Frequency Analysis of DAQ Signals

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I. Computational Method:

Signal transforms are computed using a discrete Hartley transform implemented by the FFTW library:

$$Y_k = \sum_{j=0}^{n-1} X_j[\cos(2\pi jk/n) + \sin(2\pi jk/n)]$$

Frequency-domain functions have to be scaled by 1/T, where T is the total time elapsed in the time-domain signal.

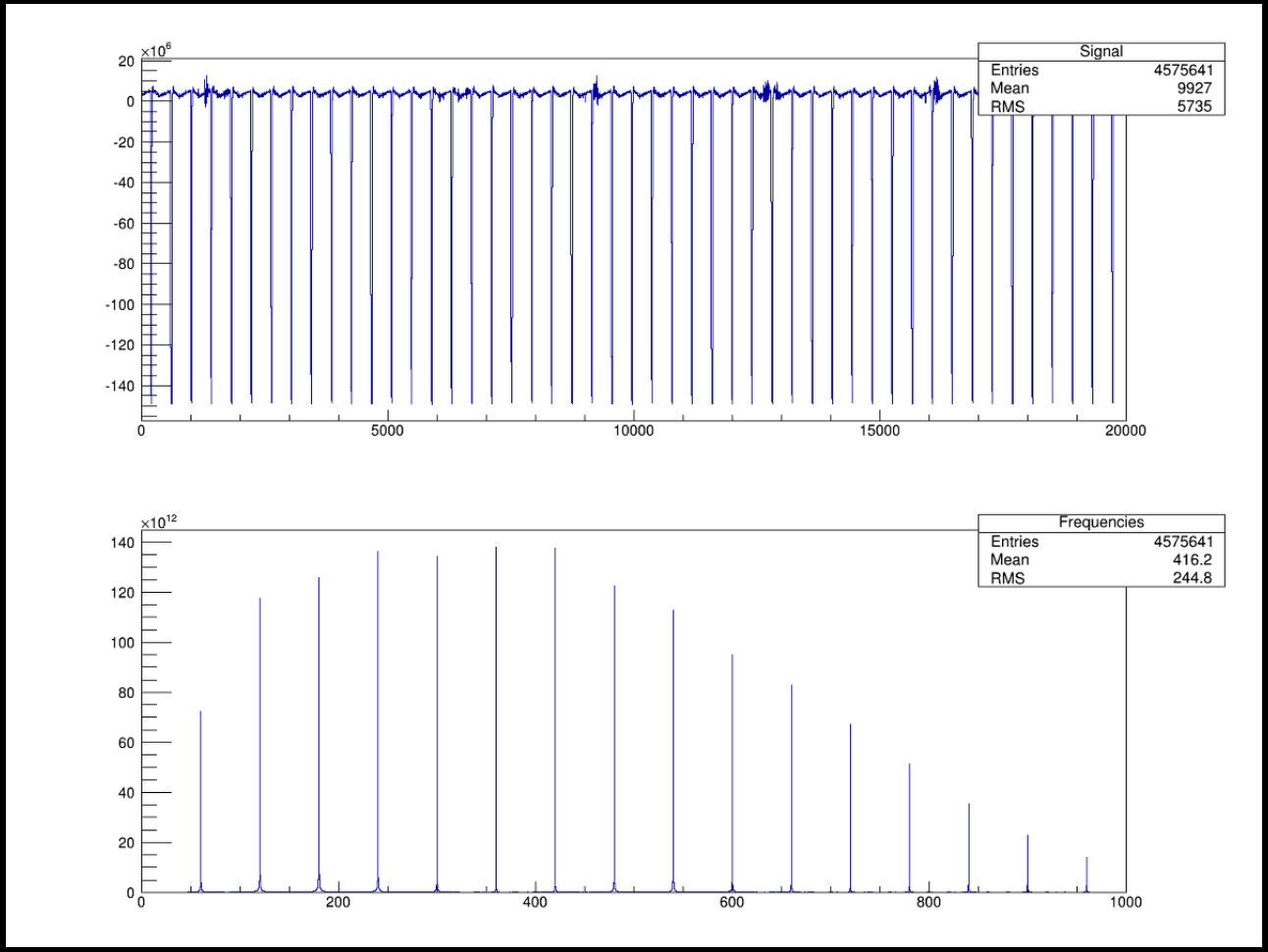
II. Results

Due to time, I used 10% of the total data from the previous run for each channel.

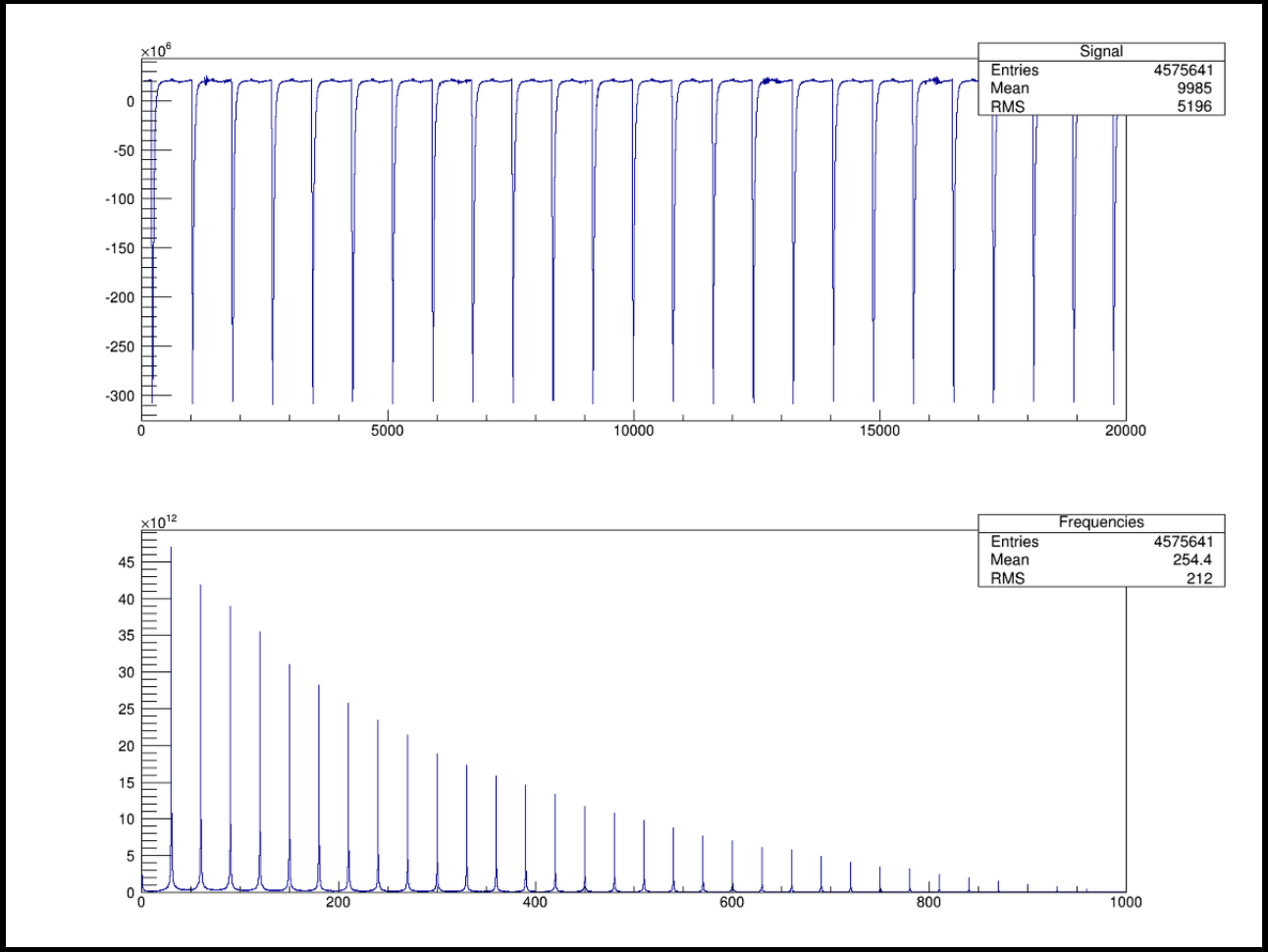
The sampling frequency is checked by counting ~407 samples for every pulse from the known 60Hz signal. This gives a frequency of ≈ 24.4kHz.

The top chart is the time-domain, and the bottom chart is frequency-domain.

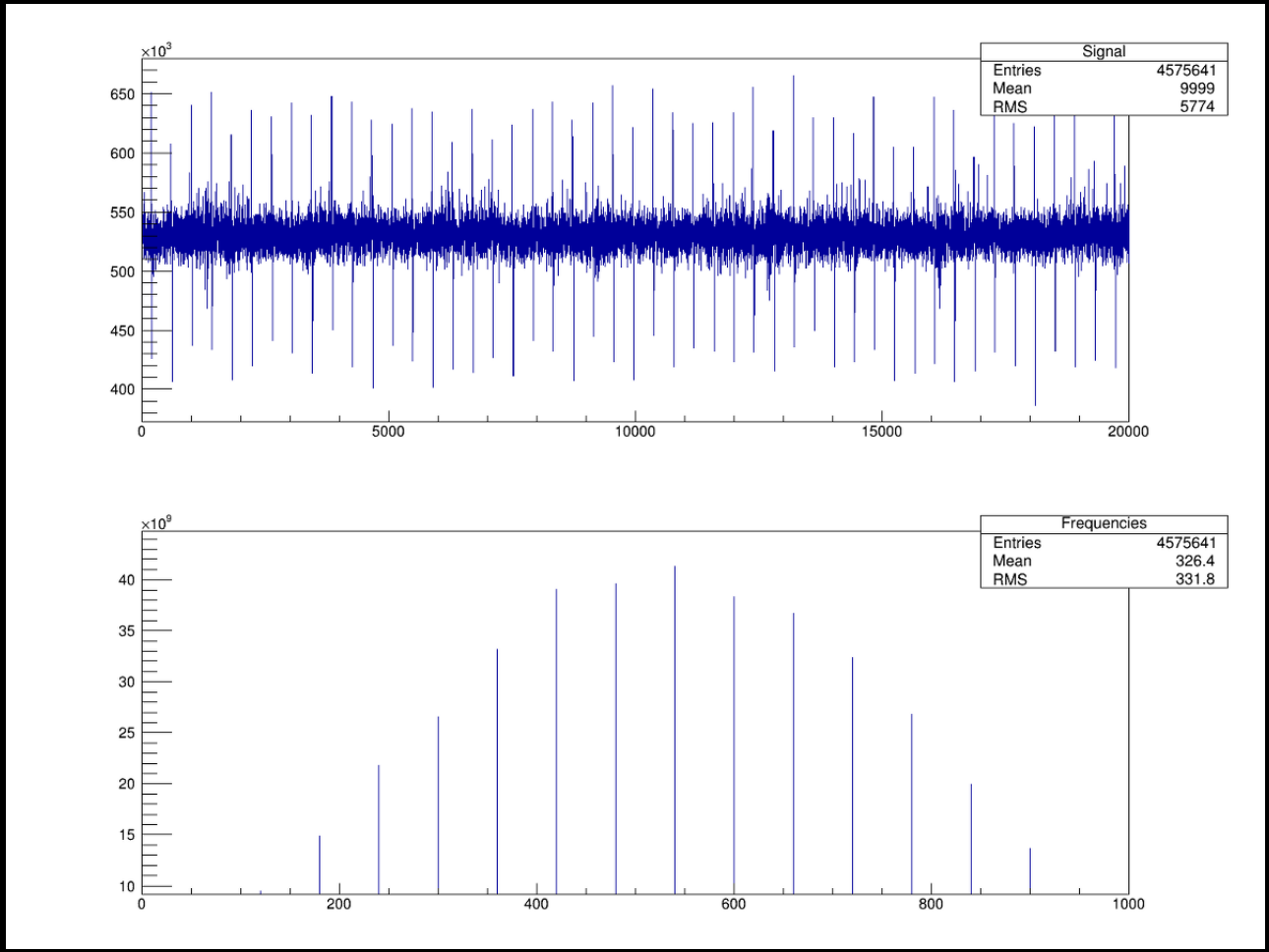
Channel 0


×10^6
20
0
-20
-40
-60
-80
-100
-120
-140
0
5000
10000
15000
20000
Signal
Entries 4575641
Mean 9927
RMS 5735
×10^12
140
120
100
80
60
40
20
0
0
200
400
600
800
1000
Frequencies
Entries 4575641
Mean 416.2
RMS 244.8

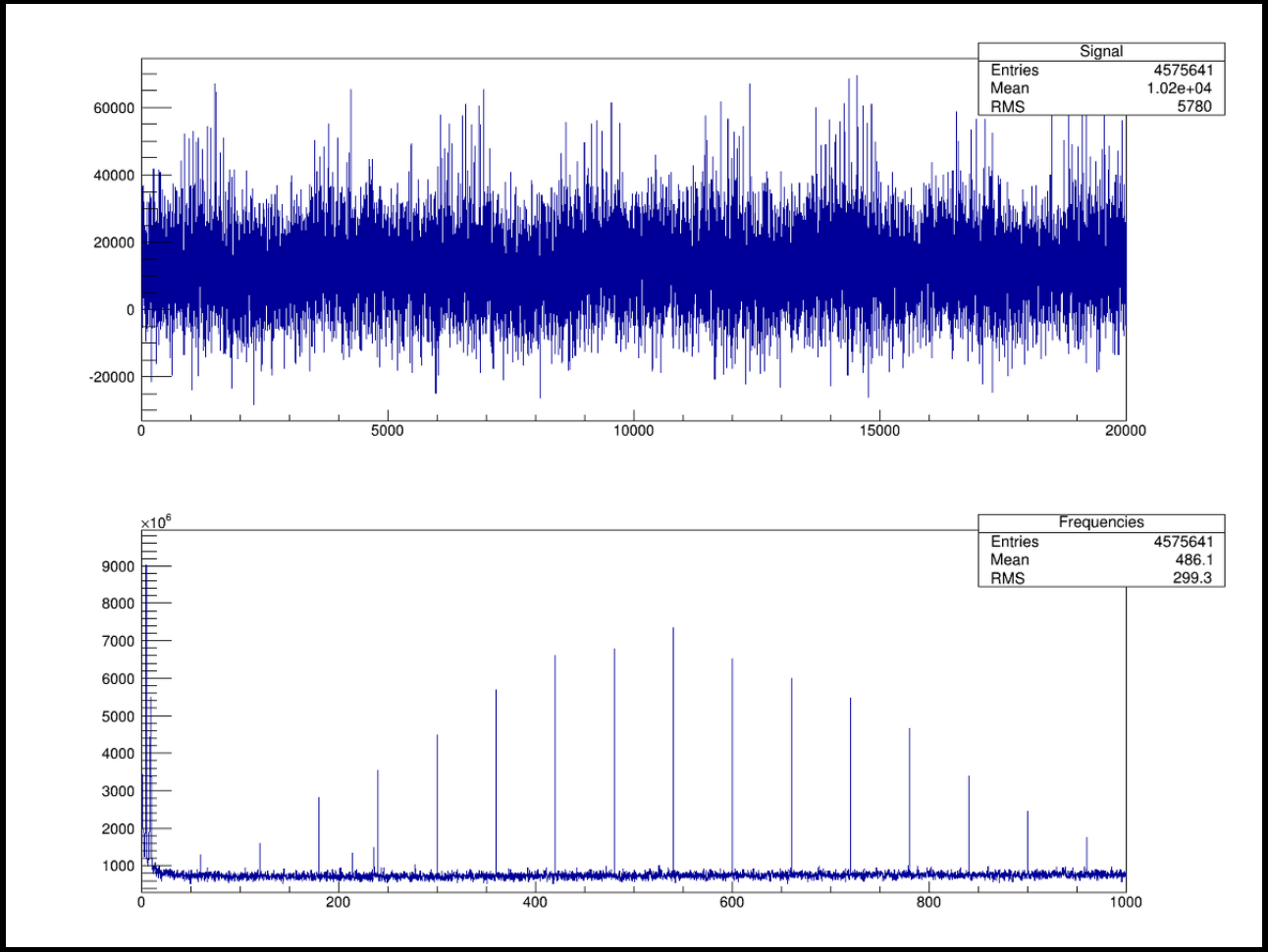
Channel 1


×10^6
0
-50
-100
-150
-200
-250
-300
0
5000
10000
15000
20000
Signal
Entries 4575641
Mean 9985
RMS 5196
×10^12
45
40
35
30
25
20
15
10
5
0
0
200
400
600
800
1000
Frequencies
Entries 4575641
Mean 254.4
RMS 212

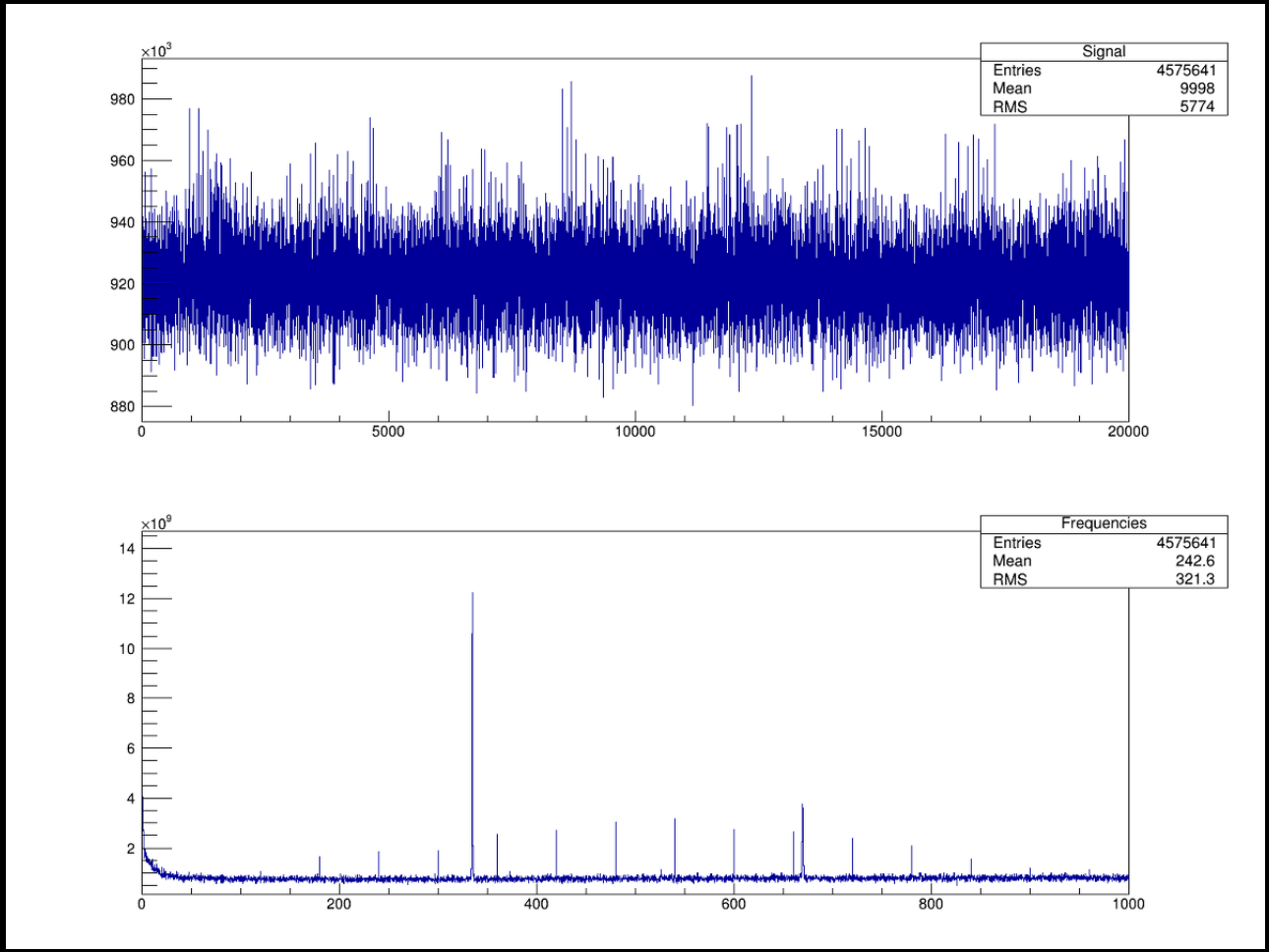
Channel 2


×10^3
650
600
550
500
450
400
0
5000
10000
15000
20000
Signal
Entries 4575641
Mean 9999
RMS 5774
×10^9
40
35
30
25
20
15
10
0
200
400
600
800
1000
Frequencies
Entries 4575641
Mean 326.4
RMS 331.8

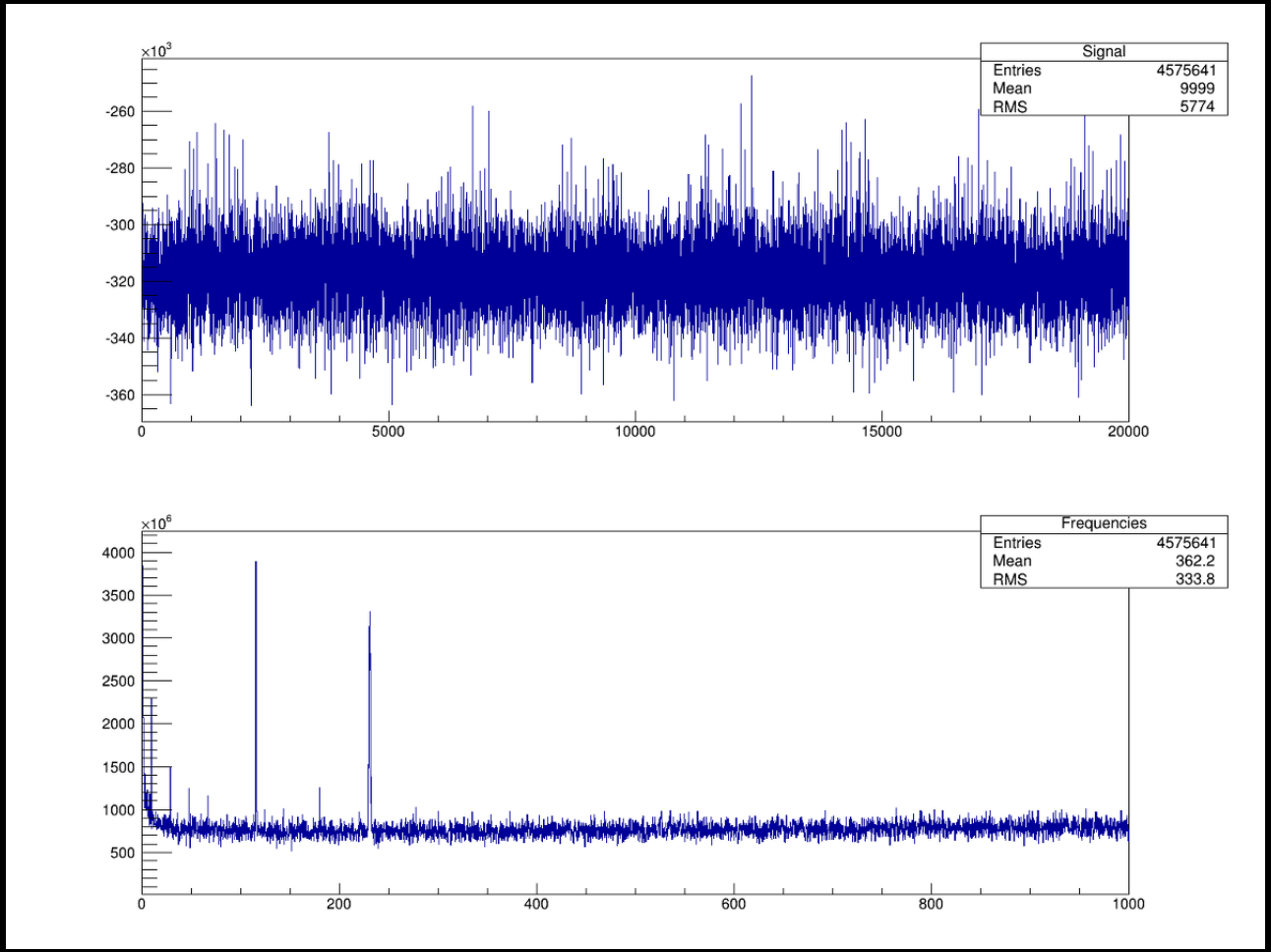
Channel 3


Signal
Entries 4575641
Mean 1.02e+04
RMS 5780
60000
40000
20000
0
-20000
0
5000
10000
15000
20000
×10^6
Frequencies
Entries 4575641
Mean 486.1
RMS 299.3
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
200
400
600
800
1000

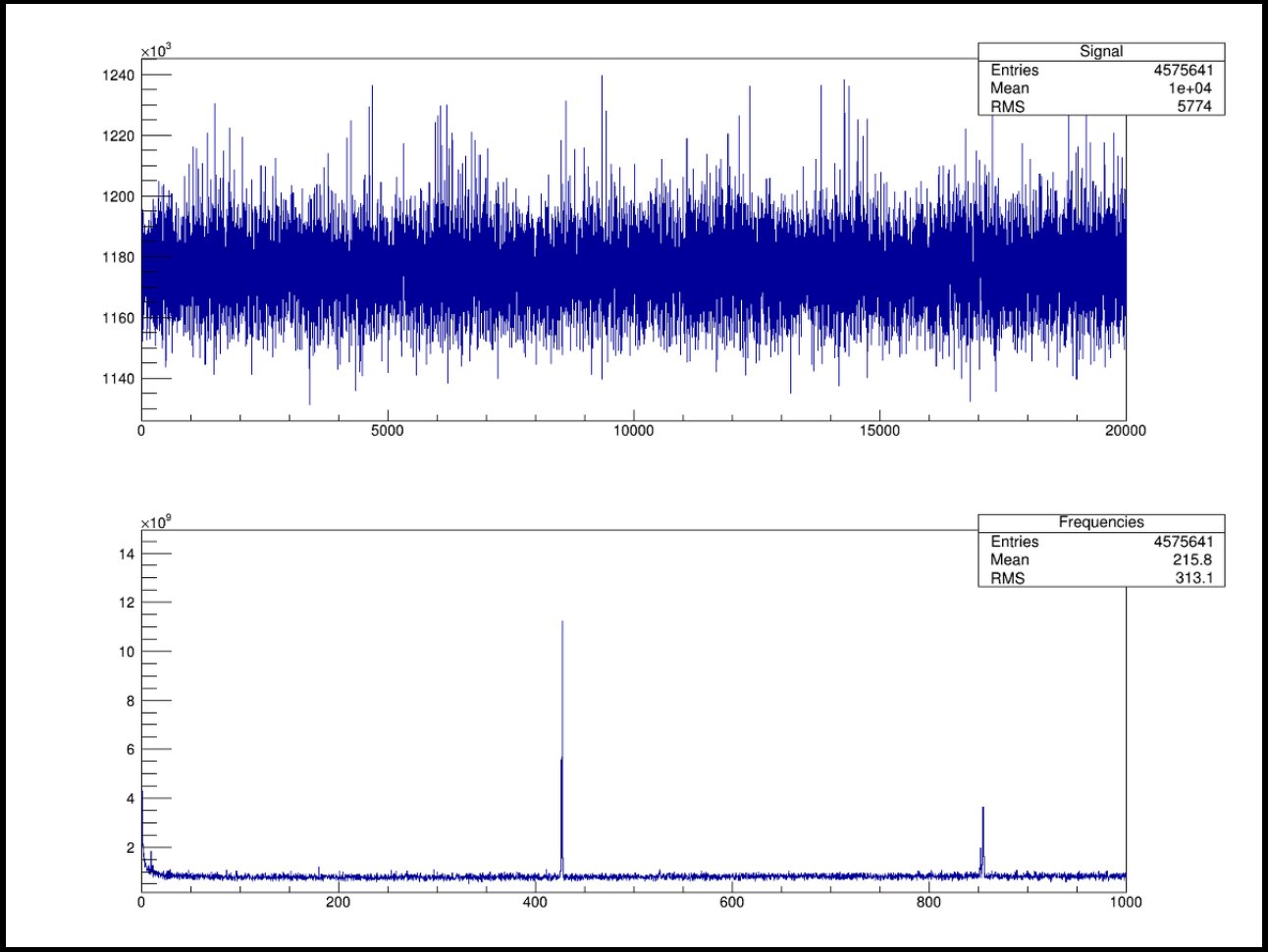
Channel 4


×10^3
980
960
940
920
900
880
0
5000
10000
15000
20000
Signal
Entries 4575641
Mean 9998
RMS 5774
×10^9
14
12
10
8
6
4
2
0
200
400
600
800
1000
Frequencies
Entries 4575641
Mean 242.6
RMS 321.3

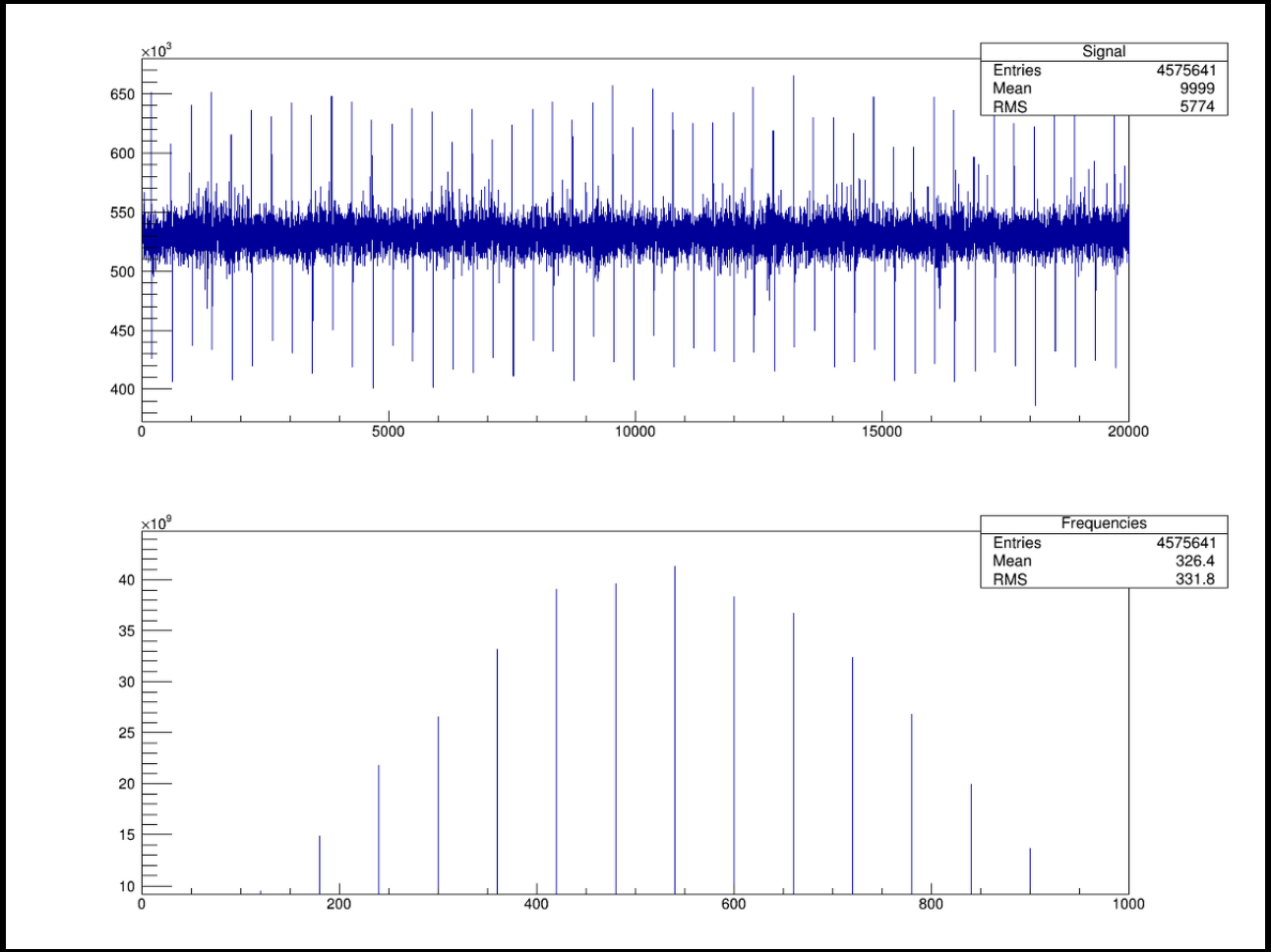
Channel 5


×10^3
-260
-280
-300
-320
-340
-360
0
5000
10000
15000
20000
Signal
Entries 4575641
Mean 9999
RMS 5774
×10^6
4000
3500
3000
2500
2000
1500
1000
500
0
200
400
600
800
1000
Frequencies
Entries 4575641
Mean 362.2
RMS 333.8

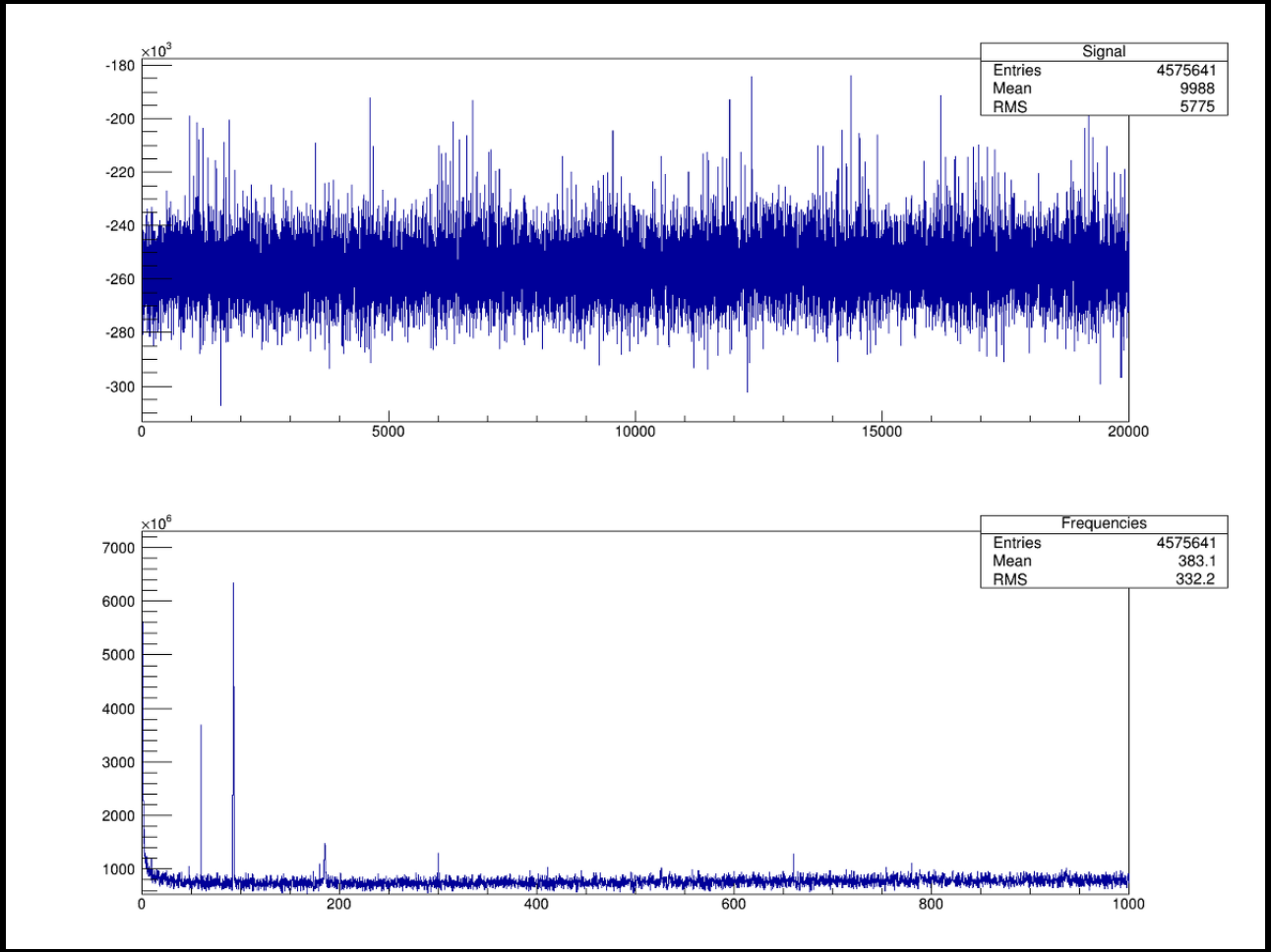
Channel 6


×10^3
1240
1220
1200
1180
1160
1140
0
5000
10000
15000
20000
Signal
Entries 4575641
Mean 1e+04
RMS 5774
×10^9
14
12
10
8
6
4
2
0
200
400
600
800
1000
Frequencies
Entries 4575641
Mean 215.8
RMS 313.1

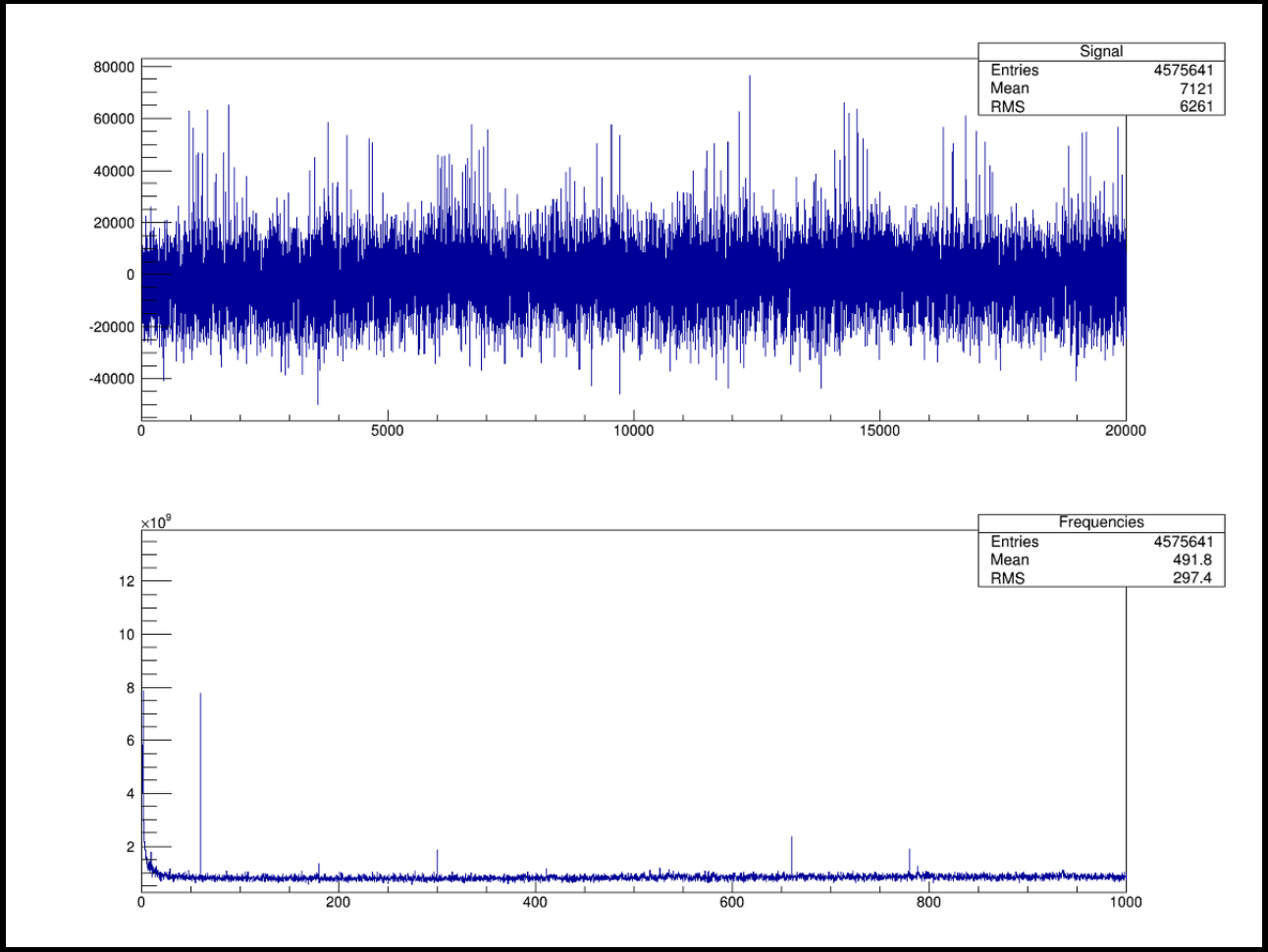
Channel 8


×10^3
650
600
550
500
450
400
0
5000
10000
15000
20000
Signal
Entries 4575641
Mean 9999
RMS 5774
×10^9
40
35
30
25
20
15
10
0
200
400
600
800
1000
Frequencies
Entries 4575641
Mean 326.4
RMS 331.8

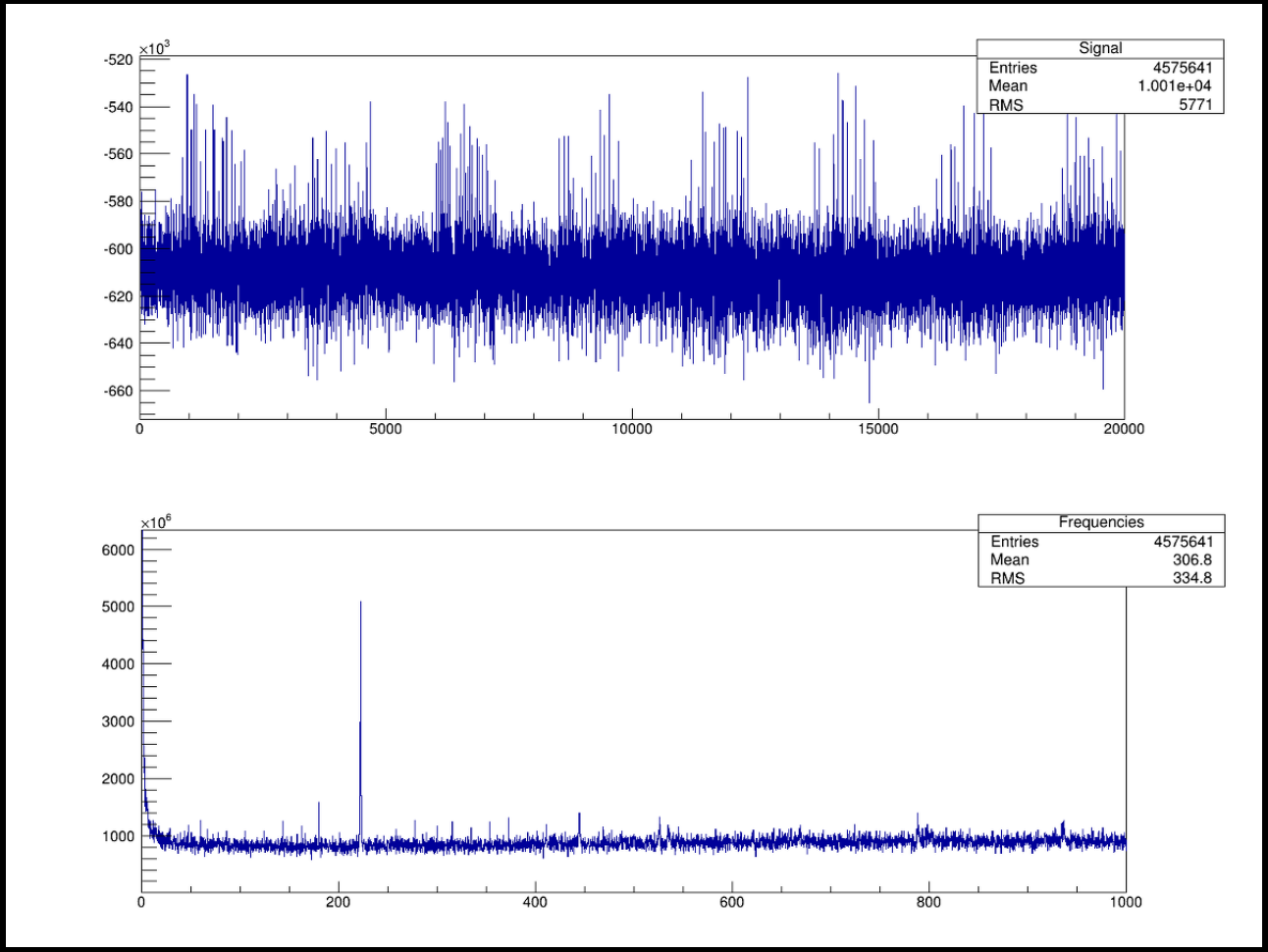
Channel 15


Signal
Entries 4575641
Mean 9988
RMS 5775
×10^3
-180
-200
-220
-240
-260
-280
-300
0
5000
10000
15000
20000
Frequencies
Entries 4575641
Mean 383.1
RMS 332.2
×10^6
7000
6000
5000
4000
3000
2000
1000
0
200
400
600
800
1000

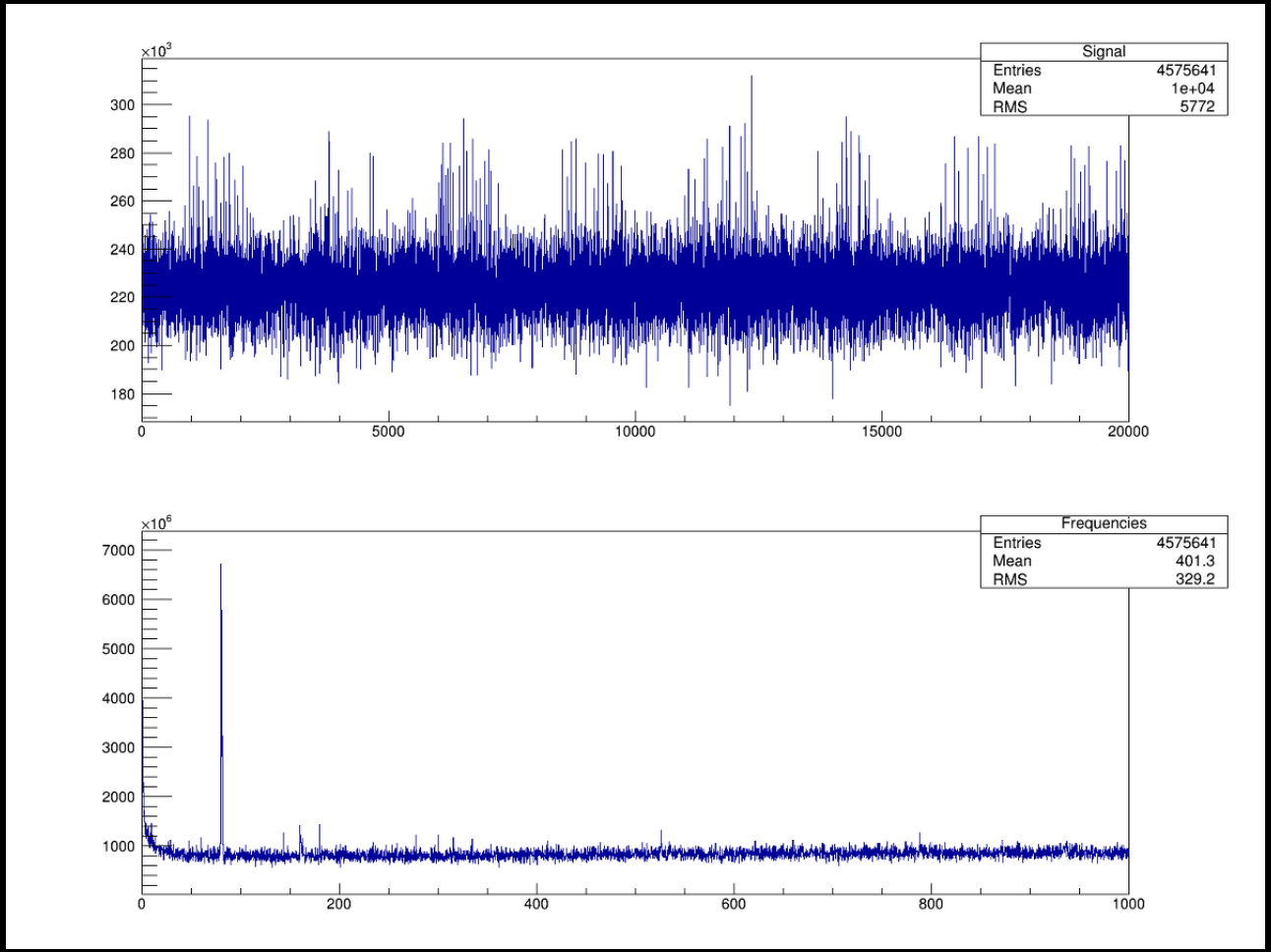
Channel 16


Signal
Entries 4575641
Mean 7121
RMS 6261
80000
60000
40000
20000
0
-20000
-40000
0
5000
10000
15000
20000
Frequencies
Entries 4575641
Mean 491.8
RMS 297.4
×10^9
12
10
8
6
4
2
0
200
400
600
800
1000

Channel 17


Signal
Entries 4575641
Mean 1.001e+04
RMS 5771
×10^3
-520
-540
-560
-580
-600
-620
-640
-660
0
5000
10000
15000
20000
Frequencies
Entries 4575641
Mean 306.8
RMS 334.8
×10^6
6000
5000
4000
3000
2000
1000
0
200
400
600
800
1000

Channel 18


Signal
Entries 4575641
Mean 1e+04
RMS 5772
×10^3
300
280
260
240
220
200
180
0
5000
10000
15000
20000
Frequencies
Entries 4575641
Mean 401.3
RMS 329.2
×10^6
7000
6000
5000
4000
3000
2000
1000
0
200
400
600
800
1000

III. Future Analysis

It is possible to analyze future signals if the group is interested. It may be useful to examine the noise taken during DAQ testing, or to check future electronics architecture for specific signal isolation.

I may also be able to produce additional transform types if desired.