Siglent Scope Issues

11 June 2023

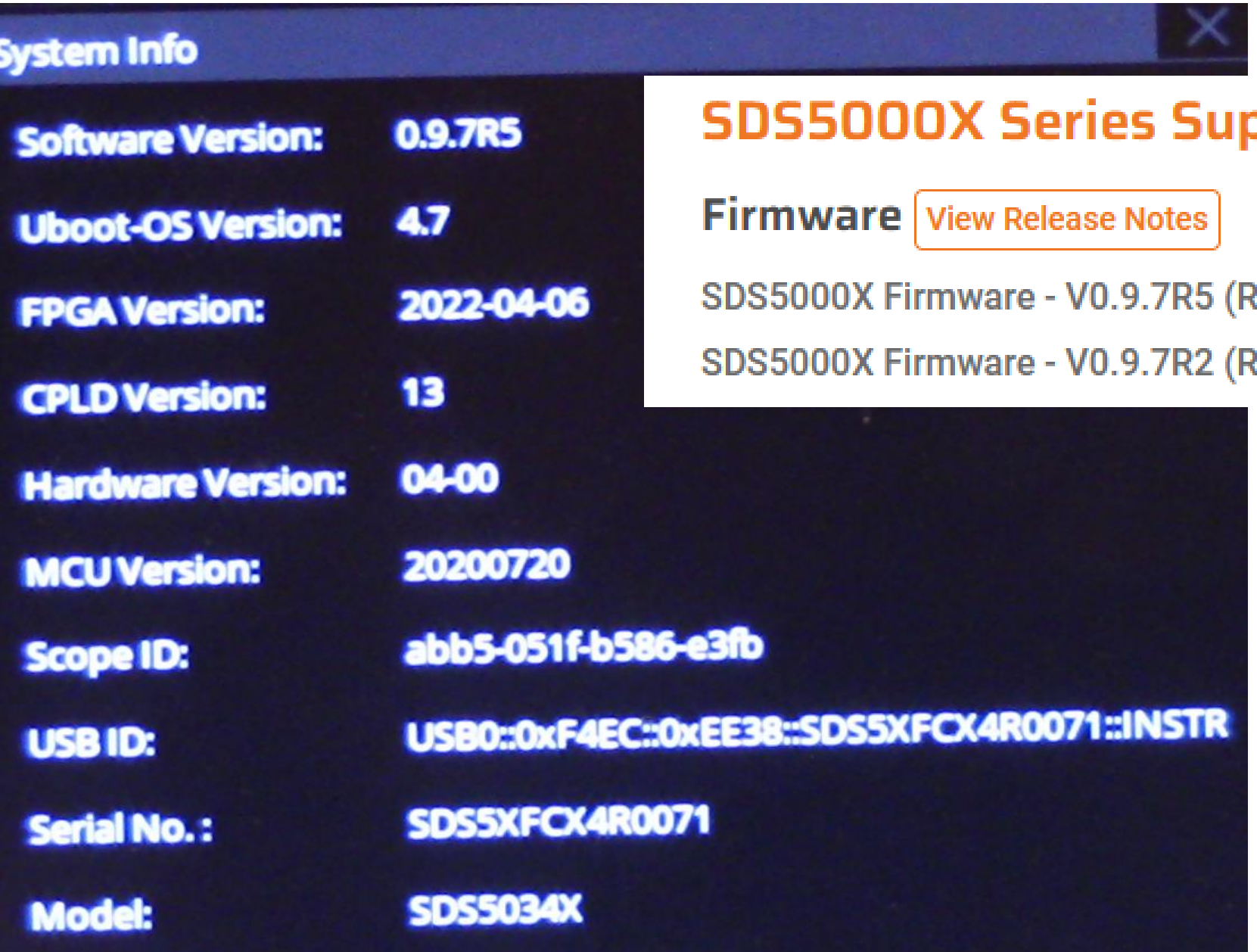
Issues with SDS5000x Scope

By Robert Distinti

Topics

- There are 6 issues that have been found
  - 1: Single Sequence Button operation with averaging
  - 2: WaveData Preamble Error in Horizontal offset (all modes)
  - 3:WaveData Preamble Error in Vertical Scale (WORD Mode)
  - 4: ERES Missing bits in WaveData (Word Mode)
  - 5: AVERAGE Missing bits in WaveData (Word Mode)
  - 6: Needed to Place 20 MS delay after each command sent (Ignore this I have to recheck this)
- Items 4 and 5 are the most important for me; without them, the 8 bit scopes are useless to me. Your competitors do return the extra resolution (ERES) for both averaging modes (ERES and AVERAGING)

Present firmware status of scope



SDS5000X Series Super Phosphor Oscilloscopes

Firmware View Release Notes

SDS5000X Firmware - V0.9.7R5 (Release Date 10.11.22) Download

SDS5000X Firmware - V0.9.7R2 (Release Date 04.27.22) Download

Problem 1: Single Sequence Button

- Single sequence button in averaging mode should keep triggering to acquire the needed traces to return an averaged waveform to the screen. Instead it only returns a single trace. Your competitors do this properly, I use it all the time on both Techtronic and Agilent scopes. Other than that, the single button works fine

Definition

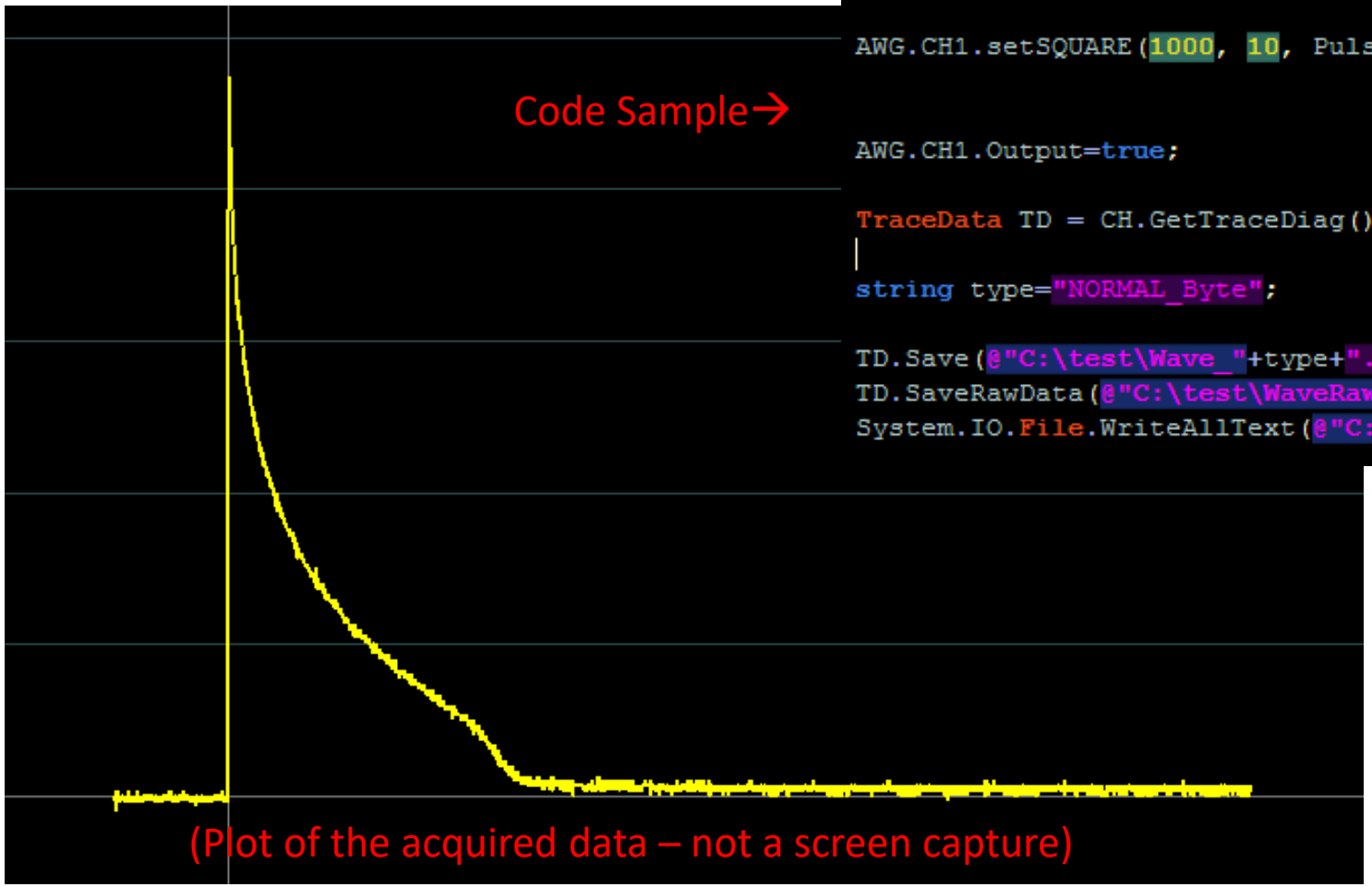
- These are the abbreviation of the modes discussed in the remainder of this presentation.
  - NORMAL_BYTE normal acquisition, Byte Data Transfer size
  - NORMAL_WORD normal acquisition, Word Data Transfer size
  - ERS3_WORD ERES 3.0 bits, Word Data Transfer
  - AVG64_WORD Average 64, Word Data Transfer

NORMAL_BYTE

For reference, Shows data collected Using normal acquire mode and Byte Transfer size. Everything works as expected except for error in preamble horizontal Offset – see next page.

Code Sample→

```
AQ.Width=sgScopeAquire.AquireWidth.BYTE;

AQ.Mode=sgScopeAquire.AquireMode.YT;
AQ.Depth=sgScopeAquire.AquireDepth._10K;
AQ.Averages=sgScopeAquire.AquireAverages._64;
AQ.SequenceMode=eOnOff.Off;
AQ.ERES=sgScopeAquire.AquireEres._3_0;
AQ.Type=sgScopeAquire.AquireType.Normal;

float PulseAmp = 2.7f;

AWG.CH1.setSQUARE(1000, 10, PulseAmp, PulseAmp/2);


AWG.CH1.Output=true;

TraceData TD = CH.GetTraceDiag();

string type="NORMAL_Byte";

TD.Save(@"C:\test\Wave_"+type+".txt");
TD.SaveRawData(@"C:\test\WaveRaw_"+type+".txt");
System.IO.File.WriteAllText(@"C:\test\WaveDiag_"+type
```



(Plot of the acquired data – not a screen capture)

Data from scope converted to volts

Wave_NORMAL_

File Edit Format

```
-7.999988E-08, -0.003333335
-6.999988E-08, -1.862645E-09
-5.999988E-08, -0.003333335
-4.999988E-08, -1.862645E-09
-3.999988E-08, -1.862645E-09
-2.999988E-08, -1.862645E-09
-1.999988E-08, 0.06666666
-9.999878E-09, 0.3233334
1.215494E-13, 0.3666667
1.000012E-08, 0.3866667
2.000012E-08, 0.43
3.000012E-08, 0.4733333
4.000012E-08, 0.4633333
5.000012E-08,
6.000012E-08,
7.000012E-08,
8.000012E-08,
9.000012E-08,
1.000001E-07,
1.100001E-07,
```

Raw data from scope (Sign extended to 16 bits)

WaveRa...

File Edit Format View Help

```
-6.999988E-08, 0xFFC4
-5.999988E-08, 0xFFC3
-4.999988E-08, 0xFFC4
-3.999988E-08, 0xFFC4
-2.999988E-08, 0xFFC4
-1.999988E-08, 0xFFD8
-9.999878E-09, 0x0025
1.215494E-13, 0x0032
1.000012E-08, 0x0038
2.000012E-08, 0x0045
3.000012E-08, 0x0052
4.000012E-08, 0x004F
5.000012E-08, 0x0045
6.000012E-08, 0x0041
7.000012E-08, 0x0046
8.000012E-08, 0x0044
9.000012E-08, 0x0040
1.000001E-07, 0x003E
1.100001E-07, 0x003E
1.200001E-07, 0x003D
```

Problem 2: Horizontal Offset

- In order to have the trigger location occur at T==0; had to adjust the horizontal offset from the wave preamble as follows. When dumping scope data to Flash drive using front panel interface, the data is adjusted such that Trigger is at T==0. Why is the wave data different?
- This problem is with all modes discussed.
- Note: I can live without this fix as long as it works the same for all your scopes for all time into the future.

```
/// <summary>
/// Horizontal Offset (Seconds)
/// Adjusted So that T=0 at trigger location
/// </summary>
public double HorizontalOffset_Corrected {
    get {
        double halfwaySeconds = WaveArrayCount_numPoints*HorizontalInterval/2;
        return halfwaySeconds-HorizontalOffset;
    }
}
```

Here is the Raw Preamble Data (for reference)

```
0000 |  57 41 56 45 44 45 53 43 00 00 00 00 00 00 00 00   "WAVEDESC........"
0010 |  57 41 56 45 41 43 45 00 00 00 00 00 00 00 00 00   "WAVEACE........."
0020 |  00 00 00 00 5A 01 00 00 00 00 00 00 00 00 00 00   "....Z..........."
0030 |  00 00 00 00 00 00 00 00 00 00 00 00 88 13 00 00   ".............."
0040 |  00 00 00 00 00 00 00 00 00 00 00 00 53 69 67 6C   "............Sigl"
0050 |  65 6E 74 20 53 44 53 00 00 00 00 00 AB CD 00 00   "ent SDS.....××.."
0060 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
0070 |  88 13 00 00 88 13 00 00 86 13 00 00 00 00 00 00   ".....×.....×....."
0080 |  87 13 00 00 00 00 00 00 01 00 00 00 FF FF FF FF   ".×...........××××"
0090 |  00 00 00 00 01 00 00 00 00 00 00 00 CD CC CC 3D   "............×××="
00A0 |  CD CC 4C BE 00 00 F0 41 00 00 00 00 08 00 FF FF   "××L×..×A......××"
00B0 |  77 CC 2B 32 F1 68 E3 88 B5 F8 F4 3E F1 68 E3 88   "w×+2×h[特]××>×h[特]××>"
00C0 |  B5 F8 F4 3E 56 00 00 00 00 00 00 00 00 00 00 00   "V..............."
00D0 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
00E0 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
00F0 |  00 00 00 00 53 00 00 00 00 00 00 00 00 00 00 00   "S..............."
0100 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
0110 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
0120 |  00 00 00 00 5F 70 89 30 00 00 00 00 00 00 00 00   "_p×0............"
0130 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
0140 |  00 00 01 00 0D 00 00 00 00 00 80 3F 0E 00 01 00   "......×?......×?"
0150 |  00 00 80 3F CD CC 4C BE 00 00 __ __ __ __ __ __   "××L×..XXXX"
```

Here is my interpretation of the preamble data

```
Structure: ScopePreamble
Siglent SDS
 Source= C1
 BWLimit= _20M 00000001
 Coupling=DC 00000000
 TimeBase=5E-06
 VerticalGain=0.1
 ProbeAttenuation=1
 VerticalOffset=-0.2
 Codes_per_div=30
 ADC Bit=8
 HorizontalInterval=1E-08
 HorizontalOffset=2E-05
 **** Data Transfer variable ***
 ArrayLength_Bytes=5000
 ArrayLength_Sample=5000
 FirstPointIndex=0
 Stride=1
 CommType=Byte
 CommOrder=LSB First
 FrameIndex=-1
 FramesTransferred=0
 FramesCollectedr=1
```

```
******** Computed Values *******
 VerticalScaleVoltsPerADCQuanta=0.00333333338300387
 VerticalScaleVoltsPerDiv=0.100000001490116
 HorizontalScaleSecPerSample=9.9999993922529E-09
 HorizontalScaleSecPerDiv=4.9999996961265E-06
 HorizontalOffset_Corrected=4.9999984806322E-06
```

Other than horizontal offset everything works fine.

NORMAL_WORD

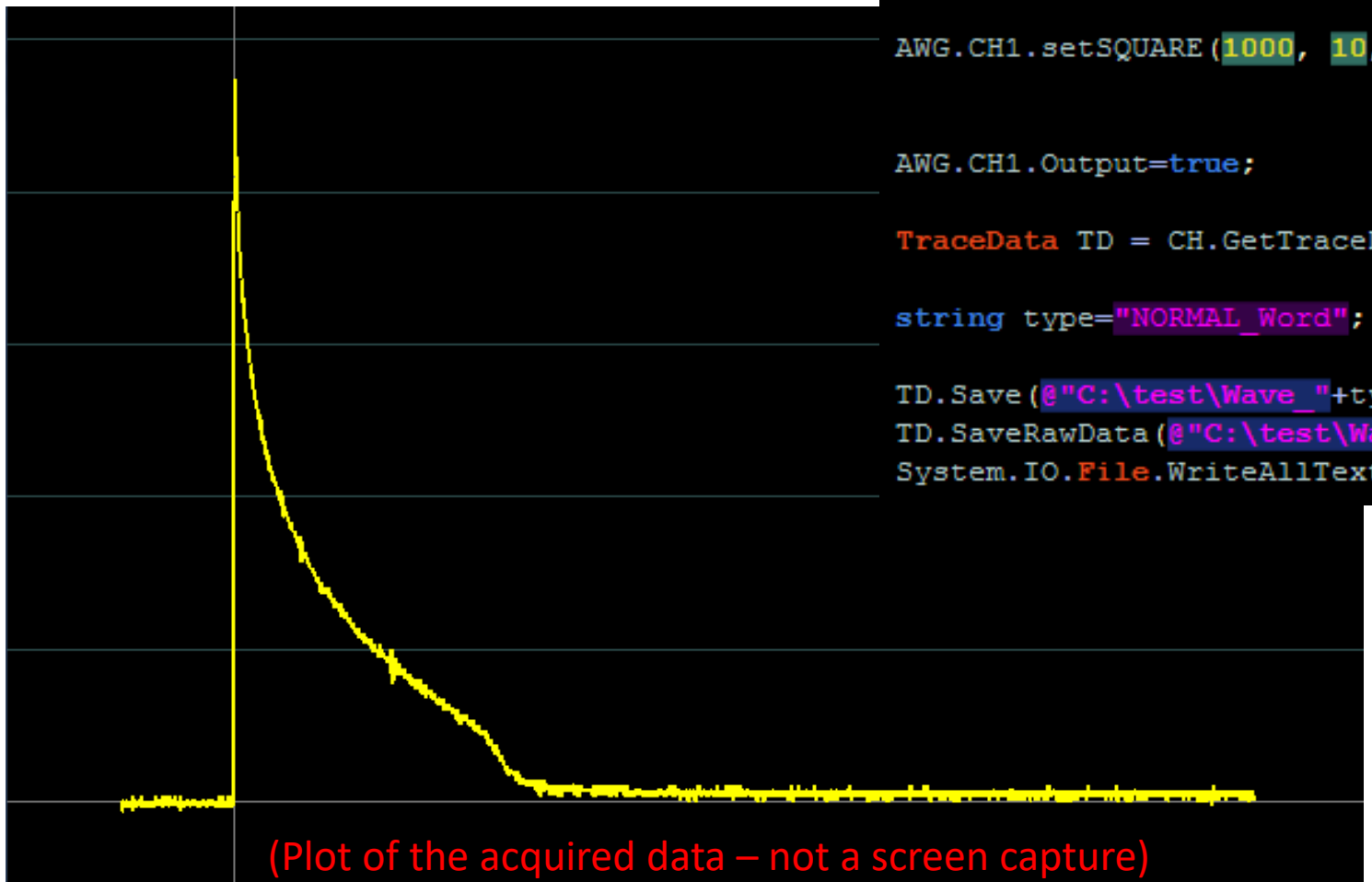
Data collected Using normal acquire mode and Word Transfer size.
Everything works as expected
Except for vertical scale (see next page)

```
AQ.Width=sgScopeAquire.AquireWidth.WORD;

AQ.Mode=sgScopeAquire.AquireMode.YT;
AQ.Depth=sgScopeAquire.AquireDepth._10K;
AQ.Averages=sgScopeAquire.AquireAverages._64;
AQ.SequenceMode=eOnOff.Off;
AQ.ERES=sgScopeAquire.AquireEres._3_0;
AQ.Type=sgScopeAquire.AquireType.Normal;

float PulseAmp = 2.7f;

AWG.CH1.setSQUARE(1000, 10, PulseAmp, PulseAmp/2


AWG.CH1.Output=true;

TraceData TD = CH.GetTraceDiag();

string type="NORMAL_Word";

TD.Save(@"C:\test\Wave_"+type+".txt");
TD.SaveRawData(@"C:\test\WaveRaw_"+type+".txt");
System.IO.File.WriteAllText(@"C:\test\WaveDiag_"+t
```

Wave_NORMAL_Word.t...

File Edit Format View Help

```
-4.999988E-08, -0.003333335
-3.999988E-08, -0.003333335
-2.999988E-08, 0.003333332
-1.999988E-08, 0.01333333
-9.999878E-09, 0.2666667
1.215494E-13, 0.35
1.000012E-08, 0.3933333
2.000012E-08, 0.41
3.000012E-08, 0.4633333
4.000012E-08, 0.4733333
5.000012E-08, 0.44
6.000012E-08, 0.4233333
7.000012E-08, 0.43
8.000012E-08, 0.4233333
```



(Plot of the acquired data – not a screen capture)

Data comes left justified, that is Excellent. This leaves Room for Extended Resolution (ERES) and Averaging results

WaveRaw...

File Edit Format View Help

```
-8.999988E-08, 0xC300
-7.999988E-08, 0xC300
-6.999988E-08, 0xC500
-5.999988E-08, 0xC400
-4.999988E-08, 0xC300
-3.999988E-08, 0xC300
-2.999988E-08, 0xC500
-1.999988E-08, 0xC800
-9.999878E-09, 0x1400
1.215494E-13, 0x2D00
1.000012E-08, 0x3A00
2.000012E-08, 0x3F00
3.000012E-08, 0x4F00
4.000012E-08, 0x5200
5.000012E-08, 0x4800
```

Problem 3: Had to adjust Vertical Scale for word mode

```
/// <summary>
/// Vertical Scale (Volts Per ADC quanta)
/// Corrected for Byte Word
/// </summary>
public double VerticalScaleVoltsPerADCQuanta {
    get {
        return (double)(ProbeAttenuation)*VerticalGain/code_per_div/(BytesPerSample==1?1:256);
    }
}

/// <summary>
/// Horizontal Offset (Seconds)
/// Adjusted So that T=0 at trigger location
/// </summary>
public double HorizontalOffset_Corrected {
    get {
        double halfwaySeconds = WaveArrayCount_numPoints*HorizontalInterval/2;
        return halfwaySeconds-HorizontalOffset;
    }
}
```

Had to adjust the vertical scale to obtain correct voltage for word mode. Next page shows preamble difference between byte and word mode

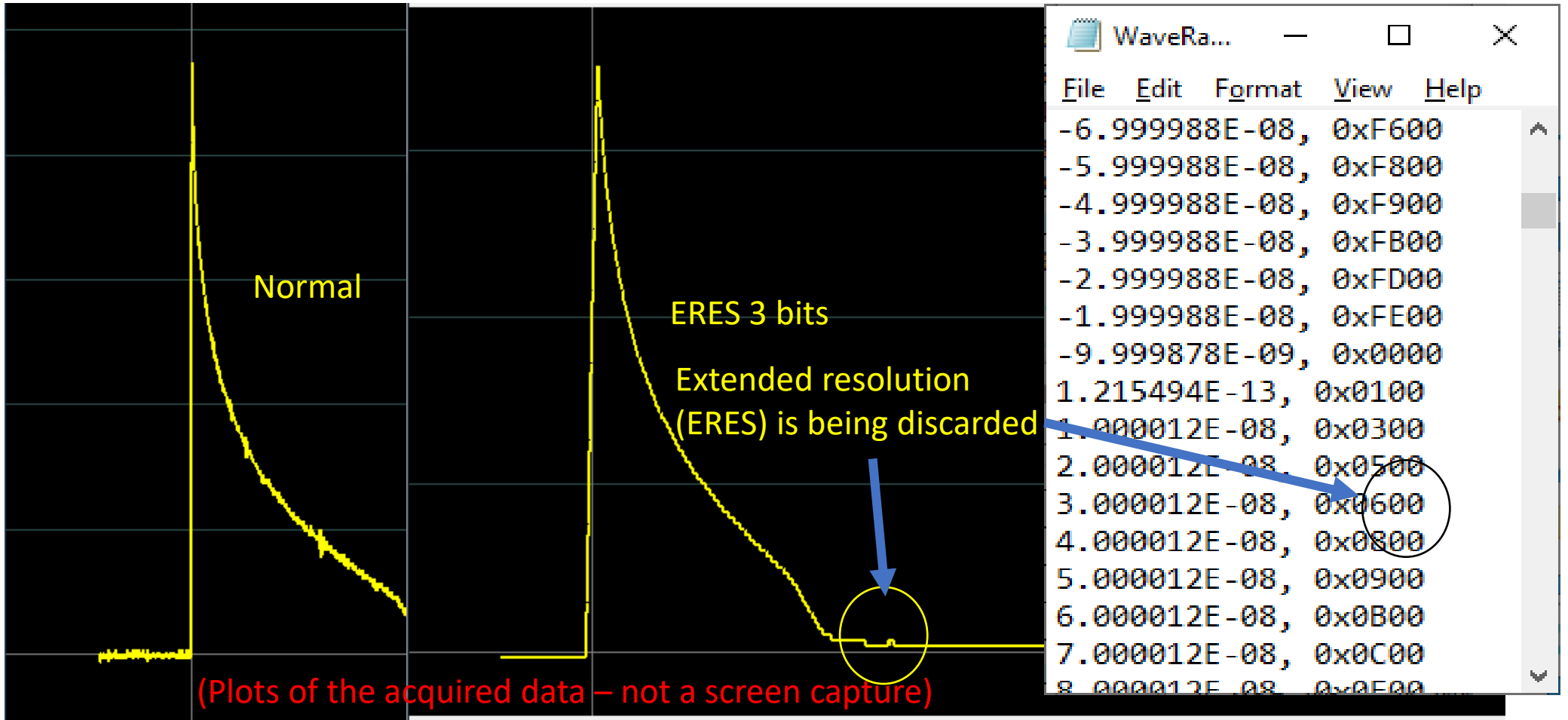
Diff of Preambles between word mode and byte mode for reference

```
**** Data Transfer variable ***
ArrayLength_Bytes=10000
ArrayLength_Sample=5000
FirstPointIndex=0
Stride=1
CommType=Word
CommOrder=LSB First
FrameIndex=-1
FramesTransferred=0
FramesCollectedr=1
******** Computed Values *******
VerticalScaleVoltsPerADCQuanta=1.302083352735 89E-05
VerticalScaleVoltsPerDiv=0.100000001490116
HorizontalScaleSecPerSample=9.99999993922529E-09
HorizontalScaleSecPerDiv=4.99999996961265E-06
HorizontalOffset_Corrected=4.99999984806322E-06

0000 |  57 41 56 45 44 45 53 43 00 00 00 00 00 00 00 00   "WAVEDESC........"
0010 |  57 41 56 45 41 43 45 00 00 00 00 00 00 00 00 00   "WAVEACE........."
0020 |  01 00 00 00 5A 01 00 00 00 00 00 00 00 00 00 00   "....Z..........."
0030 |  00 00 00 00 00 00 00 00 00 00 00 00 10 27 00 00   ".............'.."
0040 |  00 00 00 00 00 00 00 00 00 00 00 00 53 69 67 6C   "............Sigl"
0050 |  65 6E 74 20 53 44 53 00 00 00 00 00 AB CD 00 00   "ent SDS.....□□.."
0060 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
0070 |  88 13 00 00 88 13 00 00 86 13 00 00 00 00 00 00   "□...□...□......."
0080 |  87 13 00 00 00 00 00 00 01 00 00 00 FF FF FF FF   "□...........□□□□"
0090 |  00 00 00 00 01 00 00 00 00 00 00 00 CD CC CC 3D   "............□□□="
00A0 |  CD CC 4C BE 00 00 F0 41 00 00 00 00 08 00 FF FF   "□□L□..□A......□□"
00B0 |  77 CC 2B 32 F1 68 E3 88 B5 F8 F4 3E F1 68 E3 88   "w□+2□h□□□>□h□□□>"
00C0 |  B5 F8 F4 3E 56 00 00 00 00 00 00 00 00 00 00 00   "V..............."
00D0 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
00E0 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
00F0 |  00 00 00 00 53 00 00 00 00 00 00 00 00 00 00 00   "S..............."
0100 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
0110 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
0120 |  00 00 00 00 5F 70 89 30 00 00 00 00 00 00 00 00   "_p□0............"
0130 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
0140 |  00 00 01 00 0D 00 00 00 00 00 80 3F 0E 00 01 00   "......□?......□?"
0150 |  00 00 80 3F CD CC 4C BE 00 00 __ __ __ __ __ __   "□□L□..XXXX"
Size of data = 346
```

```
**** Data Transfer variable ***
ArrayLength_Bytes=5000
ArrayLength_Sample=5000
FirstPointIndex=0
Stride=1
CommType=Byte
CommOrder=LSB First
FrameIndex=-1
FramesTransferred=0
FramesCollectedr=1
******** Computed Values *******
VerticalScaleVoltsPerADCQuanta=0.00333333338300387
VerticalScaleVoltsPerDiv=0.100000001490116
HorizontalScaleSecPerSample=9.99999993922529E-09
HorizontalScaleSecPerDiv=4.99999996961265E-06
HorizontalOffset_Corrected=4.99999984806322E-06

0000 |  57 41 56 45 44 45 53 43 00 00 00 00 00 00 00 00   "WAVEDESC........"
0010 |  57 41 56 45 41 43 45 00 00 00 00 00 00 00 00 00   "WAVEACE........."
0020 |  00 00 00 00 5A 01 00 00 00 00 00 00 00 00 00 00   "....Z..........."
0030 |  00 00 00 00 00 00 00 00 00 00 00 00 88 13 00 00   "............□..."
0040 |  00 00 00 00 00 00 00 00 00 00 00 00 53 69 67 6C   "............Sigl"
0050 |  65 6E 74 20 53 44 53 00 00 00 00 00 AB CD 00 00   "ent SDS.....□□.."
0060 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
0070 |  88 13 00 00 88 13 00 00 86 13 00 00 00 00 00 00   "□...□...□......."
0080 |  87 13 00 00 00 00 00 00 01 00 00 00 FF FF FF FF   "□...........□□□□"
0090 |  00 00 00 00 01 00 00 00 00 00 00 00 CD CC CC 3D   "............□□□="
00A0 |  CD CC 4C BE 00 00 F0 41 00 00 00 00 08 00 FF FF   "□□L□..□A......□□"
00B0 |  77 CC 2B 32 F1 68 E3 88 B5 F8 F4 3E F1 68 E3 88   "w□+2□h□□□>□h□□□>"
00C0 |  B5 F8 F4 3E 56 00 00 00 00 00 00 00 00 00 00 00   "V..............."
00D0 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
00E0 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
00F0 |  00 00 00 00 53 00 00 00 00 00 00 00 00 00 00 00   "S..............."
0100 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
0110 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
0120 |  00 00 00 00 5F 70 89 30 00 00 00 00 00 00 00 00   "_p□0............"
0130 |  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   "................"
0140 |  00 00 01 00 0D 00 00 00 00 00 80 3F 0E 00 01 00   "......□?......□?"
0150 |  00 00 80 3F CD CC 4C BE 00 00 __ __ __ __ __ __   "□□L□..XXXX"
Size of data = 346
```

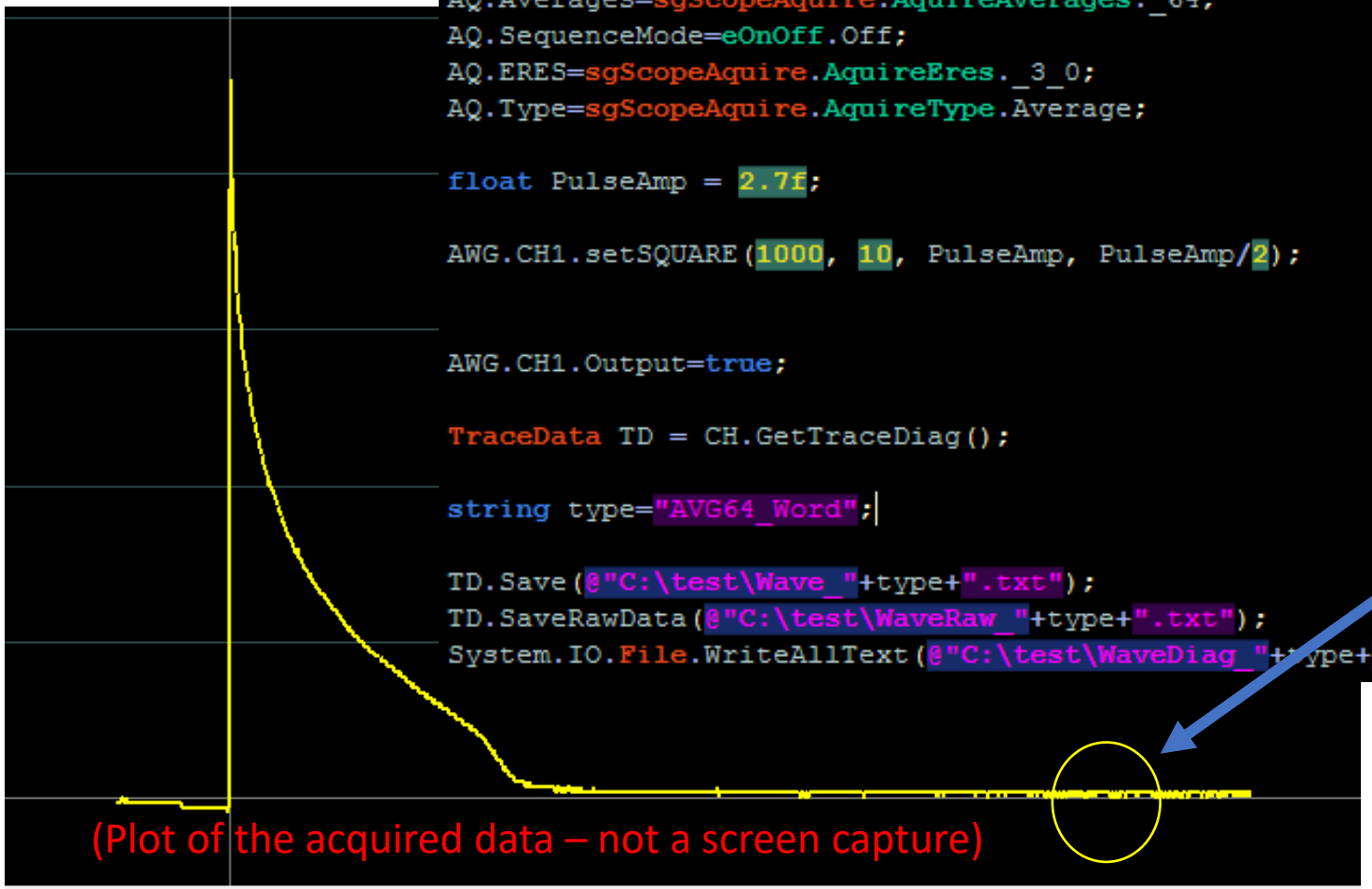
Problem 4: Missing ERES Bits in Wave Data

- It is clear from the data that the ERES averaging is being done. When retrieving the data in word mode, the averages are truncated/Rounded to 8 bits. In word mode, should Round to 16 bits. ERES stands for extended resolution -- why is the ERES not being delivered?



AVG64_WORD: Problem 5: Averaging truncated

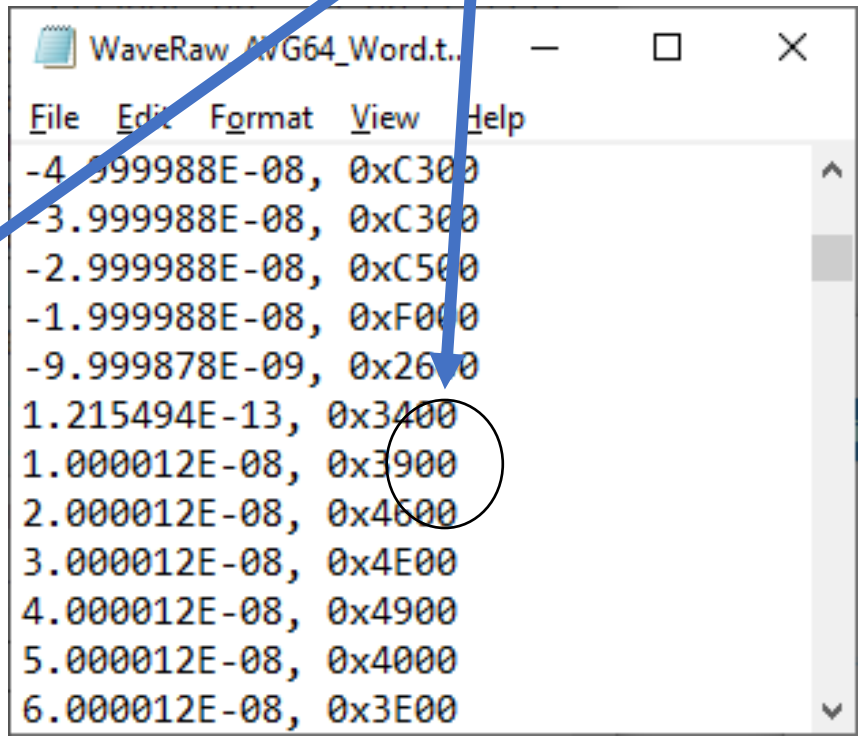
```
AQ.Width=sgScopeAquire.AquireWidth.WORD;

AQ.Mode=sgScopeAquire.AquireMode.YT;
AQ.Depth=sgScopeAquire.AquireDepth._10K;
AQ.Averages=sgScopeAquire.AquireAverages._64;
AQ.SequenceMode=eOnOff.Off;
AQ.ERES=sgScopeAquire.AquireEres._3_0;
AQ.Type=sgScopeAquire.AquireType.Average;

float PulseAmp = 2.7f;

AWG.CH1.setSQUARE(1000, 10, PulseAmp, PulseAmp/2);


AWG.CH1.Output=true;

TraceData TD = CH.GetTraceDiag();

string type="AVG64_Word";

TD.Save(@"C:\test\Wave_"+type+".txt");
TD.SaveRawData(@"C:\test\WaveRaw_"+type+".txt");
System.IO.File.WriteAllText(@"C:\test\WaveDiag_"+type+"
```



(Plot of the acquired data – not a screen capture)

The trace shows that averaging is being done; however, when returning the wave data in word mode, it is truncated/Rounded to 8-bits.

In Word Mode, scope should round to 16 bits. Why have a word mode if it serves no purpose?



RECAP

- There are 6 issues that have been found
  - 1: Single Sequence Button operation with averaging
  - 2: WaveData Preamble Error in Horizontal offset (all modes)
  - 3: WaveData Preamble Error in Vertical Scale (WORD Mode)
  - 4: ERES Missing Extended resolution bits in WaveData (Word Mode)
  - 5: AVERAGE Missing Extended resolution bits in WaveData (Word Mode)
  - 6: Needed to Place 20 MS delay after each command sent (need to recheck this)