Low End Triangle Series
Digital Sinewave Generators

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Many digital sine or cosine generators can be based on the **double integration** method. **The integral of a sinewave is minus the cosine. The integral of a cosine is plus the sine**.

Cascade and invert the two and close them on themselves and you have a sine and cosine generator. By definition of their fundamental differential equations.

Yeah, analog versions have some amplitude stability problems (which HP first brilliantly solved with a nonlinear pilot light) But it is a simple matter to force digital sinewave solutions to unity loop gain, especially when using integer math.

A superb (but flawed) double integration method was first described in the December 1994 **Byte Magazine** on pages 217 and 218. A copy of which can be found **here** .

The flaw was that they used a triangle wave instead of a sine for impressively fast and compact code. Despite **integrators inherently being lowpass filters**, the net result was unfiltered distortion in the one to four percent range.

An initial workaround involving clipping triangle waves so they looked more like a cosine. Which significantly reduced the unfiltered distortion with only minor increases in code size and processing time. This was found as column #85 **here**.

Consider the following "table lookup" digital sinewave…

[14 13 11 8 4 0 -4 -8 -11 -13 -14 -14 -13 -11 -8 -4 0 4 8 11 13 14]

Which can be difference integrated from this **IDQ** internal digital quarter of this triangle series "sine" wave…

/IDQ [-1 -2 -3 -4 -4] store

which expands as…

[-1 -2 -3 -4 -4 -4 -4 -3 -2 -1 0 1 2 3 4 4 4 4 3 2 1]

Yes, this is a low amplitude result with a crude sample rate. But it has several astounding properties. Its amplitude or **size** is 14. Otherwise known as the **integrated sum** of all your IDQ terms.

Its **speed** is four times the IDQ term count plus two (for the zeros) or 22. **Its third harmonic distortion is ZERO (!!)** and its fifth harmonic is a mere 0.19 percent! **Before filtering!!** There are no even harmonics. Several very high frequency harmonics are easily dealt with.

You start your cosine array with **size** and then add (integrate) one IDQ term at a time. Until it goes once again back around to **size**.

The maximum internal sine clip will be the rightmost IDQ term. Apparently only an **even** number of identical rightmost terms permit (but do not at all guarantee) the rather rare zero third harmonics.

Note that the above **[14 13 11 ...]** code can be scaled by a factor of 1 through 9 while retaining the same distortion and speed. Low end 8-bit micros restrict your maximum integers to a +127 to -127 range.

Only a very few **size** and IDQ choices will yield usefully low distortions.

These can sometimes be helped by going to one or more "soft" clips in which selected earlier IDQ terms are appropriately repeated.

The best found so far has been an IDQ choice of **[1 2 3 4 5 6 7 8 8 9 9 10 10 10]** which has an unfiltered third harmonic of .109 percent and a total harmonic distortion 3 through 9 of 0.141 percent.

Fourier Series

Sine and Cosine distortion is normally measured by the use of **Fourier Series**. A tutorial can be found **here** and some very fancy code (64 bit math usable to the 177th harmonic!) can be found in **this JavaScript addon** to our **Magic Sinewave Calculator**.

Skilling in his classic 1967 **Electrical Engineering Circuits** provided a brilliant but excessively painful **special numeric method** for calculating low Fourier Harmonics. Details of the original approach can be found **here**.

I did manage to eke out a modest 3,756,894:1 speedup by rewriting his table in **PostScript**. Find the raw code **here**, a demo **here**, and actual use details in the sourcecode for this document **here**.

In its present form, the code only finds the fundamental and the third, fifth, seventh, and ninth Fourier Cosine terms. It accepts a…

/signal = [64 63 61 57 ... 57 61 63 64]

…stack input to its **findfourier** command and returns definitions for **intf3**, **intf5**, **intf7**, **intf9**, and **totaldist** calculations.

Triangle Series

A little known and seldom used **triangle series** forms the basis of the original Byte generators as well as tools for exploring fancier new candidates. It is somewhat similar to but different from a **Fibonacci Series**.

The triangle series consists of the sum of its two previous terms. As in…

0 1 3 6 10 15 21 28 36 45 55 66 78 …

It is called a triangular series in that **each successive "n" can be arranged into an equalateral triangle**. The most common use is finding the total number of connections between n objects. And usually expressed as **n(n+1)/2**. We looked at this **here** with its sourcecode **here**.

The neat thing about a triangle series for cosine approximation is that **it puts "little pieces" on the "more bent" portions of the curve**, and vice versa. And thus has enormous potential for minimizing distortion.

Some Code

Two approaches can be used here to find candidate digital sinewaves suitable to create a catalog for minimalist low end 8-bit microcomputers.

The original Byte code can be modified to allow for hard or soft single or multiple clipping or single versus double triangle peaks. Or fancier PostScript code can be used in a **generate3** routine to evaluate IDQ candidates.

The modified Byte code looks like this with some of its red custom additions…

```
/cosval size store                          % initialize to size

/increment {                                % once per speed count
/sinval sinval cosval 0 gt {-1}{+1}ifelse
  false {cosval 0 eq {pop 0} if} if         % for double peak

/cosval cosval sinval
  false {sinval 10 ge {pop 10} if } if      % for top clip
  false {sinval 10 neg lt {pop 10 neg} if } if  % for bottom clip
add store
} store
```

This has been written in **PostScript** with its reference **here**, but is easily adapted to most any micros raw machine language code. The **red** additions shown above will need altered for each and every low end sinewave adaption. Custom or device specific code will be needed for single or double soft clipping.

The more elaborate PostScript **generate3** code accepts IDQ's and converts them to graphic displays of relevant data. Such as these "better" choices...

```
   [
[ 1 2 3 4 4] (14-22-04)]                                  % .000 .394
[ 1 2 3 4 5 6 6 6] (33-34-06)]                            % .000 .551
[ 1 2 3 4 5 5 6 6] (32-34-06)]                            % .183 .251
[ 1 2 3 4 5 6 6 7 7] (41-38-07)]                          % .362 .392
[ 1 2 3 4 5 6 7 8 8 8 8] (60-46-08)]                      % .000 .628
[ 1 2 3 4 5 6 7 7 8 8 8] (59-46-08)]                      % .073 .253
[1 2 3 4 5 6 7 8 9 10 10 10 10 10 ] (92-58-10)]           % .000 .674
[1 2 3 4 5 6 7 8 9 9 10 10 10 10 ] (94-58-10)]            % .036 .410
[1 2 3 4 5 6 7 8 8 9 9 10 10 10 ] (92-58-10)]             % .109 .141
[1 2 3 4 5 6 7 8 9 10 10 10 11 11 11 ] (108-62-11)]       % .166 .361
   ]{ generate3} forall
```

The shortened data values shown in the title string are **size-speed-sinclip**, while the first comment value is the third harmonic distortion in percent and the second the total THD distortion H3 through H9.

So far, **14-22-04** and its scaled gang members seem to utterly and totally blow away all of the other candidates. Especially since their unfiltered fifth harmonics are only a remarkably low 0.19 percent. Plus their ridiculously shorter size.

As before, lower **size** values may be integer scaled so long as none of them ever exceed 127. The actual **generate3** code can be read from the **sourcecode for this doc**.

The Current Catalog

The rest of our pages here are a catalog of many of the triangle series low end sinewaves explored to date.

Additional material can be found in our earlier docs **here**, **here**, and **here**.

14-22-04 hard clipped double peak

Approximate Internal Sinewave:

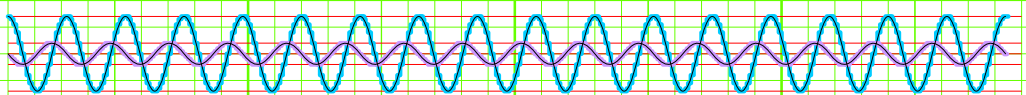
[-1 -2 -3 -4 -4
-4 -4 -3 -2 -1
0 1 2 3 4
4 4 4 3 2 1]

Approximate Cosine Wave Output:

[14 13 11 8 4
0 -4 -8 -11 -13
-14 -14 -13 -11 -8
-4 0 4 8 11 13 14]

Cosine Amplitude "size" : 14
Cosine Time Period "speed" : 22
Clipped Sin Amplitude "sinclip" : 4
Cycles Displayed : 17
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.69104e-05 %.
Fifth Harmonic: -0.192649 %.
Seventh Harmonic: 0.344111 %.
Ninth Harmonic: -1.80497e-05 %.
THD 3 - 9 : 0.394368 %.



33-34-06 hard clipped double peak

Approximate Internal Sinewave:

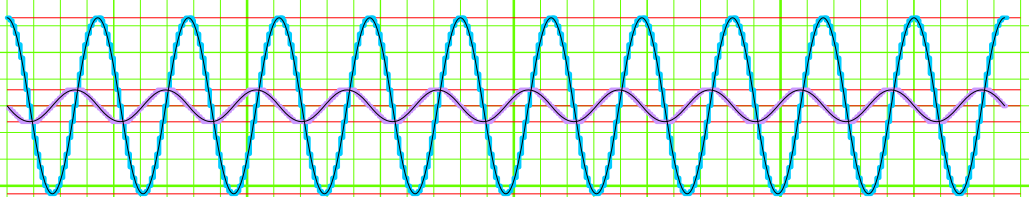
[-1 -2 -3 -4 -5 -6 -6 -6
-6 -6 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 6
6 6 6 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[33 32 30 27 23 18 12 6
0 -6 -12 -18 -23 -27 -30 -32
-33 -33 -32 -30 -27 -23 -18 -12
-6 0 6 12 18 23 27 30 32 33]

Cosine Amplitude "size" : 33
Cosine Time Period "speed" : 34
Clipped Sin Amplitude "sinclip" : 6
Cycles Displayed : 11
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -1.4427e-05 %.
Fifth Harmonic: -0.404095 %.
Seventh Harmonic: 0.379712 %.
Ninth Harmonic: -7.74133e-06 %.
THD 3 - 9 : 0.554503 %.



32-34-06 single soft clipped double peak

Approximate Internal Sinewave:

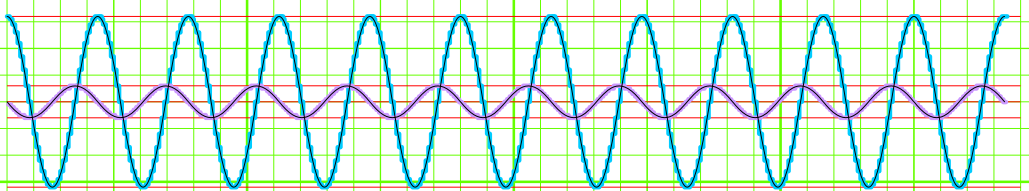
[-1 -2 -3 -4 -5 -5 -6 -6
-6 -6 -5 -5 -4 -3 -2 -1
0 1 2 3 4 5 5 6
6 6 6 5 5 4 3 2 1]

Approximate Cosine Wave Output:

[32 31 29 26 22 17 12 6
0 -6 -12 -17 -22 -26 -29 -31
-32 -32 -31 -29 -26 -22 -17 -12
-6 0 6 12 17 22 26 29 31 32]

Cosine Amplitude "size" : 32
Cosine Time Period "speed" : 34
Clipped Sin Amplitude "sinclip" : 6
Cycles Displayed : 11
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: 0.183287 %.
Fifth Harmonic: 0.10281 %.
Seventh Harmonic: -0.0576331 %.
Ninth Harmonic: 0.125097 %.
THD 3 - 9 : 0.251267 %.



41-38-07 single soft clip double peak

Approximate Internal Sinewave:

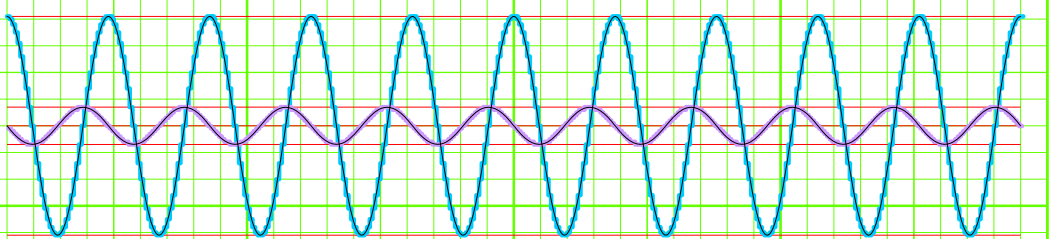
[-1 -2 -3 -4 -5 -6 -6 -7 -7
-7 -7 -6 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 6 7
7 7 7 6 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[41 40 38 35 31 26 20 14 7
0 -7 -14 -20 -26 -31 -35 -38 -40
-41 -41 -40 -38 -35 -31 -26 -20 -14
-7 0 7 14 20 26 31 35 38 40 41]

Cosine Amplitude "size" : 41
Cosine Time Period "speed" : 38
Clipped Sin Amplitude "sinclip" : 7
Cycles Displayed : 10
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -0.362397 %.
Fifth Harmonic: 0.0355263 %.
Seventh Harmonic: 0.0125729 %.
Ninth Harmonic: 0.1449 %.
THD 3 - 9 : 0.392107 %.



60-46-08 hard clip double peak

Approximate Internal Sinewave:

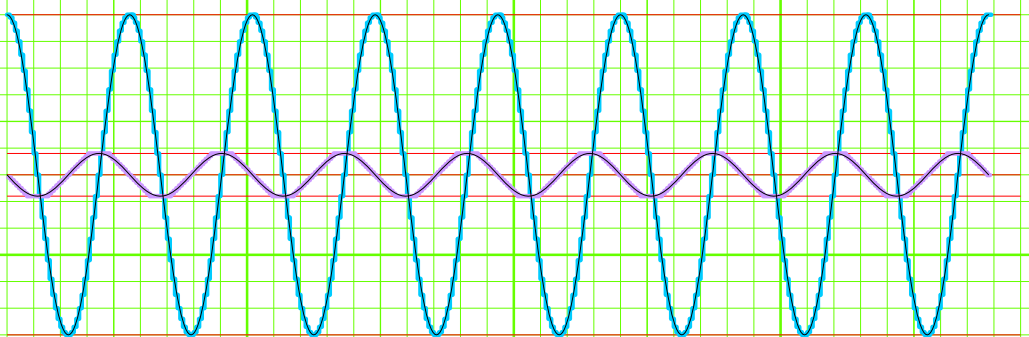
[-1 -2 -3 -4 -5 -6 -7 -8 -8 -8 -8
-8 -8 -8 -8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 8 8 8
8 8 8 8 8 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[60 59 57 54 50 45 39 32 24 16 8
0 -8 -16 -24 -32 -39 -45 -50 -54 -57 -59
-60 -60 -59 -57 -54 -50 -45 -39 -32 -24 -16
-8 0 8 16 24 32 39 45 50 54 57 59 60]

Cosine Amplitude "size" : 60
Cosine Time Period "speed" : 46
Clipped Sin Amplitude "sinclip" : 8
Cycles Displayed : 8
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.83007e-07 %.
Fifth Harmonic: -0.508279 %.
Seventh Harmonic: 0.369531 %.
Ninth Harmonic: 0.0 %.
THD 3 - 9 : 0.628411 %.



59-46-08 single soft clip double peak

Approximate Internal Sinewave:

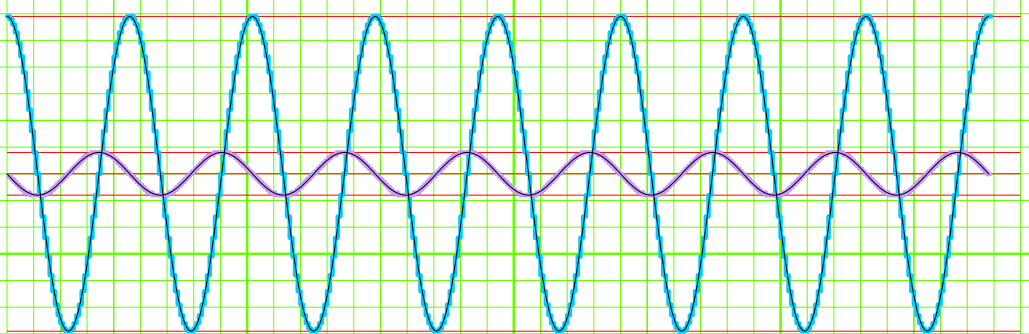
[-1 -2 -3 -4 -5 -6 -7 -7 -8 -8 -8
-8 -8 -8 -7 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 7 8 8
8 8 8 8 7 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[59 58 56 53 49 44 38 31 24 16 8
0 -8 -16 -24 -31 -38 -44 -49 -53 -56 -58
-59 -59 -58 -56 -53 -49 -44 -38 -31 -24 -16
-8 0 8 16 24 31 38 44 49 53 56 58 59]

Cosine Amplitude "size" : 59
Cosine Time Period "speed" : 46
Clipped Sin Amplitude "sinclip" : 8
Cycles Displayed : 8
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: 0.0739525 %.
Fifth Harmonic: -0.204566 %.
Seventh Harmonic: 0.111338 %.
Ninth Harmonic: 0.0611654 %.
THD 3 - 9 : 0.251899 %.



72-50-09 hard clip double peak

Approximate Internal Sinewave:

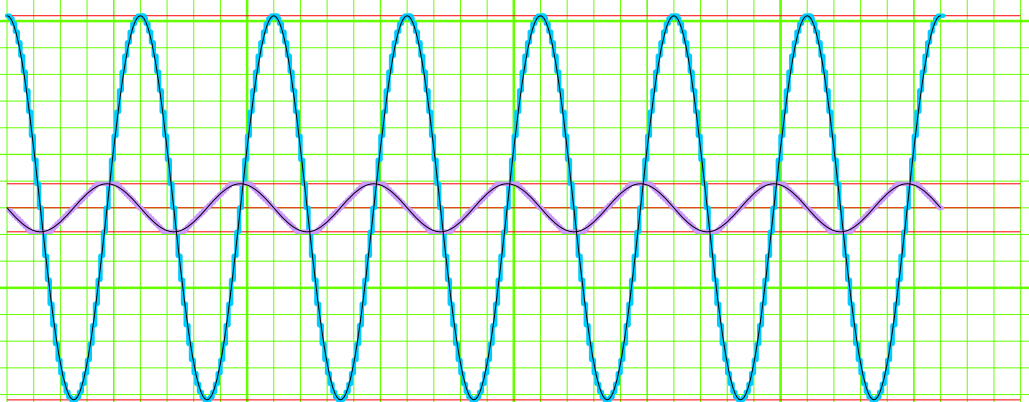
[-1 -2 -3 -4 -5 -6 -7 -8 -9 -9 -9 -9
-9 -9 -9 -9 -8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 8 9 9 9
9 9 9 9 9 8 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[72 71 69 66 62 57 51 44 36 27 18 9
0 -9 -18 -27 -36 -44 -51 -57 -62 -66 -69 -71
-72 -72 -71 -69 -66 -62 -57 -51 -44 -36 -27 -18
-9 0 9 18 27 36 44 51 57 62 66 69 71 72]

Cosine Amplitude "size" : 72
Cosine Time Period "speed" : 50
Clipped Sin Amplitude "sinclip" : 9
Cycles Displayed : 7
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -0.500034 %.
Fifth Harmonic: -0.392562 %.
Seventh Harmonic: 0.371536 %.
Ninth Harmonic: -0.0474113 %.
THD 3 - 9 : 0.737852 %.



71-50-09 single soft clip double peak

Approximate Internal Sinewave:

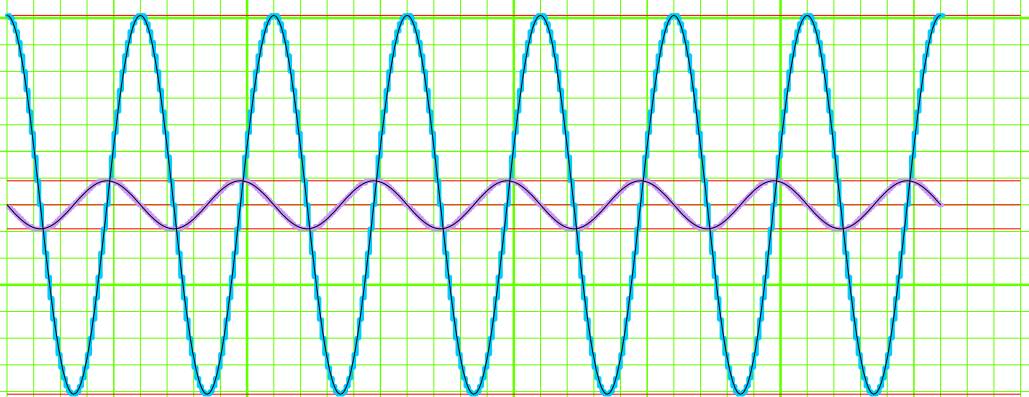
[-1 -2 -3 -4 -5 -6 -7 -8 -8 -9 -9 -9
-9 -9 -9 -8 -8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 8 8 9 9
9 9 9 9 8 8 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[71 70 68 65 61 56 50 43 35 27 18 9
0 -9 -18 -27 -35 -43 -50 -56 -61 -65 -68 -70
-71 -71 -70 -68 -65 -61 -56 -50 -43 -35 -27 -18
-9 0 9 18 27 35 43 50 56 61 65 68 70 71]

Cosine Amplitude "size" : 71
Cosine Time Period "speed" : 50
Clipped Sin Amplitude "sinclip" : 9
Cycles Displayed : 7
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -0.377453 %.
Fifth Harmonic: -0.185948 %.
Seventh Harmonic: 0.144977 %.
Ninth Harmonic: 0.0573025 %.
THD 3 - 9 : 0.44872 %.



92-58-10 hard clip double peak

Approximate Internal Sinewave:

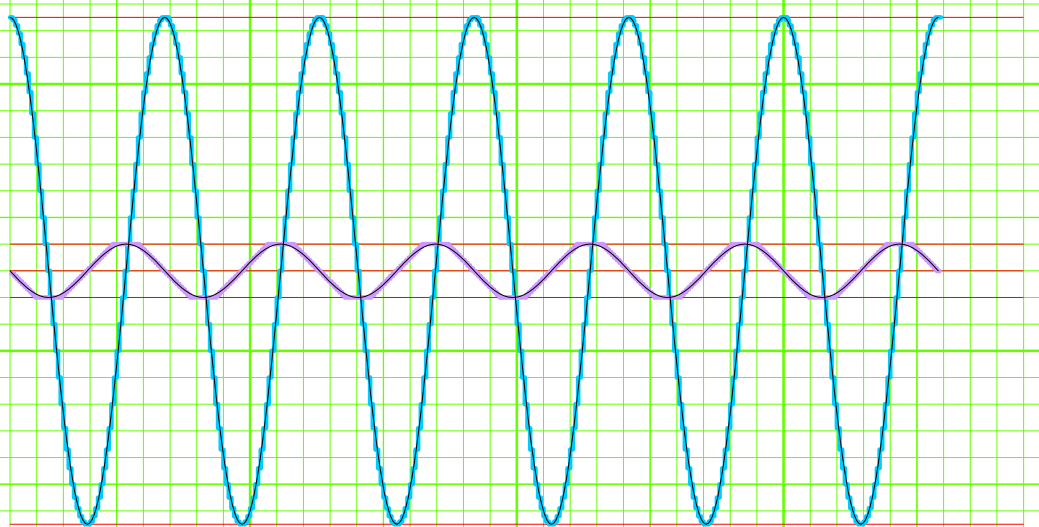
[-1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -10 -10 -10 -10
-10 -10 -10 -10 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 8 9 10 10 10 10
10 10 10 10 10 10 9 8 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[95 94 92 89 85 80 74 67 59 50 40 30 20 10
0 -10 -20 -30 -40 -50 -59 -67 -74 -80 -85 -89 -92 -94
-95 -95 -94 -92 -89 -85 -80 -74 -67 -59 -50 -40 -30 -20
-10 0 10 20 30 40 50 59 67 74 80 85 89 92 94 95]

Cosine Amplitude "size" : 95
Cosine Time Period "speed" : 58
Clipped Sin Amplitude "sinclip" : 10
Cycles Displayed : 6
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: 5.63533e-07 %.
Fifth Harmonic: -0.569413 %.
Seventh Harmonic: 0.358443 %.
Ninth Harmonic: 3.52208e-05 %.
THD 3 - 9 : 0.672839 %.



94-58-10 single soft clip double peak

Approximate Internal Sinewave:

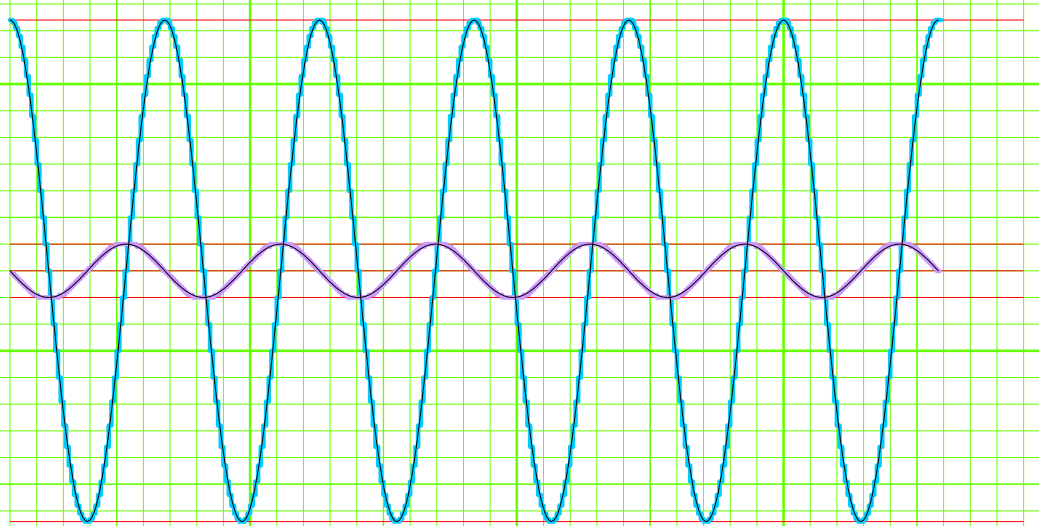
[-1 -2 -3 -4 -5 -6 -7 -8 -9 -9 -10 -10 -10 -10
-10 -10 -10 -10 -9 -9 -8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 8 9 9 10 10 10
10 10 10 10 10 9 9 8 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[94 93 91 88 84 79 73 66 58 49 40 30 20 10
0 -10 -20 -30 -40 -49 -58 -66 -73 -79 -84 -88 -91 -93
-94 -94 -93 -91 -88 -84 -79 -73 -66 -58 -49 -40 -30 -20
-10 0 10 20 30 40 49 58 66 73 79 84 88 91 93 94]

Cosine Amplitude "size" : 94
Cosine Time Period "speed" : 58
Clipped Sin Amplitude "sinclip" : 10
Cycles Displayed : 6
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: 0.0368638 %.
Fifth Harmonic: -0.369583 %.
Seventh Harmonic: 0.19189 %.
Ninth Harmonic: 0.0329017 %.
THD 3 - 9 : 0.419351 %.



92-58-10 double soft clip double peak

Approximate Internal Sinewave:

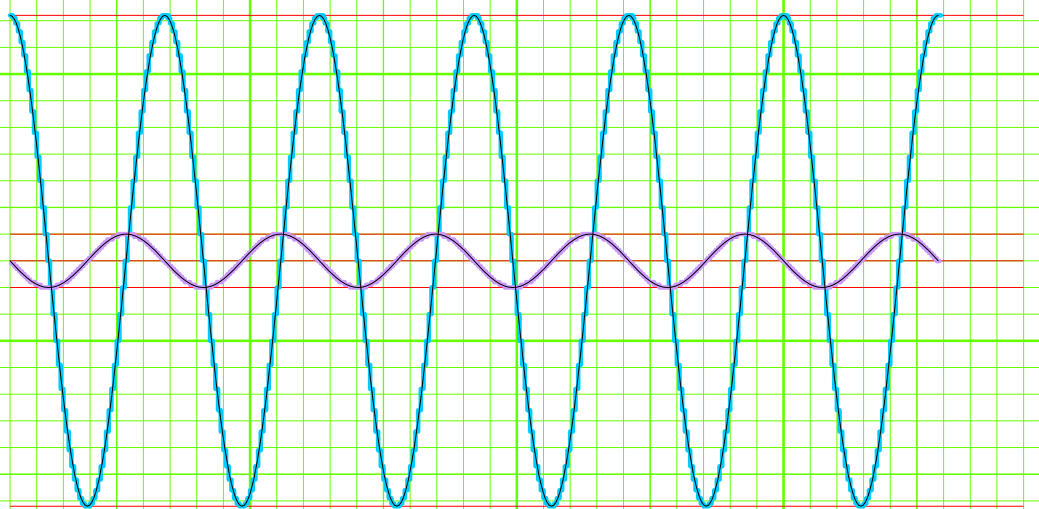
[-1 -2 -3 -4 -5 -6 -7 -8 -8 -9 -9 -10 -10 -10
-10 -10 -10 -9 -9 -8 -8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 8 8 9 9 10 10
10 10 10 10 9 9 8 8 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[92 91 89 86 82 77 71 64 56 48 39 30 20 10
0 -10 -20 -30 -39 -48 -56 -64 -71 -77 -82 -86 -89 -91
-92 -92 -91 -89 -86 -82 -77 -71 -64 -56 -48 -39 -30 -20
-10 0 10 20 30 39 48 56 64 71 77 82 86 89 91 92]

Cosine Amplitude "size" : 92
Cosine Time Period "speed" : 58
Clipped Sin Amplitude "sinclip" : 10
Cycles Displayed : 6
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: 0.109177 %.
Fifth Harmonic: -0.0179804 %.
Seventh Harmonic: -0.0542809 %.
Ninth Harmonic: 0.0705242 %.
THD 3 - 9 : 0.141996 %.



110-62-11 hard clip double peak

Approximate Internal Sinewave:

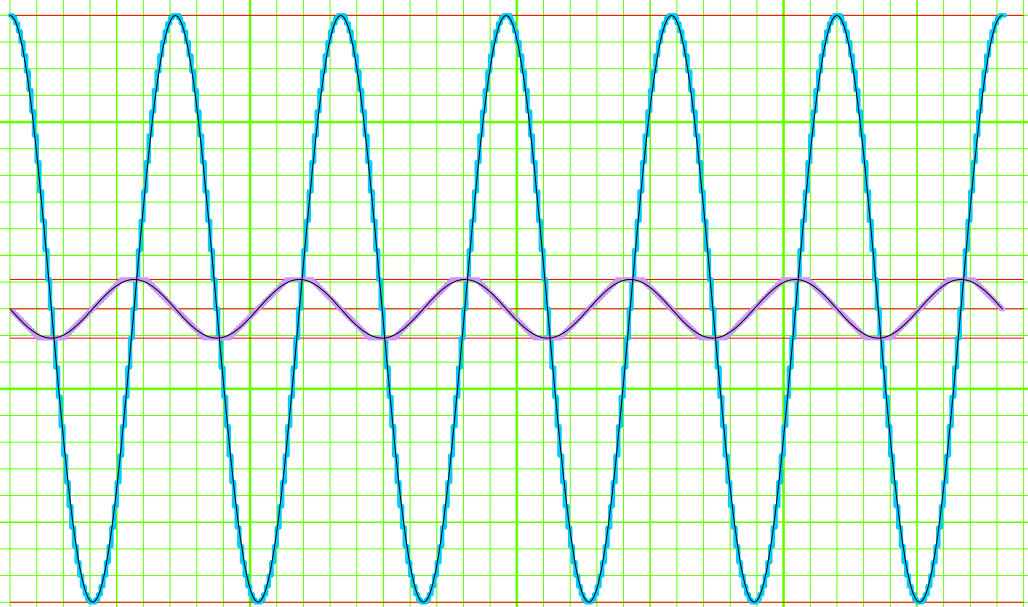
[-1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -11 -11 -11 -11 -11
-11 -11 -11 -11 -11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 8 9 10 11 11 11 11
11 11 11 11 11 11 10 9 8 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[110 109 107 104 100 95 89 82 74 65 55 44 33 22 11
0 -11 -22 -33 -44 -55 -65 -74 -82 -89 -95 -100 -104 -107 -109
-110 -110 -109 -107 -104 -100 -95 -89 -82 -74 -65 -55 -44 -33 -22
-11 0 11 22 33 44 55 65 74 82 89 95 100 104 107 109 110]

Cosine Amplitude "size" : 110
Cosine Time Period "speed" : 62
Clipped Sin Amplitude "sinclip" : 11
Cycles Displayed : 6
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -0.40982 %.
Fifth Harmonic: -0.474958 %.
Seventh Harmonic: 0.365594 %.
Ninth Harmonic: -0.0412563 %.
THD 3 - 9 : 0.727254 %.



108-62-11 single soft clip double peak

Approximate Internal Sinewave:

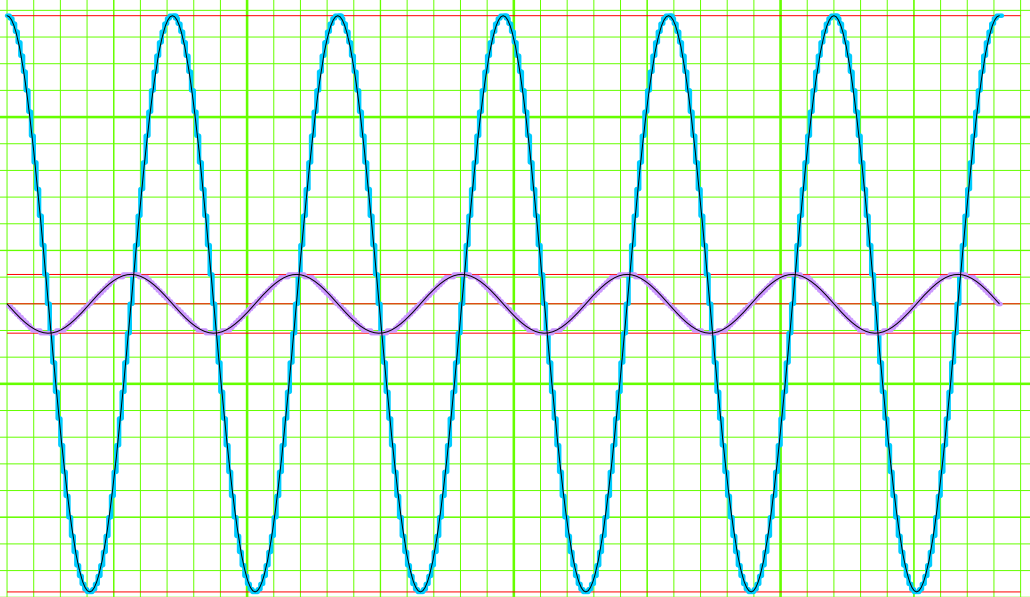
[-1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -10 -10 -11 -11 -11
-11 -11 -11 -10 -10 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 8 9 10 10 10 11 11
11 11 11 11 10 10 10 9 8 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[108 107 105 102 98 93 87 80 72 63 53 43 33 22 11
0 -11 -22 -33 -43 -53 -63 -72 -80 -87 -93 -98 -102 -105 -107
-108 -108 -107 -105 -102 -98 -93 -87 -80 -72 -63 -53 -43 -33 -22
-11 0 11 22 33 43 53 63 72 80 87 93 98 102 105 107 108]

Cosine Amplitude "size" : 108
Cosine Time Period "speed" : 62
Clipped Sin Amplitude "sinclip" : 11
Cycles Displayed : 6
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -0.16646 %.
Fifth Harmonic: -0.277496 %.
Seventh Harmonic: 0.0869093 %.
Ninth Harmonic: 0.136199 %.
THD 3 - 9 : 0.361685 %.



06-14-03 triangle series no clip single peak

Approximate Internal Sinewave:

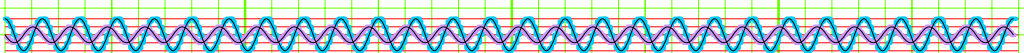
```
[ -1 -2 -3
  -3 -2 -1
  0 1 2
  3 3 2 1  ]
```

Approximate Cosine Wave Output:

```
[ 6 5 3
  0 -3 -5
  -6 -6 -5
  -3 0 3 5 6  ]
```

Cosine Amplitude "size" : 6
Cosine Time Period "speed" : 14
Clipped Sin Amplitude "sinclip" : 3
Cycles Displayed : 27
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -1.23169 %.
Fifth Harmonic: 0.429122 %.
Seventh Harmonic: -0.0925297 %.
Ninth Harmonic: -0.195859 %.
THD 3 - 9 : 1.32217 %.



09-18-04 triangle series no clip double peak

Approximate Internal Sinewave:

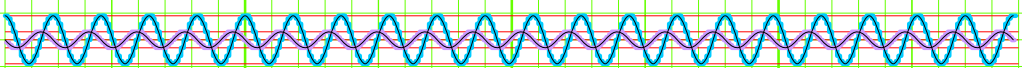
[-1 -2 -3 -3
-3 -3 -2 -1
0 1 2 3
3 3 3 2 1]

Approximate Cosine Wave Output:

[9 8 6 3
0 -3 -6 -8
-9 -9 -8 -6
-3 0 3 6 8 9]

Cosine Amplitude "size" : 9
Cosine Time Period "speed" : 18
Clipped Sin Amplitude "sinclip" : 3
Cycles Displayed : 21
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: 1.37949 %.
Fifth Harmonic: -0.347477 %.
Seventh Harmonic: 0.221474 %.
Ninth Harmonic: -0.042854 %.
THD 3 - 9 : 1.44036 %.



10-18-04 triangle series no clip single peak

Approximate Internal Sinewave:

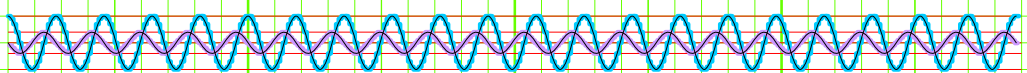
[-1 -2 -3 -4
-4 -3 -2 -1
0 1 2 3
4 4 3 2 1]

Approximate Cosine Wave Output:

[10 9 7 4
0 -4 -7 -9
-10 -10 -9 -7
-4 0 4 7 9 10]

Cosine Amplitude "size" : 10
Cosine Time Period "speed" : 18
Clipped Sin Amplitude "sinclip" : 4
Cycles Displayed : 21
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -1.90513 %.
Fifth Harmonic: 0.656034 %.
Seventh Harmonic: 0.0476129 %.
Ninth Harmonic: -0.0239772 %.
THD 3 - 9 : 2.01563 %.



14-22-04 triangle series no clip double peak

Approximate Internal Sinewave:

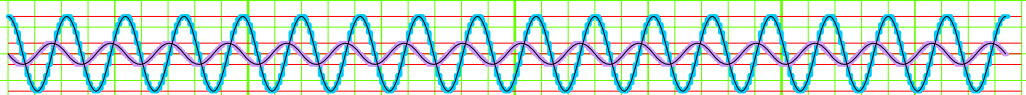
[-1 -2 -3 -4 -4
-4 -4 -3 -2 -1
0 1 2 3 4
4 4 4 3 2 1]

Approximate Cosine Wave Output:

[14 13 11 8 4
0 -4 -8 -11 -13
-14 -14 -13 -11 -8
-4 0 4 8 11 13 14]

Cosine Amplitude "size" : 14
Cosine Time Period "speed" : 22
Clipped Sin Amplitude "sinclip" : 4
Cycles Displayed : 17
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.69104e-05 %.
Fifth Harmonic: -0.192649 %.
Seventh Harmonic: 0.344111 %.
Ninth Harmonic: -1.80497e-05 %.
THD 3 - 9 : 0.394368 %.



15-22-05 triangle series no clip single peak

Approximate Internal Sinewave:

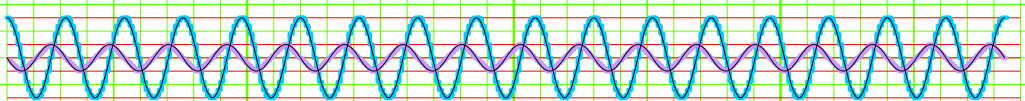
[-1 -2 -3 -4 -5
-5 -4 -3 -2 -1
0 1 2 3 4
5 5 4 3 2 1]

Approximate Cosine Wave Output:

[15 14 12 9 5
0 -5 -9 -12 -14
-15 -15 -14 -12 -9
-5 0 5 9 12 14 15]

Cosine Amplitude "size" : 15
Cosine Time Period "speed" : 22
Clipped Sin Amplitude "sinclip" : 5
Cycles Displayed : 17
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.30327 %.
Fifth Harmonic: 0.751934 %.
Seventh Harmonic: -7.22556e-06 %.
Ninth Harmonic: 0.0501246 %.
THD 3 - 9 : 2.42342 %.



20-26-05 triangle series no clip double peak

Approximate Internal Sinewave:

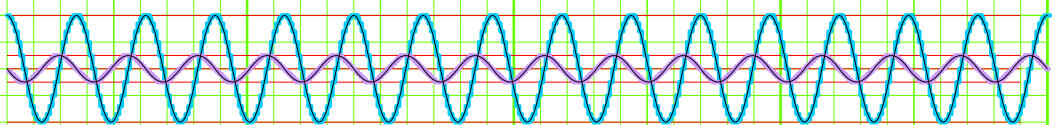
[-1 -2 -3 -4 -5 -5
-5 -5 -4 -3 -2 -1
0 1 2 3 4 5
5 5 5 4 3 2 1]

Approximate Cosine Wave Output:

[20 19 17 14 10 5
0 -5 -10 -14 -17 -19
-20 -20 -19 -17 -14 -10
-5 0 5 10 14 17 19 20]

Cosine Amplitude "size" : 20
Cosine Time Period "speed" : 26
Clipped Sin Amplitude "sinclip" : 5
Cycles Displayed : 15
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -0.87435 %.
Fifth Harmonic: -2.40716e-05 %.
Seventh Harmonic: 0.328865 %.
Ninth Harmonic: -0.0420379 %.
THD 3 - 9 : 0.935097 %.



21-26-06 triangle series no clip single peak

Approximate Internal Sinewave:

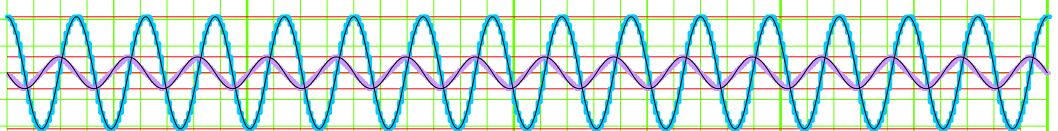
[-1 -2 -3 -4 -5 -6
-6 -5 -4 -3 -2 -1
0 1 2 3 4 5
6 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[21 20 18 15 11 6
0 -6 -11 -15 -18 -20
-21 -21 -20 -18 -15 -11
-6 0 6 11 15 18 20 21]

Cosine Amplitude "size" : 21
Cosine Time Period "speed" : 26
Clipped Sin Amplitude "sinclip" : 6
Cycles Displayed : 15
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.56185 %.
Fifth Harmonic: 0.798421 %.
Seventh Harmonic: -0.0503048 %.
Ninth Harmonic: 0.0879901 %.
THD 3 - 9 : 2.6853 %.



27-30-06 triangle series no clip double peak

Approximate Internal Sinewave:

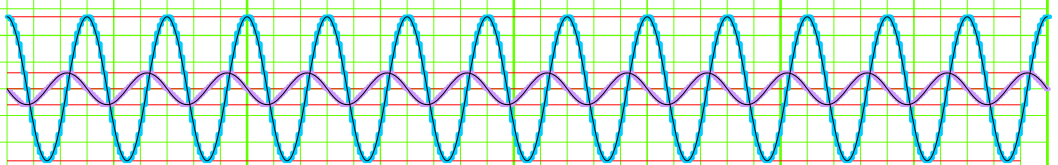
[-1 -2 -3 -4 -5 -6 -6
-6 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6
6 6 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[27 26 24 21 17 12 6
0 -6 -12 -17 -21 -24 -26
-27 -27 -26 -24 -21 -17 -12
-6 0 6 12 17 21 24 26 27]

Cosine Amplitude "size" : 27
Cosine Time Period "speed" : 30
Clipped Sin Amplitude "sinclip" : 6
Cycles Displayed : 13
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -1.45821 %.
Fifth Harmonic: 0.16339 %.
Seventh Harmonic: 0.268164 %.
Ninth Harmonic: -0.0564979 %.
THD 3 - 9 : 1.49271 %.



28-30-07 triangle series no clip single peak

Approximate Internal Sinewave:

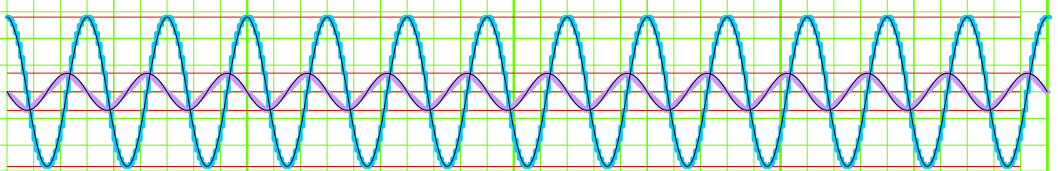
[-1 -2 -3 -4 -5 -6 -7
-7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6
7 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[28 27 25 22 18 13 7
0 -7 -13 -18 -22 -25 -27
-28 -28 -27 -25 -22 -18 -13
-7 0 7 13 18 22 25 27 28]

Cosine Amplitude "size" : 28
Cosine Time Period "speed" : 30
Clipped Sin Amplitude "sinclip" : 7
Cycles Displayed : 13
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.74196 %.
Fifth Harmonic: 0.822795 %.
Seventh Harmonic: -0.0896307 %.
Ninth Harmonic: 0.109328 %.
THD 3 - 9 : 2.86624 %.



35-34-07 triangle series no clip double peak

Approximate Internal Sinewave:

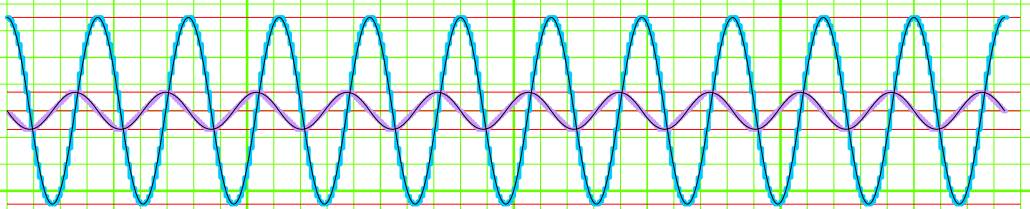
[-1 -2 -3 -4 -5 -6 -7 -7
-7 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7
7 7 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[35 34 32 29 25 20 14 7
0 -7 -14 -20 -25 -29 -32 -34
-35 -35 -34 -32 -29 -25 -20 -14
-7 0 7 14 20 25 29 32 34 35]

Cosine Amplitude "size" : 35
Cosine Time Period "speed" : 34
Clipped Sin Amplitude "sinclip" : 7
Cycles Displayed : 11
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -1.86709 %.
Fifth Harmonic: 0.291135 %.
Seventh Harmonic: 0.200267 %.
Ninth Harmonic: -0.0504109 %.
THD 3 - 9 : 1.9009 %.



36-34-08 triangle series no clip single peak

Approximate Internal Sinewave:

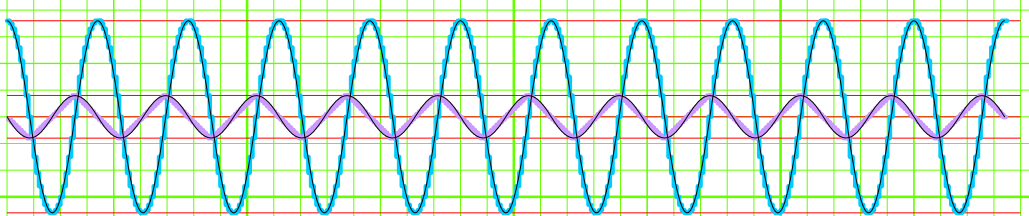
[-1 -2 -3 -4 -5 -6 -7 -8
-8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7
8 8 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[36 35 33 30 26 21 15 8
0 -8 -15 -21 -26 -30 -33 -35
-36 -36 -35 -33 -30 -26 -21 -15
-8 0 8 15 21 26 30 33 35 36]

Cosine Amplitude "size" : 36
Cosine Time Period "speed" : 34
Clipped Sin Amplitude "sinclip" : 8
Cycles Displayed : 11
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.8741 %.
Fifth Harmonic: 0.836101 %.
Seventh Harmonic: -0.11953 %.
Ninth Harmonic: 0.122306 %.
THD 3 - 9 : 2.99813 %.



44-38-08 triangle series no clip double peak

Approximate Internal Sinewave:

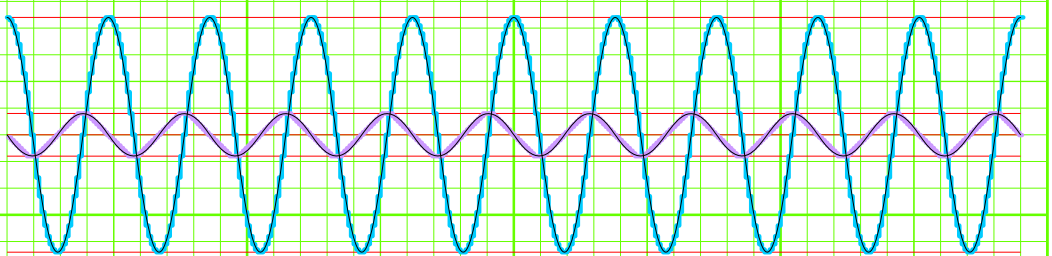
[-1 -2 -3 -4 -5 -6 -7 -8 -8
-8 -8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 8
8 8 8 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[44 43 41 38 34 29 23 16 8
0 -8 -16 -23 -29 -34 -38 -41 -43
-44 -44 -43 -41 -38 -34 -29 -23 -16
-8 0 8 16 23 29 34 38 41 43 44]

Cosine Amplitude "size" : 44
Cosine Time Period "speed" : 38
Clipped Sin Amplitude "sinclip" : 8
Cycles Displayed : 10
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.16494 %.
Fifth Harmonic: 0.389249 %.
Seventh Harmonic: 0.13777 %.
Ninth Harmonic: -0.0353161 %.
THD 3 - 9 : 2.20425 %.



45-38-09 triangle series no clip single peak

Approximate Internal Sinewave:

[-1 -2 -3 -4 -5 -6 -7 -8 -9
-9 -8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 8
9 9 8 7 6 5 4 3 2 1]

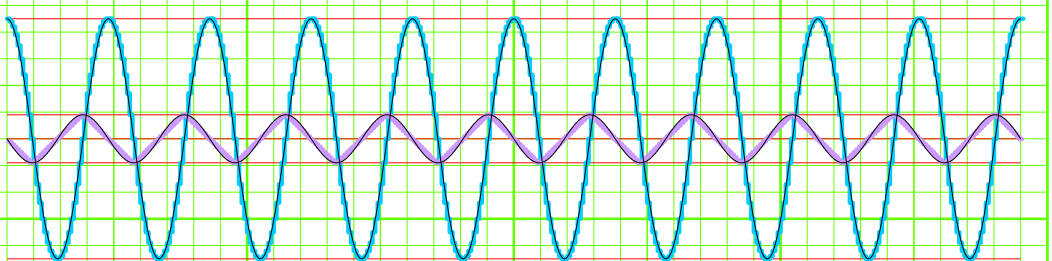
Approximate Cosine Wave Output:

[45 44 42 39 35 30 24 17 9
0 -9 -17 -24 -30 -35 -39 -42 -44
-45 -45 -44 -42 -39 -35 -30 -24 -17
-9 0 9 17 24 30 35 39 42 44 45]

Cosine Amplitude "size" : 45
Cosine Time Period "speed" : 38
Clipped Sin Amplitude "sinclip" : 9
Cycles Displayed : 10
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!

Third Harmonic: -2.9749 %.
Fifth Harmonic: 0.843401 %.
Seventh Harmonic: -0.14254 %.
Ninth Harmonic: 0.130549 %.
THD 3 - 9 : 3.09818 %.



54-42-09 triangle series no clip double peak

Approximate Internal Sinewave:

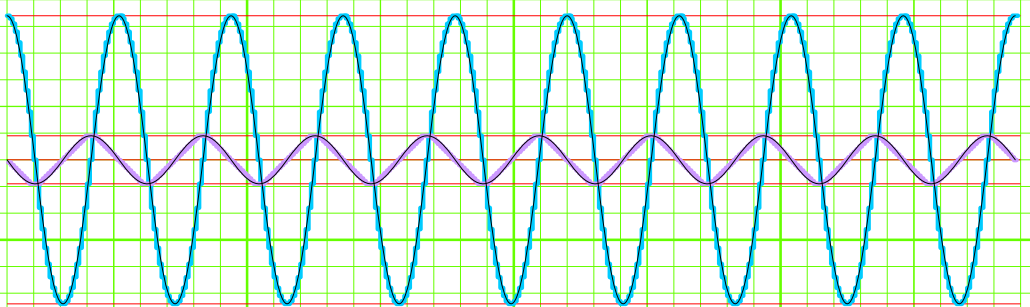
[-1 -2 -3 -4 -5 -6 -7 -8 -9 -9
-9 -9 -8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 8 9
9 9 9 8 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[54 53 51 48 44 39 33 26 18 9
0 -9 -18 -26 -33 -39 -44 -48 -51 -53
-54 -54 -53 -51 -48 -44 -39 -33 -26 -18
-9 0 9 18 26 33 39 44 48 51 53 54]

Cosine Amplitude "size" : 54
Cosine Time Period "speed" : 42
Clipped Sin Amplitude "sinclip" : 9
Cycles Displayed : 9
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.38924 %.
Fifth Harmonic: 0.464855 %.
Seventh Harmonic: 0.0837956 %.
Ninth Harmonic: -0.0175235 %.
THD 3 - 9 : 2.43554 %.



55-42-10 triangle series no clip single peak

Approximate Internal Sinewave:

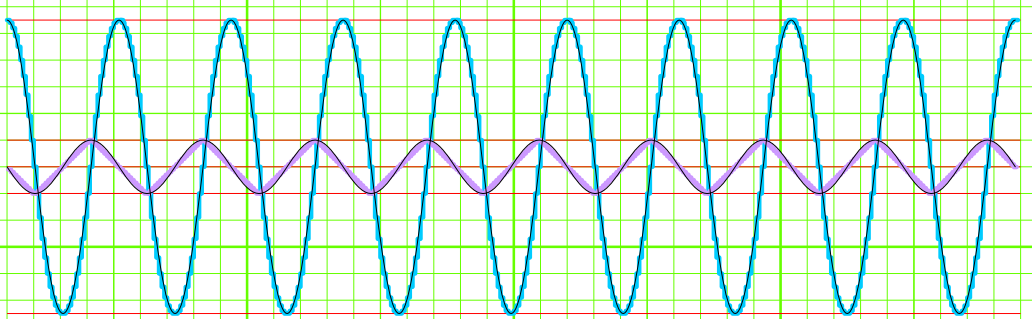
[-1 -2 -3 -4 -5 -6 -7 -8 -9 -10
-10 -9 -8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 8 9
10 10 9 8 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[55 54 52 49 45 40 34 27 19 10
0 -10 -19 -27 -34 -40 -45 -49 -52 -54
-55 -55 -54 -52 -49 -45 -40 -34 -27 -19
-10 0 10 19 27 34 40 45 49 52 54 55]

Cosine Amplitude "size" : 55
Cosine Time Period "speed" : 42
Clipped Sin Amplitude "sinclip" : 10
Cycles Displayed : 9
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -3.05426 %.
Fifth Harmonic: 0.847312 %.
Seventh Harmonic: -0.160591 %.
Ninth Harmonic: 0.136008 %.
THD 3 - 9 : 3.17659 %.



65-46-10 triangle series no clip double peak

Approximate Internal Sinewave:

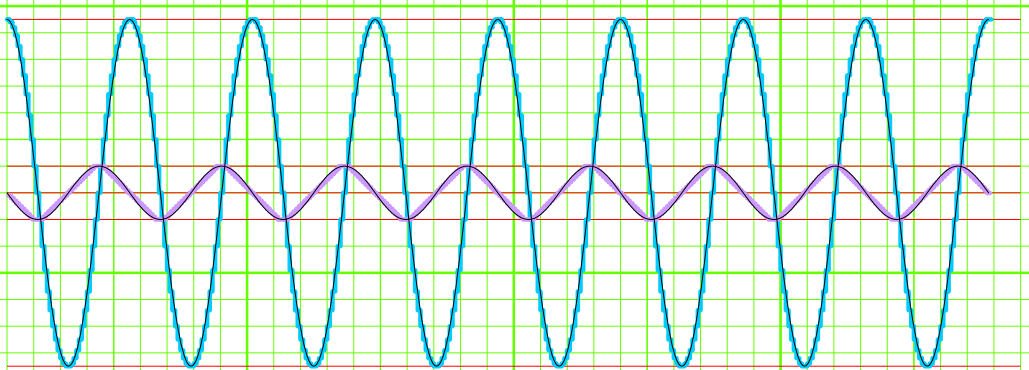
[-1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -10
-10 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 8 9 10
10 10 10 9 8 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[65 64 62 59 55 50 44 37 29 20 10
0 -10 -20 -29 -37 -44 -50 -55 -59 -62 -64
-65 -65 -64 -62 -59 -55 -50 -44 -37 -29 -20
-10 0 10 20 29 37 44 50 55 59 62 64 65]

Cosine Amplitude "size" : 65
Cosine Time Period "speed" : 46
Clipped Sin Amplitude "sinclip" : 10
Cycles Displayed : 8
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.56274 %.
Fifth Harmonic: 0.523677 %.
Seventh Harmonic: 0.0382315 %.
Ninth Harmonic: -5.12823e-07 %.
THD 3 - 9 : 2.61597 %.



66-46-11 triangle series no clip single peak

Approximate Internal Sinewave:

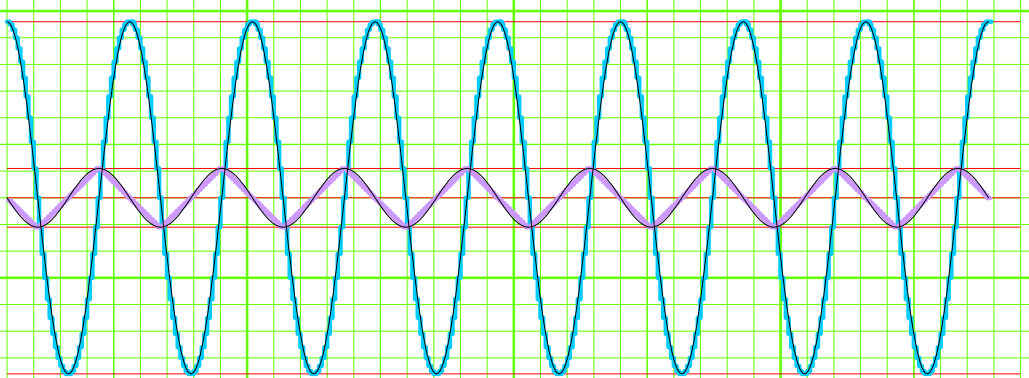
[-1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -11
-11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 8 9 10
11 11 10 9 8 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[66 65 63 60 56 51 45 38 30 21 11
0 -11 -21 -30 -38 -45 -51 -56 -60 -63 -65
-66 -66 -65 -63 -60 -56 -51 -45 -38 -30 -21
-11 0 11 21 30 38 45 51 56 60 63 65 66]

Cosine Amplitude "size" : 66
Cosine Time Period "speed" : 46
Clipped Sin Amplitude "sinclip" : 11
Cycles Displayed : 8
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -3.11822 %.
Fifth Harmonic: 0.849205 %.
Seventh Harmonic: -0.17502 %.
Ninth Harmonic: 0.13969 %.
THD 3 - 9 : 3.23953 %.



77-50-11 triangle series no clip double peak

Approximate Internal Sinewave:

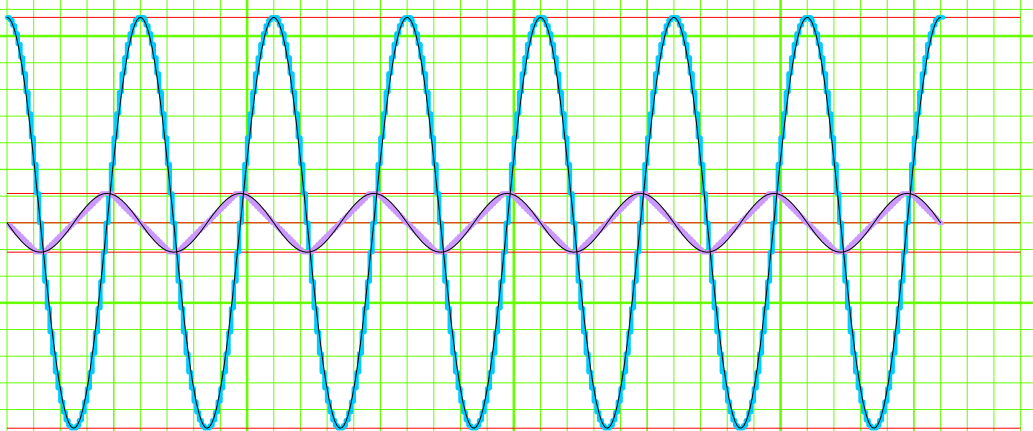
[-1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -11 -11
-11 -11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 8 9 10 11
11 11 11 10 9 8 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[77 76 74 71 67 62 56 49 41 32 22 11
0 -11 -22 -32 -41 -49 -56 -62 -67 -71 -74 -76
-77 -77 -76 -74 -71 -67 -62 -56 -49 -41 -32 -22
-11 0 11 22 32 41 49 56 62 67 71 74 76 77]

Cosine Amplitude "size" : 77
Cosine Time Period "speed" : 50
Clipped Sin Amplitude "sinclip" : 11
Cycles Displayed : 7
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.7001 %.
Fifth Harmonic: 0.57 %.
Seventh Harmonic: -1.11146e-05 %.
Ninth Harmonic: 0.0160788 %.
THD 3 - 9 : 2.75965 %.



78-50-12 triangle series no clip single peak

Approximate Internal Sinewave:

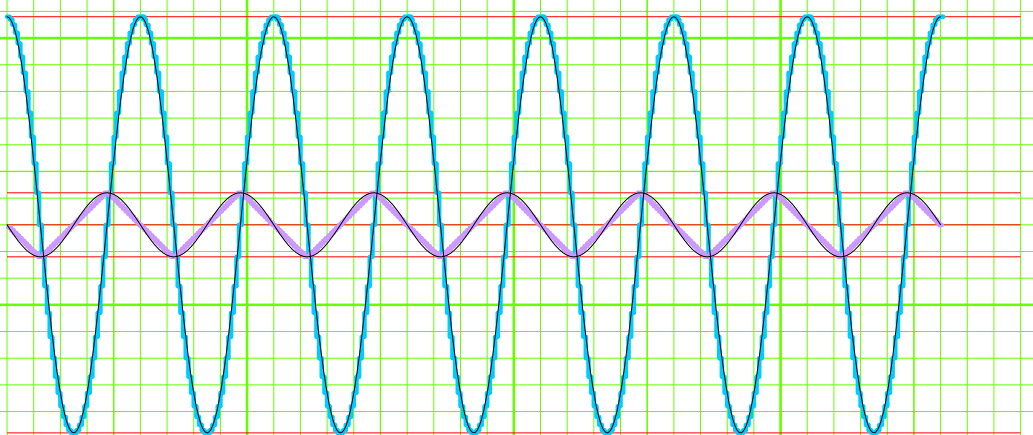
[-1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -11 -12
-12 -11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 8 9 10 11
12 12 11 10 9 8 7 6 5 4 3 2 1]

Approximate Cosine Wave Output:

[78 77 75 72 68 63 57 50 42 33 23 12
0 -12 -23 -33 -42 -50 -57 -63 -68 -72 -75 -77
-78 -78 -77 -75 -72 -68 -63 -57 -50 -42 -33 -23
-12 0 12 23 33 42 50 57 63 68 72 75 77 78]

Cosine Amplitude "size" : 78
Cosine Time Period "speed" : 50
Clipped Sin Amplitude "sinclip" : 12
Cycles Displayed : 7
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -3.17087 %.
Fifth Harmonic: 0.849885 %.
Seventh Harmonic: -0.186791 %.
Ninth Harmonic: 0.142218 %.
THD 3 - 9 : 3.29118 %.



97-58-04 triangle series hard clip double peak

Approximate Internal Sinewave:

[-1 -2 -3 -4 -5 -6 -7 -7 -8 -9 -10 -11 -12 -12
-12 -12 -11 -10 -9 -8 -7 -7 -6 -5 -4 -3 -2 -1
0 1 2 3 4 5 6 7 7 8 9 10 11 12
12 12 12 11 10 9 8 7 7 6 5 4 3 2 1]

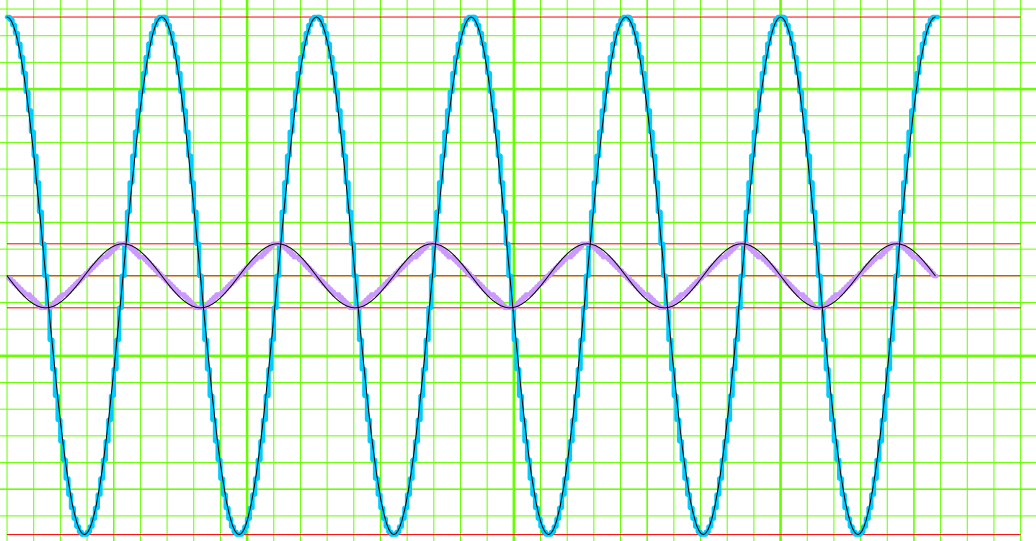
Approximate Cosine Wave Output:

[97 96 94 91 87 82 76 69 62 54 45 35 24 12
0 -12 -24 -35 -45 -54 -62 -69 -76 -82 -87 -91 -94 -96
-97 -97 -96 -94 -91 -87 -82 -76 -69 -62 -54 -45 -35 -24
-12 0 12 24 35 45 54 62 69 76 82 87 91 94 96 97]

Cosine Amplitude "size" : 97
Cosine Time Period "speed" : 58
Clipped Sin Amplitude "sinclip" : 12
Cycles Displayed : 6
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!

Third Harmonic: -2.1856 %.
Fifth Harmonic: 0.991093 %.
Seventh Harmonic: -0.241221 %.
Ninth Harmonic: -0.0362327 %.
THD 3 - 9 : 2.41218 %.



14-22-04 triangle hard clip double peak

Approximate Internal Sinewave:

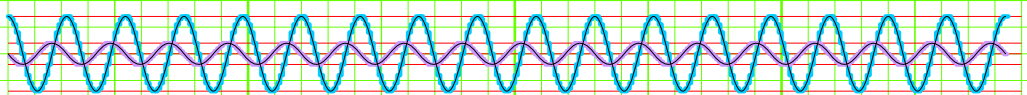
[-1 -2 -3 -4 -4
-4 -4 -3 -2 -1
0 1 2 3 4
4 4 4 3 2 1]

Approximate Cosine Wave Output:

[14 13 11 8 4
0 -4 -8 -11 -13
-14 -14 -13 -11 -8
-4 0 4 8 11 13 14]

Cosine Amplitude "size" : 14
Cosine Time Period "speed" : 22
Clipped Sin Amplitude "sinclip" : 4
Cycles Displayed : 17
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.69104e-05 %.
Fifth Harmonic: -0.192649 %.
Seventh Harmonic: 0.344111 %.
Ninth Harmonic: -1.80497e-05 %.
THD 3 - 9 : 0.394368 %.



28-22-08 triangle mag hard clip double peak

Approximate Internal Sinewave:

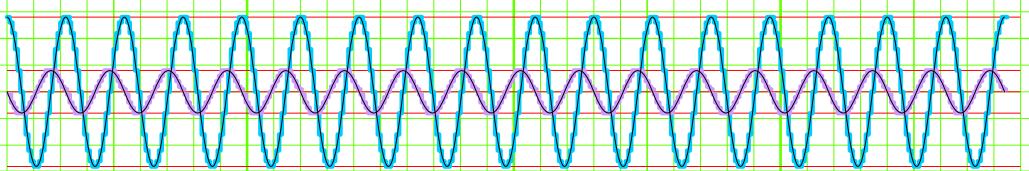
[-2 -4 -6 -8 -8
-8 -8 -6 -4 -2
0 2 4 6 8
8 8 8 6 4 2]

Approximate Cosine Wave Output:

[28 26 22 16 8
0 -8 -16 -22 -26
-28 -28 -26 -22 -16
-8 0 8 16 22 26 28]

Cosine Amplitude "size" : 28
Cosine Time Period "speed" : 22
Clipped Sin Amplitude "sinclip" : 8
Cycles Displayed : 17
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.69104e-05 %.
Fifth Harmonic: -0.192649 %.
Seventh Harmonic: 0.344111 %.
Ninth Harmonic: -1.80497e-05 %.
THD 3 - 9 : 0.394368 %.



42-22-12 triangle mag hard clip double peak

Approximate Internal Sinewave:

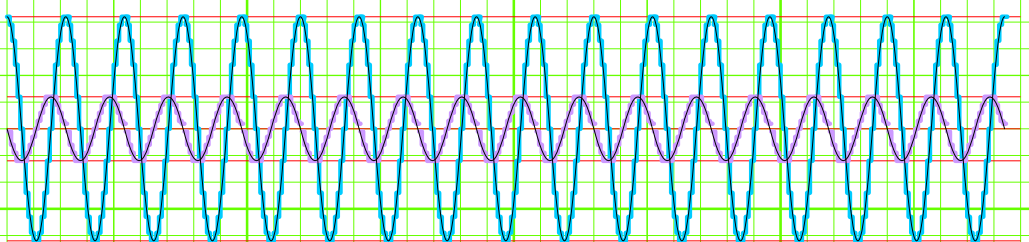
[-3 -6 -9 -12 -12
-12 -12 -9 -6 -3
0 3 6 9 12
12 12 12 9 6 3]

Approximate Cosine Wave Output:

[42 39 33 24 12
0 -12 -24 -33 -39
-42 -42 -39 -33 -24
-12 0 12 24 33 39 42]

Cosine Amplitude "size" : 42
Cosine Time Period "speed" : 22
Clipped Sin Amplitude "sinclip" : 12
Cycles Displayed : 17
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.80043e-05 %.
Fifth Harmonic: -0.192649 %.
Seventh Harmonic: 0.344111 %.
Ninth Harmonic: -1.70651e-05 %.
THD 3 - 9 : 0.394368 %.



56-22-16 triangle mag hard clip double peak

Approximate Internal Sinewave:

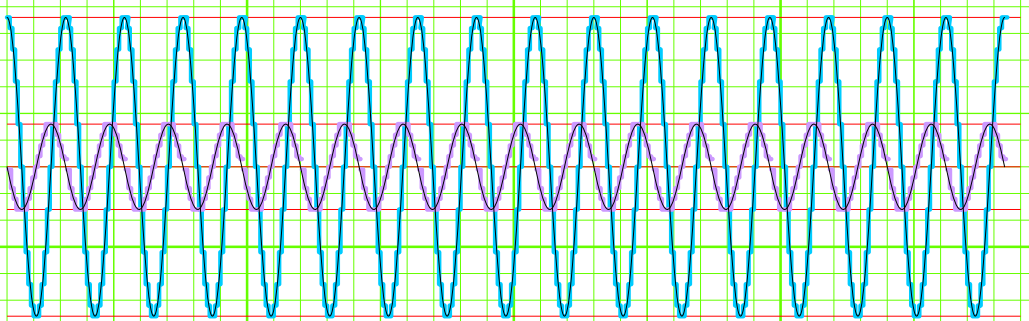
[-4 -8 -12 -16 -16
-16 -16 -12 -8 -4
0 4 8 12 16
16 16 16 12 8 4]

Approximate Cosine Wave Output:

[56 52 44 32 16
0 -16 -32 -44 -52
-56 -56 -52 -44 -32
-16 0 16 32 44 52 56]

Cosine Amplitude "size" : 56
Cosine Time Period "speed" : 22
Clipped Sin Amplitude "sinclip" : 16
Cycles Displayed : 17
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.69104e-05 %.
Fifth Harmonic: -0.192649 %.
Seventh Harmonic: 0.344111 %.
Ninth Harmonic: -1.80497e-05 %.
THD 3 - 9 : 0.394368 %.



70-22-20 triangle mag hard clip double peak

Approximate Internal Sinewave:

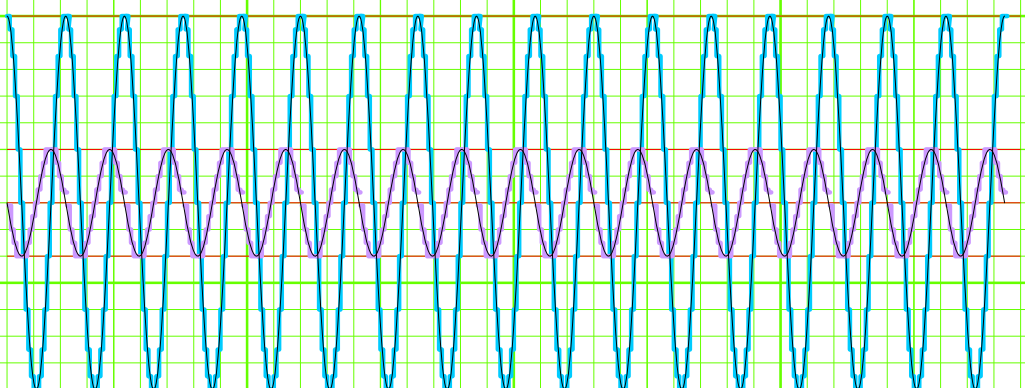
[-5 -10 -15 -20 -20
-20 -20 -15 -10 -5
0 5 10 15 20
20 20 20 15 10 5]

Approximate Cosine Wave Output:

[70 65 55 40 20
0 -20 -40 -55 -65
-70 -70 -65 -55 -40
-20 0 20 40 55 65 70]

Cosine Amplitude "size" : 70
Cosine Time Period "speed" : 22
Clipped Sin Amplitude "sinclip" : 20
Cycles Displayed : 17
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.83544e-05 %.
Fifth Harmonic: -0.192651 %.
Seventh Harmonic: 0.344111 %.
Ninth Harmonic: -1.75902e-05 %.
THD 3 - 9 : 0.394369 %.



84-22-24 triangle mag hard clip double peak

Approximate Internal Sinewave:

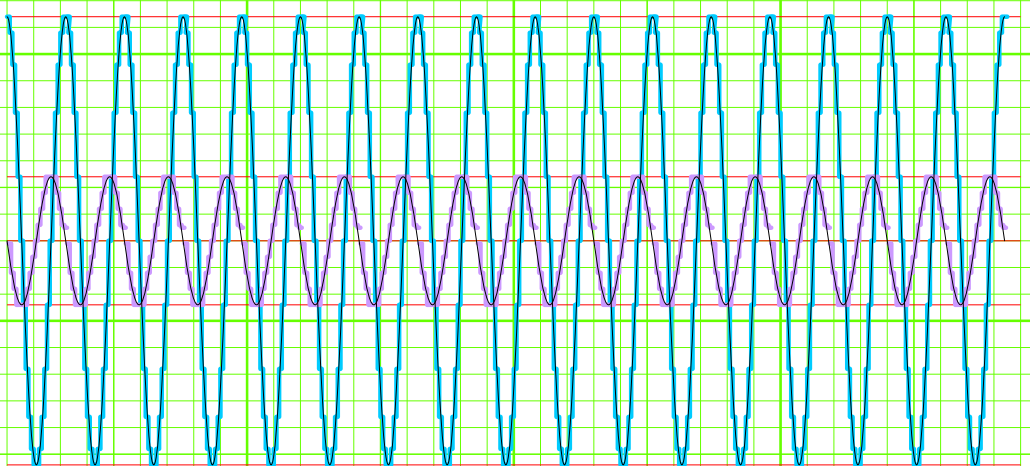
[-6 -12 -18 -24 -24
-24 -24 -18 -12 -6
0 6 12 18 24
24 24 24 18 12 6]

Approximate Cosine Wave Output:

[84 78 66 48 24
0 -24 -48 -66 -78
-84 -84 -78 -66 -48
-24 0 24 48 66 78 84]

Cosine Amplitude "size" : 84
Cosine Time Period "speed" : 22
Clipped Sin Amplitude "sinclip" : 24
Cycles Displayed : 17
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.80043e-05 %.
Fifth Harmonic: -0.192649 %.
Seventh Harmonic: 0.344111 %.
Ninth Harmonic: -1.70651e-05 %.
THD 3 - 9 : 0.394368 %.



98-22-28 triangle mag hard clip double peak

Approximate Internal Sinewave:

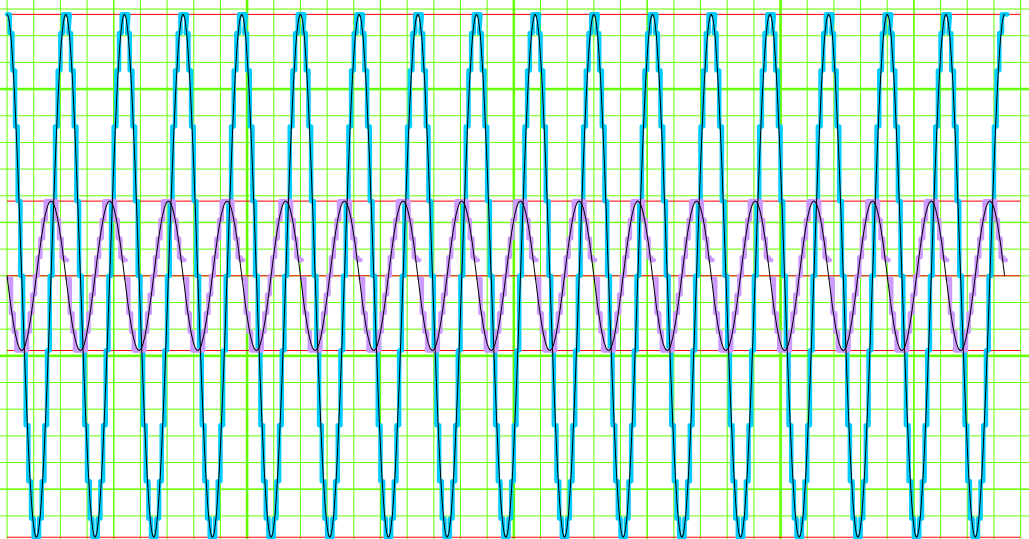
[-7 -14 -21 -28 -28
-28 -28 -21 -14 -7
0 7 14 21 28
28 28 28 21 14 7]

Approximate Cosine Wave Output:

[98 91 77 56 28
0 -28 -56 -77 -91
-98 -98 -91 -77 -56
-28 0 28 56 77 91 98]

Cosine Amplitude "size" : 98
Cosine Time Period "speed" : 22
Clipped Sin Amplitude "sinclip" : 28
Cycles Displayed : 17
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.92545e-05 %.
Fifth Harmonic: -0.192649 %.
Seventh Harmonic: 0.344111 %.
Ninth Harmonic: -1.76277e-05 %.
THD 3 - 9 : 0.394368 %.



112-22-32 triangle mag hard clip double peak

Approximate Internal Sinewave:

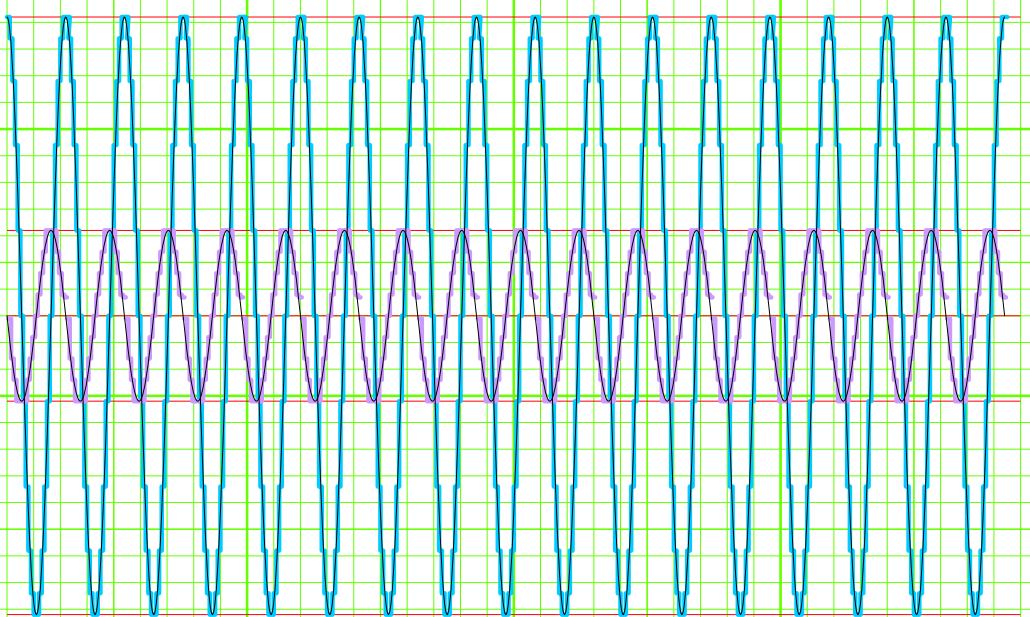
[-8 -16 -24 -32 -32
-32 -32 -24 -16 -8
0 8 16 24 32
32 32 32 24 16 8]

Approximate Cosine Wave Output:

[112 104 88 64 32
0 -32 -64 -88 -104
-112 -112 -104 -88 -64
-32 0 32 64 88 104 112]

Cosine Amplitude "size" : 112
Cosine Time Period "speed" : 22
Clipped Sin Amplitude "sinclip" : 32
Cycles Displayed : 17
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.69104e-05 %.
Fifth Harmonic: -0.192649 %.
Seventh Harmonic: 0.344111 %.
Ninth Harmonic: -1.80497e-05 %.
THD 3 - 9 : 0.394368 %.



126-22-36 triangle mag hard clip double peak

Approximate Internal Sinewave:

[-9 -18 -27 -36 -36
-36 -36 -27 -18 -9
0 9 18 27 36
36 36 36 27 18 9]

Approximate Cosine Wave Output:

[126 117 99 72 36
0 -36 -72 -99 -117
-126 -126 -117 -99 -72
-36 0 36 72 99 117 126]

Cosine Amplitude "size" : 126
Cosine Time Period "speed" : 22
Clipped Sin Amplitude "sinclip" : 36
Cycles Displayed : 17
Soft Clip: false
Double Peak: true
Clipped: true

Unfiltered!
Third Harmonic: -2.68375e-05 %.
Fifth Harmonic: -0.192649 %.
Seventh Harmonic: 0.344111 %.
Ninth Harmonic: -1.8232e-05 %.
THD 3 - 9 : 0.394368 %.