL QX NPN(IS=800E-18 BF=62.5)
..ENDS XUA741
.TRAN 0 2m UIC
.PROBE
.END
```


V(6)
V(6c)
15V
12V
9V
6V
3V
0V
-3V
-6V
-9V
-12V
-15V
0µs
50µs
100µs
150µs
200µs
250µs
300µs
350µs
400µs
450µs
500µs
--- Z:\Z_Red_Ruby\brewdoc\ece3043hwk\hwk09_Rel_Osc\OscCkts\LT_triangular_tl071.cir ---

```
Triangular Oscillator
C 2 6 1n IC=0
R 6c 2 71.526k
R1 6 3c 5.1k
R2 3c 6c 15k
Xint 0 2 7 4 6 TL071
Xcomp 3c 0 7 4 6c TL071
VCC 7 0 DC 15
VEE 4 0 DC -15
* TL071 OPERATIONAL AMPLIFIER "MACROMODEL" SUBCIRCUIT
* CREATED USING PARTS RELEASE 4.01 ON 06/16/89 AT 13:08
* (REV N/A)      SUPPLY VOLTAGE: +/-15V
* CONNECTIONS:   NON-INVERTING INPUT
*                | INVERTING INPUT
*                | | POSITIVE POWER SUPPLY
*                | | | NEGATIVE POWER SUPPLY
*                | | | | OUTPUT
*                | | | | |
.SUBCKT TL071    1 2 3 4 5
*
  C1   11 12 3.498E-12
  C2    6  7 15.00E-12
  DC    5 53 DX
  DE   54  5 DX
  DLP  90 91 DX
  DLN  92 90 DX
  DP    4  3 DX
  EGND 99  0 POLY(2) (3,0) (4,0) 0 .5 .5
  FB    7 99 POLY(5) VB VC VE VLP VLN 0 4.715E6 -5E6 5E6 5E6 -5E6
  GA    6  0 11 12 282.8E-6
  GCM   0  6 10 99 8.942E-9
  ISS   3 10 DC 195.0E-6
  HLIM 90  0 VLIM 1K
  J1   11  2 10 JX
  J2   12  1 10 JX
  R2    6  9 100.0E3
  RD1   4 11 3.536E3
  RD2   4 12 3.536E3
  RO1   8  5 150
  RO2   7 99 150
  RP    3  4 2.143E3
  RSS  10 99 1.026E6
  VB    9  0 DC 0
  VC    3 53 DC 2.200
  VE   54  4 DC 2.200
  VLIM  7  8 DC 0
  VLP  91  0 DC 25
  VLN   0 92 DC 25
.MODEL DX D(IS=800.0E-18)
.MODEL JX PJF(IS=15.00E-12 BETA=270.1E-6 VTO=-1)
.ENDS TL071
.TRAN 0 0.5m UIC
.PROBE
.END
```

# Georgia Institute of Technology

## School of Electrical and Computer Engineering

ECE 3043 Electrical and Electronic Circuits Laboratory Verification Sheet

NAME:_____ SECTION:_____

AD LOGIN:_____

Experiment 10: Relaxation Oscillators

| Procedure | Time Completed | Date Completed | Verification (Must demonstrate circuit) | Points Possible | Points Received |
|---|---|---|---|---|---|
| 1. Single Op Amp | | | | 25 | |
| 2. Triangular Wave | | | | 25 | |
| 3. Inverter | | | | 25 | |
| **4. 555** | | | | 25 | |

Enter your critical frequency below:

| | |
|---|---|
| $f_{crit}$ | |

To be permitted to complete the experiment during the open lab hours, you must complete at least **four** procedures during your scheduled lab period or spend your entire scheduled lab session attempting to do so. A signature below by your lab instructor, Dr. Brewer, or Dr. Robinson permits you to attend the open lab hours to complete the experiment and receive full credit on the report. Without this signature, you may use the open lab to perform the experiment at a 50% penalty.

SIGNATURE:_____ DATE:_____

## ECE 3043 Check-off Requirements for Experiment 10

Make sure you have made all required measurements before requesting a check-off. For all check-offs, you must demonstrate the circuit or measurement to a lab instructor. All screen captures must have a time/date stamp.

- ✓ For all oscillators: a screen capture of the output showing the peak to peak amplitude and the frequency of oscillation.
- ✓ Comparison the measured frequency of oscillation to the design value. Adjust the circuit component values if the measured value is not within 10% of the design value.